

Short notes

THE COPEPOD *PARACYCLOPS AFFINIS* AS A PREDATOR OF PLANT PARASITIC NEMATODES

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In the nematology laboratory in Dakar, plant parasitic nematodes, extracted from infested roots in a Seinhorst's mistifier (1950), were collected in plastic boxes in 1/4 liter of tap water. Once, in 1983, some boxes contained smaller numbers of nematodes than anticipated and they also contained copepods swimming in the water. Therefore, these copepods were suspected of ingesting nematodes.

The copepods in water were very active and their direct individual handling was very difficult. However, the addition of phenoxy-2-ethanol to a concentration of 0.2 % anesthetized fully and reversibly these animals. This chemical has been used to anesthetize nematodes (Bird & Saurer, 1967). The copepods recovered motility when they were transferred into freshwater. Anesthetized individuals were easily handled with a micropipette.

Some adult females, with eggs (Fig. 1), fixed in cold 70 % ethanol, were identified by one of us (B. D.) as *Paracyclops affinis* (G. O. Sars, 1863), a cosmopolitan species of the order Cyclopoida (Crustacea), common in water bodies colonized by vegetation (Dussart, 1969, 1980).

To demonstrate the ability of *P. affinis* to feed on nematodes, we used as prey some freshly hatched juveniles of *Heterodera sacchari* Luc & Merny, 1963. Juveniles were obtained from crushed cysts of this species by artificial hatching with potassium permanganate (Reversat, 1981). Active juveniles were separated, from egg shells and dead individuals, by moving in a Baermann pan. To each of five 100 ml erlenmeyer flasks were added 14 400 *H. sacchari* juveniles and ten *P. affinis* adults (including three gravid females) in 18.5 ml of water. The flasks were sealed with aluminium foil and kept at ambient temperature (23-25 °C). Then, every day, a sample of 0.5 ml of the nematode suspension (without copepod) was taken from each flask after mixing its contents, and juveniles were counted. The sample was not returned to the flask after counting. The result, given in Figure 2, shows, versus time, the theoretical number of juveniles remaining in the flasks after

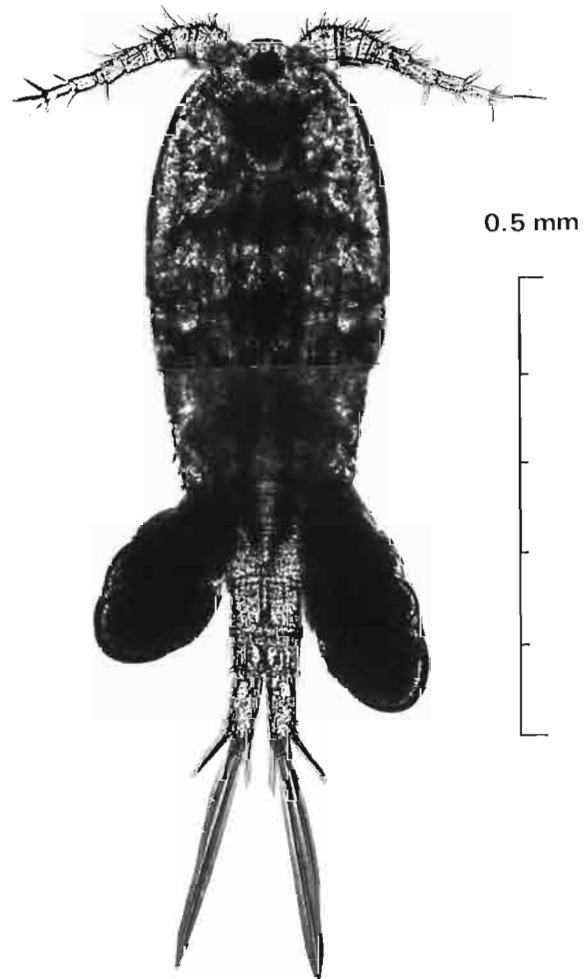


Fig. 1. Gravid female of *Paracyclops affinis*.

daily sampling (A) and the observed number of juveniles remaining in the flasks after daily sampling and predation (B). After thirteen days, there were no juvenile

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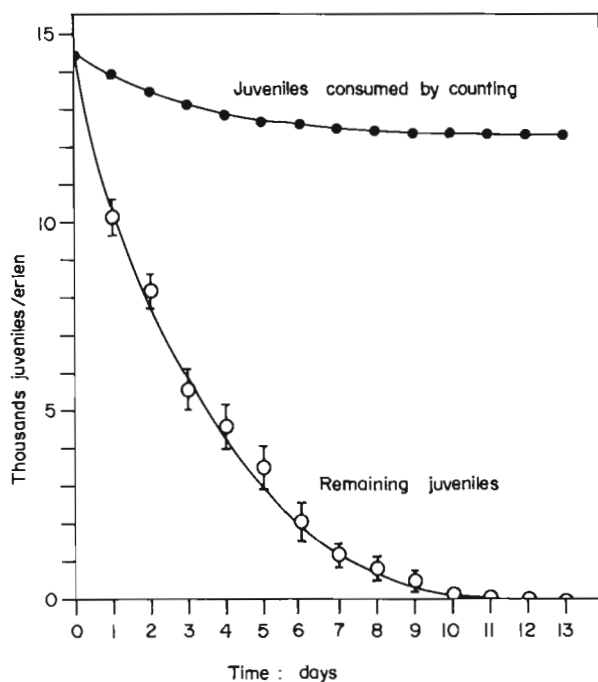


Fig. 2. Experimental predation of adults of *Paracyclops affinis* on juveniles of *Heterodera sacchari*. Above : theoretical number of juveniles remaining in the flask after daily sampling; Below : observed number of juveniles remaining in the flask after daily sampling and predation (Each point is the mean of five replicates and the vertical bar equals the standard deviation; for each replicate there were 14 400 nematodes and 10 adult copepods in 18.5 ml of water at the beginning of the experiment).

left in the flasks. The disappearance of the juveniles was attributed to predation, since copepods were observed several times with juveniles in the oral aperture. From these data, the daily consumption of juveniles of *H. sacchari* by females of *P. affinis* was calculated (Fig. 3).

Copepods are not mentioned as predators of soil nematodes in the consulted standard nematology text books. The natural biotope of copepods consists of open water surfaces, where they are active swimmers, rather than underground water (Dussart, 1980). On the opposite, most of soil nematode parasitizing plants do not swim in open water but stay in the soil. Thus, the predation observed here can be considered anecdotal and due to the particular conditions in the mistifier. In fact, the nematodes lying on the bottom of the plastic boxes in the mistifier, or of the erlenmeyer flasks during the experiment, were easily accessible to the copepods swimming in the supernatant water. It can be concluded that this predation is not common under natural conditions, but its practical importance could be considerable in the laboratory as it can lead to erroneous counting of nematode population densities.

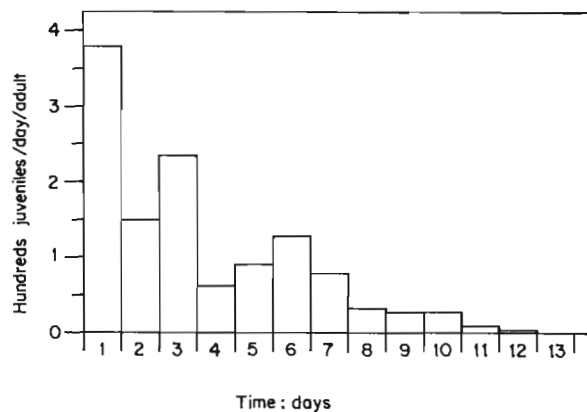


Fig. 3. Daily consumption of *Heterodera sacchari* juveniles by adults of *Paracyclops affinis* (Calculated from data of Fig. 2).

The rate of ingestion was very high as during the first day of the experiment (Fig. 3) it reached a level of 375 juveniles of *H. sacchari* for every copepod. Such a high rate of ingestion is common to many Cyclopoida, who are capable of ingesting food equal to their own body weight every day (Dussart, 1980). The rate of ingestion then decreased probably because of the lowered density of remaining juveniles and probably a lower frequency of encounters between nematodes and copepods. It appeared that the copepods did not seek the nematodes and probably could not detect them under the test conditions, but consume them inadvertently. Mankau (1980) reported similar behaviour with several other predators of nematodes.

The origin of the copepod contamination of the material in the mistifier was not determined. They probably came on root samples taken from rice fields under open water. The persistence of the infection of the material in spite of repeated washing and drying might be due to the existence of resting stages in the life cycle of this animal (Dussart, 1980). The contamination problem came to an end with a careful washing of the material with bleach.

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PAPILLAE ASSOCIATED WITH THE SPINNERET IN SOME SOIL NEMATODES

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The caudal glands in nematodes open to the exterior through the spinneret at the tail tip either terminally or at times slightly subterminally (Chitwood & Chitwood, 1974). The spinneret may be a simple opening or may open at the end of a short, apparently cuticularized tube extending from the tail tip. Caudal glands appear to be primitive structures as they predominate in aquatic species and gradually disappear in the more evolved soil forms. According to Chitwood and Chitwood (1974) caudal glands are present in the suborders Chromadorina, Monhysterina and Enoplina which now correspond to the orders Chromadorida, Araeolaimida, Monhysterida, Enoplida and Mononchida. To date, caudal glands have not been reported in the species of the orders Tylenchida, Dorylaimida and Rhabditida.

During routine observations on *Tobrilus* sp., papillae-like structures were seen near the spinneret. As these structures had not been observed earlier, it was decided to make a comparative study.

Materials and methods

For SEM observations the nematodes were fixed in glutaraldehyde and post-fixed in osmium tetroxide, dehydrated in an alcohol or acetone series and critical point dried, using CO₂. They were coated with a 25-30 nm thick layer of gold and examined in a Hitachi S-2300 SEM at 15 kV. On an average 12-20 specimens of each species were examined except *Iotonchus* sp. where only three were available.

Observations

In *Tobrilus* sp. females the spinneret opens via a short curved cuticularized tube (Fig. 1 A). Surrounding the base of the tube are ten papillae (Fig. 1 B). They are about one micrometer long and spaced unevenly; the

dorsal ones being more widely spaced than the laterals and ventrals. The tail tip of *Plectus* n. sp. (to be described by Tahseen, Ahmad and Jairajpuri) females (Fig. 1 C) resembles that of *Tobrilus* sp. in that the opening of the spinneret is at the end of a short tube. At the base of the spinneret tube are ten papillae almost evenly spaced (Fig. 1 D). The spinneret of females of *Mononchus aquaticus* Coetzee, 1968 is a cuticularized terminal pore not extending beyond the contour of the tail tip. The margins of the pore are well marked (Fig. 1 F). On the ventrosublateral sides of the tail tip are two prominent papillae (Fig. 1 E, F).

Not all species with caudal glands and spinneret had papillae at the tail tip. In *Mylonchulus minor* (Cobb, 1893) Andrassy, 1958 females, *Iotonchus* sp. females and *Thalassogenus* n. sp. (to be described by Ahmad *et al.*) females the spinneret is a simple invagination of the body cuticle at the tail tip, while in *Chromodorella* sp. it is on a small tube extending from the tail tip similar to *Plectus* sp. and *Tobrilus* sp. The spinneret of *Monhysteria* sp. females opens terminally and in *Tobrilus paludicola* Micoletzky, 1925 females and males the tip tapers to a short spinneret tube. In none of these species was any papillae observed about the spinneret.

Discussion

From the information presented generalization is not possible but it appears that papillae associated with the tail tip may have a peri-spinneret arrangement (as in *Tobrilus* sp. and *Plectus* n. sp.) or may be limited to any particular sector (as in *M. aquaticus*). The arrangement of papillae around the spinneret appears to be restricted to those species where the spinneret opens at the end of a short tube. However, the presence of the spinneret tube does not necessarily imply that papillae will always