RESEARCH NOTE

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Mode of Entry and Sites of Development of *Steinernema scapterisci* in Mole Crickets[1]

KHUONG B. NGUYEN AND GROVER C. SMART, JR.[2]

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Infective juvenile steinernematid nematodes have been reported to enter their insect hosts through the mouth, anus, and spiracles (1–3,5–8). Information is lacking, however, for *Steinernema scapterisci* Nguyen & Smart, 1990 (4), a promising biological control agent of mole crickets in the genus *Scapteriscus*. This paper reports on the mode of entry of *S. scapterisci* into mole crickets and the primary sites where they develop.

Entry via digestive system: Five mole crickets, *Scapteriscus acletus* Rehn & Hebard, 1916, were exposed to 8,000 infective juvenile *S. scapterisci* in a petri dish (90-mm) containing two filter papers (Whatman No. 2). Three hours later, the digestive system was dissected out of each insect and cut into three sections. We found an average of 66 nematodes (range: 62–69) in the anterior section (esophagus to end of crop), none in the middle section (end of crop to junction of Malpighian tubules with gut), and one (0–3) in the posterior section (above junction to anus).

In another experiment, mole crickets were inoculated through the mouth or anus with infective juveniles. The beveled tip of a hypodermic needle (B-D Tuberculin, 26G 3/8, intradermal bevel, Becton and Dickson, Rutherford, NJ) was removed, the end filed smooth, and the syringe was mounted on a stand to facilitate the inoculation process. Twenty mole crickets, not fed for 12 hours were selected; 10 were inoculated through the mouth and 10 through the anus with ca. 80 infective juveniles in 0.1 ml of water. The mole crickets were retained in individual vials without food until they died (1–7 days). One week later, infected juveniles emerged from nine of the mole crickets inoculated through the mouth, but from none of those inoculated through the anus.

The above experiments suggest that the mouth, but not the anus, is a suitable port of entry for the nematode.

Entry via spiracles: Twenty mole crickets were exposed for 4 hours to infective juveniles in the petri dish–fiter paper system, then anesthetized, and as much as possible of the tracheal system was dissected out and examined. From one to five juveniles were found in the tracheal tubes of each mole cricket (Fig. 1); most were in the thoracic area. Because it is impossible to dissect out all tracheal tubes, additional juveniles may have been present. Two juveniles were observed to move along a tracheal tube until it narrowed to a diameter that obstructed their progress. At that point, they thrashed about vigorously, broke the tube, and emerged from it (Fig. 1A).

Other mole crickets were inoculated through the spiracles with infective juveniles. About 50 juveniles were placed in a small drop of water, and, using the same needle and syringe as with mouth or anal inoculations, the nematodes were drawn into the needle. Next, a mole cricket was squeezed slightly to expel some of the air from the tracheae, the needle was inserted into the spiracle, the plunger of the syringe

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[1] Florida Agricultural Experiment Station Journal Series No. R-00726.

[2] Senior Biological Scientist and Professor, Entomology and Nematology Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611-0740.

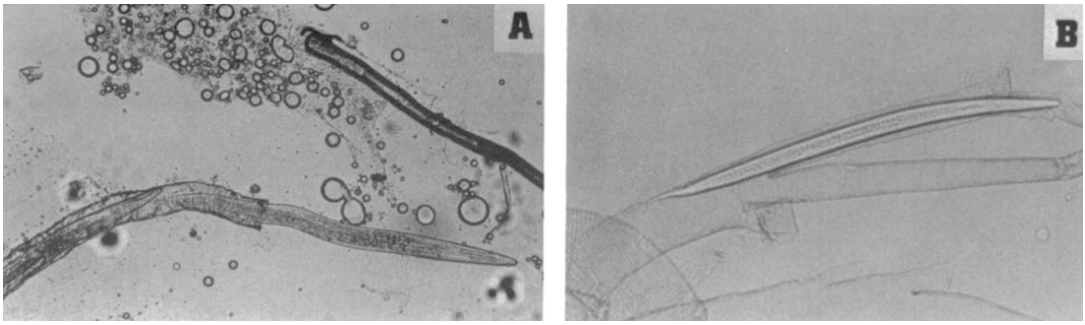

FIG. 1. A) Infective juveniles of *Steinernema scapterisci* escaping from a tracheal tube of *Scapteriscus acletus* after they were observed to break the tube (smaller portion above). B) Infective juvenile in a tracheal tube with a diameter only slightly greater than that of the nematode.

was depressed, and the pressure on the mole cricket was released. The water and juveniles were drawn into the tracheae. Five mole crickets were inoculated through the first thoracic spiracle and five through the second. Thirty minutes later, the tracheal systems were dissected out and examined. Juveniles were found in the tracheae of all the mole crickets inoculated.

Next, 15 mole crickets were inoculated through the first thoracic spiracle and 15 through the second. These mole crickets were left without food until they died (1–7 days), and 3 days later the cadavers were dissected and examined for nematodes. Twelve of the mole crickets inoculated through the first thoracic spiracle and nine of those inoculated through the second contained developing nematodes. These experiments suggest that *S. scapterisci* may enter mole crickets through the spiracles.

Sites of development of Steinernema scapterisci in mole crickets: We have observed that third-generation infective juveniles first emerged from the thorax and head regions of mole cricket cadavers. This suggested that the nematodes may not develop evenly throughout the body. In order to confirm this observation, 10 mole crickets were exposed to 8,000 infective juveniles in petri dishes as in the other experiments. After the mole crickets died (1–7 days), the cadavers were removed and placed individually in vials. Two days later, each cadaver was divided into head, thorax, and abdomen. Each section was dissected separately in an aqueous solution of 1% NaCl, and the number of nematodes was determined. Eighty-five percent (mean = 265 nematodes per cricket) of the nematodes were found in the thorax, 13% (mean = 40) in the head, and 2% (mean = 6) in the abdomen. Thus, the head and especially the thorax were the preferred sites for development of the nematode.

In conclusion, *Steinernema scapterisci* enters mole crickets through the mouth and spiracles but probably not through the anus. The juveniles develop primarily in the thorax and head.

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