LABORATORY INFECTION OF *GARYPUS CALIFORNICUS* (PSEUDOSCORPIONIDA, GARYPIDAE) WITH NEOAPLECTANID AND HETERORHABDITID NEMATODES (RHABDITOIDEA)

Entomogenous nematodes of the genera *Neoaplectana* and *Heterorhabditis* are being commercially produced as biological control agents for use against a variety of insect pests (Poinar, Jr., G. O. 1983. Proc. Tenth Int. Congr. Plant Prot. 2:751-758). Tests are being conducted to examine the ability of these nematodes to infect non-insect representatives of the Arthropoda. The present study was conducted to determine if members of these nematode genera could infect representatives of the Pseudoscorpionida under laboratory conditions.

The nematodes used in this study were the 42 strain of *Neoaplectana carpocapsae* Weiser and the NC strain of *Heterorhabditis heliothidis* (Khan, Brooks, and Hirschmann) which had been reared on wax moth larvae in the laboratory.

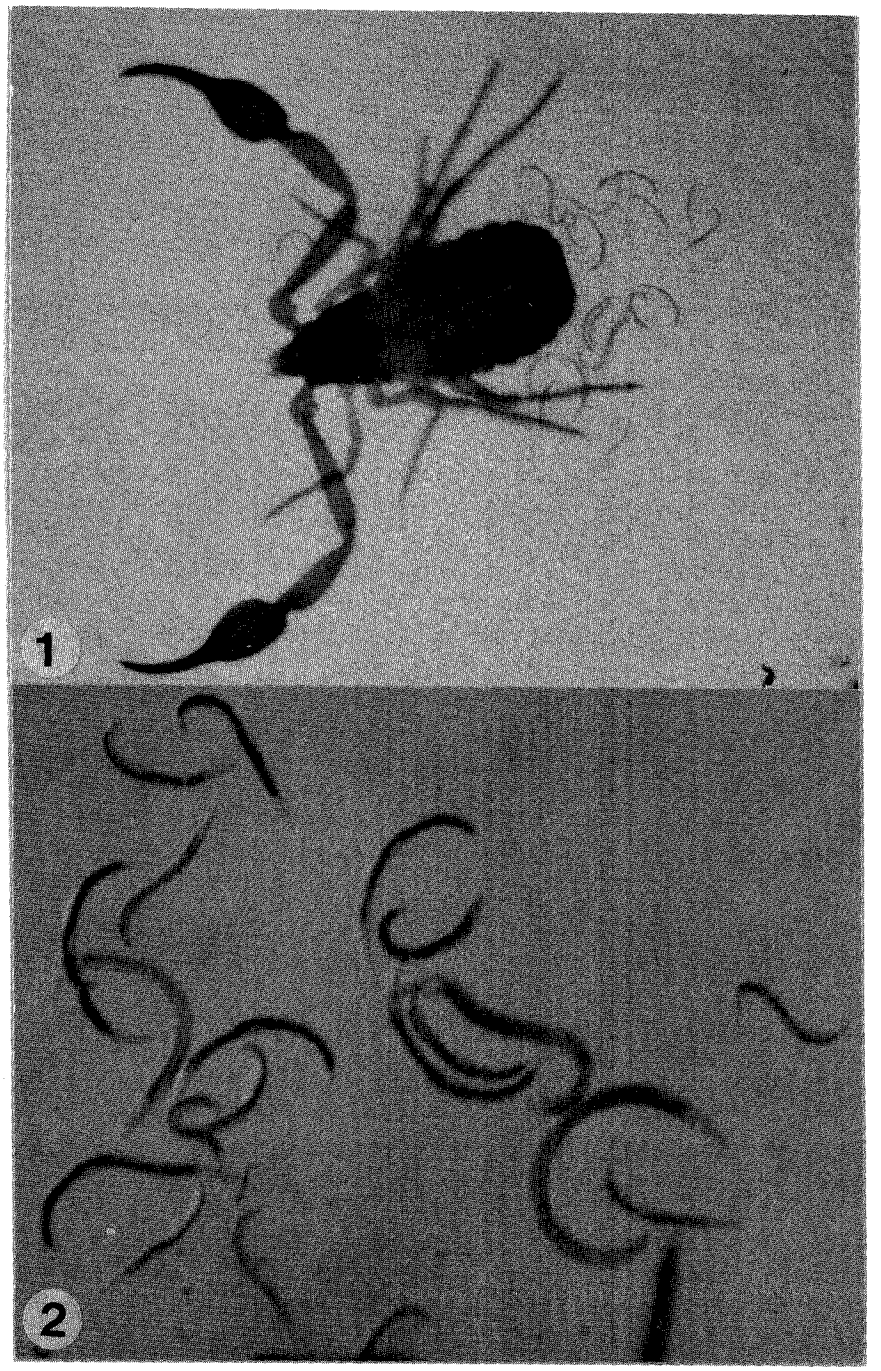

Fig. 1.—An adult *G. californicus* killed by *N. carpocapsae*. Mature nematodes removed form the pseudoscorpion surround the abdomen of the dead host.

Fig. 2.—Adults of *N. carpocapsae* removed from the abdomen of an infected *G. californicus*.

Specimens of the pseudoscorpion *Garypus californicus* Banks were collected at Bolinas Point, California, on September 23, 1984. They were brought to the laboratory and placed individually in 5 cm diameter petri dishes lined with a filter paper disc which had an area of 18.1 cm^2. One cc of infective stage nematodes in water was added to the filter paper in each dish. This resulted in 12 x 10^4 nematodes/dish for *N. carpocapsae* and 11 x 10^4 nematodes/dish for *H. heliothidis*. Ten *G. californicus* were placed in dishes containing *N. carpocapsae:* eight were challenged with *H. heliothidis* and four served as controls. Control dishes had 1 cc of water only added to the filter paper and were maintained similar to the treatments. A small piece of cotton gauze was placed in each dish as a refuge for the pseudoscorpion, and adult *Drosophila* were added as a source of food. The experiments were run at room temperature and extended for one week.

At the time of death, a drop of hemolymph was removed from the pseudoscorpion and plated out on a culture plate of Tergitol 7 agar plus TTC (triphenyltetrazolium chloride). The symbiotic bacteria (*Xenorhabdus* spp.) carried by the nematodes produce a characteristic color reaction on this medium. The presence of the bacterium in a host's hemolymph indicates that the nematodes were able to infect and enter the body cavity of the host. Dissections were performed at regular intervals after the pseudoscorpions died in order to follow nematode development.

By the end of the second day after initial contact, all treated hosts were dead. The control specimens remained alive for the duration of the experiment. Samples of hemolymph removed from the dead hosts revealed the presence of the nematodes' symbiotic bacteria (*Xenorhabdus* spp.).

The nematodes developed to the adult stage and produced progeny inside the dead pseudoscorpions (Figs. 1 and 2). However, foreign bacteria rapidly entered the host cadavers and greatly lessened the conditions for nematode development. As a result, few infective stages were produced.

This is the first report describing the ability of neoaplectanid and heterorhabditid nematodes to infect pseudoscorpions. It indicates that these nematodes are not as restricted in their parasitic habits as originally thought.

The present results show that *G. californicus* is highly susceptible to these nematodes under laboratory conditions with all deaths occurring 1-2 days after initial contact. However, this arachnid is a poor developmental host since bacteria associated with the host enter the cadaver and inhibit establishment of the nematode's symbiotic bacteria which are required for parasite multiplication.

In a program involving the placement of these nematodes on the soil surface of agricultural or horticultural land (Poinar, 1983, op. cit.), most pseudoscorpions would avoid contact with the parasites by the cryptic nature of their physical habitats (e.g. under bark of trees, in moss, under debris on the beach, etc.).

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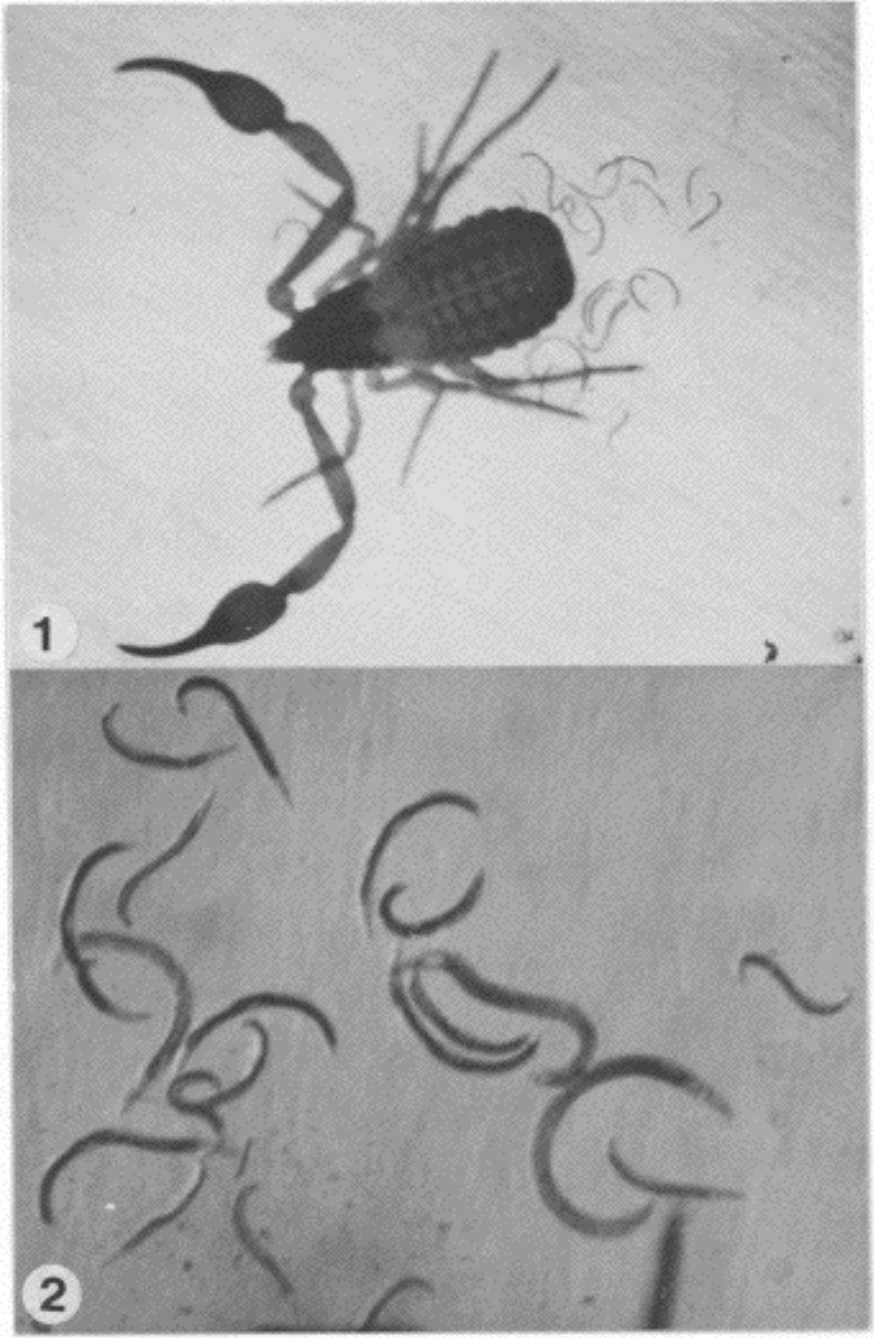

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