

## ENTOMOPATHOGENIC NEMATODES Nematoda: Steinernematidae and Heterorhabditidae

*Steinernema carpocapsae*, *S. riobrave*, *S. feltiae*, *S. glaseri*, *S. oregonense*, *Heterorhabditis bacteriophora*, *H. marelatus*, *H. megidis*

### DESCRIPTION

There are presently nine recognized species of *Steinernema* and three of *Heterorhabditis*, but the number of species will likely increase as new populations of these nematodes are discovered. Infective juvenile stages of *S. carpocapsae* are transparent and range in length from 438 - 650 um.

### LIFE HISTORY

Infection of living insect hosts by both *Steinernema* and *Heterorhabditis* is initiated by the free-living, third-stage infective juvenile (IJs). Infective juveniles may remain in the environment for prolonged periods of time in search of a host. This nematode stage enters the host through natural openings, such as the mouth, anus, and spiracles. *Heterorhabditis* spp. possess a dorsal tooth or hook that is used to break the outer cuticle of an insect host to allow entry. *Steinernema* spp. tend to remain close to the soil surface where they actively search for prey. *Heterorhabditis* spp. generally move deeper into the soil where they actively search out prey. As soon as the infective juveniles enter the host, they initiate development and release a symbiotic bacterium (*Xenorhabdus* spp., *Photorhabdus* spp.) into the insect host. The bacterium, which multiplies in the insect host, are consumed and digested by the developing nematodes. The nematodes complete development to the adult stage within its insect host and females deposit eggs in the dead insect that hatch and develop into third-stage juveniles that escape into the soil from their dead insect host. Males and females are produced in *Steinernema* spp., but in *Heterorhabditis* spp. juveniles develop into a hermaphroditic female that can produce eggs without mating.

### IMPORTANCE

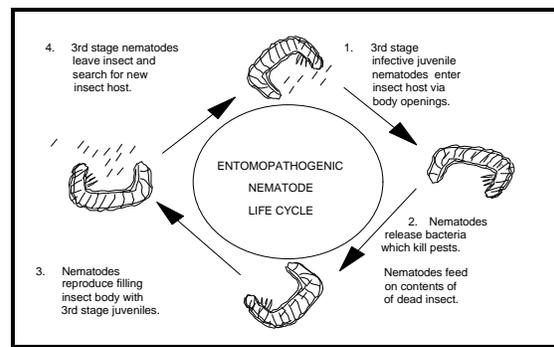
Entomopathogenic nematodes have several important attributes that make them excellent candidates for biological control of soil insects. 1) they are specialized to carry and introduce symbiotic bacteria into the insect hemocoel, 2) most have a broad host range that includes the majority of insect orders and families, 3) several species can be cultured artificially on a large scale, which makes it possible to commercially produce large quantities, and 4) they have limited impact on nontarget organisms and are not disruptive to the environment. Numerous insect pests on many different crops are controlled by parasitic nematodes. Insect hosts include



Root weevil infected with nematodes (top)



Mint root borer infected with nematodes



several species of root weevils and flea beetles, mint root borer and other species of stem borers, white grubs, and caterpillars. Parasitic nematodes have been used successfully to control insect pests on mint, citrus, cranberry, small fruit, lawns, ornamental and vegetable crops. Rates vary from 1 to 3 billion infective juveniles per acre and are most successful if applied in large quantities of water to moist soil in the evening. Timing of application to coincide with the most susceptible stage in the soil is critical for successful control. Several nematodes are available commercially, such as *H. megidis*, *H. bacteriophora*, *H. marelatus*, *S. riobrave*, *S. feltiae*, and *S. carpocapsae*.

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