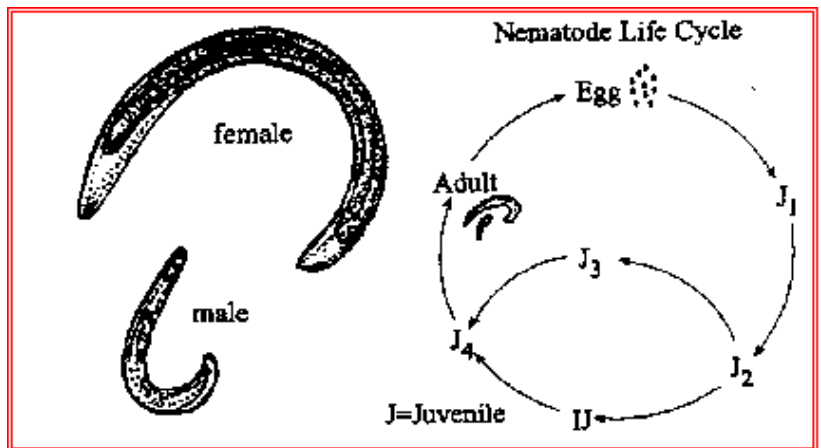


Beneficial Nematodes

The use of insect parasitic nematodes, and other biological control agents to manage insect pests has grown in popularity. This is primarily due to the changing problems associated with pest control. For example, many pests have developed resistance to certain pesticides, new pests have arisen to replace those successfully controlled, the effectiveness of natural control agents (predators, parasites and pathogens) has been reduced by pesticide use, pesticides are no longer inexpensive to use, and there is increased concern about pesticide safety and environmental quality. These beneficial organisms can be an important component of an integrated pest management (IPM) program for ornamental crops and turf grass sites.



What are beneficial nematodes?

These naturally occurring organisms are microscopic, unsegmented round worms that live in the soil. The life cycle of beneficial nematodes consists of eggs, four larval stages and the adults. The third larval stage is the infective form of the nematode (IT). They search out susceptible hosts, primarily insect larvae, by detecting excretory products, carbon dioxide and temperature changes. Juvenile nematodes enter the insect host through the mouth, anus or breathing holes (spiracles). Once the bacteria are introduced into the insect host, death of the host usually occurs in 24 to 48 hours. As the bacteria enzymatically breaks down the internal structure of the insect, the Steinernematids develop into adult males and females which mate within the insect's body cavity. Once their development has reached the third juvenile stage, the nematodes exit the remains of the insect body.

Why are these organisms beneficial?

Parasitic nematodes are beneficial for six reasons. First, they have such a wide host range that they can be used successfully on numerous insect pests. The nematodes' nonspecific development, which does not rely on specific host nutrients, allows them to infect a large number of insect species.

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Second, nematodes kill their insect hosts within 48 hours. As mentioned earlier, this is due to enzymes produced by the *Xenorhabdus* bacteria.

Third, nematodes can be grown on artificial media. This allows for commercial production which makes them a more available product.

Fourth, the infective stage is durable. The nematodes can stay viable for months when stored at the proper temperature. Usually three months at a room temperature of 60° to 80° F and six months when refrigerated at 37° to 50° F. They can also tolerate being mixed with various insecticides, herbicides and fertilizers. Check nematode product label for compatibility. Also, the infective juveniles can live for some time without nourishment as they search for a host.

Fifth, there is no evidence of natural or acquired resistance to the *Xenorhabdus* bacteria. Though there is no insect immunity to the bacteria, some insects, particularly beneficial insects, are possibly less parasitized because nematodes are less likely to encounter beneficials which are often very active and escape nematode penetration by quickly moving away.

Finally, there is no evidence that parasitic nematodes or their symbiotic bacteria can develop in vertebrates. This makes nematode use for insect pest control safe and environmentally friendly.

What are the target insects?

Experiments have shown that beneficial nematodes can reduce the populations of a variety of ornamental and turf pests. Control has been reported for the larvae of black vine weevil; strawberry root weevil; the clearwing borer; peachtree borer; dogwood borer; and banded ash borer. Turf larval pests controlled include surface pests such as cutworms and sod webworms; and the soil inhabiting pests billbugs and white grubs (larvae of Japanese beetle, oriental beetle, chafer beetle, June beetle and *Leather Jackets*, crane fly). Nematodes can be used on these and other pests as long as proper application procedures are used and the environmental conditions are favorable.

It is important to select the proper nematode species when trying to control a particular pest. Nematodes should be applied at the first sign that a pest population is causing damage. Reapplying nematodes depends on the success of the first nematodes released. Their survivorship and success are based on environmental conditions and soil type; increases in original pest population; and percentage of living nematodes actually released during the first application. Nematodes should be reapplied on seven-day intervals if damage continues.

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