You Want These Worms

Studies show beneficial worms could be high on growers' priority list.

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Nematodes are aquatic roundworms that occupy virtually all habitats on earth. The only nematodes that most people are likely to have seen are intestinal parasites that sometimes afflict pets and children. So, it may be surprising to learn that nematodes are the most numerous and perhaps diverse metazoans on earth, scientists have speculated that fewer than 5% of a half-million species have been described. Although some nematode species are harmful to human activities (all plant and animal species have nematode parasites), roundworms also play an essential role in soil fertility, and some species help regulate insect pests.

Several laboratories at the University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) Citrus Research and Education Center in Lake Alfred study both the beneficial and harmful effects of nematodes in citrus groves. Current projects involve the use of nematodes to help manage a major insect pest, Diaprepres root weevil. Entomopathogenic nematodes (EPN) exist in a remarkable symbiosis with bacterial insect pathogens. EPN harbor these bacteria in their intestines as they move through soil in search of prey. After entering insects through body openings or by penetrating the cuticle, the worms release their bacteria, which then secrete toxins that kill the insect and antibiotics that prevent other organisms from feeding on the cadaver. EPN eventually emerge by the tens of thousands in search of new prey.

New Take On An Old Trick

Florida's citrus growers have applied commercially produced EPN to help manage Diaprepes since the early 1990s. When studying the effectiveness of these products, it became evident that relatively little is known about EPN ecology — especially how EPN interact with other organisms in the soil. The simplest way to measure EPN effectiveness is to bury caged weevil larvae in soil before it is treated with EPN. Surprisingly, groves were identified in which insect mortality from naturally occurring EPN can be as high as 80% per week.

This citrus tree is growing in soil withnaturally high levels of Diaprepes root weevil and few entomopathogenic nematodes (EPN). However, the tree is in a large planting hole filled with soil typical of groves that have large and diverse communities of endemic EPN and few weevils. The site was treated with Florida-endemic EPN species. During the first six months following treatment, mortality of weevil larvae in these modified planting sites was more than twice that in unmodified sites in the grove.

In groves where endemic EPN communities are large and species-diverse, Diaprepes numbers are low, and citrus suffers little damage. Conversely, groves that support large numbers of Diaprepes have few species of EPN, which cause little weevil mortality. Because EPN clearly have tremendous potential for biocontrol of Diaprepes, the current focus is to identify the characteristics of habitats that support large or small EPN populations with the hope of discovering ways to modify groves and favor EPN.

What To Watch Out For

We've also learned that when EPN are added to soil containing a vigorous community of endemic EPN, the initial period of increased biological control is sometimes followed by a short period of lower than normal control. Often, a variety of natural enemies of EPN appear to be involved. We've shown that some species of bacterial feeding nematodes are able to enter the insect cadaver and suppress EPN reproduction. A remarkable association was also noted involving various spore-forming bacteria adapted to attach to the cuticle of specific EPN. If the nematode manages to infect an insect, the bacterium can complete its life cycle. Unfortunately, the bacteria may attach in such large numbers that the worm can no longer effectively hunt its prey.

Most soil contains numerous species of fungi with a variety of special abilities that enable them to capture or otherwise kill and consume nematodes. We have learned that EPN activity is often lowest in areas with elevated levels of these fungi, and that adding EPN to soil sometimes initiates a cascade in which antagonistic fungi increase, after which EPN prevalence and insect biocontrol temporarily decline. FG

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