The Ins and Outs of Beneficial Nematode Movement

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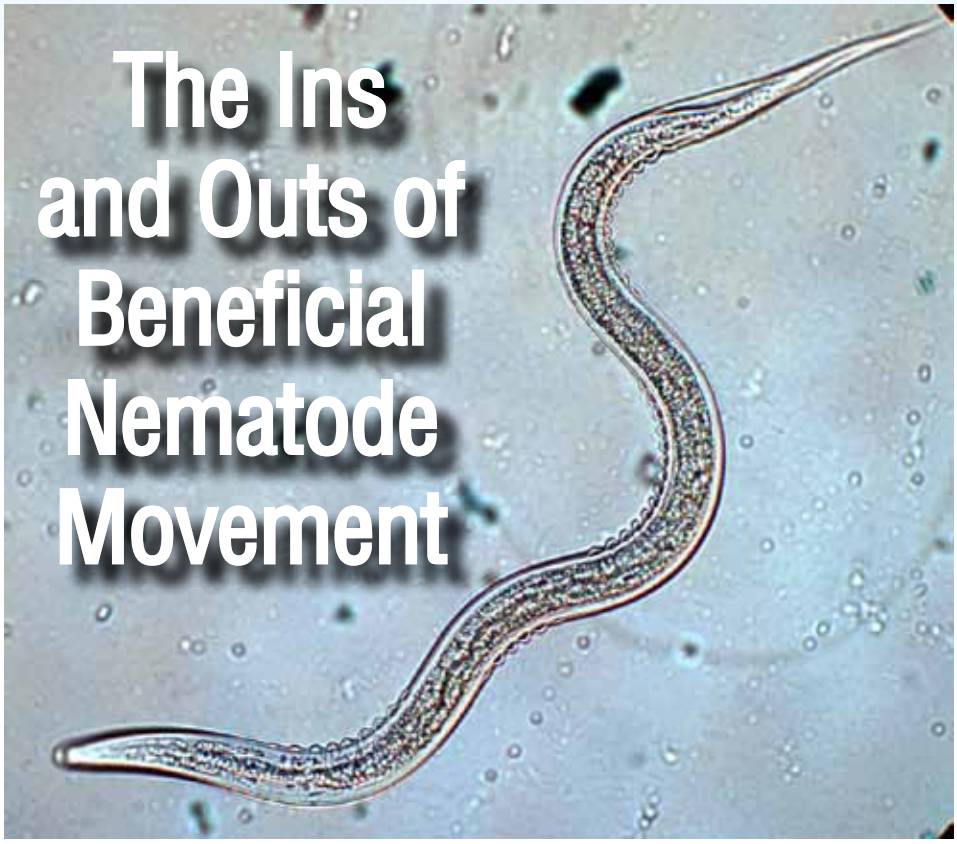

ARS scientists are studying how small roundworms, such as this *Heterorhabditis indica* nematode, navigate through soil to find insect pests to attack.

Beneficial nematodes are small roundworms that can be used as environmentally friendly biopesticides. Agricultural Research Service scientists are interested in finding out how these tiny worms navigate through soil over vast distances to find insect pests to attack.

Nematodes are known to respond directionally to various cues, including electrical stimuli. In prior research, ARS entomologist David Shapiro-Ilan, plant pathologist Clive Bock, and collaborators found that the nematode *Steinernema carpocapsae* was attracted to an electrical current they applied to an agar dish. From this study, the researchers concluded that the worms rely on electricity, or electrical fields, to help them navigate in the soil. They then hypothesized that the nematodes may also use magnetic fields for the same purpose.

To test their hypothesis, Shapiro-Ilan and Bock, both with the ARS Fruit and Tree Nut Research Laboratory in Byron, Georgia, placed magnets on opposing sides of a petri dish containing agar and *S. carpocapsae* nematodes. One magnet was oriented toward the North Pole and the other magnet was oriented to the South Pole, creating a magnetic field of 0.1752 Tesla. (For perspective, a medical MRI uses a magnetic field of 1.5 to 3 Tesla.) The scientists wanted to see whether the nematodes would move directionally—either north or south—within the magnetic field.

"We did note a directional response of the nematodes, with more of them moving toward the South Pole than the North," says Shapiro-Ilan. "Magnetoreception can be important in facilitating or enhancing foraging ability in various organisms."

The finding that the nematode responds not only to electrical fields but also to magnetic fields was published in the *International Journal for Parasitology* in August 2013. The researchers believe this study was the first report of nematode directional movement in response to a magnetic field.

Next, Shapiro-Ilan and colleagues looked at the movement of six different entomopathogenic (insect-killing) nematodes and found that their movement was not random. Instead, the worms moved together as a group. "One might liken their movement to group behavior in other animals, such as a school of fish or a pack of wolves," says Shapiro-Ilan.

In the laboratory, tests were set up to observe nematode group movement in a wet soil environment. "In 20 of 24 analyses, nematodes demonstrated nonrandom, or coordinated, movement," says Shapiro Ilan. "Based on our findings, we contend that aggregated movement behavior may further contribute to a patchy distribution, or clumping, of natural or applied entomopathogenic nematode populations that is seen in crop fields."

These findings were published in the *International Journal for Parasitology* in October 2013.

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The findings of these studies have implications for understanding nematode foraging behavior and improving natural pest-control tactics. Knowledge of how and why beneficial nematodes find their prey is essential to optimizing their use in the future.—By **Sharon Durham,** ARS.

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