


Top left: carrots with northern root-knot nematode symptoms (photo by Ben Phillips, Michigan State University Extension). Top right: damage to soybean plants from soybean cyst nematode infection (photo by Craig Grau,, Bugwood.org). Bottom left: close-up image of a juvenile root-knot nematode penetrating a tomato root (USDA photo). Bottom right: galls on sweet potato roots from root-knot nematode (USDA photo).

Sustainable Management of Nematodes in Plants & Soils

Nematodes are tiny (usually microscopic) roundworms that are incredibly common and widespread; they account for 80% of all individual animals on Earth. Some nematode species are beneficial to agriculture, while others have major detrimental impacts. Plant-parasitic nematodes can lead to poor soil and low crop yields. In the United States, annual economic losses due to nematode infection of crops is estimated at $13 billion. Nematode issues are exacerbated by climate change, which increases nematode occurrence and spread, and intensive crop production, which impairs soil quality.

Land-grant university researchers and Extension educators across the nation are working together to find and share simple, reliable low-cost tools and methods for managing nematodes without adversely affecting beneficial species or soil health. This work has enhanced the economic viability of farms and forests, sustained a steady supply of affordable, high-quality food and ornamental products, and improved soil health in the region.

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IMPACTS

Identifying & Monitoring Nematodes

Project members have tracked the distribution of nematodes and helped farmers identify species, determine whether they are problematic, and select appropriate management strategies. For example:

- University of Florida researchers detected the sting nematode in Indiana for the first time, expanding the known range of this nematode.
- A golf course in Florida had planned to renovate their greens due to unsightly yellow blotches. Traditional methods did not identify a nematode problem, but a new method developed by the University of Florida revealed a serious root knot nematode infestation. This discovery made it possible to treat the issue effectively and avoid the expensive, time-consuming renovation.

Understanding Nematode Ecology

This project has pioneered research on the ecological interactions between nematode populations, soil health, climate, and crop yield. For example:

- Michigan State University researchers published the IPE model, the first and only model to link nematode numbers to a specific soil health value.
- University of Hawaii tracked the changes of nematode communities and showed that regenerative agricultural practices are benefiting soil health over time.

Managing Nematodes with Effective Chemicals and Alternatives

Project members have developed tools and tactics to manage nematodes that affect a wide variety of crops, including soybeans, apples, peaches, grapes, strawberries, sweet potatoes, carrots, peppers, tomatoes, walnuts, and peanuts, as well as cotton, hemp, turfgrass, urban gardens, and forests.

Traditional chemical nematicides can be expensive, can lose effectiveness over time, and can pose human and environmental health risks. Project members have developed non-chemical alternatives, such as:

- Walnut genotypes with reduced susceptibility to three nematode species (University of California).
- Bacteria that parasitize nematodes (Michigan State University).
- Cover crops of ground papaya seeds, sorghum-sudangrass hybrids, and white clover that suppress nematodes without harmful effects on soil health (University of Hawaii).
- Suppressive rotation crops, which strawberry farmers now use instead of chemical nematicides or soil fumigation to reduce strawberry black root rot severity (University of Connecticut).
- A heat treatment protocol to reduce bloat nematode in garlic seed cloves without adversely affecting seedling emergence, plant growth, or yield (Cornell University).
- Earlier weed control prior to soybean planting to reduce soybean cyst nematode densities (University of Tennessee).

Researchers developed and tested new chemical nematicides, including:

- The first nematicide for managing lance nematodes in turfgrass (University of Florida).
- Two nematicides, which have been adopted as the standard for managing sting and grass root knot nematodes on golf courses in the Southeast. These nematodes impair the drought tolerance of turfgrass, leading to increased irrigation, but after nematicide treatment, a golf course in Florida was able to reduce water use by 50%; another golf course was able to reduce supplemental hand-watering, saving water and 500+ hours of labor (University of Florida).

Educating Growers

Project members have created numerous Extension materials and held multiple workshops related to plant-parasitic nematodes and soil health. This information has convinced more farmers to adopt soil-safe nematode management practices. Information and outreach have also influenced crop consultants, industry, and government.

Training Nematologists

To ensure continued advances in nematology, project members have committed to training future generations of researchers and Extension professionals. In the last two years alone, the group has developed 20 Master's, PhD, and post-doc scholars as well as 3 research assistants. Participating in a multistate, multidisciplinary project provides valuable networking and experience for early- and mid-career scientists.

The Multistate Approach

NE2140: Sustainable Management of Nematodes in Plant and Soil Health Systems (2021-2026) was funded in part by the Multistate Research Fund through USDA-NIFA and by grants to project members at participating institutions: University of California-Riverside, Cornell University, University of Florida, University of Hawaii, University of Illinois, Michigan State University, Pennsylvania State University, University of Rhode Island, University of Tennessee, University of Vermont, West Virginia University, and the USDA-ARS.

The multistate approach brings together scientists with diverse expertise and enables them to share resources and communicate regularly. Working together, scientists can engage in research and outreach that is not possible by a single state or institution, even in the private sector. As part a multistate project, scientists can embrace policy-relevant research that is national in scope but applicable to local needs. With project members in 12 states, solutions can be shared widely with diverse stakeholders.

Want to learn more?

Learn more about this project and its impacts: bit.ly/NE2140