

Control Root-Knot Nematodes in Your Garden

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Introduction

Root-knot nematodes are microscopic worms that live in soil and feed on the roots of many common garden crops (Figures 1 and 2). The nematode gets its name because its feeding causes galls (swellings or “knots”) to form on the roots of infected plants (Figure 3). Root-knot nematodes are scientifically classified in the genus *Meloidogyne*. There are several species of *Meloidogyne*, but *M. incognita*, also known as the southern root-knot nematode, is the most common one in gardens in Arkansas.

Some of the crops that may be severely damaged are tomato, pepper, okra, watermelon, cantaloupe, onion, pumpkin, squash, sweet potato, sweet corn, carrot, eggplant, bean and pea. Root-knot nematodes also feed and multiply on many garden weeds, although they may not injure these

plants to any extent. A female root-knot nematode (Figure 2) can lay up to 500 eggs at a time, and root damage results from the sheer number of nematodes feeding on roots by the end of the summer. Root-knot nematodes tend to be more of a problem in sandy soils.

Symptoms

So how do you tell if root-knot nematodes are a problem in your garden?

First, look for plants that are not performing well. Usually, not all of your plants will be affected to the same degree, and some will be “more sick” than others. Symptoms can include stunting, yellowing, wilting during the heat of the day with recovery at night, fewer and smaller fruit and general decline – usually during the summer as the plants get bigger.



Figure 1. Immature root-knot nematodes attacking root tip (highly magnified).
(Photo courtesy Nemapix.)

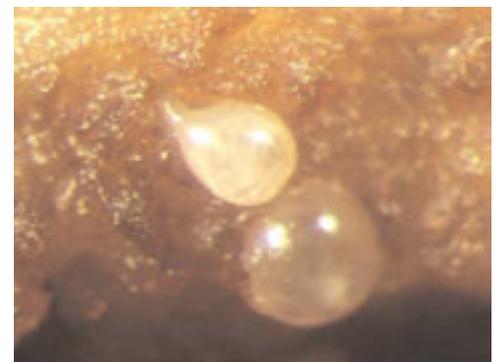


Figure 2. Mature female root-knot nematode feeding on root with round egg sac containing about 500 eggs attached at the end of the nematode.
(Photo courtesy Nemapix.)

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Figure 3. Root-knot nematode-affected root system on left, healthy on right. (Photo courtesy of Nemapix.)

Carefully dig up some of the sick plants and examine the roots to see if galls are present (Figure 3). If you are inspecting legumes (beans or peas), be careful not to confuse the galls caused by the nematode with the nitrogen-fixing nodules that are a normal part of the root system (Figure 4). It may be helpful to also pull up a healthy plant and look at its roots for comparison (Figure 3). If roots are knotted, many times also accompanied by severe rotting, then root-knot nematodes should be suspected.



Figure 4. Roots of a legume. Nitrogen-fixing nodules are attached only to the sides of roots.

(Photo courtesy of Nitragin.)

You can get a positive diagnosis of root-knot nematodes through your local county Extension office. Put the sick plants and about a quart of soil from the area where you dug them into a plastic bag and take it to the county Extension office. Tie the plastic bag to keep the soil and roots from drying out, and keep it in the shade or in your air-conditioned home or car until you can deliver it. Never allow the bag to sit in the sun. Exposure to direct sunlight, even for a few minutes, will “solarize” (cook) the nematodes and kill them.

The county Extension agent will send the sample to the Nematode Diagnostic Laboratory for a nematode assay. The laboratory will determine if nematodes are the problem and then provide advice on what can be done about them. There is a \$10 fee for this service.

Control

Although chemical nematicides have been widely used in commercial agriculture to control nematodes, they are both highly toxic and very expensive. Nematicides are not suitable for home garden use. Control of root-knot nematodes in gardens involves a combination of growing resistant varieties where available, good cultural practices and encouraging natural biological control.

Grow Resistant Varieties

Certain varieties of common garden crops are resistant to root-knot nematodes. When you buy tomato plants, pepper plants, okra seed, bean seed or pea seed, read the variety label to see if it says anything about resistance to nematodes. The label may list the capital letters VFN. These letters indicate that the variety has resistance to certain diseases: V = Verticillium wilt resistant; F = Fusarium wilt resistant; and N = root-knot nematode resistant. Some resistant varieties for different crops are listed in Table 1.

The nematode resistance gene tends to be less effective during hot weather, when the southern root-knot nematode is the most active. Although resistant varieties will perform better than susceptible varieties under these conditions, early planting would help.

Avoidance

In most gardens, there will be areas where nematodes are severe and other areas where the problem may be slight or nematodes may be absent altogether. Although nematodes do not move far on their own (probably 3 to 4 feet in a season), anything that moves soil or infected plant roots from one place to another in the garden will also move the nematodes. If areas with a severe problem can be identified, practicing common sense sanitation may prevent developing severe problems in other areas. **Avoid doing anything that moves soil or plant material from these spots into “clean” areas.**

Some common means of nematode spread include garden tillers, hand tools, dead plants that have been pulled up and muddy shoes. Tillers, hand tools, etc., should be washed free of soil after they have been used in known problem areas. As an additional precaution, these implements can be disinfected by brushing, dipping or spraying with a solution of one part household chlorine bleach to nine parts water. Dead plants (including roots) should be removed completely from the garden and disposed of properly.

Plant susceptible crops in areas of the garden that do not have root-knot nematode problems, and plant nematode-resistant varieties where the problem is severe (see Table 1). In many cases, growing

Table 1. Garden Crop Varieties Resistant to Root-Knot Nematodes (compiled from various seed companies)

Crop	Nematode-Resistant Variety
Tomato	Anahu, Atkinson, Auburn 76, Best Boy, Better Boy, Big Beef, Big Set, Bonus VFN, Bush Big Boy, Bush Early Girl, Celebrity, Champion, Empire, Ensalada, French Rose, Lemon Boy, Meltine, Monte Carlo, Nemared, Nemato, Northern Exposure, OG 50, Park's Extra Early, Park's Whopper, Patriot, Pelican, Pink Saturn, President, Red October, Resaplus, Rossol, Spring Giant, Sugar Snack, Summer Flavor 5000, Super BeefSteak, SuperSteak, Supertasty, Sweet Tangerine, Terrific, Viva Italia, Winter Red
Cherry Tomato	Small Fry
Lima Bean	Cangreen, Nemagreen
English Pea	Wando
Southern Pea	California Blackeye, Floricream, Magnolia Blackeye, Mississippi Cream, Mississippi Pinkeye, Mississippi Purple, Mississippi Silver, Worthmore, Zipper Cream
Snap or Pole Bean	Alabama No. 1
Pimento Pepper	Mississippi Nemaheart
Hot Pepper	Carolina Cayenne, Charleston Hot
Sweet Potato	Jewel

resistant varieties in the same spot for two consecutive seasons will lower nematode numbers sufficiently to allow the production of other susceptible varieties the next year. Unfortunately, however, a single year in the susceptible crop generally allows the nematodes to build back up so that a resistant variety will be necessary the following season.

Use anti-nematode crops and crop rotation.

In some gardens, nematodes may become so severe that vegetable production is impractical or consistently disappointing. In these extreme situations, relocation of the garden to a “fresh” area may be the most practical solution. If this approach is taken, be particularly careful not to reinfest the new spot by bringing soil or “dirty” tools or equipment into the new area.

Anti-Nematode Crops and Rotations

Rotate part or all of the garden to non-host crops or crops that are known to lower nematode numbers. **Broccoli, cauliflower, grain sorghum or millet** (for bird feed) can lower root-knot numbers, particularly if they are grown for two consecutive years. Rye, grown as a winter cover crop, may also help lower nematode populations. Two other possible approaches are listed below.

Plant French marigolds to reduce nematode numbers. The varieties Tangerine, Petite Harmony or Petite Gold have been shown to lower root-knot nematode populations. Marigolds should be planted in rows 7 inches apart, and plants should be spaced

7 inches apart within the rows. This “checked” pattern of planting allows hoeing in both directions to control weeds in the marigolds. Keeping the marigolds **weed-free is important since nematodes can multiply on weed roots**. Allow the marigolds to grow at least 2 months, then plow them under. You should be able to plant a susceptible crop in the area. However, you may need to do this every year. **Do not plant Tangerine Gem or hybrid marigolds as they may actually increase nematodes.**

Certain varieties of canola produce a substance that is toxic to nematodes when the plant material decomposes. Although there has been little research using this approach to nematode control in gardens, planting canola in the fall as a winter cover crop may help lower nematode populations for the next vegetable crop. Canola should be allowed to grow all winter and then be plowed under in mid to late March to allow the plants to decompose in the soil for about a month before the garden is planted. Two varieties of canola, ‘Humus’ and ‘Dwarf Essex,’ have been reported to contain high levels of the nematode-toxic compounds.

Fallow part of your garden every year to reduce the nematodes in the soil.

- Till the soil every two weeks to **keep the fallowed area weed-free**. Remember that nematodes can feed and multiply on weeds as well as crops.
- Fallow by tilling an area a couple of times, then cover with black plastic until the following spring. This reduces the amount of tillage needed to keep the area free of weeds.

“Solarize” an area of the garden each summer to reduce nematodes and other pests.

- First, till the area smooth (no clods or trash), then sprinkle-irrigate overnight or until the soil is wet. Immediately place a 2- to 4-mil clear piece of plastic over the area and weight down one edge with soil. Stretch the plastic smooth to the other side and weight that edge down. Weight down the ends with soil and allow the plastic to stay in place for at least **two months, preferably during June and July or June-August**. Remove the plastic carefully, allow soil to dry a few days, then plant a fall crop directly into the solarized soil without tilling. Tillage will bring weed seeds and nematodes back up into the solarized layer. Of course, tillage for weed control will have to be done later, but delay as long as possible. The plastic can be left until the next spring but may need repair with clear plastic tape occasionally.

General Sanitation

Pull up all nematode-infested plants and destroy them after the season. Remove the plant material, particularly the roots, completely from the garden area.

Till infested soil a few times during the winter months to expose nematodes and remaining plant roots to the cold weather. Freezing temperatures and dry, cold wind help kill surviving nematodes.

Don't bring nematode-infested plants into your garden. Look at the roots of tomato and pepper plants before planting them. Plants with galls should not be set out.

Never use borrowed gardening equipment or implements without washing and disinfecting them. Do not add native soil from other areas to fill low spots or help with drainage. Potting soil and commercially available bagged soil are acceptable because they are sterilized prior to marketing.

Promote Maximum Plant Vigor

Add organic matter to the soil using cover crops and manures. Increasing the organic matter in soil encourages the growth of numerous fungi, bacteria and beneficial nematodes that may provide some level of biological control for root-knot nematodes.

Take a soil sample to the county Extension office and have it tested for fertility.

Fertilize and lime according to soil test recommendations. Healthy plants can perform better even in the presence of nematodes than plants that suffer from nutrient deficiencies.

Water the garden as needed to keep plants healthy and growing, especially during the hot summer months. This is critical for plants suffering from root-knot nematodes because nematode feeding damages the root system, decreasing the amount of water that can be taken up by the plant.

Keep the garden weed free since weeds compete with your plants for fertilizer and water, and may be hosts for root-knot nematodes.

Other Ideas

Several products claiming to control nematodes are available. Most of these products are either biological control agents or organic compounds that are added to the soil. There is very little research data to indicate the effectiveness of these products in home gardens. Consequently, we advise that if you try these products, use a healthy degree of caution. Some of these can be expensive and should be tried on a small scale to determine if they work before you spend a lot.

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