



AVRDC - The World Vegetable Center

# Fact Sheet

## Pepper Diseases

# Root-Knot Nematode

*Meloidogyne incognita*, *M. javanica*, and *M. hapla*  
(listed in order of importance)

Found worldwide, particularly in warm climates



## Symptoms

All stages of growth are attacked. Aboveground symptoms develop slowly over time and are not noticed until plants are well developed. Symptoms consist of stunting, yellowing and a general unhealthy appearance of plants; wilting and death may occur in hot, dry weather. The plant will show reduced fruit and leaf size with consequent low yield.

Below the ground, the primary and secondary roots will have obvious galls or knot-like swellings of portions of the root tissue. With the aid of a magnifying lens, light brown egg masses may be visible on the root surface, and the female nematode may be seen if the

root tissue gall is dissected apart. These swellings prevent movement of water and nutrients to the rest of the plant resulting in stunting. Plants affected by root-knot nematodes are more easily infected by soil-borne fungi and bacteria. This secondary infection may lead to extensive discoloration of internal stem and root tissue, and rapid plant death.

## Conditions for Disease Development

These nematodes have a very wide host range including many crops and weeds. *M. incognita* is found widely on peppers. *Meloidogyne* species are found in many

## How to Identify Root-Knot Nematode Damage



Aboveground, plants are stunted and unhealthy  
(plants at right are most affected)



Belowground, numerous swollen "knots" develop on roots  
(arrows indicate a few obvious knots)

soil types, but greatest damage occurs in warm, sandy soils.

Nematodes can survive as dormant eggs a few months until environmental conditions are suitable for hatching. They are generally intolerant of flooded soil conditions. The eggs and juveniles survive in plant roots and are released into the soil as the plant disintegrates. The nematode is active throughout the year in warm, moist soil. The life cycle from egg to egg lasts 3 to 4 weeks under optimum growing conditions. The length of the life cycle is dependent on temperature and it will increase as soil temperatures decrease.

Nematodes are spread by using or moving infested soil or by transplanting infested seedlings. Soils may become infested by irrigation water, soil and water runoff, farm machinery, and workers' shoes.



*Nematode penetrating into root*

## Control

Use resistant cultivars. Check with your local extension agent to determine which pepper varieties are suitable for your region since local nematode populations may be variable and may be able to overcome resistance.

Rotate susceptible pepper crops with crops that tolerate or resist nematodes, such as grasses, sorghum, brassicas or onion. Keep the field in dry fallow during hot, dry weather if possible. Repeated plowing or turning over of the soil at the end of the growing season during hot, dry weather of the fallow period exposes nematode eggs, juveniles and adults to desiccation, and many nematodes in the upper layers of soil are killed. This practice may be sufficient to increase yield of a subsequent susceptible pepper crop. Keep fields free of weeds in the rotation crop since weeds may allow populations of the root knot nematode to increase.

Do not locate seedbeds where other susceptible

crops have been grown. In small vegetable plantings interplanting with French marigold (*Tagetes patula*) or African marigold (*T. erecta*) is very effective in lowering the nematode density in soil.

After harvesting the fruit, the foliage and stems can be composted but all infested root debris should be removed from the field entirely and burned since composting temperatures are too low to kill all the nematodes in the roots.

Adding compost or manure to the soil will increase its organic matter content and reduce nematode populations. The effectiveness of a soil amendment depends on ammonia production. The amount of ammonia produced varies with the level of nitrogen in the organic amendment. Oil-cakes and animal manures have high nitrogen contents of 2–7% and are the most useful nematicidal amendments but they must be applied at 4–10 t/ha to be effective.

Solarization for 4 to 8 weeks in small gardens is also possible. It will be most effective when conducted during the hottest season of the year. The soil should be well tilled and moistened to allow for even penetration of heat. Two layers of thin transparent polyethylene tarp should be used. The first layer is tightly pressed to the soil and the other slightly above the first creates a tent effect with higher soil temperatures obtained more rapidly than with a single layer alone. Most plant parasitic nematodes are killed between 44 and 48° C. The depth of penetration with solarization is about 5 to 10 cm. The loss of productive land and loss of economic returns for the treatment period will need to be assessed before solarization measures are implemented.

Nonfumigant chemicals such as carbofuran, oxamyl, and others are applied as granular or liquid formulations, and incorporated into the top few centimeters of soil. They may be applied scattered, banded in-row, placed in-furrow, or strip applied. They are not as effective as fumigants but they are easier to apply, more economical, and less phytotoxic. Keep fields free of weeds when the chemicals are applied since these could protect the nematodes from chemical nematicides.

Soil fumigants, although effective for the early period of plant growth, are dangerous to use and may not be economical for the small-scale farmer. They require application under certain conditions of soil tillth, soil moisture, and soil temperature. Time for aeration of soil is required between fumigation and planting. A further disadvantage is that all beneficial soil microorganisms are also destroyed.

**For more information on the production of pepper and other vegetables, go to <[www.avrdc.org](http://www.avrdc.org)>.**