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The Northern Root-Knot Nematode on Carrot, Lettuce, and Onion in New York

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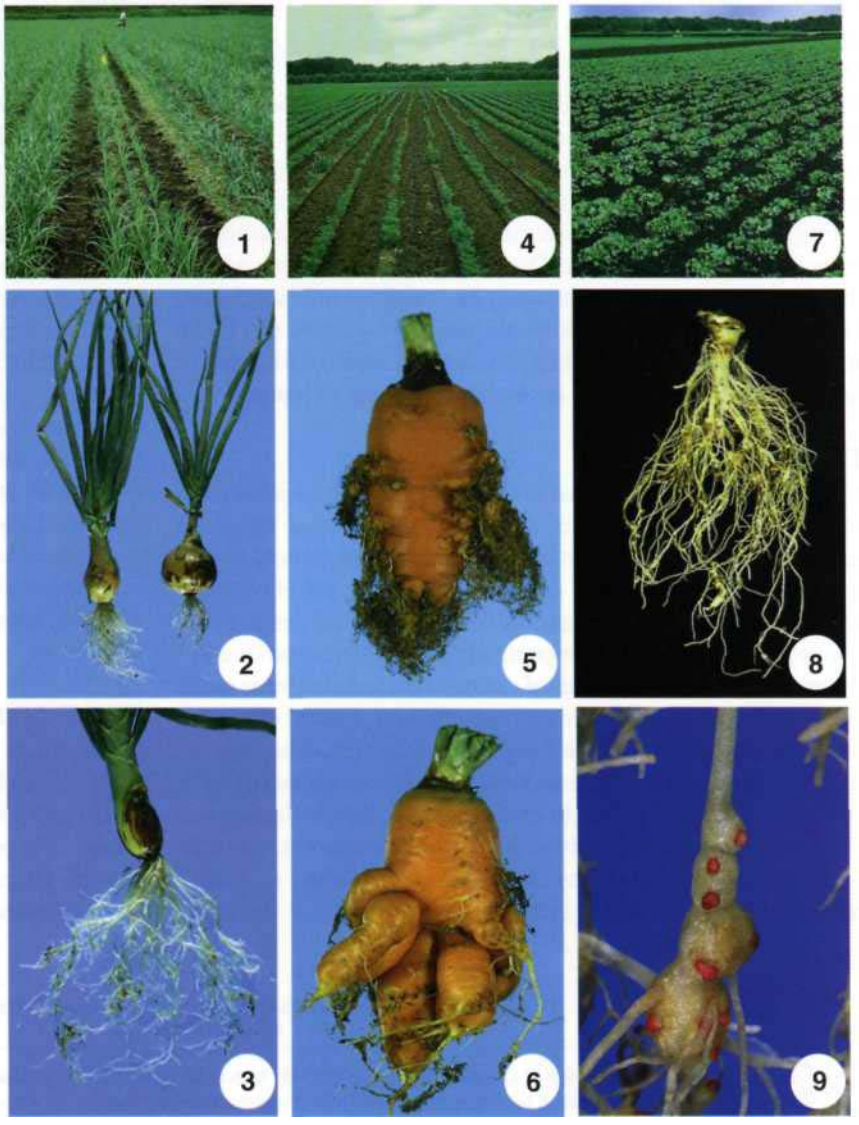
INTRODUCTION

Root-knot nematodes *(Meloidogyne* spp.) are major pathogens of vegetables throughout the United States and world, impacting both the quantity and quality of marketable yields. In addition, root-knot nematodes interact with other plant pathogens, resulting in increased damage caused by other diseases. To date, only the northern root-knot nematode (NRKN; *Meloidogyne hapla)* has been found on vegetables grown on organic or mineral soil in New York, as it is able to survive the extreme low temperatures during winter. The NRKN has a wide host range consisting of more than 550 crop and weed species, including weeds common to muck soils such as dandelion *(Taraxacum officinalis),* purslane *(Portulaca oleracea),* mallow *(Malva rotundifolia)* and plantain *(Plantago major).* The increasing occurrence and damage of this nematode to onions, lettuce, and carrots grown on organic soils in New York was recently documented.

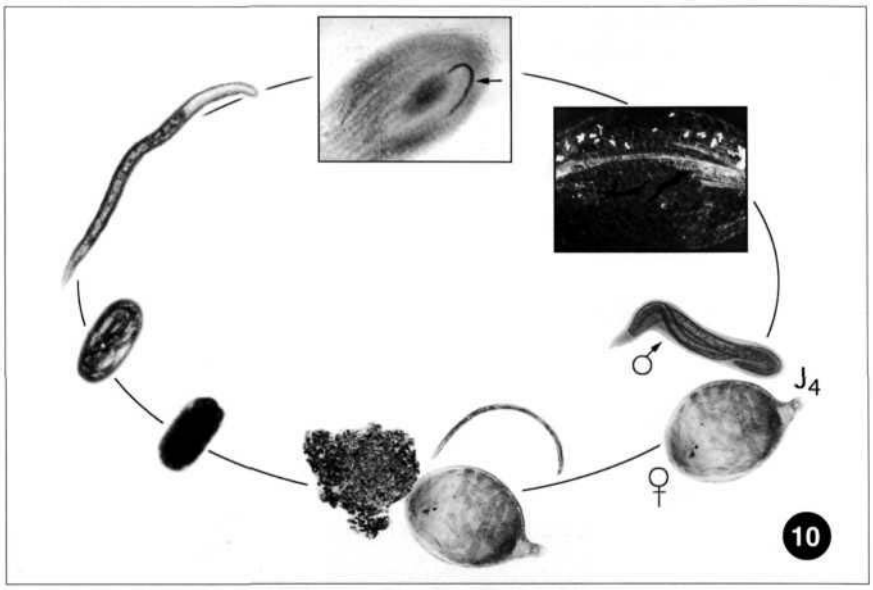


DIAGNOSIS

Above-ground symptoms on onions heavily infected with *M. hapla* are those of general stunting, uneven growth (Figure 1); thicker necks and smaller bulbs (Figure 2); and also delayed maturity. The diagnostic symptoms are found on roots as galls or root thickenings of various sizes and shapes (Figure 3). Growth of infected carrots is patchy and uneven (Figure 4). Roots of severely infected carrots exhibit forking, galls, hairiness, and stubby roots (Figures 5 and 6). Similarly, severely infected lettuce plants show stunting and uneven growth patterns (Figure 7), resulting in the production of small, loose and often unmarketable lettuce heads. Infected lettuce roots exhibit distinct and larger galls (Figure 8). Root systems of these vegetables heavily infected by *M. hapla* are not efficient in the uptake of water and nutrients that are necessary for normal plant growth.

LIFE CYCLE

The root-knot nematodes are obligate endoparasites that complete most of their life cycle within their host roots (Figure 10). The nematodes survive in soil as eggs and also second stage larvae. Mature females of root-knot nematodes deposit eggs (up to 1000 or more) in a gelatinous matrix (egg sac or egg mass) which can be observed attached to the protruding posterior end of the females on the root surface (Figure 9). This sac protects the eggs from dehydration. The infective second stage juveniles hatch from the eggs and move through the soil in search of roots of suitable host plants. The juveniles usually penetrate host roots just behind the root tip region and establish their special permanent feeding sites (giant cells) in the vascular tissues of the root. The giant cells provide nutrients for the sedentary nematodes which continue to feed, enlarge, and molt three times. Root cells around the feeding sites are also induced to enlarge and form galls (knots) and often extensive secondary root formation and branching of the main root. Depending upon the host and soil temperature, the entire life cycle may be completed in 17 to 57 days. Dissemination of nematodes within and among fields can be by irrigation water, vegetative plant parts, and soil infested with eggs or larvae which adhere to farm implements, animals, or humans.



DAMAGE

Crop losses in New York due to this nematode can be substantial in fields where populations are above the damage threshold density. Carrots are the most sensitive crop to this nematode with a damage threshold density of less than 1 egg/cc soil. Economic reductions occur on lettuce and onions when populations are at or above 2 and 8 eggs/cc soil, respectively. Depending upon levels of infestation, marketable yields of carrots were reduced by as much as 45% in commercial fields where effective control measures were not implemented. Bulb weight of onions was reduced by as much as 70% in heavily infested sections of commercial fields. In field microplots, bulb weight of the onion cultivars Norstar and Paragon were reduced by about 50% at an infestation level of 20 eggs/cc soil. Infestations by this nematode resulted in a 26% reduction in lettuce weight in experimental plots.

MANAGEMENT OPTIONS

Chemicals: The use of pre-plant soil fumigants is highly effective in controlling root-knot and other plant-parasitic nematodes. However, the majority of the fumigant-type nematicides are no longer available and are also costly and difficult to apply properly under the prevailing conditions in New York. Vapam and Telone C-17 are still available, but are not widely used. Of the nonfumigant-type nematicides, only Vydate has been registered and only on carrots for the control of this nematode in organic soils in New York. Vydate use on carrots is highly cost-effective where this nematode occurs at or above the damage threshold density.

Crop rotation: Rotating onion, carrot, or lettuce with a nonhost crop such as sweet corn and other grain crops, if economically possible, will be effective in controlling the northern root-knot nematode. Sudangrass is a nonhost to this nematode and when incorporated as a green manure will further suppress the soil population of this nematode. Current crop rotations on organic soils are of limited value as most crops grown, including potatoes, beans, celery, lettuce, onion, and carrot are susceptible.

Cover crops: The use of cover crops grown between the main crops may provide an alternative management strategy. Ryegrain, barley, oats, sudangrass, tall fescue, annual ryegrass, and wheat have been shown to be non- or poor hosts to this nematode.

Biological control (microbial/host resistance): None of the commercially available preparations of biological control organisms have been found to be highly effective against this nematode in organic soils in New York. The reaction of commercial cultivars of onion, lettuce, and carrots grown in New York is susceptible or unknown.

FIELD MONITORING

Level of soil infestation by this nematode can be monitored by analyzing soil samples directly (extracting and counting eggs and juveniles) or by indexing on a trap crop. Also, roots of susceptible crops can be examined directly in the field for the presence of galls or thickenings. Highest infections on roots and numbers in soil will be found close to harvest.

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