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Lesion nematodes: Life cycle, effects and management

Lesion or root-lesion nematodes comprise over 40 species of Pratylenchus, and several are important for potato production. This group of nematodes is found in all potato-producing areas in North America and Canada. The most common species found in the U.S.A. are *P. penetrans* and *P. neglectus.*

Life Cycle:

Eggs are laid in the soil or on roots and may be found clumped in small groups. Generations range between four and eight weeks depending on soil temperature and type. *P. penetrans* like soil temperature below 76 F. These nematodes are worm-like in all juvenile stages and in both sexes of adults. All juvenile stages and the adults can attack roots. When the soil is wet, these nematodes move little and when dry, they may become dormant. Lesion nematodes usually overwinter in soil as late-stage juveniles or adults.

Symptoms and Damage:

High population density of lesion nematodes can cause vine growth to be retarded, showing poor vigor. Stunting may be observed. Leaves may show some yellowing. Severe infestations can lower yields by the production of undersized tubers. Lesion nematodes feed primarily on roots, causing small

Root Lesion Nematode, *P. hexincisus* (Courtesy T. Powers)

elliptical lesions or cuts. Lesions may be quite small (1 mm or 0.04 inch) and on tubers, lesions may be large enough to appear like warts. Feeding on tubers and stolons is uncommon, but has been reported.

The primary problem with lesion nematodes is that these lesions form a portal or opening through which soil pathogens can enter. The most notable and common pathogen associated with lesion nematodes is the fungus *Verticillium dahliae.* Especially *P. penetrans* will synergistically increase the effect of V. dahliae (Verticillium wilt also commonly referred to as early dying). Therefore, when both the nematode and the fungus are present in the field even at below effective populations, early dying may become quite noticeable and economically deleterious by reducing yield.

Management:

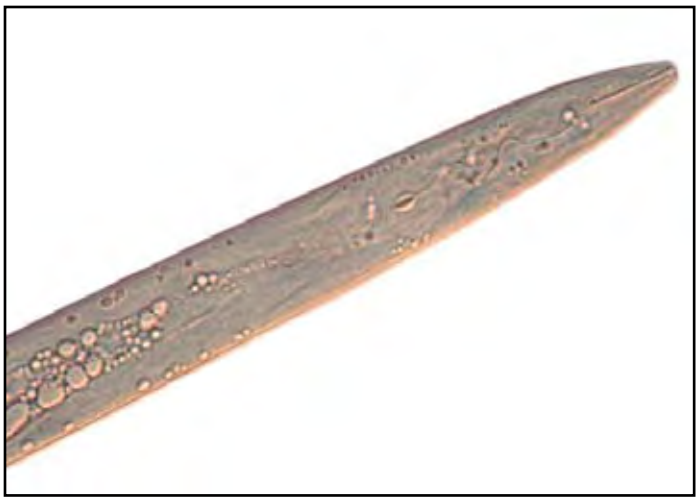
Lesion nematodes spread readily in contaminated soil via seed tubers, equipment, storage, wind, and animals. Host resistance to them is not yet commercially available but is being researched. The host range for lesion nematodes is very extensive, over 160 hosts, and includes both grasses and broadleaf plants including crops and weeds. Due to the wide host range, crop rotation is not generally effective as a means of control. Corn and other grain crops, and alfalfa are favorite hosts. If nematode populations are low, cover crops such as ryegrass or canola used as green manures could be used to inhibit population build up.

Economic thresholds for lesion nematodes have been established in potato fields in some places such as in the Columbia River Basin. Soil fumigation is the most common practice used on fields known to be infested with both lesion nematicides and Verticillium dahliae, and a history of early dying. A few non-fumigant nematicides are available for lesion nematode management but to be effective the species must be identified.

In this Issue:

Root-knot nematode: Life cycle, effects and management

Root-knot nematodes occur throughout the world and are primarily important in tropical and subtropical climates. There are over 60 species described with new ones are continuously being identified. In temperate climates on potato, the species of most concern is *Meloidogyne chitwoodi* or the Columbia root-knot nematode. In the U.S.A., it is found in the Pacific Northwest (WA, OR, ID, and northern CA), the San Luis Valley of CO, and UT. *M. chitwoodi* has caused export embargo of seed tubers from these States to some countries such as Mexico. *M. hapla* or the northern root-knot nematode predominates in northeast and north-central U.S., and east and central Canada. *M. incognita* or southern root-knot nematode is found in the southern U.S.



Columbia Root-Knot Nematode, *M. chitwoodi* (Courtesy T. Powers)

Tuber blemishes caused by *M. chitwoodi* (top) and *M. hapla* (bottom) (Courtesy G.S. Santo)

Life Cycle:

Eggs are laid inside roots and may number up to 1000. Reproduction does not require males. The second juvenile stage emerges from the egg and is the infective agent penetrating roots. Juveniles will repeatedly infect roots and may infect tubers as well. They enter tubers through the lenticels (stomates or pores). After the fourth juvenile stage, adults emerge from 'giant cells' that are developed for feeding juveniles. The males are wormlike and females are pear-shaped, about 1.5 mm (0.06 inch) long. *M. chitwoodi* likes sandy soils and soil temperatures of 68-77 F for reproduction. This nematode may complete three to five generations in a season in western U.S.A.

Symptoms and Damage:

Root-knot nematodes attack tubers and cause blemishes, making tubers unmarketable for fresh markets and reducing processing quality for chips and fries. Tubers infected with *M. chitwoodi* often appear bumpy, but this appearance does not occur with infection by *M. hapla*. In addition to external defects, internal necrosis may occur between the skin and vascular ring. These necrotic spots are caused by egg-laying females. Galls are produced on roots and tubers. In the case of *M. chitwoodi*, pimple-like galls appear on tubers but not on roots. Vine symptoms are rare, but severely infected plants may be stunted, yellowish and wilt under conditions of low precipitation.

Management:

M. chitwoodi readily moves through the soil vertically as much as four feet, making it difficult to control. Interaction by *M. chitwoodi* with soil pathogens has been noted in warm climates, but little is documented in temperate ones. Due to a wide host range, crop rotation has limited effect. Control of host weeds year to year helps suppress population build up. *M. chitwoodi* likes grasses, corn and cereals. Some green manures such as canola and sudangrass used before potato planting can reduce tuber infestation. Research to develop resistant potato varieties in North America is ongoing. Short season varieties are less affected by these nematodes since infection of potato plants is later in the season. Long maturing varieties are more affected. Soil fumigants may be used and nematicides are available.

Potato cyst nematode: Life cycle, effects and management

Species of Globodera have several pathogenic types and occur over much of the world. They have been identified in at least 58 countries. The potato cyst nematode of major concern in North America is *G. rostochiensis* or the golden cyst nematode which is characterized by gold-colored females. It is under strict quarantine regulations in North America. A related species, identified in 2006 in a field in Idaho, is *G. pallida* or the pale cyst nematode. Females of this species are characterized as being white or creamy colored.

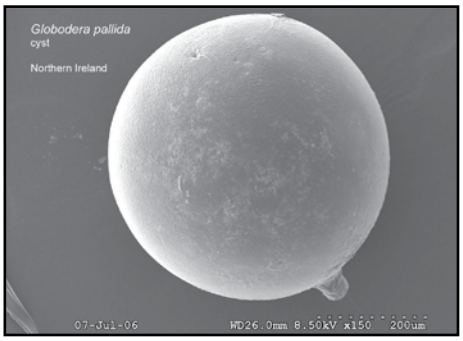
Life Cycle:

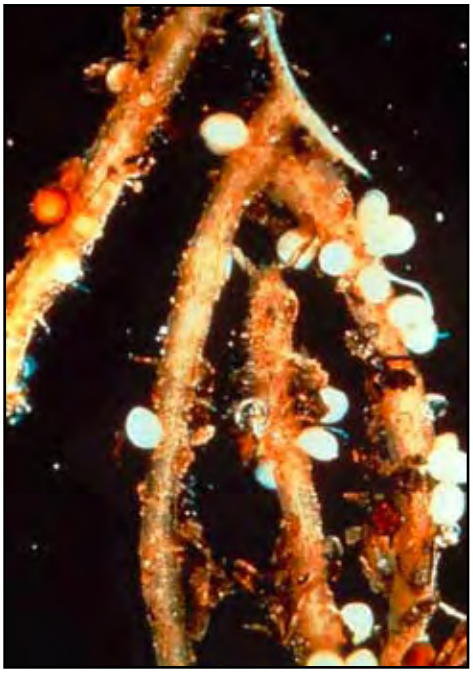
Eggs of *G. rostochiensis* hatch due to a stimulant released by potato roots into the soil. At first, juveniles develop within the female. The female gradually turns from white to creamy yellow to gold, and upon death a dark brown cyst forms. From the cyst, juveniles emerge and enter the root system in which they feed. After cycling through three to four juvenile stages, the male leaves the root with a wormlike appearance. Females are spherical; they grow and rupture through the root, protruding their bodies outwardly. Males mate with the protruding female.

The time from eggs to adults is between 38 and 48 days depending on temperature and there is one generation per season. Population increase between generations is 12- to 35-fold.

Symptoms and Damage:

Vine symptoms due to infection are similar to that of plant under water stress. There is chlorosis, then wilt and finally early death. Potato roots have small cysts that are dark brown and encapsulate 200 to 500 eggs. Cysts are the bodies of dead females that retain viable eggs. The cysts can persist in the soil for 20 years. Heavy infestations can result in total crop loss of potato.





Above: Male Pale Cyst Nematode, *G. pallida*.
Top right: Female Pale Cyst Nematode.
Bottom right: Cysts on potato roots.
(Courtesy T. Powers)

G. rostochiensis has been reported to cause synergistic losses with Rhizoctonia solani and Verticillium dahliae.

Management:

The primary method of managing the golden cyst nematode is through strict quarantine regulations. This nematode has been under these regulations on Long Island, NY, and recently the nematode has been identified in Quebec and Alberta, Canada. *G. rostochiensis* spreads readily through the transport of infected soil on seed tubers, equipment and containers. Planting infected seed tubers will spread the nematode into the soil.

Once the nematode is established in the soil, it is nearly impossible to eradicate. Some varietal resistance is known due to a gene bred into a few commercial varieties but is effective only against some pathogenic types of *G. rostochiensis* and *G. pallida*. The host range of the golden nematode is limited to tomato, eggplant and a few Solanaceous weeds. Crop rotation is effective and the rotation interval depends on the degree of infestation. Fumigation has been used for quick and drastic reduction in populations. Currently in the U.S.A. there is no non-fumigant nematicide available. Biological controls have not shown much success. Management practices for controlling an infected field requires an integrated approach using various methods over many years.

The best approach is not to plant any seed tubers from an infected field or move any equipment off infected fields or storage onto a clean field or into clean storage. Observe quarantine procedures.

Comparison of Principle North American Nematodes

	Lesion Pratylenchus spp.	Root-Knot Meloidogyne spp.	Potato Cyst Globodera spp.
North American Species of Interest	*P. penetrans* *P. neglectus*	*M. chitwoodi* *M. hapla* *M. incognita*	*G. rostochiensis* *G. pallida*
Occurrence	wide-spread	West (*M.c.*) North (*M.h.*) South (*M.i.*)	NY, QU, AB (*G.r.*) ID (*G.p.*)
Seriousness	moderate	severe	extreme
Adults	wormlike	male = wormlike female = pear-like	male = wormlike female = spherical
Major Damage	enhance early die	tuber quality	total crop loss
Vine Symptom	wilted	rare	water stressed
Primary Management	soil fumigation green manures	nematicides soil fumigation varietal selection	enact quarantine regulations !
Host Range	very extensive	extensive	limited

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The Nebraska Potato Eyes
is on the World Wide Web at:
www.panhandle.unl.edu/peyes.htm