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Potato nematodes and their control

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Nematodes are microscopic, wormlike animals that inhabit the soil and often attack plant roots and tubers. Potato plants can be parasitized and severely damaged by several nematode species. Damage by these nematodes results not only in yield losses but in inferior-quality tubers.

Nematodes parasitic on potatoes in Idaho

Root-knot nematodes (*Meloidogyne* spp.)

Root-knot nematodes are the most damaging nematodes occurring in Idaho. Of the several species of root-knot nematodes, two occur in many commercial potato-growing areas of Idaho. They are known as northern (*Meloidogyne hapla*) and columbia (*M. chitwoodi*) root-knot nematodes. These nematodes mainly affect potato quality. A wide host range (Table 1) makes their control by crop rotation difficult. Although the first generation usually attacks the roots, economic damage occurs as reduced yield and tuber quality.

Symptoms of nematode infestation are galls of various sizes and shapes on roots (Fig. 1) and wartlike bumps on the surface of tubers (Fig. 2). *M. hapla* tends to cause less distinct tuber symptoms than *M. chitwoodi*.

Carefully peeling thin layers off an infected tuber will reveal small brown spots, mostly within the outer one-fourth of an inch (Fig. 3). Tuber symptoms are rarely seen before harvest. They are most conspicuous during storage at temperatures above 45°F. Some reports indicate a possible interaction of root-knot nematodes with Verticillium wilt in increasing the symptoms of early dying.

Root lesion nematodes (*Pratylenchus* spp.)

These nematodes affect potato yield directly by reducing the size and weight of tubers. They reduce yield

Table 1. Some hosts of the major species of root-knot nematode that infest potatoes.

	Columbia *M. chitwoodi*	Northern *M. hapla*
Crops		
Alfalfa	+[a]	+
Bean	+	+
Carrot	+	+
Cole crops	+	+
Corn	+	−
Cotton	−	−
Eggplant	−	+
Grains	+	−
Grape	−	+
Hops	−	−
Lettuce	0	+
Mint	−	+
Melon	−	+
Pea	+	+
Pepper	−	+
Strawberry	−	−
Sudangrass	−	−
Sugarbeet	+	+
Tomato	+	+
Weeds		
Barnyardgrass	−	−
Bindweeds	0	+
Canada thistle	+	+
Foxtails	−[b]	−
Kochia	0	+
Lambsquarters	−	+
Mallows	0	+
Mustards	−	+
Nightshades	−	+
Nutsedges	0	0
Pigweeds	−	−
Russian thistle	−	0
Sowthistles	+	+

Source: Flint, M. L., director and technical editor. 1986. Integrated pest management for potatoes in the western United States. University of California, Division of Agriculture and Natural Resources Publication 3316 and WREP 3316.

Note: +, good host; −, poor or nonhost; 0, unknown.

[a]Alfalfa is a host for race 2 of *M. chitwoodi*.

[b]Green foxtail is a moderate host; yellow foxtail and meadow foxtail are poor or nonhosts.

Fig. 1. Root-knot nematodes cause swellings on potato roots.

Fig. 2. Root-knot nematodes cause bumps and warts on the tuber surface.

Fig. 3. Root-knot nematode damage. The tuber at left is uninfected; the tuber at right has a severe, advanced infection of columbia root-knot nematode; and the tuber at center shows brown spots caused by nematode egg masses.

Fig. 4. A potato field infested with root-knot and root lesion nematodes shows poor growth in the untreated four rows (center) and stronger growth in the treated rows on either side.

indirectly by weakening and increasing stress on the plants and by making them more susceptible to fungal and bacterial diseases. In some cases, a strong relationship has emerged between the amount of Verticillium wilt and populations of certain root lesion nematode species. Aboveground symptoms caused by high nematode populations resemble general plant stress. Patchy areas of poor growth and stunted, yellowing plants indicate nematode infestation (Fig. 4). The root symptom is sunken lesions.

Although most root lesion nematodes are primarily root parasites, some species are also known to damage potato tubers, causing a severe reduction in tuber quality. The most common root lesion nematode present in Idaho potato fields, *P. neglectus*, causes little damage. However, *P. coffeae* and *P. penetrans*, which have been found recently in a few areas, can cause severe yield and quality losses.

Stubby root nematodes (*Trichodorus* spp.)

Stubby root nematodes are important parasites of potatoes, not so much for the direct damage they cause but for the tobacco rattle virus (TRV) they transmit to potatoes. This virus causes a disease of potato tubers called corky ringspot. TRV sometimes causes a stem mottle consisting of yellowish rings and line patterns together with malformed leaves. Tubers infected with TRV may become irregularly shaped during the early stage of growth. The skin tissue cracks into arc-shaped lesions, and brown, concentric rings develop on the surface of many tubers. Rusty-brown, irregularly shaped lesions that have a corky texture may appear in the flesh of the tuber (Fig. 5). At harvest, tubers may have deep cracks and shallow, corky depressions on their surfaces, rendering them unmarketable.

Fig. 5. Corky ringspot in Russet Burbank tubers may appear as an area of concentric rings of brown tissue.

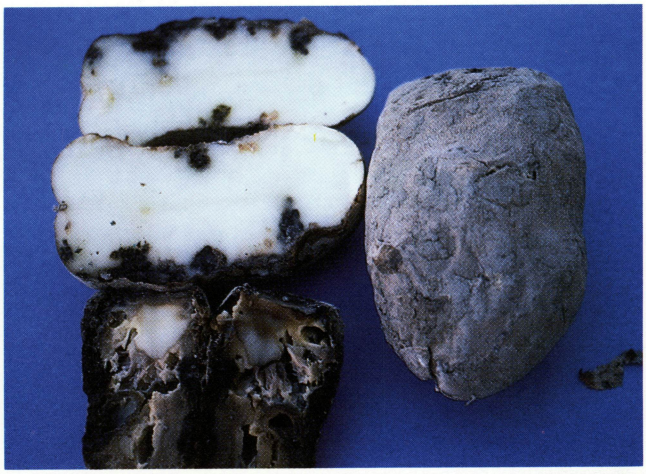

Fig. 6. Internal (left) and external (right) symptoms of potato rot nematodes.

Potato rot nematode (*Ditylenchus destructor*)

This nematode damages tubers, causing a serious problem in stored potatoes. Symptoms of the disease are not usually observable in the foliage except in cases of severe infection, which can reduce growth and deform leaves.

Initial tuber symptoms are small white spots just beneath the skin with holes in their centers. Infected areas become soft and are more readily detected by touch. Later, the tissues under the skin turn grayish brown and form slight depressions. As the disease progresses, the skin above the spots thins and frequently splits, exposing an inner, dry crumbled mass (Fig. 6). A cross section of a lesion will often reveal many nematodes along the border between diseased and healthy tissue.

Control

Nonchemical control

Before the discovery of chemical nematicides, cultural practices and land management were the most common means used to control nematode problems. Such practices include prevention, crop rotation, clean fallow, early harvest, and organic manures.

Prevention — Prevention is generally more effective and less expensive than any other control measure. There are many ways to prevent new nematode infestations and to prevent recontamination after applying nematicides:

- Use clean, certified, nematode-free seed.
- Do not return tare dirt to any cultivated land.
- Avoid moving farm machinery from infested fields to clean fields.
- Avoid using contaminated water for irrigation.
- Avoid using nondecomposed manure.
- Use a clean, disinfected storage to store potato seed.
- Don't use return-flow water from other farm operations.

Crop rotation — Crop rotation to reduce nematode populations is the most effective and most widely used land management practice. Successful practices include the following:

- Planting crops unfavorable for nematodes in the rotation
- Using resistant varieties of the rotation crop, if available
- Using a systemic nematicide on the rotation crops preceding the potato crop (if chemicals are labeled)
- Practicing good weed control in the rotation crops

Fallowing — Fallowing is the practice of keeping land dry and free of all vegetation for various periods of time depending on the target nematodes. Fallowing can be accomplished through frequent tilling of the soil by disking, plowing, or harrowing or by applying herbicides to prevent plant growth. Repeated cultivation reduces nematode populations in the upper layer of soil by exposing them to heat and air.

Plant-parasitic nematodes depend on living plant tissues for the food they need to develop to maturity and to reproduce. Some weeds can act as hosts for nematodes; therefore, it is important to keep the field weed free. During fallow, most active stages of nematodes die by starvation and desiccation.

Early harvest — Planting varieties that mature early is a good practice for reducing root-knot nematode damage. A short growing period reduces the time available for nematodes to infect tubers and cause significant symptom development. Delaying harvest will make nematode symptoms more severe and noticeable.

Organic manures — Use of aged organic manure or decomposed crop residues (green manure) affect nematodes in two ways: (1) by producing toxic fumes

and chemicals that kill nematodes and (2) by increasing the activity of naturally occurring biological control agents in the soil.

Chemical control

Two types of chemicals are in use today as nematicides: fumigants and nonfumigants. Fumigants are volatile compounds that produce toxic fumes when injected into the soil. Soil fumigation is the most cost-effective chemical method for root-knot nematode control.

Nonfumigants are nonvolatile compounds that kill nematodes by direct contact. Nonfumigant systemic nematicides are the most cost-effective chemicals for control of root lesion and stubby root nematodes.

Nematicides are generally used as a preventive measure. By the time nematode damage becomes apparent, the infested crops are usually damaged so severely that control measures are ineffective. Therefore, nematicides are normally applied preplant (mostly fumigant and contact compounds) or at planting (nonfumigant contact or systemic compounds). Because of the high cost of soil fumigation, it is most cost effective if it is used to control the quality-damaging root-knot nematodes or severe infestations of stubby root nematodes. Other nematodes can be controlled effectively by the use of nonfumigant nematicides.

Reasons for inadequate nematode control

Reinfestation — Reinfestation can occur for one or more of the following reasons:

- Missing strips
- Leaving field ends untreated
- Using contaminated water for irrigation
- Bringing contaminated equipment into a treated field
- Planting infected seed in a treated field
- Practicing poor weed control and allowing volunteer plants in the field

The wrong chemical or wrong rate — Certain nonfumigants control *M. hapla* but not *M. chitwoodi*. All chemicals are most effective when used at the rate specified on the label.

Poor timing of fumigant application — Early fall application of fumigants is recommended. Fumigants can be applied in the spring, but it is more difficult to obtain the proper soil temperature, moisture, and soil conditions.

Improper soil conditions before and during the application — Nematicides should be applied only under conditions specified on the label. Soil tilth, moisture, and temperature influence the effectiveness of chemical treatments.

Inadequate waiting period after fumigation — The soil must be left undisturbed for a period of time after application. Exposure time depends on soil condition and type and rate of fumigant.

Improper placement — Placement of nematicides is critical for proper control. Nonfumigants should be incorporated into the zone where potato roots and tubers develop. Fumigants are generally injected or watered in to a depth of 18 inches or more.

Weather favoring nematode survival and reproduction — Warm winter and spring temperatures increase nematode survival and reproduction. Even low initial populations of root-knot nematodes can lead to tuber damage when conditions are favorable for their rapid increase.

Soil sampling for nematodes

Most control practices require knowing the types and populations of nematodes present in the fields. Keep records of field locations where tuber symptoms were observed in previous potato crops. Sample soil in the fall while the crop previous to potatoes is still in the field. Take samples in the row because nematodes tend to concentrate within the root zone. Take soil samples when soils are not too dry, excessively wet, or frozen. It is a good practice to sample soils after fumigation if the field had a high nematode population or a history of infected crops.

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For further information

CIS 868, *The Potato Rot Nematode* (25 cents)
CIS 914, *Corky Ringspot of Potatoes* (50 cents)
PNW 190, *Root-Knot Nematodes of the Pacific Northwest* (25 cents)

To order publications, contact the Extension agricultural agent in your county or write to Agricultural Publications, Idaho Street, University of Idaho, Moscow, ID 83843-4196 or call (208) 885-7982. Idaho residents add 5 percent sales tax.

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