

## Parasitic phytonematodes

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**Abstract:** Nematodes are the most multicellular animals on earth. More than 80,000 species have been described, including around 2,500 plant parasites. Nematodes are elongated, unsegmented, microscopic, eel-like roundworms that may or may not be beneficial. They live in the soil and in the root tissue of plants. Many are good for the soil because they help decompose organic matter. Only a few species of nematodes are parasitic and harmful to crops, as they damage plants by feeding on the roots. Some nematodes attack soil-dwelling insect pests and can be used as biocontrol organisms. Other insect parasitic nematodes can be applied topically to caterpillars, as can a pesticide.

**Key words:** Parasite, phytonematode, segment, pesticide, ectoparasite, endoparasite, disease, climate, infestation, stylet.

### The purpose of the study.

The nematodes discussed here are classified as plant parasites. There are several species of nematodes that can cause problems in orchards. Parasitic nematodes that damage the roots of tree fruits include root rot, root knot, and dagger nematodes on apple trees and root rot nematodes on cherry and pear trees. Young apple trees infected with nematodes may exhibit poor growth and a gradual decline in yield. These may be symptoms of other diseases, making diagnosis difficult without taking a sample and looking at the roots. Nematode problems are worse in poor, sandy soils where trees may be under water or nutrient stress. Although apple replant disease is primarily caused by soil-borne fungal pathogens, nematodes may also be involved.

Apple (*Malus* spp.) – Replant disease

Cause: A complex of fungi, oomycetes and nematodes are biological pathogens that contribute to apple rot. Additionally, nonbiological factors, including poor soil structure, moisture stress, low or high pH, lack of available phosphorus, and cold stress, may increase overall symptom development, even if they are not the primary causes of the disease. Although causative factors sometimes vary within a given geographic area, studies in Washington, New York, Maine, the Netherlands, and South Africa have reached some consensus about the cause of the disease. This is a serious, common cause of poor growth in apple trees growing in apple or pear orchards or nurseries where they were previously planted. Tree growth is stunted in the first year

and throughout the life of the orchard, and serious diseases can cause tree death. Compared to healthy trees, the yield can decrease by 20 to 50% and the quality of the fruit also decreases

### Research Materials And Results.

- In order to identify nutrient deficiencies and determine whether lime is needed to adjust the pH value, a soil analysis is recommended. Replantation diseases cannot be effectively treated after trees have been planted.
- It is no longer recommended to mix monoammonium phosphate fertilizer (11-55-0 or 11-51-0) with the potting soil at a rate of 1 g/liter of soil, as a high salt concentration can burn the roots. Although there is initial growth, after 5 years the practice is no longer profitable.
- Symptoms: Apple replant disease has no obvious symptoms other than poor tree growth in the first few years after transplanting. Strong young trees planted in a problem area will stop growing at the beginning of summer. Infected trees develop leaves each spring but produce little or no shoot growth. The leaves are often smaller and light green than those of vigorous trees. Few new lateral or feeder roots form and the existing roots are discolored and damaged.
- Cultural control
- Avoid planting apples or pears on the same land where an apple or pear orchard or nursery was recently removed. It is recommended to rotate pomegranate fruits for 5-8 years.
- Monitor soil pH if it is too high or too low.
- If planting in an old garden, plant trees in the lane (walkway) of the previous garden rather than in the old garden to minimize disease pressure. Field observations show that the tree growth response to this planting method is better than old row planting, but not as good as fumigation. Plant as early as possible in the spring so as not to miss important pre-planting work.
- Use equal amounts of yellow mustard seeds (*Brassica juncea*) and white mustard seeds (*Sinapis alba*) at a rate of 1.78 tons/acre as a soil amendment prior to fall planting and also in combination with post-planting application of mefenoxam to control this disease to fight against it effectively complicated.
- Ensure proper plant management techniques from feeding to watering.
- Use resistant rootstocks such as Geneva 30, 41, 210, 214, 890 and 935.
- Chemical Control: While preplant fumigation is very effective and expensive, it typically pays for itself over the life of the orchard. Consult or refer a professional applicator to ensure application is performed safely and effectively.
- Metam sodium products such as Metam CLR (42%), Sectagon 42 or Vapam HL. Vapam HL can be used from 56 to 75 gal/A. Only use enough water to penetrate 90 cm deep. Before use, as much tree root residue as possible should be removed.

Trees adjacent to the treatment site may be injured. 5 days re-entry. Limited use of pesticides.

- Telone C-17 32.4 to 42 gal/A, depending on soil type and penetration depth. Do not use Telone alone; Was not effective in Eastern Washington. 5 days re-entry. Limited use of pesticides.

**Biological control.** The soil should be replaced with fresh soil or a well-prepared, steamed potting mix or in a ratio of 2 parts potting soil to 1 part peat. Data shows that a hole at least 6 feet square and 3 feet deep provides the best long-term management.

Special nematodes and their damage

**Root-infecting nematodes (mainly those associated with apple blight)** use their piercing-sucking mouthparts (stylets) to penetrate roots and cause damage by eating and penetrating cortical tissue. For this reason they are classified as migratory endoparasites. They eat and burrow into the roots and return to the ground to find more roots to feed on. They live and reproduce in the roots, which makes it easier for soil fungi to penetrate the affected tissue. If roots are severely damaged, feeder roots may be missing. Apple trees, especially young trees infected with *P. pentrans*, grow poorly and yield gradually decreases. The actual harm of feeding may not be clear. An overview of root lesion nematodes can be found here.

Root knot nematodes (*Meloidogyne* spp.) are sessile endoparasites, meaning they migrate into roots to find feeding sites. Once the feeding sites are established, they no longer leave the root. However, they can outgrow the roots. Their feeding leads to disruption of root functions such as nutrient and water absorption as they live in the roots. They can cause characteristic swellings called galls on the roots of affected plants.

**Dagger nematodes (*Xiphinema americanum*)** are migratory ectoparasites that attack roots from the outside and feed on epidermal cells with their long stylets. They are usually vectors of viruses such as tomato ring spot virus (particularly for Red Delicious on M106 rootstocks) and cherry rasp leaf spot virus (CRLV), which causes necrosis and decline of apple clusters.

**General symptoms.**

Recognizing nematode damage and symptoms can be problematic. Depending on the type and density of the nematode population, the sensitivity of the tree, and environmental conditions, you may not see any signs of damage. When otherwise healthy, many trees can tolerate moderate levels of parasitism without significant loss of production. However, when nematodes are a problem, you will see groups of poorly growing trees in an orchard that look healthy. This is due to areas with high population density. If left untreated, these spots can spread. The main above-ground symptoms of nematode damage are lack of vigor, branch dieback, and reduced growth and yield. Infestations of older trees can include chlorosis, orange peel, hypersensitivity to fruit peel diseases, and reduced fruit size. Below ground symptoms include poor growth of feeder roots and main roots, as well as soil clinging to the roots. Root knot nematode

infestations cause characteristic root swellings called galls. The only way to confirm that the observed symptoms are caused by nematodes is to carefully examine the soil and/or root tissue.

### **Sampling.**

For management decisions, it is important to know the nematode species present and their population densities. If a previous orchard or crop has had problems caused by the same nematode species listed as a fruit tree pest, the population size can damage young trees. If no nematode species have been previously identified, soil samples should be collected and sent to a diagnostic laboratory for identification. Sampling is best done in late summer or early fall when populations are at their highest density and are easier to detect. Soil and root samples are collected from tree debris at a depth of 6 inches to 36 inches, depending on the location where feeder roots are present. A common practice is to add a handful of soil and another handful of feeder roots to a container. Sampling thin feeder roots is important because nematodes prefer to feed on them rather than larger roots. Take 10 to 20 small samples from a given area, mix the soil thoroughly and combine into one sample. When sampling individual trees, take two to five subsamples depending on tree size. Damage can cause 20 to 50 nematodes per 100 g of soil; However, this range of numbers is only a recommended amount of damage. Figures are based on repeated surveys, but local soil types, climate, humidity and other factors vary widely, so our figures may not be representative. A list of laboratories offering nematode detection and testing services can be found at this link. Before taking the sample, you must contact the testing laboratory and request the submission and cost of the test.

### **Control status.**

Nematodes are usually introduced into new areas of infected soil or plants and can be transported from one field to another using garden machinery. Removing old roots before replanting and selecting resistant rootstocks and certified clean plants are good preventative measures for nematode control. Fumigation devices are not effective if plant debris containing nematodes (e.g. root nodes) remains in the soil. Trees can be monitored throughout the growing season for signs of decline. When a nematode infestation is suspected, it is important to know the species present and their population density when making management decisions. Crop growers use pre-plant fumigants, post-plant nematicides, short-term biological control agents (e.g. marigolds), cover crop cover crops, or biofumigants. Bionematicides such as cabbage and mustard can be used by organic and conventional growers. Bionematicides have the ability to reduce plant-parasitic nematodes by releasing chemical compounds that can be toxic to nematodes and other pathogens without affecting beneficial microorganisms and nematodes.

### **Fumigation.**

Orchards are typically fumigated with methyl bromide or other treatments before planting to kill soil organisms before replanting. Fumigants are broad-spectrum biocides that can affect soil health by killing beneficial organisms. Fumigants last long

enough for nematode populations to increase again. Since methyl bromide is now being phased out due to an international ban, alternative fumigants and treatments are needed. Research conducted at the USDA Agricultural Research Station in collaboration with Washington State University focuses on alternatives to methyl bromide fumigation. Some of these alternatives are listed below.

### Research methods.

- Cultural and alternative control methods.
- Different methods are used to combat nematodes:
- Harvesting is a practice of planting a field with non-susceptible or resistant plants for three to five years. To do this, it is necessary to remove the old roots before planting.
- Soil improvers such as mustard green manure can be used to suppress nematodes and soil-borne diseases and to improve soil quality.
- Rootstocks or seedlings that are certified free of resistant nematodes should be used.
- Cover crops. If the root-knot nematode *P. vulnes* is present, cover with short fescue, red fescue or ryegrass for this species as ground cover in the orchard. However, these are hosts for *P. penetrans* and should not be used if this species is present. Mustard plants are hosts to root nematodes and should be avoided if this nematode is present. Some cover crops that induce microbial changes in the soil or act as antibiotics to suppress pathogens (e.g. wheat and sudangrass) have been shown to be effective against nematodes and soil-borne diseases while contributing to soil quality. Lummulch has been found to reduce lesion nematode populations.
- Soil solarization is an alternative to fumigation. Moisten the soil and cover it with clear plastic wrap. Leave in place for 4-6 weeks during the hottest part of the summer. When the soil temperature reaches 125°F for 30 minutes, root nematodes, including eggs, are killed. It works for about a year because only the upper leg of the soil is heated.

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