

Non-Chemical Control of Plant Diseases in the Home Garden

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Plants are considered diseased when they do not grow and develop normally. Diseases are caused by organisms (pathogens) such as bacteria, fungi, nematodes, viruses, viroids, phytoplasmas and parasitic seed plants. There are also environmental disorders caused by air pollution, poor soil, excessive heat, inadequate or excessive nutrients, and drought. This publication discusses only diseases caused by pathogens.

Prevention is the basic approach to plant disease control, whether using chemical or non-chemical (organic) methods. To prevent disease, one must suppress the pathogen or eliminate conditions favorable for disease development. To achieve the best control, use as many disease-prevention practices as possible. With some diseases, certain control practices are more effective than others. For this reason, correct identification of a plant disease is important. Many control practices, however, will help control many different disease problems.

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Suppressing the Pathogen

Rotate crops. Vegetables in the same family group (for example, cantaloupes and watermelons) are likely to be susceptible to the same soil-borne diseases. If crops from the same group are planted one after the other, a disease organism may build up in the soil and cause severe crop loss. To prevent this, rotate vegetables from different family groups because they usually are not susceptible to the same diseases. Rotate crops listed in Table 1 so that selections from one group are not planted in the same location more than once every 2 to 3 years. Limited garden space may prevent an ideal rotation system.

Add organic matter. Organic matter increases the number and kind of microorganisms in the soil. Many of these microorganisms compete with disease agents for nourishment. In some cases, the best organic matter is obtained by turning under a green cover crop such as a small grain (wheat, oats, barley, rye) or a legume. If root knot nematodes are present in the soil, avoid using a legume as a cover crop.

Plant resistant varieties. Agricultural scientists have made great strides in developing disease-resistant varieties. Resistance, however, is a relative term and does not indicate immunity. For example, a tomato plant resistant to *Fusarium* wilt may develop

Table 1. Crop grouping for rotation to control soil-borne diseases.

GROUP A	GROUP B	GROUP C	GROUP D	GROUP E	GROUP F
Cantaloupe	Brussels sprouts	Eggplant	Beet	Sweet corn	Bean
Cucumber	Cabbage	Irish potato	Carrot		Cowpea
Honeydew melon	Cauliflower	Okra	Garlic		Peas
Pumpkin	Collards	Pepper	Onion		
Squash	Lettuce	Tomato	Shallot		
Watermelon	Mustard		Sweet potato		
	Radish				
	Rutabaga				
	Spinach				
	Swiss chard				
	Turnip				

wilt, especially if stressed, but not become as diseased as a susceptible variety might. A resistant plant develops disease symptoms more slowly, and may continue to produce well.

Practice good sanitation. Sanitation includes destroying crop residue so that pathogens can't survive in the soil and cause a problem the next season. Examples are raking and burning diseased leaves and disposing of infected fruit. If any plants are infected with root knot nematodes, dig them up and remove as much of the root system as possible from the garden site. Root knot nematodes are harder to kill when protected by root tissue.

Do not pile diseased leaves, fruits and other plant parts near the garden. Fungi often produce thousands of spores in the reproductive process and these spores can be wind-blown great distances. Shred diseased plant tissue and till it deeply into the soil. Do not put diseased plant parts in a compost pile, especially those with nematode infection. Although many disease organisms are destroyed by heat during composting, some will not be. Contaminated compost may spread disease. Make compost with grass clippings or shrub and tree leaves, as the disease organisms on turf and ornamental leaves are not likely to affect garden plants.

Treat with heat. Heating small amounts of soil to kill disease organisms is practical for potted plants and growing seedling transplants. The soil should be moist but not saturated. Heat the soil at 180 degrees F. for approximately 3 hours in a standard oven. Place an average-sized Irish potato in the middle of the soil to act as an indicator. When it is cooked, the soil should be sterile. Microwave ovens can be used for sterilizing small quantities. Using high power, heat the soil for 3 minutes. Do not over-heat with either system. Excessive heating makes certain elements more available and often at toxic levels.

A new heating approach that has shown good results in Texas is solarization (soil pasteurization). It consists of covering well-tilled, moist soil with clear plastic, sealing the edges and leaving it on for at least 4 weeks. Do not use black plastic because the soil will not heat as well. This method is most effective for killing fungi, especially those that cause root rots. Certain weeds and nematodes are controlled, but not consistently. Solarizing when residues from cruciferous plants such as cabbage are in the soil improves effectiveness; as cabbage plants degrade they produce volatile compounds that are toxic to some pathogens. Besides killing pathogens, solarization also stimulates plant growth, possibly by creating a good environment for beneficial microorganisms; however, this phenomenon is not fully understood. Solarization works best during the long, hot days of July and August. In West Texas, where sunny days are common, solarizing in late March and April can be effective.

Leave land fallow. Leaving land idle and clean through the growing season reduces disease agents in the soil. Fallowing is especially helpful if done in the summer months when soil temperatures are high. Frequent tilling or spading keeps the soil dry and free of plant growth and exposes soilborne disease organisms, such as nematodes, to killing heat and excessive drying. Other benefits of fallowing are weed and insect control. This practice is most effective when rainfall is low and temperatures are high. Like solarization, fallowing is difficult for growers with small gardens that are intensively cropped. Consider fallowing or solarizing only a portion of the garden at a time.



Leaving land idle and clean through the growing season reduces disease agents in the soil. Fallowing also controls weeds and insects.

Control weeds. Weeds harbor insects and are hosts for many viral diseases. For most viruses to survive they must remain in a living organism, either a host plant or insect, which transmits the virus from one plant to another. Destroying weeds in and around the garden may eliminate potential host plants. This should be done before planting transplants.

Avoiding Disease

Change the planting date. Some diseases are controlled by changing the planting date. Spring-planted squash usually escapes mosaic virus, whereas fall-planted squash does not. Plant warm-season vegetables, such as peas and okra, after the soil warms sufficiently to avoid seedling disease.

Obtain high quality planting stock. Check transplants such as cabbage, tomatoes, peppers and others for root knot nematode galls. Certified Irish seed potatoes are less likely to harbor a disease such as black leg. Some disease agents are seed transmitted; therefore, plant only the best seed.

Use good cultural practices.

- Select the best planting site—one with deep, well-drained soil.
- Planting on raised beds improves drainage. Raised beds also warm up faster than level soil, so seedlings emerge faster and are more likely to escape seedling diseases.
- Space plants properly so they aren't too crowded. Crowding reduces air circulation, which encourages leaf spot diseases such as septoria leaf spot on tomatoes.
- Overplanting, where possible, ensures enough production if some plants or fruits are lost to disease.
- Fertilize properly. Plants receiving all the nutrients they need may resist some disease-causing organisms. Apply fertilizer based on a soil test.
- Do not overwater. Excessively wet soil is more likely to support soil-borne fungal diseases such as root rots and wilts.
- Avoid overhead irrigation. Leaf spot diseases develop rapidly when leaves are moist.
- Do not prune roots. Cutting roots while cultivating reduces plant vigor and leaves openings where root rot and wilt fungi can enter.



Planting on raised beds improves drainage and speeds up plant emergence, thus reducing chances of seedling disease.

Control root knot nematode. Root knot nematode is a major problem in many home gardens statewide. Some gardens become infested from contaminated transplants or topsoil. Taking steps to prevent this problem is just as important as implementing controls later. When a garden is first planted, if the soil is infested nematode levels generally are low. After several years of gardening and growing susceptible plants, nematode populations increase to the point that damage becomes noticeable. Control practices include solarization, summer fallowing, rotation, adding organic matter, planting trap crops, removing diseased plants and using tolerant or resistant varieties. All these control measures are designed to reduce the soil's nematode population.

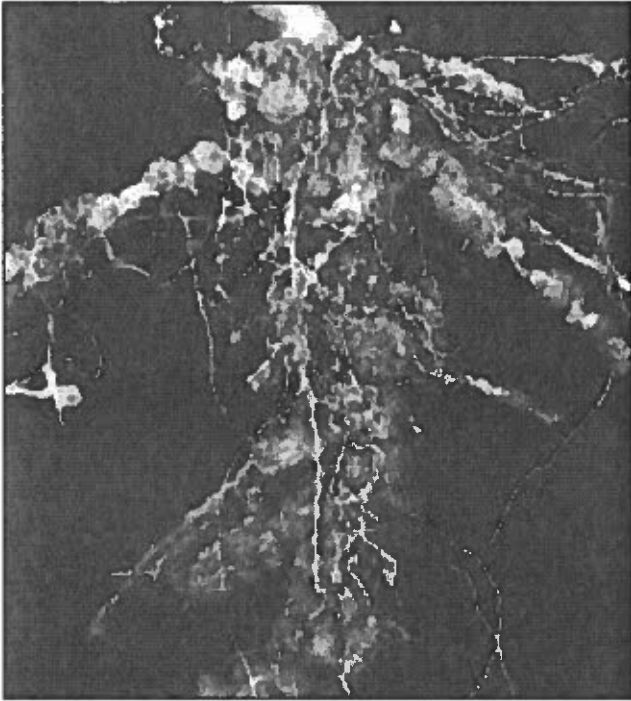
Benefits of solarization and summer fallowing have been discussed. Removing host plants and keeping the soil dry reduce nematode populations because nematodes require a moist environment for survival. Although these practices reduce nematode numbers, the nematodes are not entirely eliminated. Growing one susceptible crop can bring populations back to damaging levels. Repeated use of these practices is necessary for success.

Rotating susceptible crops with non-hosts or poor hosts of the root knot nematode is another means of reducing the population. Sweet corn is a poor host and is good to use in a rotation, especially in an area where root knot has done severe damage. Onions, garlic, asparagus and shallots also are poor hosts. Cool-season crops such as cabbage, Irish potatoes, greens (turnips), radishes and broccoli are less likely to suffer yield loss from root knot nematodes. Even though these are susceptible plants, they grow best in cooler temperatures that are not favorable for root knot nematode development.

Just having lots of organic matter in the soil does not ensure root knot nematode control. However, the more organic matter there is the better the chance that antagonistic organisms will develop. Some organic matter works better than others. Turning under a green manure crop such as small grains several weeks before planting is the best. The crop may need additional nitrogen because decay organisms use available nitrogen as they break down the green manure crop.

Sometimes people resort to home remedies to control nematodes. These include planting marigolds or mixing sugar or lye into the soil. Of these three, only marigolds are effective in controlling nematode populations, and their effectiveness has limitations.

Some people think marigolds secrete a toxic substance that kills nematodes, and that by planting a few marigolds around annual plants in infested soil they can prevent infection. This is not true. Marigolds may produce some antagonistic chemicals, but the primary reason for control is that they



These swollen and distorted tomato roots are heavily infected with root knot nematodes.

act as a trap crop. Nematodes enter their roots but are unable to complete their life cycle. Trapped nematodes die without reproducing.

French marigolds, *Tagetes patula*, are more effective in controlling root knot nematodes than the African marigold, *Tagetes erecta* which also is referred to as the American, Big or Aztec marigold. To be effective, marigolds must be planted as a solid crop and grown for 90 to 120 days to reduce the nematode population sufficiently to grow annual plants without treatment. Plant marigolds in rows 7 inches apart with 7 inches between each plant so that roots penetrate the entire soil mass to trap as many nematodes as possible. If marigolds are planted close together, they form a dense canopy which retards weed and grass development. Many weeds and grasses serve as hosts for root knot nematodes. If the weeds are not controlled, marigolds will be less likely to suppress the nematode population.

Using marigolds in a manner other than that recommended can invite disaster. For example, planting a few marigolds here and there among tomatoes encourages spider mites. The spider mite is one of the most difficult garden pests to control and can become nearly as serious a problem as the nematodes.

Remove all nematode-infected plants from the garden as soon as possible after production ceases. Removing the root system eliminates many of the nematodes. To remove as much of the root system as possible, use a shovel rather than just pulling the plant up by the stem.

Root knot-resistant vegetable varieties are not plentiful. Fortunately, progress has been made in developing root knot-resistant tomatoes. The best resistance is found in certain hybrid varieties. Root knot-resistant varieties are noted in seed catalogs by "N" following the variety name. Often "V" and "F" precede the "N." "VFN" stands for Verticillium wilt resistance, Fusarium wilt resistance and nematode resistance. Hybrid tomato seed are more expensive than open pollinated seed, but the benefits in disease resistance alone are enough to justify buying them.

Remember, for best results in controlling plant diseases with non-chemical methods, use as many of these preventive practices as possible.

Suggested References

- Agrios, G.N. 1988. Plant Pathology. Academic Press, Inc., New York, N.Y.
- National Academy of Science. 1968. Plant-Disease Development and Control. Publication 1956. National Academy of Sciences. Washington, D.C.
- Sherf, A.F. and A.A. Macnab. 1986. Vegetable Diseases and Their Control. John Wiley & Sons, New York, NY.
- Walker, J.C. 1969. Plant Pathology. McGraw-Hill Book Co., New York, N.Y.

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