



# Non-Chemical Methods for Controlling Diseases in the Home Landscape and Garden

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With the increasing concern about use and misuse of pesticides in commercial agriculture and home gardens, more and more inquiries for “organically grown” commodities are received every year. Non-chemical control practices for plant diseases have been known and recommended for years. The backbone of any integrated pest control program must always include cultural and sanitation practices, two important components of non-chemical disease control.

Unfortunately, disease problems may begin as soon as seeds are planted and can continue into harvest and storage. Plant diseases may be caused by several different living pathogenic organisms such as fungi, bacteria, viruses, phytoplasmas, and nematodes. In addition to these parasitic organisms, non-living factors such as deficiencies or excesses of water, light, temperatures, air pollution, pesticides, and nutrients can either predispose a plant to disease or directly cause plant injury.

Fortunately, many disease problems can be prevented or controlled without the use of pesticides. Effective plant disease control must begin at the onset of disease or even before symptoms appear. Several non-chemical practices that can reduce plant loss are discussed below.

## Resistance

Effective plant disease control through resistance (or a plant's tolerance or immunity to a disease) is based on the knowledge of diseases known to occur in an area. Always choose varieties of plants that are adapted to Oklahoma growing conditions. Many vegetables, fruit, and ornamental plant varieties are available with resistance to one or more diseases. For example, when purchasing tomato varieties, consider plants labeled “VFN,” “VFNA,” “VFNT,” etc. This indicates that the plants are resistant to Verticillium wilt (V), Fusarium wilt (F), Southern Root-Knot Nematode (N), early blight (A), or tobacco (tomato) mosaic virus (T). Selection of resistant plants may eliminate many disease problems. Contact your local County Extension Office for lists of plant varieties that can be successfully grown in Oklahoma.

## Exclusion

Exclusion is preventing the entrance and establishment of disease causing organisms (pathogens) into areas where plants are grown. This means avoid bringing diseases into and/or moving them around in the garden. Use certified, disease-free seed or transplants. Examine the leaves and root systems of transplants and eliminate or destroy diseased plants. Either raise your own transplants in sterilized beds or buy them from a reputable dealer. Do not purchase transplants with galls or swellings on their roots or plants that have a brown discoloration on the stem at the ground line. Galls or swellings may indicate root-knot nematode infection and a brown stem discoloration may denote the presence of damping-off organisms. Also, avoid transporting soil or tools from known disease areas to disease-free areas.

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## Eradication

Eradication is the elimination of the disease-causing organism after it has become established on a plant. Eradication can be accomplished by:

**1) Sanitation** - Plant pathogens are less likely to survive if organic matter is quickly decomposed. To encourage this, remove plant debris or infected plant parts after each growing season. Turning the soil after harvest will also help to break down small roots that may harbor nematodes, fungal, or bacterial pathogens. Gardeners may compost dead plants provided they have a good composting system; otherwise these piles may serve as a source of inoculum (infectious pathogen propagules). Prune or remove twigs and branches of woody plants affected with fire blight and other bacterial or fungal canker diseases. It is best to burn woody material that is diseased. Keep gardens weed-free. Weeds are often another source of pathogen inoculum. Eradication of weeds can break the life cycle of a pathogen, thus controlling it. Weed removal can also increase air movement in garden plots which will decrease conditions that are favorable for disease development. Always disinfect machinery and other tools with steam, hot water under pressure, a commercial disinfectant, or a freshly prepared 10 percent solution of household bleach and water so as not to spread pathogens from one area to another.

**2) Crop Rotation** - Avoid planting the same crop in the same area of the garden year after year. Continuous culture of the same kind of crop provides an opportunity for pathogen buildup. For example, rotate leafy vegetables with grains or corn or rotate annuals or biennials in seed and flower beds. It is best to grow the same or closely related plants in the same soil only once in every three to five years. This practice “starves out” most pathogens that cause leaf, flower, and stem diseases. Crop rotation is also effective against many soilborne organisms, those pathogenic fungi, bacteria, and nematodes that persist in the soil for many years.

**3) Fallowing** - To fallow soil, leave the area bare during the growing season to reduce inoculums in the soil. This is best achieved in the summer when the soil temperatures are high. The area should be kept weed-free and dry. Turn the soil frequently to bring inoculum and nematodes to the top of the soil. Fallowing is beneficial for control of weeds, insects and diseases.

**4) Soil Sanitation Treatments** - Occasionally disease causing organisms living in the soil may build up and prevent satisfactory growth of plants. Pathogen-free soil is desirable for houseplants, transplants, and garden plots. Sterile potting mixes are available at many garden centers; however it may be desirable to sanitize small quantities of soil on your own.

There are several non-chemical methods available to eradicate or reduce the amounts of pathogens in the soil. The use of solar, dry, or steam heat is the most effective non-chemical means to disinfect soil. The time to treat soil is before seeding or

transplanting. Soil to be treated must be easily crumbled and be without clods or large pieces of plant debris. Any amendments (manure, compost, peat moss, etc.) must be added before treatment. Soil must also have proper moisture. To test for this, gently squeeze a handful of soil. When the hand is opened, the soil ball should break apart somewhat. If it does not and if the ball cannot be broken apart by gently pushing down on top of the ball, the soil is too wet. If the soil is too dry add water.

### Treating Large Amounts or Areas of Soil

**Soil Solarization** - This method uses the sun's energy to heat soil to temperatures that are lethal to many soil-borne organisms and weed seeds. Treatment should be done during the summer when there are high air temperatures and intense solar radiation. Soil in the area of the garden to be treated should be loosened with a rototiller or a shovel, wet, and covered with a thin, clear, polyethylene (plastic) film. The edges of the plastic sheet should be sealed with soil to prevent heat loss and retain moisture. Leave the plastic in place for several weeks. The longer the soil is exposed to the heat generated by the solarization process the greater the kill of undesirable organisms. For more information please refer to OSU Extension Fact Sheet EPP-7640, Solar Heating (Solarization) of Soil in Garden Plots for Control of Soilborne Plant Diseases.

### Treating Small Amounts of Soil for Potting or Beds

**Oven Sterilization** - Place soil evenly but not more than four inches deep in non-plastic containers, such as clay pots, and glass or metal baking pans. Tightly cover each container with aluminum foil. Insert a meat or candy thermometer through the foil into the center of the soil. Set the oven between 180° and 200°F. Heat the soil to at least 180°F and allow it to remain at this temperature for 30 minutes or more. To determine if enough time has elapsed, place an average sized Irish potato in the center of the pan. When it is fully cooked, the soil should be sterilized. Do not allow the temperature to go above 200°F since this may cause products toxic to plants to be produced. After heating, allow to cool, remove containers from the oven, and leave the aluminum foil in place until ready for use. The heated soil will give off an odor. Microwaves or outdoor cookers can also be used. Microwave soil for 90 seconds per kg (2.2 lbs) on full power. Remember not to use metal containers and aluminum foil when using a microwave.

**Pressure Cooker Sterilization** - Pour several cups of water into the cooker. Place no more than four inches of soil in shallow containers on a rack out of the water. Level the soil, but do not pack it down. Cover each container with aluminum foil. Stack the containers to allow steam circulation. Close the lid, but leave the steam valve open somewhat until all the air is forced out and steam begins to escape. Then close the steam valve and heat at 10 pounds pressure for 15 minutes. Turn off the heat, allow the containers to cool and remove them. Again leave the aluminum foil in place until you are ready to use the soil.

**Steam Sterilization Without Pressure** - Pour about an inch of water into the sterilizing container. Follow the soil preparation procedures listed in pressure cooker sterilization. Place filled soil containers on a rack which will hold them out of the water. Close the lid and bring the water to a boil. Open the lid just enough to prevent pressure from building up. When the steam begins to escape, continue boiling for 30 minutes. Then turn off the heat and replace the lid. Remove the soil when cool.

**Avoiding Toxicity from Heated Soil** - With heavier soils and soils containing a large amount of organic matter such as manure, compost, or peat moss, a toxic effect from heat sanitation may occur. This can cause poor seed germination, plant growth abnormalities, or plant death. The toxicity is caused by an accumulation of ammonium compounds, soluble organic compounds, and minerals or salts when the soil is heated too long or at too high a temperature. To determine if the treated soil is toxic (or not) a simple bioassay can be used. Simply plant a few lettuce seeds in treated soil collected 2 - 8 inches deep. If the seed does not germinate, consider that the concentration of toxic compounds will affect plants. Be sure to use seed with a high percent germination (you may want to set up a similar test with untreated soil to check the validity of this test). If toxicity of soil is a problem, heavy irrigation of the treated soil may leach out many of these substances. Storing the soil two to three weeks without cover may also reduce soil toxicity.

### Cultural Management

Cultural management involves avoiding the onset of disease. To accomplish this without the use of pesticides, an unfavorable pathogen environment must be created. For example:

- 1) Do not work in the garden when plants and soil are wet. Spores and cells of disease causing organisms can be spread from one plant to another and initiate new disease more easily under these conditions. Wet soils are easily compacted which can decrease the amount of oxygen in the soil available for root uptake.
- 2) Make sure plants are spaced properly. Air movement is decreased when plants are grown too close together and this allows for moisture to remain on leaves for longer periods of time. Wider spacing in beds and landscape plantings promotes rapid drying after wet periods and stops development of foliage, flower, and fruit pathogens.
- 3) Avoid excessive soil moisture. Over-watering enhances seed decay, damping-off, and root rot diseases. Try not to plant in areas having poor drainage or where water stands for several days following rains. Consider planting on raised beds. The best planting soils have deep, well-drained soil.
- 4) Fertilize plants properly based on soil nutrient analyses using either organic or commercially prepared (inorganic) fertilizers.
- 5) Consider adding organic matter to the soil such as compost. Organic matter is also added by planting a green cover crop such as a legume or small grain, and turning it under. Organic matter is rich with microorganisms and they will either compete with pathogens or break down pathogen inoculum.

Vigorous plants are less likely to have disease problems than weak, undernourished ones. Grow plants under optimum conditions and there will be fewer disease problems.

Control of most plant diseases can be accomplished without the use of pesticides. As long as sound cultural practices, sanitation, and well adapted plant varieties are used, there will be few disease problems. It is important to realize that you must accept some disease loss. Do not expect a "perfect" garden or plant if you do not want to use chemicals.

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