



DISEASES

Nonchemical Disease Control

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Quick Facts...

Many disease problems can be prevented or controlled without pesticides.

Always choose plants that are adapted to Colorado growing conditions.

Avoid bringing diseases into the garden or moving them around within your garden.

Eliminate the disease-causing organism after it has become established on a plant.

With the increasing concern about use and misuse of pesticides in commercial agriculture and home gardens, there are more and more inquiries for organically grown commodities every year. Nonchemical 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 nonchemical 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 pathogenic organisms, such as fungi, bacteria, viruses, mycoplasmas and nematodes. In addition, nonliving factors, such as deficiencies or excesses of water, light, temperature, 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 pesticides. Effective plant disease control begins at the onset of disease or even before symptoms appear.

Resistance

Effective disease control through resistance (a plant's tolerance or immunity to a disease) is based on knowledge of the diseases that occur in an area. Always choose varieties of plants that are adapted to Colorado growing conditions. Many vegetable, fruit and ornamental plant varieties are available with resistance to one or more diseases.

For example, when purchasing tomato varieties, always select 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). Selecting resistant plants may eliminate many disease problems. Contact your Colorado State University Cooperative Extension county office for lists of plant varieties that are successfully grown in this area.

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 the garden or moving them around within 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. A brown stem discoloration may mean the presence of damping-off organisms.

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Also, avoid transporting soil or tools from known disease areas to disease-free areas.

Eradication

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

Remove plant debris or infected plant parts after each growing season.

Sanitation

Plant pathogens are less likely to survive if organic matter is quickly decomposed. Remove plant debris or infected plant parts after each growing season. Turn the soil after harvest to help break down small roots that may harbor nematodes, fungi or bacteria. Gardeners may compost dead plants if they have a good composting system; otherwise, these piles may serve as a source of pathogens.

Prune or remove twigs and branches of woody plants affected with fire blight and other bacterial or fungal canker diseases. (See fact sheet 2.907, *Fire Blight*.)

Keep gardens weed free. Weeds often are another source of pathogens. Eradicate weeds to break the life cycle of pathogens and control them. Weed removal also can increase air movement and thus decrease conditions that favor disease development.

Eradicating weeds can break the life cycle of a pathogen and control it.

So pathogens do not spread from one area to another, always disinfect machinery and other tools with steam, hot water under pressure, or a 10 percent solution of household bleach and water.

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 every three to five years. This practice starves out most pathogens that cause leaf, flower and stem diseases.

Crop rotation is not as effective against soil-borne organisms, those fungi, bacteria and nematodes that persist in the soil for up to 10 years or more.

Soil Sanitation Treatments

Occasionally, disease-causing organisms that live 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 nonchemical methods available to eradicate or reduce pathogens in the soil. The use of dry, steam or solar heat are the most effective nonchemical means to sanitize soil. The time to treat soil is before seeding or transplanting. Soil to be treated must be easily crumbled and without clods or large pieces of plant debris. Add any amendments (manure, compost, peat moss, etc.) **before treatment**. Soil also must 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 doesn't and the ball cannot be broken apart by gently pushing down on top of the ball, the soil is too wet.

Sterile potting mixes are available at many garden centers. However, it may be desirable to sanitize small quantities of soil on your own.

Oven sterilization. Place soil evenly but not more than 4 inches deep in nonplastic containers, such as seed flats, 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 temperature

between 180 and 200 degrees F.

Heat the soil to at least 180 degrees and allow it to remain at this temperature for 30 minutes. Do not allow the temperature to go above 200 degrees, because this may cause products that are toxic to plants. After heating, cool and remove containers from the oven. Leave the aluminum foil in place until you are ready to use the soil. The heated soil will give off an odor. Microwaves or outdoor cookers also can be used.

Pressure-cooker sterilization. Pour several cups of water into the cooker. Place no more than 4 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 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. Leave the aluminum foil in place until you are ready to use the soil.

Steam sterilization without pressure. Pour about 1 inch of water into the sterilizing container. Follow the soil preparation procedures listed earlier. Place filled soil containers on a rack that 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. Turn off the heat and replace the lid. Remove the soil when cool.

Soil solarization. This method uses the sun's energy to heat small areas of soil to temperatures that are lethal to many soil-borne organisms and weed seeds. Treat during the summer when there are high air temperatures and intense solar radiation. With a tiller or a shovel, loosen the soil to be treated, wet it and cover it with a thin, clear, polyethylene (plastic) film. Seal the edges of the plastic sheet 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, contact your Colorado State Cooperative Extension county office.

Avoid toxicity from heated soil. With heavier soils and soils that contain a large amount of organic matter (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, minerals or salts when the soil is heated too long or at too high a temperature. If soil toxicity is a problem, heavy irrigation of the treated soil may leach out many of these substances. Storing the soil two to three weeks without a cover also reduces soil toxicity.

Cultural Management

Cultural management involves avoiding the onset of disease. To accomplish this without pesticides, create an environment unfavorable to pathogens.

- Don't work in the garden when plants and soil are wet. Spores and cells of disease-causing organisms can spread from one plant to another and initiate new disease. Wet soils are easily compacted, which can decrease the amount of oxygen in the soil.
- Make sure plants are spaced properly. Air movement decreases when plants are grown too close together. This allows 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.
- Avoid excessive soil moisture. Overwatering enhances seed decay, damping-off and root rot diseases. Try not to plant in areas that have poor drainage or where water stands for several days following rains.

Effective soil sanitation treatments include:

- *Oven sterilization.*
- *Pressure-cooker sterilization.*
- *Steam sterilization without pressure.*
- *Soil solarization.*

Create an environment unfavorable to pathogens.

- Fertilize plants properly based on soil nutrient analyses using either organic or commercially prepared (inorganic) fertilizers.

In other words, use good cultural management. Healthy 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 pesticides. Use sound cultural practices, sanitation and well-adapted plant varieties to reduce disease problems. It is important to realize that you must accept some disease loss. Don't expect a perfect garden or plant if you do not want to use chemicals.