

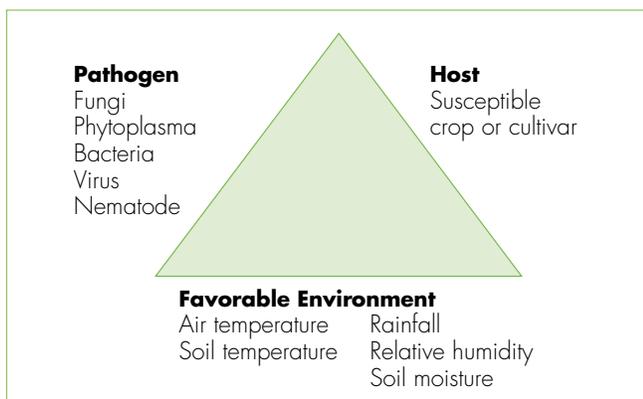


for new farmers

Ecological Disease Management

In order for a plant to become diseased, three conditions must be present: (1) a pathogen, (2) a favorable environment where the pathogen can thrive, and (3) a susceptible host. All the strategies we use to manage plant diseases work to remove or limit one of these factors, thus breaking the plant disease triangle.

THE DISEASE TRIANGLE



Rotations that include a fallow period can be the key for controlling some pathogens that have a wide host range.

MANAGE THE PATHOGEN

Exclusion

Keep the pathogens out! Make sure that your seeds and transplants are free of pathogens. The epidemic of late blight in Pennsylvania in 2009 was partially the result of the widespread distribution of the pathogen on infected transplants. Consider growing your own transplants; otherwise, inspect them carefully before you bring them to the farm.

Saving seed can easily carry over pathogens from the previous year. Only save seed from healthy plants to reduce this risk. Although pathogens may occasionally be introduced from a commercial seed source, generally they are the most reliable source (Reiners and Petzoldt 2005).

It is also essential to keep your equipment and stakes clean and sanitized. You don't want to be the grower who has bacterial spot in your peppers every year because you reuse your stakes without sanitizing them. Sodium hypochlorite at 0.5 percent (12 times the dilution of household bleach; note that household bleach contains additives and is not allowed for certified organic) is effective and must be followed by rinsing and proper disposal of solution. Hydrogen peroxide is also effective (Caldwell et al. 2006). Prior to sanitizing, remove visible organic debris from the

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stakes and/or equipment. Organic matter can quickly neutralize surface disinfectants, rendering them ineffective. Also, for the most effective results, change the solution when it becomes visibly dirty. Freezing does not sanitize stakes and equipment.

Note: These materials are on the list of allowed substances for certified organic production. However, it is important, even for allowed materials, to list them on your organic system plan. Any materials you use on certified farms must be cleared with your certifier before use to prevent mishaps that could result in losing certification.

Eradicate or Reduce the Inoculum

Crop rotation between plant families can help keep the levels of disease down. Rotating to remediate a disease problem can be challenging, especially if the pathogen is long-lived in the soil and/or has a wide host range. Rotating between unrelated crops such as beans to sweet corn, lettuce to cucurbits, and cucurbits to crucifers can help avoid the buildup of soilborne pathogens (Reiners and Petzoldt 2005). For example, northern root-knot nematode is a fairly common problem that attacks carrots and potatoes in addition to a number of other vegetable crops. In a study in New York, when field corn (which is not a host to the nematode) was included in the rotation, the number of nematodes was greatly reduced.

In general, grasses (monocots) are not susceptible to the same diseases as vegetables (dicots). Adding sweet corn, wheat, or a grass cover crop to your rotation can reduce soilborne disease problems. A good rule of thumb is that no crop family should return to the same field or bed for a minimum of three years to avoid soilborne disease buildup. Beware, some pathogens create special structures that allow them to survive in the field for much longer. See Mohler and Johnson (2009) for a detailed description of rotation recommendations for different pathogens and crops.

Many pathogens can survive on debris over the winter. Tilling in plant residue at the end of the season allows soil microorganisms to break the material down, leaving potential pathogens without a host.

Antagonistic Plants

Certain plants, such as mustards and sudangrass, can kill plant pathogens that live in the soil. They contain a chemical and an enzyme in their plant tissue, specifically their cell wall. When you mow the plant and crush the tissue, the enzyme reacts with the chemical to create a toxic gas—the same as a fumigant. If you quickly incorporate this crushed plant material into the soil after mowing, the volatilized chemical can kill plant pathogens, nematodes, and weed seeds (McGuire 2001). Farmers in Northampton County tried this method to control plant-parasitic nematodes.



Bacterial spot on tomato can spread from debris on reused tomato stakes. Photo courtesy of B. Gugino, Penn State.

Crop Rotation Affects Pathogen Persistence

Clubroot, caused by *Plasmodiophora brassica*, can be a significant problem in brassica crops. The pathogen can survive in the soil for over seven years, even in the absence of mustard family crops or weeds. But clubroot tends to decline more quickly when tomato, cucumber, snap bean, and buckwheat are grown.

Clubroot was effectively controlled by growing aromatic herbs including peppermint, garden thyme, and summer savory for two to three consecutive years (Mohler and Johnson 2009). For some brassica crops, resistant varieties are also an option.

They learned that the process can be tricky. You need to make sure you have the right varieties, enough moisture, adequate fertility, and good timing to get the result you want.

Hot Water Treatments

If you think your seed might be affected by plant pathogens, you can use a hot water bath that will both surface disinfect as well as kill pathogens within the seed. For example, hot water treatment for eggplant submerses seeds in 122°F water for 25 minutes. Be careful to find out the correct temperature and length of time for the treatment. Too cold will not work and too hot will kill the seed (Miller and Ivey n.d.).

Create an Unfavorable Environment

Keep Leaves Dry

Most fungi and bacteria that kill plants require wet environments from dew, rain, or irrigation to infect and cause disease. If you want to keep them from reproducing, don't give them the environment they like. Good air circulation and drip irrigation help keep the leaves dry and the diseases out. For example, gray mold in tomatoes is generally not a problem in the field. But, when you pack tomatoes in a high tunnel with little air circulation, it becomes common, especially within the lower portion of the plant.

Maintain High-Quality Soil

Balanced fertility, good drainage, and good soil tillth will all help promote a diverse range of soil microorganisms. Diverse microbial communities generally compete with plant-pathogenic organisms in the soil and help keep your plants healthier. Additionally, plants that are not stressed are less susceptible to disease.

Manage Weeds

Many weeds are also hosts for diseases. When your crop is surrounded by weeds, the atmosphere tends to be moist, favoring infection.

How to Hot Water Treat Seed

Step 1: Wrap seeds loosely in a woven cotton (such as cheesecloth) or nylon bag.

Step 2: Prewarm seed for 10 minutes in 100°F (37°C) water.

Step 3: Place prewarmed seed in a water bath that will constantly hold the water at the recommended temperature (see below). Length of treatment and temperature of water must be exactly as prescribed.

- Lettuce, celery: 118°F for 30 minutes
- Broccoli, cauliflower, carrot, collard, kale, kohlrabi, turnip: 122°F for 20 minutes
- Brussels sprouts, eggplant, spinach, cabbage, tomato: 122°F for 25 minutes
- Pepper: 125°F for 30 minutes

Step 4: After treatment, place bags in cold tap water for 5 minutes to stop heating action.

Step 5: Spread seed in a single, uniform layer on screen to dry.

—From Miller and Ivey (n.d.)

Check with your Extension office for possible local hot water seed treatment stations.

Choose a Less Susceptible Variety

Using disease-resistant varieties is one of the most economical and reliable methods of disease management. Resistant varieties are not available for all diseases of vegetable crops, but they definitely should be considered. Dr. McGrath from Cornell University maintains an excellent list of disease resistant cultivars (see vegetablemdonline.ppath.cornell.edu/Tables/TableList.htm). Your seed catalog will also list disease resistance. Note the letters DM, PM, etc., after each cultivar. They are codes to tell you which diseases the cultivar is resistant to. It is important to become familiar with common vegetable diseases in your region.

Resistant varieties are rarely immune to the disease. They do help delay the onset of disease development, therefore potentially increasing your yields and allowing your crop to fully mature.

PEST MANAGEMENT MATERIALS

Early detection is important for successful disease management. Make sure you scout plants regularly and know which diseases are present in the crop. When preventive and cultural methods for disease control are insufficient to manage a disease, National Organic Program (NOP) compliant inputs can be applied.

Note: Before applying any pest control product, be sure to (1) read the label to make sure the product is labeled for the crop and the disease you are trying to manage, (2) read and understand the safety precautions and application restrictions, and (3) confirm that the brand name product is listed in your Organic System Plan and approved by your certifier.

For details on the efficacy of organic pesticides, see recommendations from the organic production guide appropriate for your crop (e.g., www.nysipm.cornell.edu/organic_guide and Caldwell et al. 2006).

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