



DISEASE MANAGEMENT IN THE HOME VEGETABLE GARDEN

Diseases occur when environmental conditions are suitable for pathogens to develop on susceptible plants. Some pathogens attack a wide variety of plants and others attack only specific plants. Also, some pathogens can attack all plant parts, while other attack only selected plant parts.

There are five major groups of plant pathogens. They are fungi, water molds, bacteria, viruses and nematodes. Successful disease management begins with accurate diagnosis, or finding the cause of the problem. Knowing the common diseases of individual plants will help to identify the disease. Many diseases are identified based on signs and symptoms. The identification of other diseases requires microscopic examination of diseased tissue or more sophisticated laboratory techniques.

PREVENTION

The easiest and most economical way to manage plant disease in the home garden is by maintaining vigorously growing, healthy plants. Plants weakened by drought, improper fertility, competition from weeds, and mechanical or insect damage are more susceptible to infection by disease-causing agents. Prevent disease before it occurs because infected plants are seldom brought back to good, healthy, productive growth.

The following basic steps will help prevent plant disease:

Cultural Practices – Promote plant vigor. Avoid over-watering or planting in poorly drained soils to prevent root diseases and seed decay. Space plants for good air circulation and plant in well-drained soil. The use of raised beds and organic matter as a soil amendment will help on sites that are poorly drained.

Use fertilizers and any pesticides only as directed. Measure accurately and apply properly to avoid toxicity to plants.

Use drip irrigation and avoid overhead watering to prevent foliar diseases. If this cannot be done, water in the morning so that upper plant parts dry off rapidly or by applying water directly at the plants' roots and avoiding splashing water up onto the leaves. Do not cultivate or harvest when plants are wet. Be especially alert for excessive moisture and disease symptoms under row covers and mulches.

Apply mulch around plants to keep disease spores from splashing from soil onto foliage.

Monitor crops regularly for disease symptoms.

Sanitation – Maintain a “cleanliness” program in the garden. Remove and destroy all badly diseased plants, trash, weeds and dying plant parts. Many pathogens survive between crops in or on the residue from diseased plants, so it is important to remove as much of the old plant debris as possible. Weeds should be eliminated as they may harbor pathogens or serve as a host for insects that may transmit viruses and other pathogens. Frequent disinfections of tools will also help prevent the spread of pathogens.



Resistant Varieties – Choose resistant varieties whenever possible. Many varieties of vegetables have been developed that are resistant to specific diseases. This does not mean that they are immune to these diseases, but when disease does develop, it will generally be less severe on them than on susceptible varieties. Resistant varieties should always be used in combination with other management practices. For many diseases, such as the vascular wilts and viruses, the use of resistant varieties is the primary means of control.

Resources for resistant varieties:

<http://www.hort.uconn.edu/ipm/veg/htms/tolvar.htm> <http://vegetablemdonline.ppath.cornell.edu/> <http://pubs.cas.psu.edu/freepubs/pdfs/uj250.pdf>

Rotation – Avoid growing the same or related crops in the same garden area for successive seasons. A good practice is to treat members of the same plant family as a group (for example, tomatoes, potatoes, peppers and eggplants) and rotate based on groups rather than individual crops. This helps to reduce the incidence of soil borne diseases. Try dividing your garden into quarters and rotating plants into different quarters each year.

Common Vegetable Families

Solanaceous: Tomato, potato, pepper, eggplant Crucifers/Brassicas: Broccoli, cabbage, cauliflower, kale, brussel sprouts Cucurbits: Melons, pumpkins, winter squash, summer squash Legumes: Beans, peas Alliums: Onions, leeks, garlic, shallots Umbelliferae: Carrots, parsnips, parsley, celery, celeriac

Organic Amendments – The addition of organic matter such as compost can aid in reducing diseases caused by soil-borne pathogens. Organic matter improves soil structure and its ability to hold water and nutrients; it also supports microorganisms that contribute to biological control.

Exclusion – Purchase and plant only disease-free seeds, cuttings and young plants. Control insect vectors which introduce and spread disease in your garden. One way to do this is through the use of lightweight row covers.

Lightweight, floating row covers are an excellent barrier to some early pests that vector disease, such as cucumber beetles and aphids. Row covers prevent pests that carry plant viruses from feeding on plants as long as the insect did not overwinter in the same location that is being covered. Pests that emerge near its target plant under the protection of a row cover may damage plants even faster than usual!

Row covers are made of lightweight fabric that can be laid directly over plants; leave enough excess fabric so plants can grow under it. The fabric needs to be secured to keep pests out. This can be accomplished using rocks, burying the fabric edges with soil down each side of the row, or by using metal staples made for this purpose. Row covers can also be supported with hoops. The fabric allows water and light to pass through and protects young plants from wind. Row covers should be removed from vine crops such as cucumbers when flowers appear because vine crops need bees for pollination. Covers should also be removed when temperatures regularly reach the high 80's for four or more hours per day.

Protection – Early detection and treatment are important to manage foliar diseases such as leaf spots and mildews. Fungicides work by protecting foliage from infection by fungi. When there is a history of disease caused by fungi in your garden, watch for symptoms and apply a proper fungicide as soon as possible, covering both upper and lower leaf surfaces. Follow all directions on pesticide labels precisely.

Home Garden Fungicides and Bactericides

Chemical control can be used as a supplement to prevention practices as described above, not as a first line of defense. Fungicides and bactericides are used to prevent, not cure, diseases. Treatments are most effective if applied before disease appears, or at the first sign of disease. All chemical controls work only if an appropriate material is used. Accurate identification of the disease is necessary before deciding what to use. Always check the label to be sure the disease and crop are listed.

If a disease has been a problem in previous seasons, then assume it probably will be a problem in the present season and treat accordingly. A number of diseases do not show symptoms until well after infection. For these diseases, it is best to apply fungicides on a PREVENTIVE SCHEDULE beginning a couple of weeks before symptoms usually appear. Apply before rain and continue applications at weekly intervals until the danger of further infection has passed.

There are several fungicides available for managing diseases in the organic vegetable garden including sulfur, copper, oils and bicarbonates.

COMMON DISEASES

• Diseases Affecting Roots and Crowns

Seed decay and Seedling damping-off. Prepare the beds to ensure good drainage and do not overwater during germination. Sow seeds when soil temperatures are favorable for rapid germination and growth, and do not sow them too deeply. The use of fungicide-treated seeds also may help prevent these diseases.

Root, crown and stem rots. Check the condition of the roots of transplants visually before purchasing them to avoid introducing these diseases into the garden. Roots should be intact and healthy. Choose a well-drained site, or plant on raised beds that allow for adequate drainage. Water on a regular basis, but do not over-water.

• Diseases Affecting Leaves, Stems and Fruit

Anthracnose, leaf spots, leaf blights and fruit rots. Buy disease-free transplants. Choose resistant varieties, if available. Plant in sunny locations with good air circulation to reduce the length of time the leaves remain wet. Avoid the use of overhead irrigation. Fixed copper or other fungicide sprays applied prior to the onset of rainy periods will provide some protection. Only copper-containing fungicides are effective against bacterial diseases.

Bacterial wilt on cucurbits (cucumbers, melons, squash, watermelons)

Striped cucumber beetles are tiny (1/4" long) yellow and black beetles that feed on young leaves of cucurbits (cucumbers, squash, melons) and vector *Erwinia tracheiphila*, the causal agent of bacterial wilt. This disease causes cucumber seedlings to turn yellow and die. Young cucumber seedlings are more susceptible to infection with bacterial wilt than older plants. Adult beetles spend the winter in plant debris and emerge in early spring when cucurbit seedlings emerge. Studies have shown that setting out transplants instead of directly planting seed results in earlier and higher yields. Among the benefits - plants are bigger when cucumber beetles arrive so that they are less vulnerable to both feeding damage and to wilt. Floating row covers can be used as a barrier to prevent cucumber beetles and bacterial wilt.

Powdery mildew. Choose resistant varieties or plant susceptible varieties in sunny locations with good air movement. Protect the plants with sprays of potassium bicarbonate, sulfur or other fungicides.

• Diseases Affecting the Whole Plant

Vascular wilts. Choose resistant cultivars or do not plant susceptible plants for three years in areas known to be infested with these pathogens.

Viruses. Choose resistant varieties when possible. Do not introduce virus-infected plants into the garden. Prevent their spread by controlling insects and weeds that may serve as alternate hosts and by regularly disinfecting tools used to work with the plants. Insects such as aphids, thrips, mites, leafhoppers and beetles provide the most important means for viruses to move from infected to healthy plants. Some viruses, such as Tomato Ringspot Virus and Squash Mosaic Virus, can be transmitted through infected seed. Perennial weeds and ornamental hosts provide an important reservoir for viruses to survive from one season to the next.

The use of reflective plastic mulches aids in disrupting insect transmission of some viruses. In general, the spread of viruses is best controlled by cultural practices, such as cultivar selection, planting date and location, weed reduction and rouging out of diseased plants. Row covers may prevent aphids from probing and feeding on plants early in the season, preventing the spread of viruses. Occasionally, seed or transplants are infected and the problem is not apparent until

well into the growing season. There are no chemical control measures for virus diseases other than those directed at the vector or weed hosts.

DISEASES OF VEGETABLES

Following are a list of vegetables, the diseases that affect them, and specific management strategies that are known, in parenthesis.

Asparagus: Fusarium (crown rot - tolerant varieties available), asparagus rust

Beans: Anthracnose, downy mildew, bacterial blights, viruses, rust, white mold, seed decay, root rot.

Beet and Swiss Chard: Leaf spots, blights, downy mildew, seed decay.

Carrot and Parsnip: Leaf blight, root-knot nematode, parsnip blight, yellows (mycoplasma – control six-spotted leaf-hopper), root and crown rot (two year crop rotation).

Cole crops (broccoli, Brussels sprouts, cabbage, cauliflower): Alternaria, black rot, club root (maintain a pH of 6.8 or more), downy mildew, fusarium yellows (resistant varieties available), seed decay, wire stem, turnip mosaic virus (spread by aphids and most common in Chinese cabbage and bok choy, resistant varieties available).

Corn (Sweet): Maize dwarf mosaic virus (resistant varieties available), rust (resistant varieties available), seed decay, Stewart's wilt (control corn flea beetle).

Cucurbits (cucumbers, melons, watermelons): Alternaria leaf blight (sanitation at the end of the season, two-year rotation away from cucurbits), Anthracnose (two-year rotation away from cucurbits), bacterial wilt (control cucumber beetles), cucumber mosaic virus (resistant varieties available), downy mildew, blight and fruit rot (plant in well-drained soil, rotate away from cucurbits), powdery mildew, viruses (control aphids), seed decay.

Eggplant: Anthracnose, seed decay, Verticillium wilt (avoid rotating with tomato, pepper, potato and strawberry).

Lettuce, Endive, Escarole: Botrytis (Gray mold - plant in well drained areas or raised beds), bottom rot, leaf spot (sanitation at the end of the season, one-year rotation away from lettuce), seed decay, yellows (mycoplasma – control six-spotted leafhopper).

Onion: Botrytis (Gray mold -avoid close planting and plant on well-drained soil), downy mildew (plant on well-drained soil), purple blotch.

Peas: Seed decay.

Peppers: Bacterial spot (rotate away from solanaceous crops for at least 2 years, sanitation after harvest), cucumber mosaic virus (manage aphids and weeds, resistant varieties available), crown rot and blight (sanitation including clean tools), tobacco mosaic virus (carried in tobacco products, spread by hands and tools, resistant varieties available).

Potatoes: Early blight, late blight, scab, Verticillium and Fusarium wilt (rotate with nonsusceptible crops), virus (manage aphids).

Pumpkins, Squash, Gourds: Powdery mildew, downy mildew, anthracnose (rotate away from susceptible crops for at least two years), scab (rotate away from cucurbits for at least two years), angular leaf spot (rotate away from cucurbits for at least one year), fruit rot (rotate away from cucurbits), virus (resistant varieties, control aphids).

Radish: Seed decay, damping-off, alternaria leaf spot (sanitation at end of season, crop rotation)

Rutabaga and Turnip: Downy mildew, Alternaria leaf spot, seed decay.

Spinach: Seed decay, virus (control aphids, resistant varieties available), downy mildew (resistant varieties available), white rust.

Tomatoes: Early blight, leaf spot (Both diseases - rotate away from tomatoes for at least two years), anthracnose, late blight, powdery mildew, Botrytis - gray mold, bacterial canker (sanitation at end of growing season, rotate away from tomatoes for at least two years), virus (manage aphids and weeds, resistant varieties available for some viruses), wilt (resistant varieties available)

FUNGICIDES and BACTERICIDES

Active Ingredient - This is the chemical component of a pesticide formulation that is toxic to the pest. Become familiar with the active ingredients. Other or Inert ingredients are carriers which are not toxic to the target pest. Pesticide products generally are recognized by their advertised brand names. Pesticides with different trade names can have the same active ingredient.

Chemical Formulations - The formulation of a chemical refers to the form in which a pesticide is prepared for sale. Some of the more common formulations that the gardener may encounter include “emulsifiable concentrate” (EC), “flowable” (F), “granules” (G), “dust” (D), and “wettable powder” (WP). The same pesticide may be available in more than one formulation. Different formulations of the same pesticide may be more effective in certain circumstances and may be registered for different uses. It is important that the user read the label to be sure that the correct material is being selected for the job.

Days to Harvest - Some pesticides require a period of time for residues to dissipate before treated produce can be safely used. This information is found on the LABEL of the pesticide.

Disclaimer - The most reliable information was included that was available at time this information was compiled. Due to constantly changing laws and regulations, UMass Extension can assume no liability for recommendations. The pesticide user is always responsible for the effects of pesticide residues on their own crops, as well as problems caused by drift from their property to other properties or crops. Always read and follow all instructions on the label.

PARTIAL LIST OF FUNGICIDES AND BACTERICIDES BY ACTIVE INGREDIENT

Active Ingredient	Diseases	Crops	Comments
Bacillus subtilis	Anthracnose, bacterial leaf spot, Alternaria, Botrytis, downy mildew, early blight, late blight, leaf spots, rusts, powdery mildew, scab	All vegetables	Preventative biofungicide, apply early.
Copper	Bacterial and fungal leaf spots, powdery mildew, scab, white rust	Most vegetables	Do not mix with liquid fertilizers. May burn new growth.
Jojoba Oil	Powdery mildew	All vegetables	
Neem Oil	Powdery mildew, downy mildew, anthracnose, fungal leaf spots and blights, botrytis, rust, scab	All vegetables	
Potassium bicarbonate	Powdery mildew	All vegetables	
Sulfur	Gray mold, Powdery mildew, downy mildew, rust	Beans (may burn some varieties), cole crops, onions, peas Do not use on cucurbits.	Do not use when temperatures are 85F or higher.

WARNING! PESTICIDES CAN BE DANGEROUS. Read and follow all directions and safety precautions on container labels. Handle carefully, and store in original containers with complete labels, out of reach of children, pets, and livestock.

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- Compiled by Tina Smith and Ellen Weeks, Agriculture and Landscape Program 4/09