

Home Vegetable Garden Disease Control

*Steve Bost, Professor
Department of Entomology and Plant Pathology*

Plant diseases are caused by fungi (molds), bacteria, viruses and nematodes. These pathogens are not harmful to humans, but they can be very damaging to plants. Gardeners must be attentive to disease control by taking appropriate proactive and reactive measures. The cultural practices and protection products discussed below will help reduce losses to diseases. Specific diseases and their controls are provided in Table 2.

CULTURAL PRACTICES

Garden site selection impacts disease development through its influence on moisture conditions. A well-drained soil discourages soilborne diseases such as root rots. If the site does not have good natural drainage, soil amendments or the use of a raised garden may be advisable. Full sunlight and good air movement through the garden improve drying conditions after wetting events, thus reducing disease pressure. Try to locate the garden away from trees, fences or buildings.

Provide **optimal growing conditions**. Plants that have good, but not excessive, vigor are the most resistant to disease. Plants weakened by improper soil pH, inadequate fertilization, crowding, weed competition or planting when the soil is too cool are more subject to

pathogen invasion and disease development. Lush growth caused by excessive nitrogen fertilization can decrease drying conditions and, thus, lead to more disease problems. Excessive weed growth can have the same effect, and certain weeds can serve as hosts for diseases. Likewise, plants spaced too closely together will also experience poor drying conditions. In addition, adequate penetration of the plant canopy with disease-control sprays will be difficult. Follow closely all production recommendations for each crop.

Use of resistant varieties is one of the most economical ways of controlling diseases. However, resistant varieties are available only for certain diseases. Heirloom varieties, in general, have much less disease resistance than modern varieties.



Gardeners should consult their seed catalogs for the disease resistances available in the vegetables of interest. Avoid purchasing varieties touted simply as “disease resistant.” Diseases should be specified. Accurate disease identification is key to choosing the appropriate variety.

Crop rotation, for the home gardener, is the movement of crops to different locations in the garden each year, so that pathogens will not build up in the soil. Crop rotation is very effective against pathogens that survive short periods in the soil on plant debris, such as those that cause foliar and fruit diseases. Crop rotation will reduce, but not eliminate, long-lived pathogens such as Phytophthora and Fusarium.

Because pathogens tend to attack several members of one plant family but not another, crop rotations should involve different families. Grass crops or corn almost always make a good rotation crop. At least two years should be allowed between plantings of the same family, but the longer the rotation, the better the disease control. Disease organisms are reduced even by one year out of a

crop. Family groupings for commonly grown vegetables are provided in Table 1.

Sanitation is the removal of the pathogen from the garden. The term is also often used to refer to the sanitization of contaminated equipment or containers before being used again.

Many pathogens survive between crops in plant debris (old leaves, fruits, etc.) left in the garden. This carryover may take place over winter or between successive plantings in the same year. Regardless, infested plant debris can lead to early disease problems. When a crop is completed, plant residue should be plowed under to hasten decomposition. Most pathogens are unable to survive for long once the crop residue decomposes. An alternative to plowing under is to compost the crop debris. However, disease organisms can survive the composting process if some parts of the pile are not exposed to the high temperatures. Certain disease organisms can even survive complete composting. As a result, it is not recommended that diseased plant parts be composted.

Table 1. Botanical families for vegetables

Family common name	Representative crops
Nightshades	Tomatoes, eggplant, peppers, potatoes
Cucurbits	Cucumbers, gourds, melons, pumpkins, squashes (all types), watermelons
Cole crops	Broccoli, Brussels sprouts, cabbage, cauliflower, collard, kale, kohlrabi, mustard, radish, rutabaga, turnip
Legumes	Beans, cowpeas, peas, peanuts
Goosefoot family	Beet, spinach, Swiss chard
Sunflower family	Endive, globe artichoke, Jerusalem artichoke, lettuce, sunflower
Onion family	Chives, garlic, leeks, onions, shallots
Carrot family	Carrots, celery, cilantro, dill, fennel, parsley, parsnip
Cotton family	Okra
Grass family	Sweet corn
Morning-glory family	Sweet potato

Another sanitation method is roguing, or removal of entire plants from the garden during the growing season. It generally is only effective when done immediately upon the first detection of a disease, with the goal of arresting an outbreak in its initial stage. Furthermore, roguing can actually result in increased disease by scattering the pathogen during the removal process (e.g., southern blight) or by causing insect vectors to move (e.g., tomato spotted wilt virus).

Disease-free seed and transplants are a must in vegetable production. Infected transplants sold by the bedding plant industry are a major source of infestation in Tennessee gardens. Buy locally grown transplants or grow your own, from disease-free seed. Seeds should not be saved from diseased plants, as seeds contaminated with disease-causing organisms may appear normal. Certain geographical areas, such as the arid western states, can produce disease-free seeds because climatic conditions are less favorable for disease.

Seed disinfection. Seeds can be disinfested, i.e., cleaned of most pathogens carried on the seeds, by treatment with hot water or diluted chlorine bleach. These treatments control bacterial pathogens that cause diseases in mature plants, as well as certain fungal pathogens. Bleach kills pathogens only on the seed surface, while hot water kills bacteria both on and inside the seed. Neither of these treatments provides residual protection against organisms encountered in the soil after planting. Treatment of seeds with fungicides will protect against seedling disease fungi.

Some seed companies offer hot water treatment for their seeds, and it is recommended that you utilize such services, rather than attempt to treat the seeds yourself. Unless the procedures are adhered to closely, much damage can be done during the seed treatment process.

Planting date. Planting in soil that is too cool results in seedling disease problems such as seed rots and damping-off. Transplanted crops such as tomato have more problems with stem rots in cool soils, especially when planted too deeply. Diseases that are spread by insects tend to increase as the season progresses, corresponding with

population buildup of the insect vectors. Examples are virus diseases of squash and beans. Downy mildew is also more of a threat to late cucurbit crops than to early ones.

Mulches reduce fruit rot on crops such as strawberries, tomatoes, squash, cucumbers and melons by preventing direct contact with the soil. By reducing fluctuations in soil moisture, mulching reduces blossom-end rot of tomato and pepper.

Organic amendments and soil treatments. The addition of organic matter (compost, manures, grass clippings, etc.) to the soil can reduce diseases by increasing populations of microorganisms that can reduce plant pathogens (biological control). Incorporation of cover crops, especially members of the mustard family, is an effective method of increasing organic matter. However, cover crop plow-down should be done early enough (at least six weeks prior to planting) to allow decomposition of green matter.

Certain soil treatment products (e.g., Actinovate, Serenade Soil and RootShield) are available and can reduce diseases caused by pathogens that enter the roots and stems. These products are for protection only and must be applied at or before planting. Mustard seed meal products, when moistened, produce a gas that may reduce several types of pathogens in the soil. Monterey Nematode Control is a botanical extract product for nematode control.

Another type of soil treatment is solarization, which utilizes the sun's energy to heat the soil and reduce populations of soilborne pathogens. This technique involves placing clear plastic on moist (but not wet), tilled soil. The edges must be well-sealed by burying to a depth of 6 inches, so that the trapped heat does not escape and to prevent loosening by the wind. Repair any holes so that heat does not escape. Apply the plastic in June or July and allow it to remain in place for six to eight weeks.

Staking or trellising tomatoes, pole or half runner beans and cucumbers reduces diseases by improving air circulation and pesticide application to the plants. Staking or trellising also prevents soil contact with the foliage and fruit.

Watering practices have a strong influence on severity of many diseases, since most diseases are favored by wet conditions. Excessive soil moisture can result in increased seedling diseases and root and stem rots. Leaves that remain wet for too long are more subject to foliar diseases. If irrigation must be applied to the foliage, do so early enough in the day to allow the foliage to dry before evening. Trickle irrigation is preferred.

PROTECTION PRODUCTS

Protection products are often referred to as **fungicides**, since most diseases are caused by fungi. However, some of these products also control other types of pathogens. These products may be synthetic, natural or biological. They all have one thing in common: they work by protecting healthy plant tissue from infection by pathogens. They will not cure infected tissue as they are not systemic in the plant. They are not effective when applied to advanced cases of disease outbreaks. They simply slow the progress of the disease from its beginning, and should be considered a supplement to the cultural practices described above.

Natural products for disease control include copper, sulfur, botanical extracts, petroleum distillates, humic acid, fish oil and other ingredients. Biological products contain living bacteria or fungi that help reduce pathogenic microbes by competition or antagonism. Most natural and biological products are safer to humans and the environment than synthetic products, but they are not as effective against many diseases. An acceptable level of disease control is possible with natural or biological products if they are used when disease pressure is low and sound cultural practices are followed. Copper provides valuable control of bacterial diseases, and both copper and sulfur provide good control of certain fungal diseases.

Protection products are available for application to the soil, seeds and foliage. For **soil treatment products**, see the *Organic amendments and soil treatments* section, above.

Seed treatments serve primarily to protect the seed after planting (from seed rot) and the developing seedling from seedling disease, also

known as damping off. Seed treatments do little to reduce pathogens already on the seeds. Hot water or chlorine bleach treatments are more effective for that purpose (see *Seed disinfection*, above). Seed treatments also do not control diseases of older plants.

A seed treatment is usually applied by the seed company, unless the customer requests non-treated seeds. Homegrown seed can be treated at home with relative ease. Thiram or captan fungicides can be used as seed treatments on most vegetable crops. For small quantities of seed, such as packets, apply sufficient fungicide to coat the seed surface. Simply place a small quantity (comparable to the size of a match head) in the packet, reclose and shake to coat the seed with the fungicide.

Foliar treatments are only effective against diseases of the leaves and fruit. They will not protect against pathogens that enter the roots or stems. They must be reapplied as new growth emerges and as weather removes the residue from the sprayed leaves. To reduce the number of applications needed, the first application can usually be delayed until the first appearance of disease. Sprays should be repeated every seven (wet weather) to 14 (drier weather) days.

All home garden fungicides are protectants, and should be in place on the plant before infection occurs. Since most pathogen infections occur during rains and shortly afterwards, it is prudent to apply fungicides prior to extended rainy periods. Some wash-off does occur during rains, but this is not a problem as long as the spray has time to dry before the rain begins. Application of fungicides more frequently than seven days is not necessary unless rainfall exceeds two inches.

Fungicides for home garden use are available primarily as liquids and as dry formulations known as wettable powders and dry flowables. All of these formulations are applied as a spray, diluted in water. Some dust formulations are available. These are applied directly to the plant, as they will not dissolve in water. Sprays are the preferred method for foliar applications.

Most gardeners will find a 1- or 2-gallon pump-up sprayer suitable for most purposes. A cone pattern adjustment of the nozzle will usually provide the most effective coverage of plant tissues. Keep the pressure up to ensure small spray particle size and good coverage.

Rates are not provided in Table 2 because these can vary among brands. Home garden product labels express rates as amount per gallon of water. The amount of solution to use in a given area depends on the size of the plants and the spacing of the rows. Leaves should be wetted only until the

spray just begins to run off. Avoid wetting to the point of excessive runoff. Take steps to protect yourself from exposure when mixing or applying pesticides. Always read the label for use directions and precaution statements.

Proper identification of diseases and other plant problems is key to implementation of appropriate control measures. Gardeners are encouraged to become familiar with plant disease symptoms. The following website may be helpful: vegetablemdonline.ppath.cornell.edu/PhotoPage/PhotoGallery.htm.

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products ¹ and cultural practices)
ASPARAGUS	Cercospora leaf spot	Tan spots with purple margins.	Chlorothalonil, mancozeb. Apply only to fern stage. Cut and remove diseased ferns in fall. Rust resistant varieties available.
	Rust	Bronze pustules on ferns.	
BEANS	Anthracnose	Dark, sunken spots on pods and stems.	Chlorothalonil, fixed copper. Avoid sprinkler irrigation. Follow crop rotation. Plow under plant debris at end of crop. Do not graze chlorothalonil-treated areas or feed treated plants to livestock. Resistant varieties of snap beans are available.
	Bacterial blights	Brown, irregular spots on leaves and pods. May have yellow halo.	Fixed copper. Use disease-free seed. Follow crop rotation. Plow under plant debris at end of crop. Do not work when plants are wet. Resistant varieties for bacterial brown spot, halo blight and common blight.
	Gray mold (Botrytis)	Gray moldy growth on pods and stems.	Chlorothalonil. Do not graze treated areas or feed treated plants to livestock. Increase plant spacing.
	Mosaic viruses	Leaves yellowed, crinkled, or speckled. Leaves cupped, runners killed.	Half runners very susceptible, particularly "Pink." Make successive plantings to reduce risk. Resistant bush varieties available.
	Powdery mildew	White, powdery mold on surface of leaves.	Sulfur. Resistant varieties available.
	Nematodes	See Footnote 2.	See Footnote 2.
	Rust	Reddish-brown pustules on leaves and pods.	Chlorothalonil, sulfur. Do not graze chlorothalonil-treated areas or feed treated plants to livestock. Resistant varieties available.

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products¹ and cultural practices)
BEANS (CONT'D)	Seedling disease	See Footnote 3.	See Footnote 3.
	Southern blight	See Footnote 4.	See Footnote 4.
BEET	Leaf spots		Fixed copper. Follow crop rotation.
	Rust	Bronze pustules.	Sulfur.
	Seedling disease	See Footnote 3.	See Footnote 3.
BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER	Alternaria leaf spot	Target spots on older leaves; small, black spots may occur.	Chlorothalonil. Practice crop rotation.
	Downy mildew	Yellow leaf spots with gray flecks.	
	Bacterial soft rot	Dark rot of head.	Control of black rot will also reduce bacterial soft rot. Avoid mechanical damage to the crop.
	Black leg	Linear decay or canker on lower stem, may result in girdling.	Use certified disease-free seed or transplants.
	Black rot	Yellow to brown, V-shaped spots on edge of leaves.	Use certified disease-free seed or transplants. Do not work wet fields. Crop rotation. Resistant cabbage varieties.
	Yellows (Fusarium)	Leaves turn yellow. Brown discoloration in vascular bundles.	Use resistant varieties. Practice crop rotation. Resistant cabbage varieties.
BRUSSELS SPROUTS – SEE BROCCOLI			
CABBAGE – SEE BROCCOLI			
CARROT	Alternaria blight	Numerous dark brown spots and blighting. Can spread rapidly.	Chlorothalonil. Plow under crop debris at end of growing season. Practice crop rotation.
	Cercospora leaf spot.	Small, dark brown to black spots on leaves.	
	Southern blight	See Footnote 4.	See Footnote 4.
COLLARD, KALE, MUSTARD, TURNIP	Alternaria leaf spot	Dark target spots.	Fixed copper. Maintain thin plant stand. Avoid low-lying or poorly-drained soils. Plow under crop debris at end of season. Follow crop rotation.
	Anthracnose	Small leaf spots, elongate stem spots.	

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products¹ and cultural practices)	
COLLARD, KALE, MUSTARD, TURNIP (CONT'D)	Cercospora leaf spot	Tan leaf spots with yellow halos.		
	Downy mildew	Yellow spots upper surface, white downy growth undersurface.		
	Powdery mildew	White, powdery mold on leaves and stems.	Spray with sulfur as needed.	
CORN, SWEET	Blights	Elongate spots and drying of leaves.	Chlorothalonil, mancozeb. Do not apply chlorothalonil to sweet corn to be processed.	
	Rust	Bronze spores rub off on hands.	Do not graze treated areas or feed treated plants to livestock.	
	Smut	Large, whitish galls on ears, tassels, and nodes, filled with dark, powdery spores.	Partially resistant varieties available. Control corn borers and avoid mechanical injuries. Avoid excessive nitrogen. Remove galls before they rupture, and discard.	
CUCUMBER, MELONS, WATERMELON	Alternaria leaf spot	Brown target spots on leaves.	Chlorothalonil, mancozeb. Use disease-free seed. Practice crop rotation. Plow under crop debris at end of year. Avoid sprinkler irrigation. Resistant varieties available for anthracnose in cucumber and watermelon; for downy mildew in cucumber and cantaloupe; and for scab in cucumber.	
	Anthrachnose	Leaf spots drop out; sunken spots on fruit.		
	Cercospora leaf spot	Tiny, dark brown spots.		
	Downy mildew	Yellow leaf spots, gray mold on underside.		
	Gummy stem blight	Tan stem lesion exudes sap; brown leaf spots.		
	Scab	Sunken spots on fruit can resemble insect punctures. Brown leaf spots.		
	Angular leaf spot	Brown, angular spots on leaves.		Fixed copper. Many resistant cucumber varieties available.
	Bacterial wilt	Individual runners suddenly wilt and die.		Apply insecticide to control cucumber beetles, which spread the bacterium.

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products¹ and cultural practices)
CUCUMBER, MELONS, WATERMELON (CONT'D)	Fusarium wilt	Stunting and yellowing of vine; sunken streak on stem may crack and ooze sap.	Resistant varieties available. Crop rotation helpful. Watermelon, cantaloupe and cucumber do not share the same strain of Fusarium wilt fungus.
	Powdery mildew	White, powdery mold on leaves and stems.	Sulfur, chlorothalonil. Sulfur can cause leaf burn on cucumber and cantaloupe at temperatures above 90 F. Resistant varieties available for cucumber and cantaloupe.
	Nematodes	See Footnote 2.	See Footnote 2.
EGGPLANT	Leaf spots	Various spots, usually minor.	Fixed copper. Follow crop rotation.
	Southern blight	See Footnote 4.	See Footnote 4.
KALE – SEE COLLARD			
MUSTARD – SEE COLLARD			
OKRA	Nematodes	See Footnote 2.	See Footnote 2.
	Pod blight	Young pods fail to develop and deteriorate.	Often caused by poor pollination. The fungus <i>Choanephora</i> can cause a rot of the flowers and young pods. Improve drying conditions by removing several upper leaves.
	Seedling diseases	See Footnote 3.	See Footnote 3.
	Verticillium wilt	Yellowing of leaves. Inside of stem with brown discoloration.	Rotate with other crops.
ONION	Downy mildew	Pale green, oval, sunken spots on leaves. Purplish mold in spots.	Chlorothalonil, mancozeb. Do not apply mancozeb to exposed bulbs. Do not apply chlorothalonil within 7 days of harvest on dry bulb onions or within 14 days on green onions, leeks or shallots.
	Leaf blight (Botrytis)	Papery spots on leaves, followed by dieback.	
	Purple blotch (Alternaria)	Purple target spots on leaves.	
PEA	Powdery mildew	White, powdery mold on leaves, stems and pods.	Sulfur. Resistant varieties available.
	Fusarium wilt	Yellow leaves, wilting.	Resistant varieties available. Follow crop rotation.

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products¹ and cultural practices)
PEA (CONT'D)	Viruses	Several viruses affect pea, causing leaf mottling, distortion, chlorosis and necrosis.	Resistant varieties available. Control aphid vector.
	PEA, SOUTHERN	Fusarium wilt	Yellowed leaves, wilted plants, interior of stem yellow.
	Nematodes	See Footnote 2.	See Footnote 2.
	Pod blight	Soft rot of pods, beginning on tips, with whisker-like growth.	Provide good air circulation by wide plant spacing and not planting near tall vegetables, shrubs or fences. No effective control products.
	Powdery mildew	Dull white, felt-like growth on leaves.	Sulfur.
	Seedling diseases	See Footnote 3.	See Footnote 3.
PEPPER	Anthracnose	Sunken spots on ripening fruit.	Chlorothalonil, mancozeb. Follow crop rotation.
	Bacterial spot	Black, brown or tan leafspots. Dark, raised spots on pods. Plants shed infected leaves.	Fixed copper mixed with mancozeb. Varieties with resistance to some, but not all, races of the pathogen are available. Do not work plants when wet. Infected plants sold by the bedding plant industry are a major source of infestation. Buy locally-grown transplants or grow your own, from disease-free seed.
	Blossom-end rot	Tan, sunken areas on blossom end and side of pods.	Apply trickle irrigation or mulch to maintain uniform soil moisture content. Lime soil if pH is low.
	Nematodes	See Footnote 2.	See Footnote 2.
	Phytophthora blight	Rapid wilt and death of plants in wet area of garden.	There are some resistant bell pepper varieties, but not widely available. Plant on raised beds and/or amend soil to improve drainage. Do not plant wet areas of garden.
	Southern blight	See Footnote 4.	See Footnote 4.
	Sunscald	Dry, white, bleached spot on side of pod exposed to sun.	Staking plants prevents leaning and reduces pod exposure to sun.
	POTATO, IRISH	Early blight	Brown, target spots on leaves.

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products¹ and cultural practices)
POTATO, IRISH (CONT'D)	Late blight	Water-soaked, irregular spots on leaves. Plants appear scalded.	sprouting the following year.
	Nematodes	See Footnote 2.	See Footnote 2.
	Scab	Rough, scabby spots on tubers.	Use scab-free seed pieces. Where scab has occurred, use resistant varieties and rotate crops.
	Seed piece decay.	Rotting of seed piece.	Use certified seed pieces and keep at 50 to 55 F until ready to plant. Avoid deep planting to encourage early emergence.
	Southern blight	See Footnote 4.	See Footnote 4.
PUMPKIN, SQUASHES, GOURDS	Angular leaf spot	Small, brown, angular-shaped spots.	Fixed copper.
	Anthracnose	Large, brown spots on fruit and leaves of birdhouse gourds. Large, black spots on pumpkin fruit.	Chlorothalonil, mancozeb. For spring-planted crops, can wait until 1 st appearance of disease symptoms. For summer-planted crops, a protective spray program should be followed, beginning when vines begin to run. Avoid sprinkler irrigation. Crop rotation helps with control of all except downy mildew. Giant pumpkins less susceptible to downy mildew than other pumpkin types. Luffa sponge is resistant to all of these diseases.
	Downy mildew	Small leafspots, initially yellow, turning brown. Extensive blighting. Destructive.	
	Plectosporium (Microdochium) blight	White to tan lesions on stems and leaf veins of pumpkin and summer squash.	
	Scab	Dark, sunken or raised spots on fruit, can resemble insect punctures. Leaf spots.	
	Blossom blight (wet rot)	Rot of blossoms and end of fruit, with gray whisker-like growth.	Provide good air circulation by wide plant spacing and not planting near tall vegetables, shrubs or wooden fences. No effective control products.

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products¹ and cultural practices)
PUMPKIN, SQUASHES, GOURDS (CONT'D)	Mosaic virus	Green patterns on fruit. Leaves distorted and mottled.	Several viruses are the cause. Varieties resistant to one or more viruses are available in pumpkins, winter squashes and summer squashes. In addition, yellow-stemmed summer squash varieties mask the fruit-greening effects.
	Nematodes	See Footnote 2.	See Footnote 2.
	Powdery mildew	White, powdery mold on leaves and stems.	Sulfur, chlorothalonil. Intermediate resistant varieties available in pumpkin, summer squashes and winter squashes. There are a few highly resistant pumpkin varieties.
SPINACH	Downy mildew (blue mold)	Yellow spots on upper leaf surface, gray mold on underside.	Fixed copper. There are many downy mildew resistant varieties, a few white rust resistant varieties.
	White rust	Yellow spots on upper leaf surface. White, powdery mass on underside.	
	Seedling disease	See Footnote 3.	See Footnote 3.
SQUASH – SEE PUMPKIN			
SWEET POTATO	Black rot	Dry, black decay on potato.	Buy certified, disease-free slips. Do plant sweet potatoes for 3 years in locations in which this disease has been present.
	Nematodes	Cracking of potato or bumps on surface.	See Footnote 2.
	Scurf	Brownish stain on surface of potato.	Buy certified, disease-free slips. Do plant sweet potatoes for 3 years in locations in which this disease has been present.
	Fusarium wilt	Plants yellowed and stunted.	Use resistant variety.
TOMATO	Anthracnose	Circular, sunken spots on ripe fruit.	Chlorothalonil, mancozeb. Crop rotation, staking and crop debris plow-under will help.
	Bacterial spot	Small, dark spots on leaves, more easily seen on undersides. Fruit may have dark, scabby lesions.	Fixed copper mixed with mancozeb. Infected bedding plants sold by the bedding plant industry are a major source of infestation. Do not work when plants are wet. Buy locally-grown transplants or grow your own, from disease-free seed. Difficult to control in rainy weather.

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products¹ and cultural practices)
TOMATO (CONT'D)	Blossom-end rot	Dark, flattened, leathery area on blossom end of fruit.	Usually only affects the first few clusters of fruit, then clears up, with no action needed. The application of trickle irrigation or mulch to maintain uniform soil moisture minimizes the condition. Lime soil if pH is low.
	Buckeye fruit rot	Circular, zonate bands within large spot on fruit.	Stake and mulch plants to keep soil off fruit clusters.
	Early blight	Brown target spots followed by blighting of foliage.	Chlorothalonil, mancozeb. Stake plants and remove lower suckers. Destruction of crop debris at season's end, and rotation with non-solanaceous crops are important, because there are few other effective control practices for these diseases. Mulching is of limited benefit because spores of these fungi can easily enter a planting on air currents. There are a few varieties partially resistant to early blight.
	Septoria leaf spot	Small, dark leaf spots may develop light centers. Extensive blighting.	
	Fusarium wilt	Yellowing and dying of foliage, brown discoloration inside stem.	Use resistant variety and rotate tomatoes to non-solanaceous crops.
	Gray mold	Shoot tips turn brown, covered with gray-colored mold during humid weather.	Chlorothalonil. Avoid injuries to leaves, stems or fruit.
	Late blight	Irregular, water-soaked spots on young and old leaves, turning necrotic.	Can be highly destructive in cloudy, wet weather but seldom occurs in Tennessee. Stake plants so that can easily spray with chlorothalonil, mancozeb or copper. Spores enter planting on air currents, overwinter only in potato tubers.
	Leaf mold	Yellow spots on upper surface of leaves. Olive mold on underside of leaves.	Chlorothalonil. Seldom a problem outside of greenhouses. Greenhouse varieties with resistance are available; no garden varieties.
	Nematodes	See Footnote 2.	See Footnote 2.
	Stem rot	Decay of lower stem and stunting or death of young plants.	Plant in well-drained sites or in raised beds. If planting in spring before soil has warmed, DO NOT plant deeply, as is often suggested.

Table 2. Control options for common diseases.

Crop	Disease	Major symptoms	Controls (products ¹ and cultural practices)
TOMATO (CONT'D)	Southern blight	See Footnote 4.	See Footnote 4.
	Tomato spotted wilt virus	Purplish-bronze discoloration of young leaves.	Insecticides containing spinosyn help to control the thrips vector. Resistant varieties available.
	Verticillium wilt	V-shaped yellowing on leaf margins. Brown discoloration inside stems.	Use resistant varieties. Practice crop rotation.
TURNIP – SEE COLLARD			
WATERMELON – SEE CUCUMBER			

Footnotes for Table 2:

1 - Refer to *Protection Products* section, above, and to product label for directions on application. Additional information:

Common names (active ingredients) are provided. Brand names for these products include:

- Chlorothalonil: Bonide Fung-onil, Ferti-lome Broad Spectrum Landscape & Garden Fungicide, Gardentech Daconil, Liquid Ornamental and Vegetable Fungicide, Ortho Max Garden Disease Control, Ortho Disease B Gon Garden Fungicide.
- Mancozeb: Bonide Mancozeb Flowable, Dithane, Manzate.
- Fixed copper: Ortho Disease B Gon Copper Fungicide, Bonide Liquid Copper Fungicide, Southern Agriculture Liquid Copper Fungicide, Camelot O. Note: Copper sulfate pentahydrate is not a fixed copper and may burn foliage unless it is applied as a solution with lime to form Bordeaux mixture.
- Sulfur: Southern Agriculture Wettable/Dusting Sulfur, Bonide Sulfur Plant Fungicide, Safer Brand Garden Fungicide, Safer Brand 3-in-1 Spray.

For all products, follow the label for crop clearance and rate to use.

2 - Root-knot nematodes cause galls or swellings on roots of susceptible plants. Controls include resistant varieties, removal of infested roots and incorporation of organic matter. Further information on detection and control practices can be found in *Nematode Control in the Home Garden* (<https://utextension.tennessee.edu/publications/Documents/SP341-L.pdf>).

3 - Seedling diseases include seed rotting and death of seedlings, also termed damping off. Controls: Wait until soils have warmed in spring and do not sow too deeply. Choose well-drained soil; amend or use raised beds if necessary; do not overwater during germination. Use fungicide-treated seed. Soil solarization is helpful.

4 - Southern blight can occur on many types of vegetable crops, infecting the stem at the soil line and fruit in contact with the soil. Controls include removing the plant (including the roots), turning over the soil and not tilling. Additional information on identification and control can be found in *Southern Blight of Vegetables* (<https://ag.tennessee.edu/EPP/Extension%20Publications/Southern%20Blight%20of%20Vegetables.pdf>).

Pesticide Safety

Pesticides (insecticides, fungicides, herbicides, etc.) used improperly can be injurious to humans, animals and plants. Follow the directions and heed all precautions on the labels. Store pesticides in original containers under lock and key — out of the reach of children and animals — and away from food and feed. Apply pesticides so they do not endanger humans, livestock, crops, beneficial insects, fish and wildlife. Do not apply pesticides when there is danger of drift, when honeybees or other pollinating insects are visiting plants or in ways that may contaminate water. Do not dump excess spray material near ponds, streams or wells, or pour down a drain. Abide by the pre-harvest interval on the label. Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container. If your hands have become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on the skin or clothing, remove the clothing immediately and wash skin thoroughly. Dispose of empty pesticide containers promptly and according to the law.

Disclaimer

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication.

Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others that may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product. The author(s), the University of Tennessee Institute of Agriculture and University of Tennessee Extension assume no liability resulting from the use of these recommendations.

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