

Root-knot Nematodes

Root-knot nematodes (*Meloidogyne* species) are microscopic worms that live in the soil and in plant roots. Affected plants are usually stunted, discolored, and may die. Knots or galls develop on the roots.

Prevention & Treatment: When nematodes are not yet present, move the tomato crop to a different area within the garden every year, purchase disease-free plants, pull up and dispose of roots immediately after harvest, and use resistant cultivars (indicated by N following tomato cultivar name). See Table 7 for cultivars resistant to root-knot nematodes.

When root-knot nematodes are present, relocate the garden to a nematode-free area. Use nematode resistant tomato cultivars. Establish a rotation system using marigold cultivars Tangerine, Petite Gold, or Petite Harmony, which reduce root-knot nematode populations in soils. For more information, see [HGIC 2216, *Root-Knot Nematodes in the Vegetable Garden*](#).

Disorders



Blossom end rot symptoms on tomato fruit.

Joey Williamson, ©2009 HGIC, Clemson Extension

Blossom End Rot: Blossom end rot is a physiological disorder of tomato. Symptoms are water-soaked spots on the blossom end of the fruit. These spots enlarge and become black. Secondary infection by decay-causing organisms usually follows.

The cause of this disorder is a calcium deficiency in the developing fruit. Extreme fluctuations in moisture, rainy or cloudy weather with high humidity, cool temperatures, insufficient soil calcium, root pruning from nearby cultivation, and excessive ammoniacal (NH_4^+) nitrogen, potassium, or magnesium fertilization can also increase the chances of blossom end rot, especially early in the season.

Prevention & Treatment: Late spring planting of tomatoes should be at the recommended date for your area. The soil should be limed according to recommendations of a soil analysis report to bring the soil pH to 6.5 and to provide adequate calcium levels in the soil. Limestone is best applied 3 to 6 months in advance and tilled into the garden soil. Follow the soil report for recommendations for pre-plant

nutrient (fertilizer) applications. If calcium levels are not sufficient, but the soil pH is correct, then gypsum (calcium sulfate) is best tilled into the soil before planting at 1 to 2 pounds per 100 square feet.

Avoid excessive potassium or magnesium fertilization as these nutrients will compete with calcium for uptake by the plants. Epsom salt is an example of a magnesium source, so do not apply to garden soil unless a recent soil report indicates a magnesium deficiency.

Avoid ammoniacal nitrogen fertilizers for sidedress applications (beside or around the plants), as ammoniacal nitrogen also will compete with calcium for uptake. Examples of fertilizers with ammoniacal nitrogen are ammonium sulfate, ammonium nitrate, and most complete fertilizers, such as 10-10-10. A calcium nitrate (15.5-0-0) side dress fertilizer is usually the best choice and is applied monthly at 2 pounds per 100 feet of row.

Maintain a uniform supply of moisture through irrigation and adequate soil mulches. Mulches will not only keep the soil cooler and more evenly moist but will suppress weeds, thus reducing the need for nearby cultivation that may damage tomato roots. Remove fruit with blossom end rot symptoms from the plants.

However, if blossom end rot occurs because the soil was not tested and neither lime nor gypsum was applied pre-plant, then the application of gypsum at 1 to 2 pounds per 100 square feet as a sidedress supplement has proven beneficial. See Table 8 for tomato cultivars with resistance to blossom end rot.

Sunscald: Sunscald occurs when tomatoes are exposed to the direct rays of the sun during hot weather. It is most common on green fruit. Decay causing fungi frequently invade the damaged tissue.

Prevention: Cover exposed fruits. Control leaf diseases, as foliage shades the fruit.

Growth Cracks: Tomatoes crack when environmental conditions (drought followed by heavy rain or watering) encourage rapid growth during ripening. Some cracks may be deep, allowing decay organisms to enter the fruit and cause fruit rot.

Prevention: Maintain even soil moisture with regular watering and adequate mulch. Some tomato cultivars are crack-tolerant; see Table 9 for suggested cultivars.

Poor Fruit Set: Poor fruit set occurs for several reasons:

- Extreme temperatures: The blossoms drop off without setting fruit when temperatures are below 55 °F or above 90 °F for extended periods. Try Arkansas Traveler, Talladega Hybrid, Homestead 24, Bella Rosa Hybrid, Top Gun Hybrid, Solar Fire Hybrid, Florida 91 Hybrid, Sioux, or Costoluto Genovese for heat-tolerance.
- Dry soil: Blossoms dry and fall when the plants do not receive enough water.
- Shading: Few blossoms are produced when the plants receive less than six hours of sun a day.

- Excessive nitrogen: High nitrogen levels in the soil promote leaf growth at the expense of blossom and fruit formation. Correct the nitrogen imbalance with superphosphate or 0-20-20 fertilizer.
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Seedling Disease (Damping-off)

The fungi *Pythium* and *Rhizoctonia* cause damping-off of tomato seedlings. Seedlings fail to emerge from the soil in the greenhouse, or small seedlings wilt and die soon after emergence or transplanting. Surviving plants have water-soaked areas on the stem close to the soil line.

Prevention & Treatment: Damping-off is often a problem in plants that are planted too early in the spring. The fungi are more active in cool, wet, rich soils. To prevent damping-off, take these precautions:

- Start seeds indoors in sterilized potting mix and use new or clean containers.
- Do not start seeds in soil that has a high nitrogen level. Add nitrogen fertilizer after the seedlings have produced their first true leaves.
- Allow the surface of the soil to dry between waterings.

Tomato Spotted Wilt

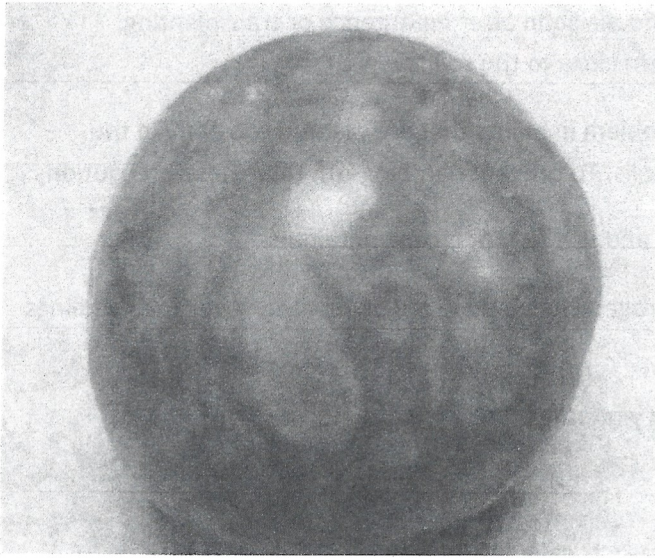
Tomato spotted wilt virus (TSWV) is spread by tiny insects called thrips, which acquire the virus by feeding on one of many infected weeds or ornamental hosts, and then spread it to the developing tomato plants. Several weeks after transplanting the tomato plants into the garden, random plants may appear stunted, and younger leaves may be marked with bronze or dark spots or have prominent purple veins. Often the upper foliage will become twisted and cupped as the bronze areas expand. Fruits may have yellow spots. Younger plants may wilt and die, but older plants may survive and bear discolored fruit that may not fully ripen.

Prevention & Treatment: Eliminating weeds in the garden is the first step in reducing the chance of acquiring TSWV. Keeping the grass and weeds mowed in areas surrounding the garden may reduce the spread of thrips onto susceptible garden plants. Weeds in the garden area during the winter may harbor both the thrips and the virus. For best prevention, remove the old crop debris, till, and then mulch the garden for the winter to keep weeds and thrips down for the next year.



TSWV symptoms on tomato foliage.

Meg Williamson, ©2012 Plant Problem Clinic, Clemson University



TTSWV symptoms on tomato fruit.

Meg Williamson, ©2012 Plant Problem Clinic, Clemson University.



TSWV infected vines will bear discolored fruit that may not fully ripen.

T.J. Savereno, ©2018 Clemson Extension

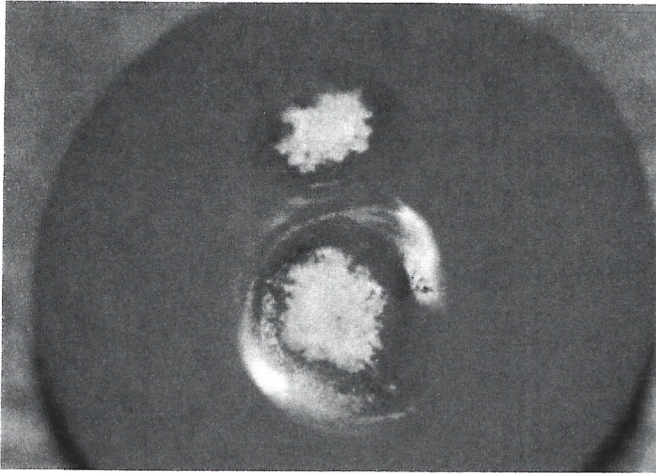
Reflective (aluminum or silver-colored) mulch beneath the tomato plants may reduce the number of thrips that arrive and feed upon the plants. If reflective mulch is not available, paint black plastic mulch silver before transplanting the tomatoes.

There is no cure for a plant with TSWV. Roguing or removing infected plants immediately from the garden may help reduce the incidence of disease on additional plants. However, feeding by thrips can

transmit the virus to plants within minutes. Because of this rapid infection time, insecticidal sprays may be of no use for the home gardener.

Seeds of several TSWV-resistant cultivars of tomatoes are available from mail-order seed companies. These cultivars are resistant but not totally immune. They may acquire the virus, but yields and fruit quality may remain acceptable. Look for cultivars with resistance if this has been a problem in the past. See Table 5 below for recommended TSWV-resistant cultivars.

Anthracnose



Anthracnose (*Colletotrichum* species) on tomato fruit.
Joey Williamson, ©2013 HGIC, Clemson Extension

Anthracnose on tomatoes is caused by a group of fungi within the genus *Colletotrichum*, and these species are primarily pathogens of the tomato fruit. As the fruit are ripening, the symptoms first become noticeable as small, circular indented areas, which later develop darkened centers. The diseased spots continue to grow larger with time as each infection site also spreads deeper into the fruit. With warm, moist, and humid weather (from rainfall or overhead irrigation), the fungus produces salmon-colored spores that are exuded from the black fungal material in the center of the spots. These spores are spread by splashing water.

Prevention & Treatment: Purchase disease-free seed, as the fungus that causes anthracnose of tomato may be within the seed. Tomato seed may be treated by soaking them in hot water (122 °F) for 25 minutes to destroy the fungus. Some varieties of tomatoes have resistance to anthracnose, such as Chef's Choice Orange Hybrid.

Do not overhead irrigate tomatoes, as splashing water aids in the spread of fungal spores. Plant the garden in a sunny site and stake or cage tomato plants to provide better air movement and leaf drying conditions. Keep the garden weed-free, as the presence of weeds may raise humidity levels around plants and slow drying conditions.

Because this disease affects other plants in the tomato family (Solanaceae), such as eggplants and peppers, the site for the tomatoes should not be planted again with solanaceous plants for at least a year. Some weeds that infest the garden are also in the same family, which is another reason to keep the garden free of weeds. Fungal spores can remain in the soil to infect plants the following year. Mulching the garden helps create a barrier between the soil surface and the fruit to reduce infections.

Some insects feed on ripe fruit, such as leaf-footed plant bugs and stink bugs. Their feeding punctures the skin of the fruit and allows the fungus to infect.

Harvest tomato fruit daily as soon as they are ripe. Remove and destroy crop debris as soon as the crop has finished bearing. Do not add debris to compost.

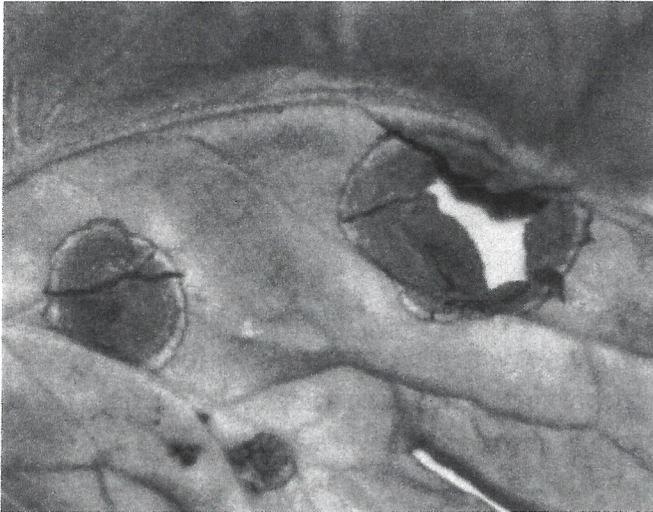
Fungicide sprays can help reduce disease. Products containing mancozeb or chlorothalonil can be sprayed weekly to reduce infection. Follow label directions. There is a five-day waiting period between spraying and picking if using mancozeb, and a one-day waiting period for using chlorothalonil. See Table 1 for examples of products containing this active ingredient.

Fusarium Wilt

This is a warm-weather disease caused by the fungus *Fusarium oxysporum*. The first indication of disease in small plants is a drooping and wilting of lower leaves with a loss of green color followed by wilting and death of the plant. Often leaves on only one side of the stem turn golden yellow at first. The stem of wilted plants shows no soft decay, but when cut lengthwise, the lower stem will have a dark brown discoloration of the water-conducting vessels. The fungus is soil-borne and passes upward from the roots into the water-conducting system of the stem. Blocking of the water-conducting vessels is the main reason for wilting. Invasion occurs through wounds in roots growing through infested soil. Long-distance spread is through seed and transplants.

Prevention & Treatment: For control, grow plants in pathogen-free soil, use disease-free transplants, and grow only cultivars with at least resistance to races 1 and 2 of Fusarium wilt (indicated by FF following the tomato cultivar name). Some newer cultivars are resistant to races 1, 2, and 3, and are found listed in Table 4. Raising the soil pH to 6.5 – 7.0 and using nitrate nitrogen (such as in calcium nitrate) rather than ammoniacal nitrogen (as in 5-10-10, 10-10-10, or 34-0-0) will retard disease development. No chemical control is available.

Early Blight



Early blight (*Alternaria linariae*) on tomato foliage.
Joey Williamson, ©2012 HGIC, Clemson Extension

This disease is caused by the fungi *Alternaria linariae* (formally known as *A. solani*) and is first observed on the plants as small, brown lesions mostly on the older foliage. Spots enlarge and concentric rings in a bull's-eye pattern may be seen in the center of the diseased area. The tissue surrounding the spots may turn yellow. If high temperature and humidity occur at this time, much of the foliage is killed. Lesions on the stems are similar to those on leaves and sometimes girdle the plant if they occur near the soil line (collar rot). On the fruits, lesions attain considerable size, usually involving nearly the entire fruit. Concentric rings are also present on the fruit. Infected fruit frequently drops.

The fungus survives on infected debris in the soil, on seed, on volunteer tomato plants, and other solanaceous hosts, such as Irish potato, eggplant, and black nightshade (a common, related weed).

Prevention & Treatment: Use resistant or tolerant tomato cultivars. Use pathogen-free seed and do not set diseased plants in the field. Use crop rotation, eradicate weeds and volunteer tomato plants, space plants to not touch, mulch plants, fertilize properly, don't wet tomato foliage with irrigation water, and keep the plants growing vigorously. Trim off and dispose of infected lower branches and leaves.

To reduce disease severity, test the garden soil annually and maintain a sufficient level of potassium. Lime the soil according to soil test results. Side dress tomato plants monthly with calcium nitrate for adequate growth.

If the disease is severe enough to warrant chemical control, select one of the following fungicides: mancozeb (very good); chlorothalonil or copper fungicides (good). Follow the directions on the label. See Table 1 for examples of fungicide products for home garden use. See Table 2 for tomato cultivars with resistance or tolerance to early blight.

Late Blight

Late blight is a potentially serious disease of potato and tomato and is caused by the water mold pathogen *Phytophthora infestans*. Late blight is especially damaging during cool, wet weather. This pathogen can affect all plant parts. Young leaf lesions are small and appear as dark, water-soaked spots. These leaf spots will quickly enlarge, and a white mold will appear at the margins of the affected area on the lower surface of leaves. Complete defoliation (browning and shriveling of leaves and stems) can occur within 14 days from the first symptoms. Infected tomato fruits develop shiny, dark, or olive-colored lesions, which may cover large areas. Fungal spores are spread between plants and gardens by rain and wind. A combination of daytime temperatures in the upper 70s °F with high humidity is ideal for infection.

Prevention & Treatment: The following guidelines should be followed to minimize late blight problems:

- Keep foliage dry. Locate your garden where it will receive morning sun.
- Allow extra room between the plants, and avoid overhead watering, especially late in the day.
- Purchase certified disease-free seeds and plants.
- Destroy volunteer tomato and potato plants, as well as nightshade family weeds, such as Carolina horsenettle or black nightshade, which may harbor the fungus.
- Do not compost rotten, store-bought potatoes.
- Pull out and destroy diseased plants.
- If the disease is severe enough to warrant chemical control, select one of the following fungicides: chlorothalonil (very good), copper fungicide, or mancozeb (good). See Table 1 for examples of fungicide products for home garden use. Follow the directions on the label.
- Plant resistant cultivars. See Table 3 for tomato cultivars with resistance to late blight.

Blossom Drop

- **What it looks like:** Flowers appear on your tomato plants, but they fall off without tomatoes developing.
- **What causes it:** Temperature fluctuations cause blossom drop. Tomatoes need night temperatures between 55 to 75 degrees F in order to retain their flowers. If the temperatures fall outside this range, blossom drop occurs. Other reasons for blossom drop on tomatoes are insect damage, lack of water, too much or too little nitrogen, and lack of pollination.
- **What to do about it:** While you can't change the weather, you can make sure the rest of the plant is strong by using fertilizer for tomatoes, drawing pollinators by planting milkweed and cosmos, and using neem oil insecticides.



Fruit Cracks

- **What they look like:** Cracks appear on ripe tomatoes, usually in concentric circles. Sometimes insects use the cracks as an opportunity to eat the fruit, or birds attack cracked fruit.
- **What causes them:** Hot, rainy weather causes fruit crack. After a long dry spell, tomatoes are thirsty. Plants may take up water rapidly after the first heavy rainfall, which swells the fruit and causes it to crack.
- **What to do about them:** Although you can't control the rain, you can water tomatoes evenly during the growing season. This prevents them from being so thirsty that they take up too much rainwater during a heavy downpour.



Sunscald

- **What it looks like:** The plants look healthy, and the fruit develops normally. As tomatoes ripen, yellow patches form on the red skin. Yellow patches turn white and paper-thin, creating an unpleasant appearance and poor taste.
- **What causes it:** As the name implies, the sun's rays have actually scalded the tomato.
- **What to do about it:** Tomato cages, or a wire support system that surrounds the plants, give the best branch support while shading the developing tomatoes naturally. Sunscald usually occurs on staked plants that have been too-vigorously pruned, exposing many of the tomatoes to the sun's rays. Leaving some foliage and branches provides shade during the hottest part of the day.

Poor Fruit Set

- **What it looks like:** You have some flowers but not many tomatoes. The tomatoes you do have on the plant are small or tasteless.
- **What causes it:** Too much nitrogen in the soil encourages plenty of green leaves but not many flowers. If there aren't enough flowers, there won't be enough tomatoes. Another cause may be planting tomatoes too closely together. Tomatoes are self-pollinating, meaning that each flower contains both the male (stamens) and female (pistils) parts. Wind typically pollinates tomatoes, but if plants are too close together, the wind can't reach the flowers.
- **What to do about it:** Have your soil tested. If you're planting tomatoes in the spring, leave at least two feet or more between plants so that good air circulation can help pollinate them. If your plants are already in the garden, you can simply shake the flowering branches to simulate wind and get the pollen from the stamens to the pistils.



Catfacing

- **What it looks like:** Catfacing makes tomatoes appear deformed. The blossom end is rippled, bumpy and lumpy.
- **What causes it:** Plants pollinated during cool evenings, when the temperatures hover around 50 to 55 degrees F, are subject to catfacing. Blossoms fall off when temperatures drop too low. However, if the flower is pollinating before the petals begin to drop off, some stick to the developing tomato. This creates the lumps and bumps typical of catfacing.
- **What to do about it:** If possible, plant tomatoes a little later in the season. The weather should be warm enough to support proper tomato development. Devices such as a “Wall of Water” can help keep temperatures high enough on cold nights to prevent cold-related problems. Using black plastic on the soil can also help. The plastic heats during the day and releases the heat back towards the plants at night. Use until the temperatures warm up enough that it’s no longer needed.

- **What it looks like:** You'll find brown spots on tomato leaves, starting with the older ones. Each spot starts to develop rings, like a target. Leaves turn yellow around the brown spots, then the entire leaf turns brown and falls off. Eventually the plant may have few, if any, leaves.
- **What causes it:** A fungus called *Alternaria solani*. This fungus can live in the soil over the winter, so if your plants have had problems before like this, and you've planted tomatoes in the exact same spot, chances are good the same thing will happen to your plants this year.
- **What to do about it:** Crop rotation prevents new plants from contracting the disease. Avoid planting tomatoes, eggplants or peppers in the same spot each year as these can all be infected with early blight. A garden fungicide can treat infected plants.



Septoria Leaf Spot

- **What it looks like:** After the plants begin to develop tomatoes, the lower leaves break out in yellow spots. Within the yellow spots, dark gray centers with dark borders appear. Black dots appear in the center of the spots. Foliage dies and falls off.
- **What causes it:** A fungus called *Septoria lycopersici* that infects foliage.
- **What to do about it:** Avoid watering tomatoes from the top, as the spray can force the spores developing on the leaves back into the soil and continue the disease cycle. Use a spray that fights fungal diseases, such as Safer® Brand 3-in-1 Garden Spray.



Fusarium Wilt

- **What it looks like:** Your tomato plants look fine, when suddenly, they start to wilt. At first, only one side may be affected, but then the whole plant is wilting. You water them, and the problem gets worse. Within a day or two, the plant is dead!
- **What causes it:** A nasty fungus called *Fusarium oxysporum f.sp. lycopersici* that attacks the vascular system of the plant, roughly equivalent to a human's veins. The fungus destroys the xylem tubes, which transport water and nutrients up from the roots and into the leaves.
- **What to do about it:** In the case of fusarium wilt, the best defense is a good offense. Rotate your crops so tomatoes aren't planted in the same section of the garden each year. Purchase wilt-resistant varieties if you've lost tomatoes to wilting diseases in the past, since the fungus can overwinter in garden and lawn soils.



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Verticillium Wilt

- **What it looks like:** Yellow blotches appear on the lower leaves. As the blotches spread, the veins in the leaves turn brown. After the leaves turn brown, they fall off. The disease progresses up the stem until the plant is stunted.
- **What causes it:** A fungus that lives in the soil, *Verticillium albo-atrum*, attacks the roots and travels up the xylem tubes with water. It then prevents the normal flow of water and nutrients to the leaves.
- **What to do about it:** Once plants are infected, there isn't much you can do to treat Verticillium wilt. Rotate your crops, because the fungus can live for long periods in the soil and even live among weeds such as ragweed. Choosing wilt-resistant varieties to plant is the best way to prevent Verticillium wilt.



Viral Diseases

- **What they look like:** Viral diseases mainly attack the tomatoes themselves. You might find black spots on tomatoes, or weird stripes on them. Don't confuse signs of disease for just how some heirloom tomatoes look with natural stripes.
- **What causes them:** Many of these viruses spread when plants are stressed by heat, drought or poor soil.
- **What to do about them:** If you've read through all of these tomato problems and think your tomatoes may be suffering from a viral disease, spray your tomato plants with neem oil. Good soil management and using organic fertilizer for tomatoes helps keep your plants healthy, which can help them naturally resist viruses better.



Powdery Mildew

- **What it looks like:** Powdery mildew is easy to find on tomato plants as it looks like someone brushed the leaves with a white powder. You might find white spots on tomato leaves or even the stem. If you let the fungi thrive it will turn your tomato leaves yellow and then brown.
- **What causes it:** Powdery mildew on tomatoes is more common in greenhouses than an outdoor garden because of the lack of air flow and high humidity.
- **What to do about it:** The best way to prevent powdery mildew on tomato plants is to use a [preventative spray formulated with sulfur](#). For more information, read this post on [prevention and treatment of powdery mildew on plants](#).