Tomatoes are one of the most common cultivated crops, whether it be on a commercial scale or within a home garden. They are relatively easy to grow with regular maintenance, but they are not without production problems and issues, especially in the realm of pests and diseases.

Please note that, although there is a lot of information here on disease, pests, and other tomato production problems, this is not an exhaustive list and does not go into great detail on any one issue. For more in-depth information and images, there are many books available, such as *The Tomato Disease Handbook* and *Tomato Health Management*, both published by the American Phytopathological Society. Your local Cooperative Extension Service agency also provides a wealth of information on production challenges. Additional images can also be found at the APS Image Database: [https://imagedatabase.apsnet.org/search.aspx](https://imagedatabase.apsnet.org/search.aspx)

**DISEASES**

For any disease, the most certain way to positively identify which one is afflicting your crop is to collect a sample of an infected plant. The sample can then be sent to your local Cooperative Extension Service agency or a plant disease diagnostics clinic for identification. Selecting varieties with particular disease resistances can be quite effective in the prevention of disease, in addition to methods that are specific to the type of disease present.

**Foliar diseases**
High humidity and elevated temperatures are the main conditions that makes foliar diseases more prevalent. General prevention techniques include increasing ventilation, proper pruning to allow for better airflow between plants, and not conducting maintenance or harvesting when the plants are wet. Many foliar diseases can survive in plant residue from season to season, so remove debris and practice crop rotations. Common foliar diseases that affect tomatoes include:

- **Bacterial speck** (*Pseudomonas syringae*)
  Bacterial speck is a foliar disease that can also affect the fruit, whether green or ripe. On the leaves, it is identified by miniscule dark spots; on green fruit, dark spots; and on ripe fruit, sunken dark spots. It can reduce vigor and yield of plants, and make fruits unmarketable.

- **Gray leaf spot** (*Stemphylium solani*)
  The most obvious symptom of gray leaf spot is the development of small, dark-colored lesions on the leaves that progress into dead leaf tissue. As a result, there is reduced productivity and eventually leaf drop. Gray leaf spot is more common in southern states.

- **Early blight** (*Alternaria solani*)
  Also known as “Alternaria leaf blight”. Early blight is most common on mature plants, particularly on the older, lower leaves. Lesions first form as irregular-shaped dark spots that later progress into increasingly larger rings surrounded by yellow, often resembling a bulls-eye target in shape and appearance. As the disease develops, it causes leaf drop and reduced yields. Although the infection begins on the lower portion of the plant, it can extend to the upper leaves and is also capable of infecting the stems in the form of Alternaria Stem Canker — see the Stem diseases below for more information.
- **Late blight** (*Phytophthora infestans*)
The cause of the infamous Irish Potato Famine, late blight can affect both potatoes and tomatoes. The classic symptoms are nickel-sized, wet or greasy-looking, grayish black or brown spots on leaves, with white, fuzzy fungal growth on the underside of leaves. The fruit can also be infected, resulting in dark-colored lesions that are hard & sunken. Late blight has the potential to spread rapidly and can be very destructive.

More information on late blight, including details on the different races and disease-resistance genes to better manage the disease, can be found in our Late Blight Awareness and Prevention technical sheet, located in the Grower’s Library on the Johnny’s website.

- **Leaf mold** (*Fulvia fulva, Passalora fulva*)
A type of fungus, leaf mold is proliferated by spores. It affects both the upper- and undersides of leaves with yellow, irregularly-shaped spots on the upper-side and fuzzy olive-green, gray, or tannish-brown splotches on the underside. Typically, leaf mold develops first on the older leaves, near the bottom of the plant. Leaf mold is most common in greenhouse- or tunnel-grown tomatoes, when humidity is high and air circulation is reduced. Disease resistance is specific to races of leaf mold. New races can develop over the course of a couple of seasons.

- **Powdery mildew** (*Oidium lycopersicum*)
As is true of powdery mildew affecting other crops, the species of that afflicts tomatoes is host-specific to only tomatoes. The most obvious symptom is the collection of white, powdery spores on the leaf surface. These spores are easily dispersed, allowing the disease to spread quickly. Leaves infected with powdery mildew eventually die as the infection spreads. The disease occurs most often in greenhouses and high tunnels.

### Soil-borne diseases
Soil-borne diseases occur mostly in areas and fields where tomatoes have been grown for repeated seasons. Since the funguses that cause the diseases are present in the soil, most infect the plants starting at the roots, which can lead to reduced movement of nutrients to other parts of the plant. Crop rotation with non-Solanaceous crops may help reduce the occurrence of soil-borne diseases. Common soil-borne diseases include:

- **Bacterial Wilt** (*Ralstonium species*)
Within the United States, bacterial wilt is most prevalent in the South. The early symptoms include leaf wilt, especially at high temperatures, but recovery during cool, nighttime temperatures. As the disease advances, extreme wilting and desiccation occurs, leading to plant death. Use of varieties with bacterial wilt resistance has shown some success in controlling the disease, including the use of disease-resistant rootstocks for grafting.

- **Corky root rot** (*Pyrenochaeta lycopersici*)
More prevalent in cool-temperature plantings, larger roots take on a corky texture while smaller roots may rot and decay. Because the roots, which are responsible for acquiring nutrients for the plant, are affected, plants exhibiting signs of corky root rot are often small and less vigorous.

- **Fusarium crown and root rot** (*Fusarium oxysporum f. sp. radicis-lycopersici*)
The fungal pathogen that causes fusarium crown and root rot first affects the roots of young plants by entering through wounds and natural openings. At early onset, plants are stunted, show signs of leaf yellowing, and lose lower leaves. As the disease progresses, it causes a girdle around the stem where the root and stem join, and causes root rot, leaf wilting, and eventual plant death.
- **Fusarium wilt** (*Fusarium oxysporum f. sp. lycopersici*)
  Fusarium wilt is a host-specific disease that is further divided into races; in order to achieve the best resistance, be sure to select a variety with resistance to the specific race in your area. Fusarium wilt disrupts the flow of nutrients and water in a plant's vascular system, leading to yellowing and eventual leaf drop.

- **Root-knot nematodes** (*Meloidogyne arenaria, M. incognita, M. javanica*)
  Nematodes are a type of parasitic worm. The species that infect tomato plants receive their name by the galls, or knots, that form on the roots. Roots that have galls are less effective at acquiring nutrients and water. As a result, the plants are stunted and produce smaller yields.

- **Verticillium wilt** (*Verticillium albo-atrum*)
  The fungus that causes Verticillium wilt enters through small cuts and lesions that may occur on the root surface. Like Fusarium wilt, it also disrupts the flow of nutrients and water in a plant's vascular system, leading to wilting and yellowing on the plant's lower leaves. Leaves may also develop a V-shaped lesion that may enlarge and cause leaf death.

### Seed-borne Diseases
- **Bacterial Canker** (*Clavibacter michigensis*)
  Bacterial canker is a common and destructive disease, especially for greenhouse growers. Infected seedlings develop white leaf spots and show wilting, often leading to plant death. More mature plants show symptoms on the leaves, fruit, and stems. As a seed-borne disease, many growers buy seed from Good Seed and Plant Practices (GSPP) accredited businesses or hot water treat purchased seeds.

- **Bacterial Spot** (*Xanthomonas species*)
  Symptoms begin as small, irregular brown spots. As the disease progresses, leaves turn yellow and may shed, which exposes fruits to the possibility of sunscald. Large lesions may also develop on the fruit. There are multiple races of bacterial leaf spot and varietal resistance corresponds to specific races. Manage with preventative seed treatments.

### Stem Diseases
- **Alternaria stem canker** (*Alternaria alternate f. sp. lycopersici*)
  Alternaria stem canker may affect not only the stems, but also leaves and fruits. However, the dark-colored cankers that form on plant stems can cause the most damage to the plant. As the cankers grow, they can encircle the stem, causing the plant to die.

- **Damping off**
  A common seedling disease that is the result of a number of fungi that cause damage to young seedlings at the base of the stem, near the soil line. Stems appear weak, withered, or pinched. Since it is caused by a fungus, it is in wet, cool conditions that damping off occurs most often. Control damping off using properly sterilized or composted soil mixes and spraying trays with light copper after sowing.
Viruses
Viruses require a host, in this case a tomato, to complete their full lifecycle and reproduce. In general, a plant virus requires some sort of carrier, known as a vector, to transmit disease from plant to plant because plants are relatively sedentary. This is why insects are commonly associated with the transmission of plant viruses. Common tomato viruses include:

- **Tobacco and Tomato mosaic virus** *(abbreviated: TMV and TomV)*
  Plants showing signs of tobacco or tomato mosaic virus, can appear stunted or malformed, and commonly exhibit a splotchy yellowing appearance or mosaic pattern between leaf veins. The disease results in reduced yields, brown spots on fruits, and, in some cases, can cause the plants to die. It spreads easily from plant to plant through touch and can also be transferred by people who handle tobacco products. It is most problematic in reduced light situations, such as in a high tunnel.

Both viruses are host-specific diseases with multiple races.

- **Tomato yellow leaf curl virus** *(abbreviated: TYLCV)*
  Tomato yellow leaf curl is another virus that is spread by sweet potato whiteflies that carry the virus. Plants that are affected have malformed leaves, smaller than usual, that are wrinkled or cupped, and may have yellow coloring between leaf veins.

- **Tomato apex necrosis virus**
  The tomato apex necrosis virus can affect any number of Solanaceous crops, including tomatoes, via sweet potato whiteflies *(Bemisia tabaci)* which act as a vector for this virus. Necrosis (death of the plant tissue) occurs on the leaves, fruit, and the top, or “apex” of the plant, is one of the main symptoms of the virus. The apex contains the growing point of the main stem, and so damage here can stunt plant growth and reduce yields.

- **Tomato spotted wilt virus**
  Originally only problematic in the southern United States, tomato spotted wilt virus has also been detected in more northern states. The virus is spread by thrips, and so control of the pests is important. The symptoms begin as small, dark spots on newer leaves, with dark streaks later forming on stems. Mature fruit take on an extreme mottling of red and orange or yellow.

- **Pepino Mosaic Virus** *(abbreviated: PepMV)*
  A newly-introduced virus, symptoms of pepino mosaic virus on leaves include yellow discoloration, including a mosaic pattern, and malformation. Although pepino mosaic virus does infect members of the Solanaceous family, its primary hosts are tomatoes and pepinos, for which the virus receives its name.

- **Cucumber Mosaic Virus** *(abbreviated: CMV)*
  One of the most common viruses that affect tomatoes, cucumber mosaic virus is spread by aphids. Leaves of infected plants fail to form fully, taking on a spindly appearance. Fruit often do not reach their full size and are malformed.

PESTS

**Tomato hornworm**
The tomato hornworm is the caterpillar or larval stage in the lifecycle of the five-spotted hawkmoth. While the moths are relatively harmless, the eggs they lay become the hornworm, which is one of the most damaging pests that affect tomatoes.

Hornworms can be identified by their large size – much larger than most caterpillars, the dark-colored “horn” on the posterior end from which they get their name, and the 8 white stripes on either side. Younger hornworm caterpillars are lighter in color without marking, but still have the telltale horn.
Plant leaves are most affected by the hornworms. They feed on the leaves in grave amounts, consuming large numbers of whole leaves. This level of defoliation can be devastating to the plants, greatly reducing productivity and yield. More mature hornworms are also known to feed on fruit. It is common to see their large fecal droppings left behind on the plants and ground before you see the caterpillars themselves.

Tomato hornworms can be controlled by picking the caterpillars off the leaves and destroying them, utilizing natural enemies that will parasitize the caterpillars, or applying an insecticide, such as one that contains Bacillus thuringiensis or spinosad.

**Whitefly**

There are a number of different species of white flies, but only select species cause damage, specifically by feeding on fruit and leaves and carrying diseases such as tomato yellow leaf curl virus. The species in question are the sweet potato whitefly and greenhouse whitefly. Both species can be controlled with natural enemies, proper sanitation, and crop rotations with non-host species; insecticides, such as insecticidal soaps and azadirachtin, have been shown to have some affect; and, like with aphids, the placement of silver mulch can repel whiteflies.

- The adult **sweet potato whitefly** is light in color, pale yellow. They are not true flies, as they have two pairs of wings, white in color, that are peaked over their backs when at rest. Eggs are laid on the underside of leaves and are white, turning brown as they are closer to hatching. The immature whitefly, known as a nymph, goes through four development phases.

- In contrast, the adult **greenhouse whitefly** has wings that are much broader and are carried flat on the back when at rest; other than those distinctions, they are similar in appearance. Eggs are also laid on the underside of leaves. The oldest nymphal development phase is clear and has several setae, bristle-like hairs, surrounding the body.

- As a relative of the greenhouse whitefly, the **silverleaf whitefly** has many of the same characteristics. However, their color is a deeper yellow and their wings are carried at their sides. Feeding by silverleaf whiteflies causes irregular fruit ripening in greenhouse tomatoes.

**Thrips**

Thrips pose the most damage to tomatoes due to the fact that they carry tomato spotted wilt virus. Their bodies are long, slender, and small, and light colored to brown. Wings of thrips have long hairs on the margins. Prevent thrips by rotating crops and planting tomatoes away from locations other host plants were previously located.

**Aphids**

There are a few main species of aphids that infest tomato plants: green peach aphids and potato aphids. Aphids can be controlled with the use of natural enemies or repelled by the placement of silver mulch. Damage caused by aphids varies depending on the species.

- The **green peach aphid** occurs in their greatest numbers early in the season; they are, as the name suggests, green and have darker green stripes. The damage they inflict can cause wilting, but typically only delay maturity slightly. However, green peach aphids are known as a vector, or carrier, for many disease-causing pathogens.

- The **potato aphid** is larger than the green peach aphid and can be either green or pink in color. It is more prevalent later in the season. In great numbers, potato aphids can cause substantial damage: malformed leaves, stunted plants, and necrosis, or dead plant tissue. The defecate, called honeydew, can create an environment that is prone to the development of mold. Ultimately, infestations can result in large yield reductions.
PHYSIOLOGICAL DISORDERS
Not all issues with tomatoes are caused by disease or insects. Environmental or nutritional pressures can disrupt the normal processes of a tomato and cause any number of disorders.

Blindness
Tomato plants normally produce one main stem and several side shoots that may be pruned or a limited number retained for additional leaders. On occasion that main stem will cease growing — often when plants only have a few sets of true leaves — due to a phenomenon called “blindness”. The cause of blindness is uncertain, though it has been attributed to plant genetics, day length, and temperature. When day length is the cause for blindness, ensure plants receive a minimum of 13 hours of daylight at planting. Fortunately, it is only the growing point on the main stem that is affected and side shoots continue growing and can replace the main stem for fruit production.

Tomatoes in the Johnny’s French Heritage series are an example of varieties that require a minimum of 13 hours of daylight to prevent blindness.

Blossom end rot
As the name suggests, blossom end rot occurs at the blossom end of the fruit and can be identified by a brown-colored sunken area on the bottom of the fruit. The cause is due to a localized calcium deficiency in the fruit, similar to tipburn in lettuce.

Drought stress can exacerbate the localized deficiency. If the plant does not receive enough water it cannot transport calcium and other nutrients to the fruit. Inadequate soil pH can also affect a plant’s ability to take up nutrients.

Fruits affected by blossom end rot cannot recover from it and should be discarded. However, if adequate watering and proper fertilization occurs, fruits that develop subsequently should develop normally.

Cracking, Splitting, and Catfacing
The different types of cracks and splits are named based on their orientation on the fruit. They all have similar causes: excessive water following drought conditions or temperature extremes. The sudden uptake of water causes fruits to grow faster than the skin, and subsequently the skin breaks – keep the moisture even and consistent to help prevent cracks and splits. These types of malformations can increase the chance of fruits rotting, especially if it occurs in green fruits. Fruits with cracks, splits, and catfacing are still edible, but are less visually appealing. Some varieties are more crack resistant than others, so look for these if you have difficulty managing water.

- **Cracking** – There are two categories of fruit cracking: radial and concentric. Radial cracks are linear, typically beginning at the stem. Concentric cracks encircle the fruit, also starting at the stem end.
- **Catfacing** – As opposed to other cracks, catfacing occurs at the blossom end of the fruit. There may be cracks and scarring, or in severe cases holes in the fruit. In addition to inconsistent watering, catfacing can occur when there are cold temperatures when the plant is flowering. Catfacing appears to be more prevalent in larger tomatoes and in heirlooms.

Misshapen fruits
On occasion, there are fruits that are distinctly non-uniform with the rest of the crop and do not match the description of what it should be. Inadequate pollination often causes this. There are a number of reasons for inadequate pollination:

- Temperatures and humidity are outside the ideal range for pollination. Optimal pollination temperatures are between 70-82°F/21-28°C, while 70% humidity is preferred.
- Lack of water.
- Nutrient deficiencies or toxicities.
- Lack of pollen transfer. Wind typically disturbs tomato plants, causing pollen to move from the male flower parts, the anthers, to the female flower parts, the ovaries. In an area with reduced wind, such as a greenhouse or high tunnel, pollen is less easily transferred. Pollen transfer can be stimulated by vibrating a flower cluster with an electric pollinator or by gently shaking the plants.
**Sunscald**

Often a result of lack or loss of leaves, sunscald is the tomato equivalent of sunburn. Fruit with sunscald develop blisters that may become lighter in color and change to a papery texture. In addition to damaging the fruit, it can also create conditions that can make it more prone to infection by disease or infestation from insects. There is no way to cure sunscald once it occurs, but you can use shade cloth over your greenhouse to reduce light levels or avoid excessive pruning leaf which will expose the fruit.

**Yellow or Green Shoulders**

Yellow or green shoulders in ripening tomatoes occurs when lycopene production in fruits is inhibited. Lycopene is the pigment in tomatoes that cause their red color, and production of it ceases when there are extremely high temperatures, 80°F/27°C and above, and intense light. At the onset of this disorder, shoulders will remain green. As the fruit continues to develop, the shoulders become an intense yellow, with that portion of the fruit remaining firm. Green or yellow shoulders are more common with certain varieties, but can be managed with proper air flow and ventilation for temperature control and pruning only as necessary to leave some leaf protection over ripening fruits.

**Various ripening disorders**

There are a number of physiological issues in tomatoes that may cause uneven ripening or discoloration of the fruits. Among these are puffiness, zippering, graywall or blotchy ripening, and internal white tissue. These disorders are caused by a combination of inadequate or extreme temperatures, nutritional issues, and other environmental conditions.