



William T. Kemper Center for Home Gardening

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Tomato Diseases and Disorders

Tomatoes are the most widely grown vegetable in the U.S. and it is not uncommon to find a number of problems that must be contended with during a normal growing season. Among the problems are infectious diseases of leaves, fruit and roots which reduce yield and affect fruit quality. There are over 40 recorded diseases of tomatoes. Fortunately, we are likely to see only a few of these each year. Tomato diseases can be grouped into symptom categories to assist us with their identification. Once identified, with an understanding of the disease agent and its ability to cause damage and spread, the proper control can be initiated. Disease categories include: wilts, leaf spots/blights, fruit spots and rots.

Other tomato problems commonly encountered are physiological and do not spread from one plant to another. These are called disorders and generally relate to growth conditions associated with soils, cultural practices and weather. The most common disorders reported are blossom-end rot, fruit cracks, and uneven ripening.

Infectious Diseases of Tomato

Wilts

During the growing season, tomato plants may wilt for a variety of reasons. Normal temporary wilting may occur when daytime temperatures are high and the plants cannot transport water to the leaves at a fast enough rate to keep up with water loss. This condition is called "mid-day wilt" and is a function of temperature as well as water availability. It is temporary because later in the afternoon the plants will recover, provided there is ample moisture in the soil.

Alternatively, when wilting occurs at other times during the day and the plant does not respond to additional watering, it may have a disease. There are two common wilt diseases of tomato: verticillium wilt and fusarium wilt. Both are caused by fungi. These are easily confused with each other since they cause the same wilting symptoms. Unfortunately, once the symptoms have been expressed, the plant is likely to be infected internally throughout the stem and perhaps into the roots. At this point, the only reasonable thing to do is dig the plant out of the garden and dispose of it. It may be helpful to identify the disease agent so that this problem can be managed in future seasons.

Verticillium Wilt

Verticillium wilt is a disease caused by a fungus which infects many plants including tomatoes, potatoes, eggplants, peppers, strawberries, raspberries and ornamentals. The fungus is soil-borne and can persist for many years. This means that once identified as a problem, you should not plant any of the susceptible crops listed in the same area for at least three consecutive seasons. The disease is more prevalent in cool than in warm climates.

Wilting symptoms may appear first on older, bottom leaves. These leaves may become yellowed, dry up and drop prematurely. The upper shoots may also wilt especially during mid-day. Leaf tips curl upward at the margin and defoliation may continue up the plant. At an advanced stage of infection, the internal portion of the stem at the base of the plant will appear dark and discolored.

Fusarium Wilt

Fusarium wilt is caused by fungus. Like verticillium wilt, the initial symptoms include lower leaf wilting and yellowing. Unlike verticillium wilt, wilting may only be associated with a branch or one side of the plant. One, then maybe two shoots will be affected as the disease progresses. Eventually, the whole plant will wilt and die. This may take a number of weeks from the first wilt symptom until death.

The fungus is soil-borne and can live in the soil for many years. It will infect susceptible roots and once inside the stem will progress upward. There are several races of the fungus which have been identified. Fusarium wilt is primarily a cool-weather disease.

Control of Fungal Wilt Diseases

The first step in the control of these diseases is to get an accurate diagnosis. This is best confirmed by an expert who might send a sample of the plant to a plant clinic to have it cultured. During the process, sample pieces are placed on a nutrient medium which allows the fungus to grow out, enabling identification. Once confirmed as a disease caused by one of the fungi, there are several steps that might be taken to avoid the problem in the future.

Since both of the fungal wilt diseases reside in the soil for years, they represent a threat for an extended period of time, but only to a susceptible host. In the case of verticillium there are many hosts, most of which are in the potato family, while fusarium also attacks pea, spinach and melons. Therefore, the area in which a diseased plant was grown should be rotated to a non-susceptible crop like cabbage, broccoli, beans or carrot. Susceptible crops should not be planted for at least three growing seasons. This period of time will cause the fungal population to decline to levels which represent a lower risk at the end of the rotation period.

The next step is to plant resistant cultivars of tomato. Fortunately, a good deal of work has been done to breed resistant plants. One way to know if the cultivar in question is resistant is to check the seed packet. On the front of the packet should be the letters VF or VFT or VFTN. These stand for Verticillium (V), Fusarium (F), Tobacco Mosaic (T) and Nematode (N) resistant. If these are not on the packet, then the cultivar may not be resistant to any of the diseases.

Preventive chemical treatments with fungicides are not recommended for these wilt diseases.

Leaf Spots and Blights

There are many leaf spots and blights of tomatoes caused by disease organisms. Of these, early blight and septoria leaf spot are the most common and contribute to the greatest number of problems. These diseases are caused by fungi and are difficult to control especially if the weather is wet. Splashing water is the main vehicle for spreading these diseases from leaf to leaf and plant to plant.

Early Blight

This disease is caused by the fungus, *Alternaria solani*. It may affect seedlings, but is most common on older plants. It first appears on older, lower leaves as dark brown spots with dark concentric rings. Spotted

leaves may dry up and die prematurely. Plants will become defoliated if the infection becomes severe. This leads to poorly colored fruit.

The initial infection begins when spores of the fungus, overwintering in residue of diseased plant tissue from previous seasons, splash onto new leaf tissue. The fungus can persist in infested residue for about one year and therefore, represents a threat each year that infected tomatoes are grown in the same spot. The fungus can also be seedborne and introduced with the seed and on transplants. Spread of the disease occurs under conditions of high moisture (heavy dews and rainfall) and can be most severe when plants are under drought stress caused by a lack of soil moisture or poor soil conditions.

This disease is more likely to be found on foliage; however, the fungus can also infect green or ripe fruit. Generally, fruit infection appears at the stem end and develops into black, shriveled areas which become sunken. Often the infected area will appear leathery with a pattern of concentric rings outlining the dark, discolored zone.

Septoria Leaf Spot

This leaf spot disease is caused by the fungus, *Septoria lycopersici*, and is probably the most common leaf spot disease of tomato. It first appears as small, water-soaked spots on lower leaves that eventually expand to an eighth-inch in diameter and become semicircular. The center of each lesion will become grayish-white in color with dark borders or edges.

As conditions become favorable, lesions will produce small fungal fruiting bodies in the center of each spot from which spores are generated. Spores are spread from leaf to leaf by splashing rain. Leaves which become heavily infected will turn yellow, eventually dry and fall off.

Infection can occur at any stage of plant development, however, it is most severe after plants have set fruit. Lower leaves are infected first and the disease will progress upward if wet weather prevails. Defoliation occurs when the disease has become well established, generally after periods of wet, warm weather.

The fungus will overwinter in infected tomato debris which remains in the bed or garden. It can also become established on weeds like ground cherry, horse nettle and nightshade.

Control of Leaf Spot Diseases

The best place to start in controlling leaf spot diseases of tomato is to buy or raise disease-free seedlings or transplants. Plants should be spaced out in the garden so that they are not crowded and the tops do not touch each other. This allows free moisture on the foliage to dry more quickly. Other steps which should be taken to avoid problems include:

- 1) do not overhead water or water in the evening
- 2) water and fertilize to maintain vigorous plants
- 3) remove infected leaves to reduce the spread of spores
- 4) avoid working with the plants when they are wet
- 5) remove plant debris in the fall and plow under any remaining debris
- 6) rotate crops of tomatoes with other vegetables on a three to four year schedule

7) fungicides can be applied prior to symptom development to protect the foliage and fruit

Fruit Diseases and Disorders

There are a couple infectious and non-infectious problems which affect tomato fruit quality commonly found in the home garden. Of the infectious diseases, anthracnose and early blight are observed most frequently and are both caused by fungal pathogens. Several bacterial diseases can also be found, however, they are generally not significant. Fruit quality can be reduced by physiological disorders. The most prominent are blossom-end rot and disorders which cause the fruit to crack or ripen unevenly.

Infectious Diseases of Tomato Fruit

Anthracnose

This is a fungal disease caused by *Colletotrichum coccoides* and occurs primarily on fruit. Leaf infections may also be found, but generally coincide with the occurrence of other leaf disorders such as another disease or physiological problems. In that sense, anthracnose is not an aggressive disease on foliage.

Considered the most damaging disease of fruit, anthracnose can infect green, immature tomatoes, however, the symptoms will not appear until the fruit ripens. Small, circular, indented dark spots will appear as the fruit changes to its mature color. The spot will expand to form concentric rings of dark specks which are the fruiting bodies of the fungus and contain spores. When conditions are moist, these fruiting bodies will exude large numbers of spores which may give the lesion a creamy-pink coloration. Infection will progress to the point where internal discoloration can be quite deep. Generally, the rot is localized and portions of the fruit can be eaten. In other cases, the disease will cause a predisposition of the fruit to other problems which accelerate the decay process.

The fungus survives the winter on diseased tomato vines, in the soil and in seeds. It also can become established on foliage infected by other pathogens late in the season. Spores are spread by splashing water and rain and infections are typical during times of warm weather in the '80s. Both green and ripe tomatoes can become infected, yet symptoms may not develop until after ripening has occurred.

Early Blight

This disease was discussed above as related to foliage diseases. The fruit-infective stage commonly is associated with the stem end of the tomato. It is diagnosed by recognition of a series of concentric rings that give a distinguishing appearance to the lesion. Like anthracnose, the fruit can become infected at any stage of development, however, symptoms may not be noticeable until fruit ripening. While the disease is primarily found on tomato, other common vegetable crops like potato, pepper and eggplant can also serve as hosts.

Control of Fruit Diseases

Control measures for fruit diseases follow those outlined for diseases of foliage. The primary aim is to remove all infected debris from the garden because this is the source of initial infection. In addition with fruit diseases, it is helpful to harvest at frequent intervals and pick all ripe fruit at each harvest so that the disease does not build up.

Non-infectious Disorders of Tomato Fruit

Blossom-end Rot

Blossom-end rot is a very common problem on green and ripe tomatoes appearing as a sunken brown to black circular spot on the blossom end of the fruit. Although there is little actual rot associated with the disorder, secondary organisms may invade the lesion and cause complete rotting of the fruit. The disorder is often associated with rapidly developing fruit during periods of hot, dry weather.

The main cause of blossom-end rot is a calcium deficiency of the soil, that is related to fluctuations in available moisture. Despite the fact that soils may have plenty of calcium available for uptake, moisture problems aggravate the deficiency. Addition of calcium will not solve the problem. A consistent supply of moisture can reduce the problem. Mulching will also help by stabilizing the moisture supply. If excessive levels of nitrogen are applied, blossom-end rot can be more serious. Also, staking and pruning may increase the incidence of the disorder. When fruits become affected, harvest them immediately so that other fruits will have a better chance of developing normally.

Fruit Cracking

Generally, there are two types of cracking which might be found on tomato fruit. With the first, radial cracks may appear coming out from the stem and running down the sides of the fruit. A second type of crack looks like concentric rings which encircle the fruit usually on the shoulders. In both cases, cracking is associated with rapid fruit development and wide fluctuations in moisture supply to the plant. If fruit has reached the stage of ripening during dry weather, the odds of developing some cracks will increase especially if heavy rains and high temperatures prevail during the ripening stage. In addition, often the condition is associated with specific varieties, like with blossom-end rot, mulching and avoidance of heavy nitrogen applications will lessen the chance of occurrence of this disorder.

Uneven Ripening

When fruit does not ripen evenly throughout and the normal red pigment is absent from localized areas, and then a condition of blotchy ripening is indicated. This disorder may appear as yellow to gray-green patches on the fruit. When sliced open a brown discoloration may be apparent. Cultural, weather and nutritional problems may contribute to the condition. Associated with this problem are low potassium levels, cloudy periods and inadequate light intensities. Other possible contributing factors are high soil moisture, high humidity, low temperature and soil compaction as well as excessive fertilization. All of these factors may promote a nutrient imbalance, which results in abnormal pigment formation. Beyond climatic conditions, provide balanced fertility and good cultural conditions to maintain plant vigor.