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# Leaf and Fruit Diseases of Tomatoes

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Tomatoes are a common vegetable crop grown throughout Nebraska and the United States. This publication provides symptoms, disease development and management options available for common foliar and fruit diseases affecting tomatoes.

## Fungal Diseases

### Early Blight

This fungal disease is caused by the pathogen *Alternaria solani* and is observed everywhere tomatoes are grown. It starts at the bottom of the plant, infecting the oldest leaves first.

#### *Symptoms*

This disease develops on the lower leaves of the plant first and appears as brown to black circular spots 1/4 to 1/2 inch diameter with dark edges. These spots have a "target-like" appearance because the fungus grows in concentric rings as the spots enlarge (*Figure 1*). The tissue surrounding the spot may turn yellow, and spots can coalesce to form large irregular blotches. Eventually the infected leaves turn brown and defoliation occurs.

#### *Disease Development*

Spores residing in the previous season's debris in soil, on seed or other Solanaceous hosts such as potato (*Solanum tuberosum*), eggplant (*S. melongena*), horsenettle (*S. carolinese*), and black nightshade (*S. nigrum*) are transmitted to susceptible leaves by either wind, water, or splashing rain when temperatures are between 75°F and 84°F. The spores germinate and penetrate the leaf directly or enter through wounds. After initial infection, lesions can become visible in as little as two or three days. Spores are produced in the new lesion when it is approximately 1/10 of an inch in diameter.


**Figure 1. Tomato leaf with symptoms of early blight. (Photo courtesy of Sarah Browning, Extension Educator, University of Nebraska–Lincoln.)**

### Septoria Leaf Spot

This fungal leaf spot can infect a tomato at any stage of development but starts at the bottom of the plant because it infects older leaves first. It is caused by the fungus, *Septoria lycopersici*, and is a common disease of tomato.

**Figure 2. Tomato leaf with symptoms of *Septoria leaf spot*.**

*Symptoms*

Initially there are small, water-soaked circular spots that appear on the underside of older leaves. These spots are 1/16 - 1/8 inch in diameter with a dark brown margin and gray or tan centers (*Figure 2*). Maturing spots will enlarge to 1/4 inch in diameter and may coalesce. With mature spots, tiny black specks, which are the fruiting bodies of this fungus, can be seen with the aid of a hand lens. As leaves become severely infected, they become yellow in coloration, dry up, and defoliation can occur.

*Disease Development*

The spores are released from the mature fruiting bodies when temperatures range from 59°F to 80°F with the optimal temperature of 77°F. Upon release, the spores can move either by wind, water, splashing rain, or insects, and by humans during pruning and harvesting. When temperatures are optimal, spores can germinate within 48 hours when moisture is available and a new lesion can appear within five days. The tiny black specks observed in the spot can be observed within 7 to 10 days, and spores are being produced within 10 to 13 days after spore germination. The moisture required for germination can occur during the summer months when relative humidity is high for several hours.

Septoria overwinters on diseased plant debris that is incorporated into the soil. It also survives on solanaceous weeds such as seed horsenettle (*Solanum caroinense*) and black nightshade (*Solanum nigrum*). This fungus can also infect other vegetables grown in a garden such as potato and eggplant.

**Figure 3. Tomato fruit with symptoms of anthracnose. (Photo courtesy of Sarah Browning, Extension Educator University of Nebraska–Lincoln.)**

## Anthracnose

Anthracnose is caused by the fungus *Colletotrichum coccodes* and is considered the most common ripe or overripe fruit-attacking fungal pathogen.

*Symptoms*

Symptoms, which do not become apparent until the fruit begins to ripen, are initially small, circular indented spots in the skin. The lesion continues to enlarge and can increase to 1/2 inch in diameter and become more sunken (*Figure 3*). The center of the lesion becomes dark in coloration or concentric rings of dark specks can develop. The dark specks observed are the spore-producing bodies of the fungus. However, when weather conditions are moist, these black bodies will produce large numbers of cream to salmon-pink colored spores. Typically once spores are observed, the fungus has penetrated deeply into the fruit flesh and decay is occurring. Eventually spotted fruits will rot completely due to the colonization of other secondary fungi.

*Disease Development*

The fungus survives the winter on infected tomato residue, in the soil and in seeds. Spores are spread to fruit by rain splash or irrigation. When the weather is moist and temperatures are between 55°F and 95°F, spores will germinate and infect the ripening fruit.

## Late Blight

Late blight is caused by the fungus *Phytophthora infestans*, which is considered a minor disease of tomato in Nebraska; however, it can be devastating when weather is conducive for disease development.

**Figure 4. Tomato leaf with symptoms of late blight.**

**Figure 5. Tomato fruit with symptoms of late blight.**

**Figure 6. Mature tomato fruit with severe symptoms and rotting due to late blight infection.**

### *Symptoms*

This pathogen can infect all parts of the tomato plant and initially leaf symptoms are small dark, water-soaked spots. These small spots can enlarge quickly and a white mold can develop at the margins of the spot on the lower leaf surface. Enlarged spots on the leaf give the plant a frost-damaged appearance. Infected plants become completely brown with shriveled leaves and stems (*Figure 4*) within 14 days following initial symptoms when weather is very favorable for disease development. Green or ripe fruit also can become infected, initially appearing as gray-green with water-soaked spots (*Figure 5*). The fruit spots enlarge to affect half the fruit, turning the fruit dark brown with complete rot (*Figure 6*).

### *Disease Development*

Disease development is favored by moist weather with cool nights (50-55°F) and moderately warm days. When daytime temperatures are above 86°F, late blight will not develop. The pathogen overwinters in dead tomato and potato (very susceptible host) vines from the previous year. It also survives in potato seed tubers and in infected tomato plants. The spores are spread by wind and water splash.

### *Management of Fungal Diseases*

Managing and preventing fungal diseases can be successful through the use of a combination of several cultural practices.

- Good sanitation in the fall and during the growing season. Remove as much plant debris as possible, and bury the remaining residue to promote decay of the infested material. During the growing season, remove infected leaves to reduce the amount of inoculum present to cause new infections.
- Plant certified disease-free seeds and transplants, and plants with resistance.
- Rotate the position of tomatoes in the garden when possible. Avoid planting eggplant, peppers, or potato in the same garden area where tomatoes were grown the year before.
- Avoid overcrowding plants in the garden. The strategy is to promote air movement through the plants and allow the foliage to dry quicker.
- Apply water at the base of the plant to prevent water splashing and minimize movement of spores to non-infected tissue. Also try to water during the morning which will reduce the amount of time the leaves are wet. Soaker hose irrigation is the optimum way to water plants.

**Table 1. Fungicides[a] available for early blight, septoria, anthracnose and late blight.**

| *Fungicide Active Ingredient* | *Trade Name* | *Early Blight[b]* | *Septoria* | *Anthracnose* | *Late Blight* | *Commercial (C)/ Homeowner (H) Use* |
|---|---|---|---|---|---|---|
| **Azoxystrobin** | Amistar (Syngenta) | X | X | X | X | C |
| | Quadris (Syngenta) | X | X | X | X | C |
| **Bacillus subtillis** | Natria Disease Control (Bayer Advanced) | X | X | X | X | H |
| | Serenade® Garden (AgraQuest, Inc) | X | X | | X | H |
| **Chlorothalonil** | Bravo Weather Stick (Syngenta) | X | X | X | X | C |
| | Chlorothalonil 720 (Chem Nut Inc) | X | X | X | X | C |
| | Echo® 720 (Sipcam Agro USA, Inc) | X | X | X | X | C |
| | Equus® 720 SST (Makhteshim Agan of North America, Inc) | X | X | X | X | C |
| | Early May Fung-Onil Multi-purpose Fungicide (Bonide Products) | X | X | X | X | H |
| | Fertilome Broad Spec-trum Landscape and Gar-den Fungicide (Voluntary Purchasing Groups Inc) | X | X | | X | H |
| | Fruit Tree, Vegetable and Ornamental Fungicide (Lawn and Garden Products, Inc) | X | X | X | X | H |
| | Ortho® Max Garden Disease Control (The Ortho Group) | X | X | X | X | H |
| | Ridomil Gold Bravo (Syngenta) | X | X | X | X | C |
| **Copper** | Dragoon Dust with Cooper (Bonide Products Inc.) | X | X | X | X | H |
| | Cuprofix® Ultra 40 Dispress (Cerexagri-Nisso LLC) | X | X | X | X | C |
| | Earth-tone Garden Fungicide (The Espoma Co) | X | X | X | X | H |
| | Liquid Copper Fungicide Concentrate (Bonide Products Inc.) | X | X | X | X | H |
| **Copper Hydroxide** | Champ® WG (NuFarm Americas INC) | X | X | X | X | C |
| | Kocide® 2000 (DuPont) | X | X | X | X | C |

| *Fungicide Active Ingredient* | *Trade Name* | *Early Blight*[b] | *Septoria* | *Anthracnose* | *Late Blight* | *Commercial (C)/ Homeowner (H) Use* |
|---|---|---|---|---|---|---|
| | Nu-Cop® 3L (Micro Flo Company) | X | | | | C |
| **Cyazofamid** | Ranman® Fungicide (FMC Agricultural Products Corporation) | | | | X | C |
| **Dimethomorph** | Acrobat 50WP (BASF Chemical Company) | | | | X | C |
| | Forum® (BASF Chemical Company) | | | | X | C |
| **Famoxadone + Cymoxanil** | Tanos® (DuPont) | X | X | X | X | C |
| **Fenamidone** | Reason® 500 SC Fungicide (Bayer Crop Science) | X | X | | X | C |
| **Fluoxastrobin** | Evito™ 480 SC | X | | | X | C |
| **Hydrogen Dioxide** | OxiDate (BioSafe Systems) | X | X | X | X | C |
| **Mandipropamid + Difenoconazole** | Revus Top® (Syngenta) | X | X | X | X | C |
| **Maneb** | Maneb 80 WP Fungicide (Cerexagri) | X | X | X | X | C |
| **Mancozeb** | Dithane DF Rainshield (Dow AgroSciences) | X | X | X | X | C |
| | ManKocide® (DuPont) | X | X | X | X | C |
| | Gavel 75DF (Gowan) | X | X | | X | C |
| **Phosphorous Acid** | Rampart® Fungicide (Loveland Products, Inc) | | | X | X | C |
| **Polyoxin D Zinc Salt** | Veranda™ O (OHP) | X | | | | C |
| **Propamocarb hydrochloride** | Previcur® Flex Fungicide (Bayer Crop Science) | X | | | X | C |
| **Pyraclostrobin** | Cabrio® EG Fungicide (BASF Chemical Company) | X | X | X | X | C |
| **Pyrimethanil** | Scala™ Brand SC Fungicide (Bayer Crop Science) | X | | | | C |

[a]This list is presented for information only and no endorsement is intended for products listed nor criticism meant for products not listed. Consult the product label for specific application rates and plant growth stage. Read the label carefully before making any application.
[b]Product is labeled to manage that particular tomato disease.

- Mulch around the base of the plants to prevent splashing soil and spores on leaves.
- Avoid working with plants when the foliage is wet to reduce human movement of the pathogen.
- Control Solanaceous weeds, such as black nightshade and horsenettle around the garden area.
- Fungicides can be used to manage these diseases. Refer to *Table 1* for fungicide active ingredients that can be used on tomatoes.

## Bacterial Diseases

### Bacterial Spot

Bacterial spot is caused by *Xanthamonas campestris* pv. *vesicatoria* and can infect tomato and pepper.

**Figure 7. Tomato leaf with symptoms of bacterial spot.**

**Figure 8. Tomato with symptoms of bacterial spot.**

*Symptoms*

Symptoms on the leaves and stems are small circular to irregular shaped lesions, up to 1/8 inch across (*Figure 7*). Leaf symptoms are very similar in appearance to Septoria leaf spot, however bacterial spot lesions do not develop a grayish brown center. Typically a yellow halo surrounds each spot which can coalesce causing leaves to wither and turn brown. The most common symptom observed is on the fruit. Green fruit is susceptible to infection and symptoms initially start as small water-soaked spots. As the spots age, they enlarge up to 1/8 to 1/4 inch in diameter, becoming gray-brown and scabby with sunken, pitted centers (*Figure 8*).

*Disease Development*

This pathogen overwinters on the surface of seeds, in infected tomato or pepper debris, and in the soil. It also is commonly carried on infected transplants. The bacterium is spread by water splashing. Infections are favored by warm temperatures (68-95°F), high humidity, and long dew periods.

### Bacterial Speck

Bacterial speck is caused by *Pseudomonas syrinage* pv. *tomato*. This tomato pathogen does not infect pepper, eggplant, potato, or other Solaneceous crops.

*Symptoms*

Foliar symptoms consist of small (1/16 to 1/4 inch) black spots that are slightly raised and have a yellow halo. The symptoms on the fruit are the most distinct for this bacterial infection. Fruit infections occur on young green fruit and are slightly raised, 1/32 to 1/16 inch in diameter, and have well-defined margins (*Figure 9*). The raised

**Figure 9. Tomato with symptoms of bacterial speck on the leaves and green fruit. (Image courtesy of Ken Pernezny, University of Florida – IFAS Extension.)**

lesions are typically numerous on the fruit but are very superficial and can be scraped off with a fingernail.

### *Disease Development*

The bacterial speck pathogen overwinters in seed, in plant debris, in soil, and on other weedy hosts. Infection is favored by temperatures of 55°F to 75°F, dew, and high humidity. Major outbreaks often follow rainstorms that cause injury to leaves and splash infested soil onto the leaves.

### *Management of Bacterial Diseases*

Managing and preventing bacterial diseases can be successful through the use of cultural practices.

- Good sanitation in the fall and during the growing season. Try to remove as much plant debris as possible and bury the remaining residue to promote decay of infested material. During the growing season, remove infected leaves to reduce the amount of inoculum that can cause new infections.
- Rotate the position of tomatoes in the garden when possible. Avoid planting pepper in the same area where tomatoes were grown the year before.
- Avoid overcrowding plants in the garden. The strategy is to promote air movement through the plants and allow the foliage to dry quicker.
- Water at the base of the plant to prevent water splashing to move bacterial cells to noninfected tissue. Also try to water during the morning which will reduce the amount of time the leaves are wet. Soaker hose irrigation is the optimum way to water plants.
- Purchase certified disease-free seeds and transplants.

## Viral Diseases

### Tomato Spotted Wilt Virus

Tomato spotted wilt virus (TSWV) is the most common viral disease of tomato in Nebraska. This virus is transmitted primarily by four thrip species including western flower thrips (*Frankliniella occidentalis*), tobacco thrips (*F. fusca*), blossom thrips (*F. schultzei*), and onion thrips (*Thrips. tabaci*).

**Figure 10. Tomato spotted wilt virus causing yellow/orange ringspots on mature fruit.**

### *Symptoms*

Symptoms vary widely due to varying cultivar reaction and the age of the plants when infection occurs. Young leaves may have a bronze appearance and can later develop numerous small, dark spots. The growing tips are severely affected by necrosis and stunted growth, which may be confused with growth regulator herbicide injury. The most characteristic symptom is on the tomato fruit: green fruit have mottled, light green rings with raised centers, and mature fruit have distinctive yellow and/or orange ringspots (*Figure 10*).

### *Disease Development*

TSWV can be transmitted by seed, but thrips are largely responsible for the movement of this pathogen from infected hosts. Thrips acquire the virus only during the larval stage of development. This virus also has been reported to infect 174 different plant species including potato, pepper, eggplant, pea, chrysanthemum, zinnia, impatiens, bindweed, lambsquarter, and several others. Thrips are able to feed on other hosts to acquire the virus and then transmit it to tomatoes in the area.

### Tobacco Mosaic Virus

Tobacco mosaic virus (TMV) is a virus that is distributed worldwide. This virus is seedborne, however it is transmitted very efficiently by humans. Unlike tomato spotted wilt virus, this virus is not spread by insects.

*Symptoms*

Plants infected by tobacco mosaic virus have leaves that are mottled with light and dark green and occasionally have a fern-like appearance with the leaf edges turned down. Overall the plants are stunted and are not vigorous. Typically fruits do not show symptoms except for the reduction in fruit size and uneven ripening. Occasionally fruits may develop internal browning or "brownwall." This symptom is observed in mature but unripened fruit and usually involves the fleshy sidewalls. This symptom has been attributed to a "shock reaction" of the plant to the viral infection.

*Management of Viral Diseases*

- Remove infected plants to prevent further spread of the disease.
- Control weedy hosts such as bindweed and lambsquarter.
- Separating vegetables from flower beds may reduce the potential of infection but will not eliminate the problem completely.
- Plant virus resistant tomatoes.
- In a greenhouse setting, monitor for thrips and when populations become significant, using insecticides may be beneficial.
- Tobacco products can be carriers of the virus. Thus tobacco users should wash their hands with soap and water before handling plants to prevent accidentally introducing the virus.

**This publication has been peer reviewed.**