

VEGETABLE DISEASES IN GREENHOUSES

April 4, 2013

Dan Egel & Shubin K. Saha - Over the last several years, an increasing number of growers have built greenhouses to facilitate the early production of vegetables. (By definition, a greenhouse is heated, whereas a high tunnel is not. This article will use the term greenhouse. However, the disease management issues are similar for both types of structures.) By far, the most common crop in greenhouses is tomatoes.

The diseases common in field-produced tomatoes differ from diseases of greenhouse grown tomatoes. Tomatoes grown in a greenhouse are often exposed to higher relative humidity than field grown tomatoes. High humidity in greenhouses is due to the covering over greenhouses that tends to keep moisture inside the greenhouse. Also, greenhouse tomatoes are often grown closer together than field grown tomatoes, decreasing airflow and increasing humidity. Finally, tomatoes grown in greenhouses to maturity are often not rotated with another crop, increasing disease pressure. (Tomatoes grown in the greenhouse are most often grown in the soil; tomatoes that are grown in containers in the greenhouse do not have the same crop rotation requirements.) This article will discuss common tomato diseases of the greenhouse and management recommendations.

Botrytis gray mold is favored by cool conditions. Lesions on leaves often start as small water soaked areas. Under drier conditions, the lesions turn a light brown. Lesions often are wedge shaped with the wide edge on the leaf margin (see Figure 1). The growth of the causal fungus is easily visible with a 10X hand lens. Similar lesions may be observed on stems and fruit. Gray mold affects many other crops such as several flowers/ornamentals, lettuce, pepper and snap beans. Since gray mold is often associated with injury to tissue, practices that cause wounding of plants should be avoided. Temperatures above 75 F decrease disease severity. Although high humidity for extended periods is not necessary for gray mold, any practice that lowers relative humidity tends to lower disease severity of gray mold and many other diseases (see suggestions at the end of the article.) Adding lime to soils to increase the calcium content of tomato plants helps to reduce the susceptibility of tomato plants to gray mold.

Leaf mold causes bright yellow lesions on the top of tomato leaves (see Figure 2). On the underside of leaves, the fungus that causes leaf mold can clearly be seen as olive-green 'fuzz'. The spores blow around the greenhouse easily; spore germination is favored by high humidity. The optimum temperatures for disease are between 72 and 75 F. It is possible to find tomato varieties that are listed as partially resistant to leaf mold. However, the fungus that causes leaf mold is extremely variable and host resistance is often overcome. Management options should include measures to reduce humidity/increase airflow and sanitation.



Figure 1: The symptoms of Botrytis gray mold include a wedge shaped lesion on tomato leaves. The gray sporulation of the fungus along the margin of the lesion is visible in this photograph. (Photo by Dan Egel)



Figure 2: Leaf mold of tomato causes bright yellow lesions on the top of leaves (shown here). The underside of such lesions often has an olive colored fungal growth visible (not shown). (Photo by Dan Egel)

White mold (also known as timber rot) causes woody looking lesions on the stems that can girdle and kill the tomato plant. The white growth of the causal fungus can often be found on the diseased tissue as well as the dark, irregularly shaped fungal structures (sclerotia) (see Figure 3). Sclerotia may be found on the outside or inside the stem and are overwintering structures for the fungus. In the spring, sclerotia germinate to form very small mushrooms. Spores from these mushrooms can infect a wide host range of plants. White mold is favored by cool temperatures (from 59 to 70 F). High humidity and moist conditions contribute to the disease. Crop rotations of tomato after tomato seem to favor the disease, however, the causal fungus has a large host range so crop rotation may not be sufficient to control the disease.



Figure 3: The wood-like area of the stem shown here is typical of white mold (timber rot) of tomato. The dark, irregular shaped fungal bodies shown here are diagnostic for the disease and function as overwintering structures. (Photo by Dan Egel)

General management methods for greenhouse diseases

Crop rotation - A good crop rotation of 3 to 4 years out of tomato or a related solanaceous crop will help to control most tomato diseases. However, many vegetable growers who operate out of greenhouses find that it is not practical to rotate away from tomatoes. In such cases, I recommend that the grower take as much of the tomato plant as possible out of the greenhouse and away from all potential production areas as soon as the crop is finished in the late summer or fall. I also recommend a landscape cloth be used between the plastic mulch on each row. The landscape cloth will help to prevent crop residue that might contain plant disease microbes from entering the soil. Landscape cloth is also easily cleaned up, facilitating sanitation. The landscape cloth would be changed or cleaned between seasons. Further, the landscape fabric almost entirely eliminates weed problems in the greenhouse in addition to reflecting light into the canopy to maximize solar radiation.

Greenhouse ventilation - In general, any practice that reduces relative humidity and moisture in a greenhouse will reduce disease severity of many tomato diseases. These practices may help to ventilate and thus reduce disease severity.

- Ventilate the greenhouse at dusk so that the drier air from outside may replace humid air inside the greenhouse.
- In high tunnels where heating is passive, it becomes important to close the vents before dusk to allow some heat to build up before temperatures start to drop. This allows the trapping of heat to avoid cold damage overnight. Note, this is how to approach ventilation when cool temperature damage is a concern. However, once cool temperatures are no longer a concern, one can manage the ventilation the same way as you would for a greenhouse.
- Avoid the temptation to crowd as many tomato plants as possible into the greenhouse. Spacing of plants can vary depending on your situation, but a good starting point would be rows spaced 4-5 ft apart and 24 inches between plants within the row.
- Prune tomato plants to facilitate airflow. Lower leaves may be pruned periodically without reducing yields. This is especially true with indeterminate tomato varieties.

- Avoid pruning too much material at any one time. As a general rule indeterminate tomatoes should be left with at least twenty fully mature leaves after any pruning.
- To further facilitate reduction of humidity and leaf wetness, in greenhouses it is important to utilize appropriate air circulation fans. The placement and number of fans will be dependent on the size volume of air within the structure.

Fungicides - The use of fungicides can help to reduce the severity of tomato diseases in the greenhouse. However, fungicides will not substitute for good management practices. The Midwest Vegetable Production Guide for Commercial Growers (ID-56) can help with fungicide recommendations. See page 119 for the start of the tomato disease section and see page 41 to see which fungicides can be used in the greenhouse. As always, read and follow the label carefully.

While greenhouse conditions may favor certain vegetable diseases, such as the ones discussed above, greenhouse conditions may also slow the spread of several diseases since there is no rain on greenhouse tomatoes to splash spores and bacteria from plant to plant. For example, the fungal disease early blight and the disease bacterial spot may occur under greenhouse conditions, but are likely to be limited due to the lack of rain that is necessary for disease spread.

The list of diseases given here is not exhaustive. Many more diseases may occur in Indiana greenhouses. This article includes the top three diseases of greenhouses that I have observed over the last several years. If you have disease questions, please contact Dan Egel.