

TOMATO DISEASES: IDENTIFICATION AND MANAGEMENT

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Managing diseases is critical to successful tomato production because diseases, unfortunately, are a common occurrence wherever tomatoes are grown. All plantings are at risk, even those grown under protection (greenhouses and high tunnels) and in small home gardens. An important aspect of effective management is accurate and early identification to ensure control practices used are appropriate. A key for diagnosing tomato diseases is on-line at: <http://vegetablemdonline.ppath.cornell.edu/DiagnosticKeys/TomKey.html>. Many more disease images posted on the web can be found by launching Google Image Search (click on 'Images' in the upper left corner of the Google page) and then entering 'tomato' and a disease name in the search box. Mine are at <http://www.longislandhort.cornell.edu/vegpath/photos/index.htm>.

Septoria leaf spot is probably the most common foliar disease of field-grown tomatoes in the northeast. Bacterial speck, early blight and bacterial canker are also common. Protected tomatoes are most commonly affected by leaf mold and gray mold, which occur rarely in the field. Powdery mildew and white mold occur in both production systems. As does late blight which has been occurring more frequently. There are several other diseases that generally occur less frequently and have less impact.

Some pathogens causing foliar diseases infect fruit as well; others indirectly affect yield by causing defoliation, which exposes fruit to sunburn, reducing fruit quality (including taste), and reducing fruit production.

Symptoms and key aspects of diseases occurring in the northeast are described below followed by an integrated management program.

Bacterial speck, bacterial spot, and bacterial canker. Symptoms include small black spots on leaves sometimes with a yellow halo. Young affected leaves can be distorted. Leaf edges can be brown, sometimes with a yellow inner margin, especially with canker. Dark spots form on stems and petioles. Small black spots also develop on fruit affected by speck or spot; spots due to canker are raised, white with brown center.

Botrytis gray mold. Gray fuzzy fungal growth developing on affected leaves, stems, dying flowers and fruit is diagnostic. The pathogen usually needs to first become established on dead or wounded tissue. Occurs in the greenhouse on transplants and established plants as well as in the field.

Early blight. Dark brown spots appear first on oldest leaves. They begin as small spots that develop a characteristic target-shape as they enlarge. Note that susceptibility is related to maturity, thus early maturing varieties are affected first.

Late blight. Leaf spots begin as small, olive green to brown, water-soaked spots that rapidly enlarge, become darker, and develop a characteristic whitish fuzzy fungal growth especially on the lower leaf surface under moist conditions. Large, dark brown areas form on stems and fruit. Affected tissue can die rapidly when fungicides are not applied. Late blight occurs very sporadically but has been more common in recent years.

Leaf mold. Pale yellowish spots develop on upper leaf surfaces opposite the characteristic gray fuzzy fungal growth on the lower surface.

Powdery mildew. White powdery spots develop on both leaf surfaces. Low leaves inside the canopy often are affected first.

Septoria leaf spot. Symptoms resemble those of initial early blight, but spots remain small and develop a tan center with very tiny black pimple-like structures containing spores. Dark spots also form on stems and petioles.

Tomato spotted wilt (TSWV) and other viruses. Typical foliar symptoms caused by most viruses include various shades of green in a mosaic pattern and distorted leaves (e.g. shoestring appearance). These are very different from symptoms caused by fungi and bacteria. An exception is TSWV, which causes die-back of growing tips, brown lesions on stems and brown discoloration on leaves and fruit. Diseases caused by viruses are difficult to manage. Fortunately they rarely are sufficiently severe in the northeast to be of economic concern with the exception of TSWV when transplants become infected due to being produced in a greenhouse with infected ornamental plants.

White mold. Stem lesions start at leaf axils or stem joints as water-soaked areas. Affected tissue becomes light gray (bleached appearance), develops cottony growth under moist conditions, and eventually the characteristic black, hard fungal sclerotia form in or on the stem. Large areas of the stem usually are affected causing the distal portion to wilt.

Integrated Management Program for Tomato Diseases:

Select resistant varieties. See <http://vegetablemdonline.ppath.cornell.edu/Tables/TableList.htm> for tables of varieties with resistance.

Use seed that has been treated and tested for pathogens. Treatments for seed-borne pathogens include hot water, which is best for pathogens inside seeds but it can impact germination, hydrochloric acid, and sodium hypochlorite. Fungicides are then applied to seed for seed decay. Bacterial diseases, early blight and Septoria leaf spot.

Clean and sanitize greenhouses and planting materials, also trellising stakes. Avoid bringing soil into greenhouse.

Inspect transplants for symptoms. Purchase certified transplants. Do not plant seedlings with symptoms. An entire tray with even a few symptomatic seedlings should be discarded because the pathogen likely has been spread, possibly also to adjacent trays, especially with bacterial diseases. Seedlings can be infected but not develop symptoms until in the field.

Rotate land to control diseases caused by pathogens that can survive in soil on infested crop debris, which include bacterial diseases, early blight, Septoria leaf spot. Very long rotation is needed for white mold and wilt diseases caused by *Fusarium* and *Verticillium*.

Sign up for late blight alerts at <http://usablight.org/> and monitor the map there to be aware of current occurrences.

Mulch and trellise to physically and spatially separate foliage from pathogens in soil.

Minimize leaf wetness. Select a site with good air movement and use drip irrigation or overhead irrigate when leaves are dry to start and will have time to dry before evening dew period to manage most foliar diseases caused by fungal and bacterial pathogens.

Reduce humidity in protected crops (greenhouses and high tunnels) with fans and vents, spacing plants (5-ft row spacing recommended), and pruning lower leaves.

Physically separate successive plantings.

Manage volunteer tomatoes, solanaceous weeds and other weeds susceptible to tomato diseases.

Avoid moving infested soil into clean fields. Work last in fields where pathogens occur that survive in soil, then clean equipment before working in fields where these diseases haven't occurred (see list under rotate above).

Do not handle wet plants. Routinely clean hands and disinfect tools contacting plant sap.

Inspect plants weekly for symptoms. Begin shortly after transplanting because some diseases, notably late blight, have demonstrated ability to appear very early in the season. Some diseases often begin when plants are stressed by fruit production. Include leaves that are low and buried in the canopy where conditions are most favorable for several diseases. Early in the day when humidity is high is the best time to look because fungal growth characteristic of some diseases is more likely to be present. Maintain records of disease occurrence and management practices.

Destroy infested crop debris after harvest and incorporate deeply into soil to hasten decomposition for pathogens that can survive on debris in soil. Bacterial diseases, early blight, and Septoria leaf spot.

Apply fungicides and bactericides preventively or beginning at disease onset. Do not wait until a disease is well established to start treatments. Use TOM-CAST to determine when to apply fungicides for early blight. A complete list of fungicides labeled for use on tomatoes is online at <http://vegetablemdonline.ppath.cornell.edu>. Do not spray when plants are wet or use an airblast sprayer for bacterial diseases to avoid moving pathogens.

General fungicide program for field-grown tomatoes (always alternate among products with different FRAC codes when available to manage resistance):

During transplant production: streptomycin for bacterial diseases, Decree for Botrytis gray mold, copper for bacterial and fungal diseases, and Ridomil Gold, Previcur Flex and microbials (ex. Mycostop) for damping-off.

Contans for white mold before or at planting. Treatment in the fall and again in the spring may improve control.

Protectant conventional fungicides (copper, chlorothalonil, mancozeb, ziram) before disease observed and afterwards combined with selective, mobile fungicides. Alternate with Actigard for bacterial speck and spot.

Mobile fungicides for specific diseases (alternation recommended to manage resistance):

Anthracoze: QoIs*, Catamaran, Inspire Super, Revus Top, Tanos.

Botrytis gray mold: Endura, Scala + protectant, Cabrio (suppresses), Switch.

Early blight: Endura, Gavel, Reason, Previcur Flex, Scala, Switch, Inspire Super, Tanos, QoIs*. Pathogen strains resistant to QoI fungicides have been detected in a few locations in the US.

Late blight: Curzate, Tanos, Ranman, Reason, Revus and Revus Top, Previcur Flex, Gavel, and Forum. These need to be tank-mixed with a protectant fungicide, except for Gavel which contains mancozeb. Ridomil Gold Bravo is recommended when only a sensitive pathogen strain is present (eg US-22 and US-23). Note that applying chlorothalonil weekly starting before disease onset has provided good control in fungicide efficacy experiments.

Powdery mildew: Rally.

Septoria leaf spot: QoIs*, Gavel, Inspire Super, Reason, Revus Top, Tanos.

Leaf mold: Gavel, Quadris Top, Inspire Super, Revus Top, Tanos.

*QoI fungicides (FRAC Group 11): Quadris, Quadris Top, Cabrio, Flint

Switch and Reason not labeled for use on Long Island.

Organic fungicides registered for use on tomato in NYS (some are labeled broadly for several diseases): copper (inc. Badge, Champ, Nordox, Nu-Cop), sulfur (inc. Kumulus, Microthiol Disperss), Actinovate, Contans, JMS Stylet-oil, Kaligreen, MilStopMycostop, Organocide, PlantShield, Regalia, Serenade, SerenadeSoil, Sonata, SoilGard,

See <http://www.nysaes.cals.cornell.edu/recommends/27frameset.html> for more information on tomato diseases and their management.

Please Note: The specific directions on fungicide labels must be adhered to -- they supersede these recommendations, if there is a conflict. Check labels for local use restrictions (eg Reason cannot be used on LI). Any reference to commercial products, trade or brand names is for information only; no endorsement is intended.