

WHAT'S NEW IN MANAGING TOMATO DISEASES

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Effectively managing the many diseases that plaque tomatoes is essential to obtain a good crop. Achieving this necessitates knowing about new management tools and changes in disease occurrence.

Early Blight. Pathogens affecting tomato and potato have proven more adept at developing resistance than was initially expected. Resistance to QoI (FRAC Code 11) fungicides has been detected in the tomato pathogen, *Alternaria linariae* (pka *A. tomatophila*). More research has been conducted with *A. solani* causing early blight in potato. Resistance has developed to three chemical classes of fungicides in the USA. Resistance to QoI (FRAC 11) fungicides was detected in 2001, after 2.5 growing seasons of commercial use. Resistance to boscalid, the first SDHI (FRAC 7) fungicide, was detected in 2009, the fifth year of use. Resistance to the AP (FRAC 9) fungicide pyrimethanil, an active ingredient in Scala and Luna Tranquility*, was detected in ID in 2010, which was five years after first registration. Isolates resistant to multiple fungicides did not exhibit significant fitness penalties compared to sensitive isolates in laboratory studies, therefore they are expected to be able to compete and persist in the pathogen population when these fungicides are not used. Isolates with one of the SDHI resistance mutations were more aggressive than sensitive isolates. A recent survey revealed that multi-fungicide resistant isolates are common: over 95% of isolates examined from several states in the west had mutations conferring SDHI resistance and most also had mutations for QoI resistance. Loss in sensitivity to DMI (FRAC 3) fungicides was documented in 2010-2012, but *A. solani* isolates examined more recently (2013-2015) were fully sensitive.

In tomato crops it is critical to use a good resistance management program, select resistant variety when feasible, start applying fungicides preventively or at first symptom, alternate among fungicides in different chemical groups as indicated by FRAC Code, monitor disease occurrence, and report poor control despite good fungicide program to extension specialist during the season so isolates can be collected for testing. Also use long crop rotation. Pathogen surviving in crop debris is an important source of inoculum and can be a source of resistance if the field has a long history of use of targeted fungicides for early blight. Minimize use of QoI (FRAC 11) fungicides: Cabrio, Flint, Priaxor*, Quadris, Reason*, Tanos, Topguard*, etc. Other labeled fungicides include: Rhyme* (FRAC 3), Aprovia Top (3 + 7), Inspire Super (3 + 9), Scala (9), Luna Tranquility* (7 + 9), Miravis Prime* (7 + 12), Switch (9 + 12), and Previcur Flex (28). Alternate among products based on FRAC code and tank-mix with chlorothalonil or another protectant fungicide. Most can be applied at most twice sequentially.

Late Blight. While there were few occurrences of late blight last season in the U.S., despite conditions being favorable (frequent rain) in several areas, there were noteworthy occurrences. A new genotype (US-25) was detected in upstate NY. It is especially noteworthy because US-25 is mating type A2 whereas US-23, the dominant strain in the Northeast for the past 6 years, is mating type A1. This is important because if these two genotypes occur together, the pathogen could produce a specialized spore (oospore) that enables the pathogen to survive in soil without living plant tissue and oospores form as a result of sexual reproduction, thus they are an important way to increase genetic diversity. Infested tubers is how the pathogen normally survives. Also US-25 is insensitive to mefenoxam, whereas US-23 is sensitive and so can be managed effectively with Ridomil fungicides. US-25 was found on tomato but determined to also be able to infect potato.

Late blight caused by genotype US-23 was found 7 Oct on Long Island. This first occurrence in an area is noteworthy for its extreme lateness, especially considering it was an atypically wet season there which should have provided favorable conditions for late blight to develop much earlier. The source of inoculum for this outbreak and the one in 2017, which started in late Aug to early Sep, was not determined. Since 2009 first observations on Long Island have typically been in June. No late blight was found in 2015 or 2016. Unexpected occurrences serve as a reminder to remain vigilant about late blight through the end of the season even when there are no reported occurrences anywhere nearby.

Information about late blight is available at <http://www.usablight.org/> and <http://blogs.cornell.edu/livegpath/extension/tomato-late-blight/>.

Powdery Mildew. This disease is common in high tunnels and greenhouses, but also occurs outdoors. It has been occurring sporadically but more frequently. Recent increase in high tunnel production at least partly accounts for increased importance of powdery mildew in the Northeast. Symptoms are the typical powdery white spots characteristic of this type of disease. They usually appear first on lower leaves inside the plant canopy. Left unmanaged, powdery mildew can quickly kill affected leaves. See images at: <http://blogs.cornell.edu/livegpath/gallery/tomato/powdery-mildew-on-tomatoes/>.

When purchasing seedlings, ask producer about powdery mildew management program being used and inspect plants thoroughly when received. Rejecting affected plants is worth considering because of the cost of needing to start a weekly fungicide program so early in crop production.

Fungicides with targeted activity that move through leaves are needed to effectively manage powdery mildew because of the challenge of getting spray material to the leaf underside. It is important to examine the underside of leaves when inspecting a crop that has been treated with a broad-spectrum protectant fungicide like chlorothalonil to determine if powdery mildew is present. Sulfur can provide some control on the underside of leaves due to its volatility enabling it to redistribute to the underside of leaves. For field-grown crops choose fungicides with FRAC Code U6, U8, 3, 7, and/or 11 active ingredient(s). Alternate among products in different FRAC Groups to manage resistance and to ensure effective control. Torino (FRAC U6), Vivando (U8) and FRAC 3 products

like Rally are only effective for powdery mildew. Products with 2 active ingredients that have activity for other diseases include Aprovia Top (FRAC 3 + 7), Luna Tranquility* (7 + 9), Quadris Top and Topguard* (3 + 11), Inspire Super (3 + 9), Priaxor* (7 + 11), and Miravis Prime* (7 + 12). Revus Top (3 + 40) is a good choice when late blight is also present. Drop nozzles will improve coverage in trellised tomatoes and thus improve control especially with protectant fungicides. Fungicides listed above that can be used in high tunnels and greenhouses are Inspire Super**, Luna Tranquility*, Switch* (not on cherry, grape, or other small fruit types), Torino**, and Vivando** (**no statement on label prohibiting which other product labels have). Additionally, Trionic (FRAC 3) is only for use in commercial greenhouse crops and on transplants. Fungicide program suggested for organic high tunnel and greenhouse tomatoes is a micronized sulfur like Microthiol Dispers until first fruit are nearing maturity, a non-oil product for 2 wks to avoid sulfur toxicity, and then a mineral or botanical oil during harvest period so visible residue will be minimal on harvested fruit.

New Fungicides.

Miravis Prime*. pydiflumetofen (FRAC 7) + fludioxonil (FRAC 12). 12 hr REI. 0 d PHI. Labeled diseases include early blight, leaf mold, powdery mildew, Septoria leaf spot and gray mold (suppression only). Not permitted used on greenhouse crops. Accumulates in the wax layer of leaves and then translocates through them. Apply up to 2 times. Use in alternation with fungicides in different FRAC group. *Not permitted used on Long Island.

Some Results from Recent Fungicide Evaluations.

Early blight and Septoria leaf spot. Excellent control of EB and good control of SLS were achieved with Bravo Weather Stik alternated with Fontelis or with Miravis Prime at low or high label rates. Among organic treatments tested, Stargus + Badge were effective for both whereas Stargus applied alone or with Regalia was ineffective; Badge was not tested alone. In another trial with just SLS, similar results were obtained with Bravo alternated with Miravis Prime or Luna Sensation or Aprovia Top, but alternating with Fontelis was not as effective. Aprovia Top, Fontelis, Luna Sensation, and Miravis Prime all have an SDHI (FRAC 7) fungicide. Control was reduced when Serenade was applied for 2 of 4 Bravo applications. Trials done in OH in 2018. In a trial conducted in PA in 2018, EB was also well controlled with Miravis Prime alternated with Bravo, better than Bravo alt Quadris + Bravo, which was similar to LifeGard, Double Nickel, or Champ alt Quadris + Bravo.

New Disease Resistant Varieties. An important component of a successful, integrated management program is resistant varieties. Some new round red tomato varieties and some of the important diseases in the Northeast that they are resistant to are: Mountain Gem (late blight, TSWV), Mountain Rouge (late blight), Mountain Vineyard (Fusarium wilt race 3, TSWV), Roadster (TSWV), and Resolute (TSWV, nematode). Edox is a leaf mold-resistant truss cherry for whole cluster harvest. Goal of the Cornell tomato breeding program is developing varieties with resistance or tolerance to early blight, late blight, Septoria leaf spot, bacterial speck, bacterial spot, and TSWV plus general resistance to insects. Varieties released recently with resistance/tolerance to early blight, late blight,

and Septoria leaf spot include Brandywise (cross with Brandywine; organic) and Summer Sweetheart (heart-shaped large saladette; organic). Plum Perfect has resistance to late blight, Verticillium wilt, Fusarium wilt, and rootknot nematode.

Scientific Advancements for Developing Disease Resistant Varieties. Ability now to sequence DNA of plants and pathogens inexpensively and the CRISPR/Cas9 genome (gene) editing technology have enabled scientists to discover the molecular basis of plant-pathogen interactions, to find new genes for resistance, and to engineer plants to make new resistant varieties. Genome editing technology allows knowledge-based alterations to a plant genome such as to precisely knock out (silence) gene(s) responsible for susceptibility or to insert a gene for resistance from a related plant.

Grafting and Anaerobic Soil Disinfestation for Managing Soilborne Diseases in High Tunnel Tomatoes.

Over successive years of producing tomatoes in high tunnels, common due to it being the most popular and economic crop for this system, pathogens that survive in soil can increase to a level impacting yield. Grafting tomatoes to a resistant rootstock such as Maxifort has proven effective for root-infecting pathogens. Recent on farm studies in Ohio documented that anaerobic soil disinfestation is another viable option. First soil is amended with a carbon source such as wheat bran or molasses (both can be purchased at feed mills) at 4.5-9 tons/A (0.2065-0.413 lb/sq ft). Dilute molasses 1:3 to 1:4 with water. A watering can is suitable for applying the molasses solution. Green cover crop is also a suitable carbon source. Incorporate the carbon source to a depth of 6 to 8 inches with a rototiller. Beds can be formed after the carbon amendment is worked into the soil. Next irrigate to saturate soil to the depth of incorporation and until water ponds on the surface, which will take at least 4 hours depending on soil type. The last step is covering treated area with a heavy grade black or clear plastic mulch promptly after irrigation, and burying edges well with soil to prevent air exchange. Leave for 3-5 weeks. Beneficial soil microbes will break down the added carbon source, deplete oxygen in the soil and produce toxic byproducts that kill soilborne pathogens and a strong odor. Weed seeds are also killed. Treatment efficacy increases with increasing soil temperature and tarping duration. Three weeks can be enough time when soil temperature stays above 85 F. Afterwards remove the plastic and let soil dry and breath for at least 5 days before planting. Survey of OH farms revealed black dot root rot was present at most. Corky root rot, Verticillium wilt, and root knot nematodes were also found.

* Fungicide not permitted used on Long Island, New York.

Please Note: The specific directions on fungicide labels must be adhered to -- they supersede these recommendations, if there is a conflict. Before purchase, make sure product is registered in your state. Any reference to commercial products, trade or brand names is for information only; no endorsement is intended.

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