



**Vegetable Disease Update – Amanda J. Gevens, Assistant Professor & Extension Vegetable Plant Pathologist, UW-Madison, Dept. of Plant Pathology, 608-890-3072 (office), Email: [gevens@wisc.edu](mailto:gevens@wisc.edu).**

**Vegetable Pathology Webpage: <http://www.plantpath.wisc.edu/wivegdis/>**

**Late blight update:** We reported late blight in Wisconsin potato fields last week in Barron, Adams, and Portage Counties. There was an additional report out of Oneida County over the weekend. The genotype of the Barron and Adams County late blight samples was US-23 based on allozymes analysis. My lab will continue to work on further samples and we will report in this newsletter.

It is critical that potato fields are intensively scouted and are receiving protective fungicides on a 7-day schedule at this time. Fields that have received or are scheduled to soon receive vine kill treatments should continue to be protected with appropriate fungicides. Fields should not be harvested 2-3 weeks after vine kill.

***Why apply fungicides to apparently dead plant foliage?*** Depending upon the health of the crop at application, some time may be needed for vines to die after desiccant application. Even when vines appear to be dead, the lower stems of potato plants may remain green and succulent and can provide host to the late blight pathogen. Sporulating lower stems can lead to a wash down of spores from lower plant to tubers in the hill, causing direct infection. Tubers are also at risk if aerial spores make their way to the vine-killed field and are ‘washed out’ in rain.

In order to help better understand the epidemic at hand, please submit samples to my lab or work through your county agent and request that they send to me for genotyping. All we need to know is the county of sample origin, we do not need to have specific field or grower information associated with the sample. Identification of genotype at the county level would be very helpful in improving our understanding of this epidemic and potential future risks. Lab address is: Amanda Gevens, 1630 Linden Dr, Room 689, Plant Pathology Dept., University of Wisconsin, Madison, WI 53706. Please send infected leaves in a slightly inflated ziplock bag with no paper towel. Overnight shipping is best.

Further information on late blight and its management can be found in the Vegetable Crop Updates newsletters archived at the University of Wisconsin Vegetable Pathology Website. Also, fact sheets on late blight are available under the “Late Blight” tab at the website.

## Managing Late Blight in Tomatoes

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**Introduction:** Late blight is a potentially destructive disease of tomatoes (and potatoes) caused by the fungal-like organism, *Phytophthora infestans*. This pathogen is referred to as a ‘water mold’ since it thrives under wet conditions. Symptoms of tomato late blight include leaf lesions beginning as pale green or olive green areas that quickly enlarge to become brown-black, water-soaked, and oily in appearance. Lesions on leaves can also produce pathogen sporulation which looks like white-gray fuzzy growth. Stems can also exhibit dark brown to black lesions with sporulation. Fruit symptoms begin small, but quickly develop into golden to chocolate brown firm lesions or spots that can appear sunken with distinct rings within them; the pathogen can also sporulate on tomato fruit giving the appearance of white, fuzzy growth. The time from first infection to lesion development and sporulation can be as fast as 7 days, depending upon the weather. In Wisconsin, late blight has been reported in each of recent years since 2009, after having an approximately 7 year period (2002-2009) without detection. We know that the predominant clonal lineage (strain or genotype) of *Phytophthora infestans* that we have in WI this season is US-23 and can be aggressive on tomato and potato. Based on the biology of the pathogen, we know that this A1 mating type late blight strain cannot produce persistent overwintering spores in the soil without pairing with a strain of the opposite (A2) mating type. However, the pathogen can overwinter on infected plant material that is kept alive through the winter. Such plant materials can include late blight infected tomato plants kept warm in a compost pile and late blight infected potato tubers that remain in the soil after harvest or are stored in a warm place. For this reason, do not compost late blight infected tomatoes or potatoes, get seed potatoes from a certified clean source, and control volunteer tomato and potato plants in your 2013 planting. Although the late blight pathogen has the potential to infect other plants in the Solanaceae family (tomato, potato, pepper, eggplant, nightshade weeds), we have seen late blight on just tomatoes and potatoes in recent years.



**Symptoms of tomato late blight on foliage and fruit.** A. Brown, water-soaked lesion on surface of leaf. B. Brown lesion with white pathogen sporulation on leaf underside. C. Brown and sporulating lesion on stem. D. Entire row of plum tomatoes with dead foliage. E. Brown, firm, lesions on ‘Roma’ tomato fruit. F. Sporulating lesion on shoulders of a ripening fruit.

**Management:** Every effort should be made to avoid introducing late blight into the production field. This includes getting potato seed from certified clean sources and purchasing only healthy-appearing tomato transplants (or raising your own transplants from seed). There are tomato varieties with varying levels of resistance to late blight. A list of tomato varieties with documented late blight resistance is included at the end of this document. Once late blight has been identified in a region, it is critical that tomato plants be protected prior to first infection. Although there are several fungicides registered for control of tomato late, there are considerations to be made for your specific production system.

**For organic production,** coppers are most effective if applied before initial infection and applied repeatedly. Copper products must be present on new foliage in order to have a protective, disease-slowng effect, so repeat sprays are necessary. Little disease control can be had when copper applications are made only after disease onset. A recent study compared copper and non-copper containing organic-approved fungicides for late blight control on potato. Results from these replicated trials showed that the best organic-approved fungicide for potato late blight control was copper (Dorn, et al. 2007. Control of late blight in organic potato production: evaluation of copper-free preparations under field, growth chamber, and laboratory conditions. Eur. Journal of Plant Pathology 119:217-240). If you are a certified organic grower, check with your certifying agency as to what copper products you can use. From year to year, the list of OMRI-approved coppers may change.

**For conventional production,** there are many fungicides registered for managing tomato (and potato) late blight. A complete list of registered products can be found in the University of Wisconsin Extension publication entitled Commercial Vegetable Production in Wisconsin Guide A3422 (available at the UW-Extension Learning Store). For smaller operations or home gardens, the list is a bit more narrow and includes products which contain chlorothalonil and/or copper. Both products can be effective when applied in advance of initial infection and when applied repeatedly, if conditions remain favorable for disease. Be sure to follow all label instructions to ensure that the product you select is used in the safest, most effective means possible. We recently released a fact sheet which list fungicides available to the home gardener (link below).

<http://www.plantpath.wisc.edu/wivegdis/pdf/2012/Home%20Garden%20FungicidesLC.pdf>

## Frequently asked questions

### *Where did this late blight come from?*

Based on symptoms, timing of appearance of symptoms, and spread of this disease in WI, it is likely that inoculum (source of spores for late blight infection) entered the state on air that had moved into WI. The late blight pathogen produces a lot of spores on infected plants and spores can move in air up to 40 miles. Many states have experienced late blight epidemics on tomatoes and potatoes this season. Such states include: CA, CT, FL, MA, ME, NC, NH, NJ, NY, PA, VA, VT, and WI.

### *Where can I find more information on tomato late blight symptoms and management?*

<http://www.extension.org/article/18351>

<http://www.extension.org/article/18361>

<http://www.attra.org/attra-pub/lateblight.html>

<http://www.plantpath.wisc.edu/wivegdis/>

***How do I destroy and/or dispose of my late blight-infected tomato plants?***

There are several methods of destroying infected plants: 1) pull up plants by the roots, bag, leave in the sun for a few days for plant and pathogen to die, and put out for trash pickup. This method is OK for a few plants. 2) For many infected plants, plants can be cut at the base and allowed to die in place. Once plants are dead, you can go in and remove stakes, strings, and plastic and dead plant material can be incorporated into the soil. Shallow incorporation of debris is recommended to avoid creating a warm, sheltered environment which would keep the plant tissue and pathogen alive for extended periods of time beneath the soil surface. 3) Plants can be flame-killed with a propane or other torch; and 4) infected plants can be pulled and placed in a small pile covered over with a dark colored plastic tarp and left in the sun. This will create heat in the pile from the sun beating on the plastic tarp and plants will die within a few days. The winter will provide an excellent freeze kill for exposed infected plants. Do not compost late blight infected plant material, as many piles may have warm centers that can allow plant material and the pathogen to remain viable. The goal is to kill the plants and this will kill the pathogen.

***Are tomato fruits from late blight infected tomato plants safe to eat?***

Healthy-appearing fruit from late-blight-infected tomato plants are safe for human consumption. If they have been infected, but aren't yet showing symptoms, they won't keep in storage. There are some concerns about canning infected fruit because bacteria can enter late-blight infected fruit and impact quality. UW-Extension food science extension specialist, Dr. Barbara Ingham recommends avoiding canning tomatoes that exhibit late blight infection. Further information: <http://www.uwex.edu/news/2009/9/tomatoes-and-potatoes-infected-with-late-blight>.

***How fast will late blight infected tomato plants die?***

This depends upon how many points of infection the plant received, the cultivar (some cultivars are more susceptible than others), the history of use of protectant fungicides (such as copper), and on the weather. Hot, dry, sunny weather typically holds back late blight; whereas cool, rainy, overcast weather will cause late blight to progress rapidly killing the plant in 7 to 10 days.

***I have tomato late blight in my garden – will I get it next year if I plant tomatoes again?***

The strain of late blight that we have detected in WI in 2012 (US-23) cannot survive outside of living plants. It requires living plants or plant parts to remain viable and infective. Therefore, it is critical to kill infected tomato plants and plant parts such as fruit. Infected potato tubers can also serve as a source of overwintering inoculum and should be destroyed.

***Can late blight be seedborne in tomatoes?***

Generally, the late blight pathogen is not considered a seedborne pathogen in tomato.

### Late Blight Resistant Tomato Cultivars

*Information in this table was compiled from commercial seed catalogs, field observations, and a Cornell University online report by Drs. Tom Zitter and Meg McGrath.*

<b>Cultivar</b>	<b>Sources</b>	<b>Organization Claiming Resistance</b>	<b>Comments</b>	<b>Fruit Type</b>
Mountain Magic	Bejo Seeds, Seedway	North Carolina State University, Cornell University, many producers	Excellent resistance to many strains of late blight (LB) including new strain of late blight seen in WI and other US states in 2009, also has resistance to early blight, Verticillium wilt 1+2 and Fusarium wilt 1 +2, fruit are crack resistant with a long shelf life	Compact, indeterminate, red Campari-type, small to medium size
Plum Regal	Bejo Seeds	North Carolina State University, Cornell University, many producers	Excellent resistance to many strains of LB including new strain of late blight seen in WI and other US states in 2009, also has resistance to early blight, TSWV, Fusarium 1+2, and Verticillium, fruit are resistant to gray wall and cracking	Determinate, red large plum, high yielding, late maturing, fruit taste described as 'heirloom quality'
Defiant	Bejo Seeds	North Carolina State University, Cornell University, many producers	Excellent resistance to many strains of LB including new strains (US-22, 23, and 24 in WI studies)	Mid-sized slicer, red fruited
Legend	Jung's, Victory Seeds, Territorial Seed Co., Tomatofest, Ed Hume Seeds, Twining Vine Garden, and many others	Cornell University, Oregon State University, Jung's, many producers	Excellent LB resistance	Determinate, large round red fruit, early bearing, large fruit, self fertile,
Wapsipinicon	Reimer, Tomatofest, Diane Seeds, Seed Savers, Amishland Seeds, and many others	Many producers	Some resistance to new strain of LB seen in WI and other US states in 2009	Indeterminate, high yielding, 2 inch pink-yellow fuzzy (peach-like) fruit, flavorful and sweet
Matt's Wild Cherry	Johnny's, Tomatofest, Seeds of Change, Reimer Seeds, and others	Inglis et al. 2000	Good LB tolerance, frost tolerance	Indeterminate rampant vines; many fruit per plant, borne in clusters, red cherry ½ in. sweet flavor
Juliet	Johnny's, Harris Seeds, Reimer Seeds, 2B Seeds, Park Seed, and others	Cornell, Dillon et al. 2000	Some resistance to LB based on field trials in NY, crack resistant fruit	Indeterminate, red grape tomato
Stupice	Reimer Seeds, Victory Seeds, Diane's Flower Seeds, and others	Dillon, et al. 2005	Some LB resistance in field trials, potato leaf type, heavy yielding, early ripening	Indeterminate heirloom, round, medium sized red fruit

Slava	Reimer Seeds, Tomatofest, and others	Dillon, et al. 2005	Some LB resistance in field trials, early fruiting, potato leaf variety, described often as 'blight resistant'	Indeterminate heirloom, 2 inch round red
Golden Sweet	Johnny's	Cornell University	Some LB resistance, fruit resistant to cracking	Indeterminate yellow grape
Pruden's Purple	Johnny's, Tomatofest, Victory Seeds, Heirloom Seeds, and many others	Inglis et al. 2000	Good resistance to LB, potato leaf vine type	Indeterminate brandywine type, color is purple to black
Wisconsin 55	Jung's, Reimer Seeds, Tomatofest, and others	Pristou and Gallegly, 1954, University of Wisconsin (bred by J.C. Walker in the 1940's)	May not be resistant to new strains of LB, with some resistance to blossom end rot, early blight, and leaf spot, resists shoulder cracks, good shipping tomato	Semi-determinate, large red tomato fruit
Better Boy	Burpee, Urban Farmer, and others	WI field observations 2009	Some resistance to new strain of LB seen in WI and other US states in 2009, excellent overall disease resistance	Indeterminate, large red fruit
Sun Sugar	Reimer, Henry Field's, and others	WI field observations 2009	Some resistance to new strain of LB seen in WI and other US states in 2009, also resistant to Fusarium wilt race 1 and tomato mosaic virus (ToMV), crack resistant	Orange cherry fruit, high yielding, very sweet and flavorful, thin skin
Green Zebra	Territorial Seed Co., Tomatofest, Golden Harvest Organics, Local Harvest, and others	WI field observations 2009	Some resistance to new strain of LB in WI and other US states in 2009, no other disease resistance claims	Indeterminate, ~2 inch round gold with green stripes, green flesh, lemon-lime flavor
Roma	Gurney's, Peter's Seed Co., Territorial Seed Co., Yankee Gardener, and many others	WI field observations 2009	Some resistance to new strain of LB seen in WI and other US states in 2009, also resistance to Verticillium wilt, Fusarium wilt race 1, and Alternaria Stem Canker	Determinate, pear-shaped red plum type fruit, open pollinated, few seeds in meaty fruit, good for canning and sauces
New Yorker	Tomato Fest, Hudson Valley Seed Library and others	Cornell University	Some resistance to LB and Verticillium wilt	Determinate, beefsteak fruit, 4-6 oz. sweet, round meaty red
West Virginia 63	West Virginia Univ. Greenhouse at 304-293-4480, few sources	Cornell University; West Virginia University	Some resistance to LB, Fusarium and Verticillium Wilt.	Indeterminate, med-large fruit 6-8 oz., sweet, red and meaty, uniform ripening
Aunt Ginny's Purple	Tomato Fest, Tomato Growers Supply Company, Reimer seeds and others	Cornell University	Good resistance to LB, resistant to cracking	Indeterminate, vigorous, large pink beefsteak fruit 12-16 oz.
Aunt Ruby's German Green	Tomato Fest, Seed Savers, Victory Seeds and others	Cornell University	Moderate resistance to LB	1 lb fruit, pale greenish color, with a slightly flat

				shape
Big Rainbow	Burpee, Southern Exposure, Park Seed, Local Harvest and others	Cornell University	Good resistance to LB	Indeterminate, color variation on fruit – green to red, large fruit 2 lb
Black Krim	Planet Natural, eCrater, Local Harvest and others	Cornell University	Moderate resistance to LB, susceptible to cracking	Indeterminate, med- sized fruit, 10-12 oz, maroon color with dark green shoulders
Black Plum	Diane's Flower, White Flower Farm, Cozy Cabin Nursery and others	Cornell University	High resistance to LB	Indeterminate, sweet, meaty, oval-shaped fruit 2-4 oz
Brandywine	Local Harvest, Versey's, American Meadows and others	Cornell University	Moderate resistance to LB	Large meaty 1lb beefsteak fruit, pinkish to red color, ribbed
Red Currant	Local Harvest, Park Seed, White Flower Farm and others	Cornell University	Good resistance to LB	Indeterminate, vigorous, small, red, tart fruit 1/3 inch diameter
Tigerella (AKA Mr. Stripey)	Pase Seeds, eCrater, and others	Cornell University	Good tolerance to LB	Indeterminate, apricot sized fruit, orange & yellow stripes, high yields
Yellow Currant	Bonanzle, eCrater, Tomato Growers Supply Co. and others	Cornell University	Excellent tolerance to LB	Indeterminate, tiny sweet yellow fruit