



Vegetable Crop Update

A newsletter for commercial potato and vegetable growers prepared by the University of Wisconsin-Madison vegetable research and extension specialists

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Calendar of Events

July 14, 2016 – UW-Rhineland Agricultural Research Station Field Day
July 21, 2016 – UWEX Langlade County – Antigo Research Station Field Day
July 28, 2016 – UW-Hancock Agricultural Research Station Field Day
February 7-9, 2017 – UWEX/WPVG Grower Ed. Conf., Stevens Point, WI

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

Potato blackleg (contributions from Dr. Amy Charkowski, Professor of Plant Pathology, UW-Madison, Dept. of Plant Pathology): The primary bacterial pathogens that cause potato blackleg and tuber soft rot are *Pectobacterium atrosepticum*, *P. carotovorum*, *P. wasabiae*, and more recently in the U.S., *Dickeya* spp. Previously, all of these pathogens were grouped in the same genus *Erwinia*. *Dickeya* and *Pectobacterium* affect many host species including potato, carrot, broccoli, corn, sunflower and parsnip; legumes and small grains are not known hosts. *Dickeya dianthicola* was confirmed in the eastern U.S. in just 2015, causing significant potato losses in some areas. *Dickeya* appears to spread rapidly over long distances via seed potatoes, was first reported in the Netherlands in the 1970s, and has since been detected in many other European countries, and now the U.S. Pictures, below, show symptoms of *Dickeya*.



Stem lesions are mainly seen at the base of the stem.



Decayed stem is a dull brown.



Pith at base of stem is soft or missing. Vascular system above lesion is brown.



Plants may show symptoms on only one of the stems.



Leaves of plants with milder symptoms are curled.



Under the right environmental conditions, infection of seed with blackleg pathogens can result in symptoms including poor emergence, chlorosis, wilting, tuber and stem rot, and darkened or black stems which are slimy, and death. These symptoms result from the cell-wall-degrading enzyme activity of the bacteria within the plant tissues on which they infect.

Blackleg and soft rot bacterial diseases are promoted by cool, wet conditions at planting and high temperatures after emergence. While the pathogens can be spread in infested seed, other sources of inoculum include soil, irrigation water, and insects. Levels of infection are dependent upon seed-handling/cutting techniques, soil moisture and temperature at planting and emergence, cultivar susceptibility, severity of infection of seed, and potentially, amount of bacteria in irrigation water, cull piles, or other external sources. Sanitation and disinfecting of potato cutting equipment and proper handling reduces spread and aids in control of the pathogen. Treating seed to prevent seed piece decay by fungi can also contribute to blackleg control. Since the pathogen does well in cool, wet soils, avoid planting in overly wet soil. Crop rotation away from potato for 2-3 years for *Pectobacterium* and just 1-2 years for *Dickeya* species will help control this disease as the bacteria do not survive well in soil.

While seedborne or vascular blackleg cannot be reversed with applications of fungicides or bacteriacides, spread of the bacterial pathogen from infected to healthy plants and aerial stem rot may be managed in the field with fungicide tank-mixes which contain copper. Remember that the pathogen is inside of the plant (until severe symptoms develop) and copper treatments are not internalized. Most often, conditions which favor plant to plant spread include high winds and driving rains or heavy overhead irrigation.

Wisconsin growers are concerned about *Dickeya* this season, as this genus is new to our state and represents a more aggressive and problematic pathogen than experienced before. Yield losses of up to 35% or more have been reported due to this pathogen in other regions.

It is likely that this pathogen was present and spreading in seed potatoes and on farms in the affected states for a few years (2013-2014) without causing significant disease damage due to cool temperatures. In 2015, however, temperatures were warmer and the presence of *Dickeya* resulted in significant disease outbreaks on commercial potato farms. Increased detection and recognition of this rapidly spread disease problem has prompted additional sampling and monitoring efforts from within numerous seed certification and regulatory agencies.

Field control of aerial stem rot is challenging. Copper containing fungicides such as Kocide can provide some control of aerial stem rot, and can aid in managing bacterial infection after the crop has suffered hail or driving rain/wind damage. However, note that results of these approaches have had varied success throughout the U.S. In work by Dr. Dennis Johnson of Washington State University, the famoxadone+cymoxanil (Tanos) plus mancozeb tank-mix alternated with mancozeb+copper hydroxide (ie: Kocide) was an effective chemical tool in reducing aerial stem rot in potato. Irrigation management to reduce excess water also greatly enhanced control of aerial stem rot. Copper hydroxide applications alone did not have as effective of control as Tanos+copper hydroxide. As Tanos is also an excellent late blight control material, its use as we approach DSVs of 18 at this time offers an appropriate program for control of both diseases.

Additional photos of blackleg due to *Pectobacterium* are included below.



Additional information on *Dickeya* as well as cultural management information is provided below, from an excerpt of a previously published Spudsmart article.

***Dickeya*: A New Threat to Potato Production in North America**

By **Khalil Al-Mughrabi** on May 19, 2016

<http://spudsmart.com/dickeya-new-threat-potato-production-north-america/>

Disease thresholds for *Dickeya* are not yet determined. The Maine Department of Agriculture, Conservation and Forestry's Seed Potato Certification Program is proposing a regulation process in response to the *Dickeya* situation in Maine. It is likely that a new regulation pertaining to *Dickeya* in seed potatoes will be drafted to take effect in Maine next year.

Testing for *Dickeya* and *Pectobacterium* is available using new standard polymerase chain reaction (PCR) assays. Random sampling of 400 tubers per lot will likely identify seed lots with one per cent or greater incidence (1,200 tubers per lot will likely identify seed lots with 0.3 per cent or greater incidence).

Research is being carried in both Canada and the United States to learn more about the *Dickeya* pathogen, its presence in seed lots, how it spreads and survives, and how to properly manage it using seed certification, chemicals and cultural practices.

How *Dickeya* Spreads: The most important means of dissemination for *Dickeya* and other bacterial pathogens of potato is the movement of latently infected seed tubers. The pathogen can be carried on the tuber surface and in lenticels (as for *Pectobacterium* spp.), but is also likely to be found in the tuber vascular system, which it enters systemically via the stolon from the infected mother plant or via root infection.

Although disease symptoms are often indistinguishable from those of the more established blackleg pathogen *Pectobacterium* spp., *Dickeya* spp. can initiate disease from lower inoculum levels, have a greater ability to spread through the plant's vascular tissue, are considerably more aggressive, and have higher optimal temperatures for disease development.

However, they also appear to be less hardy than *Pectobacterium* spp. in soil and other environments outside the plant. *Dickeya* is not a good soil survivor (generally less than two years) and rotation out of potato for at least three years will greatly reduce the disease. *Dickeya* and *Pectobacterium* thrive in water and low oxygen, and therefore over-irrigation, poor drainage or excessive rain will spread *Dickeya* and *Pectobacterium*. Both pathogens can spread after severe storms.

Generally, disease caused by *Dickeya* spp under warm, wet conditions leads to stem rotting with symptoms similar to those of *P. atrosepticum*. Under conditions with lower humidity, less rotting is observed with *Dickeya* spp but symptoms such as wilting, increased leaf desiccation, stem browning and hollowing of the stem can be present.

Symptoms of soft rot on potato tubers appear to be similar whether caused by *Dickeya* or *Pectobacterium*. Tuber soft rot ranges from a slight vascular discoloration to complete decay. Affected tuber tissue is cream to tan in colour and is soft and granular. Brown to black pigments often develop at the margins of decayed tissue. Lesions usually first develop in lenticels, at the site of stolon attachment or in wounds. Symptoms caused by *Dickeya* spp. tend to develop when temperatures exceed 25°C (77°F), while *Pectobacterium* predominate below 25°C. Recent studies showed that *Dickeya* spp., particularly at temperatures of 27°C (80°F) or above, cause more severe rots than *P. atrosepticum* and are more likely to produce a creamier, cheesy rot.

Dickeya dianthicola, the new blackleg pathogen recently confirmed in the United States, has the ability to remain dormant in tubers when temperatures are low (for example, at harvest time and in seed storages). Tubers infected with this form of *Dickeya* look healthy at planting, but the disease develops when soil temperature increases. Seed tubers may rot in the soil, causing poor emergence, or infected plants may emerge that eventually die but not before spreading the disease to neighboring plants.

Controlling *Dickeya*: Management challenges of both *Pectobacterium* and *Dickeya* include the lack of curative chemicals or resistant varieties, and the limited ability to predict the severity of

the disease in the field. Growers are therefore advised to take precautions when acquiring seed potatoes in order to prevent the introduction and spread of *Dickeya* to their farms.

For one, it's recommended that growers purchase and plant only certified *Dickeya*-free seed potatoes. It is extremely important that they request a laboratory testing confirmation from the seller showing that seed to be purchased was tested at a certified testing facility and found to be free from *Dickeya*.

Cutting seed will spread *Pectobacterium* and *Dickeya* within a seed lot. For this reason, growers should consider planting uncut seed when possible. If cutting seed, it's important to ensure that the cut surfaces are suberized prior to planting to avoid new infections. *Dickeya* may be managed through biosecurity measures and on-farm precautions such as decontamination of farm machinery, eliminating plant debris and alternative hosts, and avoidance of mechanical harvesting during the early phases of pre-basic seed tuber multiplication.

Growers should make sure to thoroughly sanitize seed cutting equipment and planter between seed lots. Seed should be warmed prior to planting so that it is approximately the same temperature as the soil, and to reduce water condensation on tubers. Bacteria cannot enter plant tissues unless there is a port of entry (for example, un-suberized cut surfaces of the seed tuber, or bruises) and a film of water or a wet surface.

At harvest, growers should reduce the chances of inflicting damage to the skin such as cuts and bruises. If soft rot is present in a portion of the field, this part of the field should not be harvested. In addition, harvesting equipment should be sanitized between lots. Improved storage management can reduce bacterial load on tubers and tuber rotting. Both physical (especially hot water treatment) and chemical methods have been explored with limited success.

Dickeya grows slowly or not at all at seed storage temperatures, so if the crop looks good going into storage, it will likely not decay in storage due to *Dickeya*, but the bacteria will likely cause disease and spread the next year if infected potatoes are planted. Tissue culture plants are unlikely to survive if infected with *Dickeya*. However, tissue culture testing for soft rot pathogens is already a routine. *Dickeya* could spread in a greenhouse in nutrient film technique (NFT) or potting-soil based systems. Irrigation water can be tested for *Dickeya* to ensure freedom from the pathogen.

Grower Checklist for Preventing *Dickeya*

1. Plant certified, disease-free tubers, into well-drained soil with temperature under 10°C.
2. Plant whole seed tubers if possible. Suberize cut seed before planting.
3. Plant seed tubers during conditions that favor fast emergence.
4. Clean and disinfect tools and equipment used for cutting and planting seed.
5. Avoid wounding during seed cutting, planting and harvest.
6. Fungicidal seed treatment of potatoes to prevent seed piece decay can indirectly prevent seed contamination, especially during the cutting operation.
7. Utilize crop rotation of two or more years with a non-host crop.
8. Avoid over-irrigation.

9. Avoid excessive fertilization, which may impact plant and tuber maturity.
10. Consider copper fungicides, which are partially effective against disease and dry out existing lesions.
11. Delay harvest until skin set is complete (up to 21 days after top-kill).
12. Avoid wet conditions during harvest to prevent soil from sticking to tuber skins.
13. Store contaminated potato lots separately.
14. Provide adequate ventilation in storage.
15. Check storages regularly for temperature increase and odors. If problems are detected, hot-spot fans can be used to cool the pile.
16. Dry potatoes before storage or shipping.

National Late Blight Updates (www.usablight.org). There were no new late blight confirmation in this past week (6/10-17). The Jun 1st, Washington (Walla Walla Co.) report of late blight on potato was confirmed to be of the US-8 strain/genotype. On Jun 2nd, Virginia reported late blight on potato which was US-23. Earlier reports have come from MD (tomato US-23), CA (potato, types US-8 and US-11), and FL (potato and tomato US-23). **US-11** can infect both tomato and potato, is of the A1 mating type, and is resistant to Ridomil. **US-8** can infect both potato and tomato, but favors potato, is of the A2 mating type and is also resistant to Ridomil. **US-23** is a genotype that can be controlled with mefenoxam/metalaxyl fungicides (ie: Ridomil Gold SL) and can infect both tomato and potato. It should be noted, however, that some US-23 isolates can be intermediately or fully resistant to mefenoxam. As such, ongoing tests/screens should be conducted to best prescribe appropriate treatment responses.

Cucurbit Downy Mildew Updates (<http://cdm.ipmpipe.org/>). In the past week there were 3 states reporting new confirmations of cucurbit downy mildew: FL, NC, and SC. Previous confirmations were made in FL, GA, NC, SC, and TX.

For further information on common diseases, insect and weed pest information, please consider the 2016 A3422 Commercial Vegetable Production in Wisconsin guide is available for purchase (\$10) through the University of Wisconsin Extension Learning Store website: <http://learningstore.uwex.edu/Commercial-Vegetable-Production-in-Wisconsin2016-P540.aspx>

A pdf of the document can be downloaded for free at the following direct link: <http://learningstore.uwex.edu/Assets/pdfs/A3422.pdf>

Current P-Day (Early Blight) and Severity Value (Late Blight) Accumulations (R.V. James, UW-Plant Pathology/R.V. James Designs): A P-Day value of ≥ 300 indicates the threshold for early blight risk and triggers preventative fungicide application. A DSV of ≥ 18 indicates the threshold for late blight risk and triggers preventative fungicide application. Red text in table below indicates threshold has been met/surpassed. “-“ indicates that information is not available. Blitecast and P-Day values for actual potato field weather from Grand Marsh, Hancock, Plover, and Antigo are now posted at the UW Veg Path website at the tab “P-Days and Severity Values.” http://www.plantpath.wisc.edu/wivegdis/contents_pages/pday_sevval_2016.html

<i>Location</i>	Planting Date	50% Emergence	P-Day Cumulative	Disease Severity Value	Date of DSV Generation	Increase in DSV from 6/14
<i>Antigo</i>	Early 5/1	6/2	113	25	6/17	10
	Mid 5/18	6/7	78	15	6/17	10
	Late 6/3	-	-	-	-	-
<i>Grand Marsh</i>	Early 4/15	5/22	212*	31*	6/17*	3
	Mid 5/1	5/27	175*	25*	6/17*	3
	Late 5/15	6/3	116	14	6/17*	3
<i>Hancock</i>	Early 4/18	5/24	197	31	6/17	3
	Mid 5/3	5/29	156	18	6/17	3
	Late 5/20	6/5	99	9	6/17	3
<i>Plover</i>	Early 4/20	5/25	188	32	6/17	4
	Mid 5/5	5/30	145	17	6/17	4
	Late 5/20	6/6	89	8	6/17	4

*We continue to work on our Grand Marsh station and despite installation of a new modem and battery, we are still unable to regularly generate hourly data. As such, we have used some of the Hancock data to provide estimates for Grand Marsh based on the Grand Marsh emergence dates.

Summary: Disease Severity Values (DSVs) and Late Blight Blitecast: We now have most potatoes in WI at 50% emergence or greater and are generating forecast values for all but late planted potatoes in Antigo. Conditions were moderate for promotion of late blight in this past week with 3 day accumulations of just 3-4 Disease Severity Values in the Hancock and Plover locations. Conditions were more favorable for late blight in the Antigo area, with 3-day accumulations of 10. Recall the maximum number of DSVs that one day can accumulate is 4.

Wisconsin commercial conventional fungicides for late blight control can be find at: <http://www.plantpath.wisc.edu/wivegdis/pdf/2016/Potato%20Late%20Blight%20Fungicides%202016.pdf>

P-Days indicating early blight risk are still below threshold for the locations monitored, but it won't be long until the 300 value is met. Few to no lesions have been observed, to date, in central and southern WI.