Vegetable Crop Update

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

Extension
UNIVERSITY OF WISCONSIN-MADISON

No. 14 – August 18, 2024

In This Issue:

- Potato and bean production updates
- Potato and vegetable disease forecasting updates – thresholds met for late blight and early blight treatments
- Cucurbit downy mildew
- Bacterial blackleg and aerial limb rot of potato

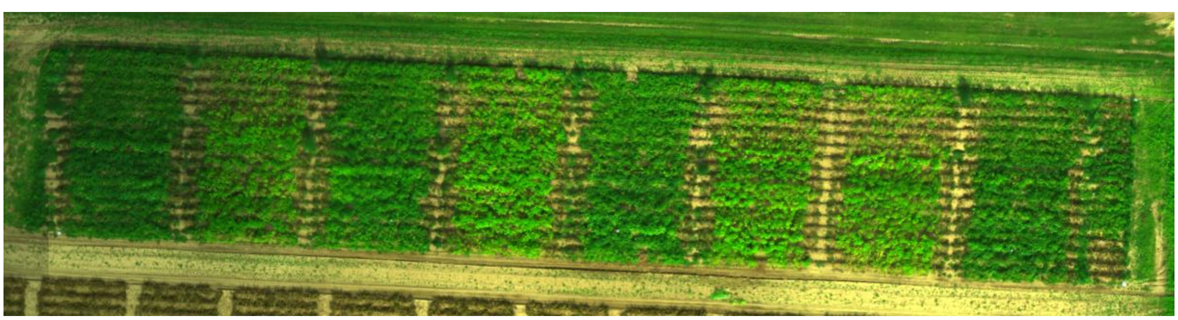
Calendar of Events:

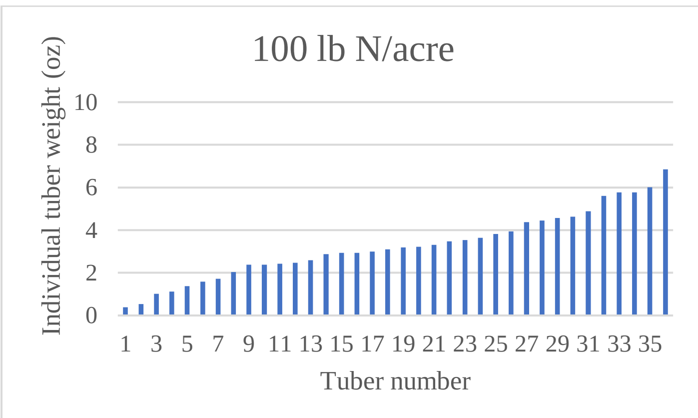
December 3-5, 2024 – Midwest Food Producers Assoc. Processing Crops Conference, Kalahari Convention Center
January 13-14, 2025 – Wisconsin Agribusiness Classic, Alliant Energy Center, Madison, WI
February 4-6, 2025 – UW-Madison Div. of Extension & WPVGA Grower Education Conference & Industry Show, Stevens Point, WI

Yi Wang, Associate Professor & Extension Potato and Vegetable Production Specialist, UW-Madison, Dept. of Plant and Agroecosystem Sciences, 608-265-4781, Email: wang52@wisc.edu.

It's close to the end of the growing season, and our two N treatments in the Russet Burbank plots are showing more obvious differences, as can be seen in the aerial image and in the image with dug plants/tubers. We can clearly see that the lower N rate at 100 lb/acre set much less tubers, had yellower and dying canopies, and yielded less than the higher N rate at 300 lb/acre. We are expecting that the lower N treatment will stop bulking pretty soon with the senecing vines, whereas the higher N treatment will keep building more tuber weights until vine kill.

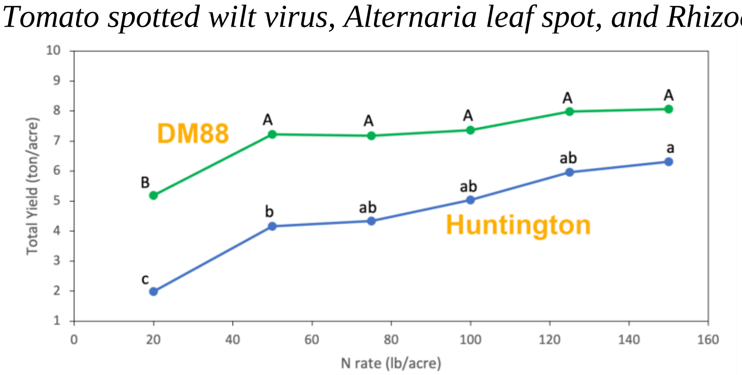
We sent some diseased vines/leaves with blackleg symptoms to the UW Plant Disease Diagnostic Clinic, and have found that they were *Pectobacterium* spp. (Pspp), *Pectobacterium carotovorum* subsp. *carotovorum* (Pcc), and *Pectobacterium parmentieri* (Pp) positive. It has been reported that due to the humid weather conditions this summer, Pectobacterium-related diseases are commonly observed all around the Central Sands.





Total tuber weight from two plants under 100 lb N/acre: 7.4 lb

With regard to our snap beans trial this year, due to the heavy rainfall over the season, we did not receive as many N credits from the irrigation water as last year, and therefore the N treatment effects were pretty apparent to view. We can see that overall the total yield of DM88 is 1.3 to 2.6 times as much as that of Huntington under varied N rates. DM88, a nodulating variety, needed no more than 50 lb N/acre to reach high yield potential not significantly different from that under higher N rate at 150 lb N/acre. In comparison, Huntington, a non-nodulating variety, needed as high as 150 lb N/acre to reach the significantly highest yield potential. On our snap bean plants, we have found *Tobacco mosaic virus, Tomato spotted wilt virus, Alternaria leaf spot, and Rhizoctonia root rot.*



Amanda Gevens, Chair, Professor & Extension Vegetable Pathologist, UW-Madison, Dept. of Plant Pathology, 608-575-3029, gevens@wisc.edu, Lab Website: https://vegpath.plantpath.wisc.edu/

Current P-Day (Early Blight) and Disease Severity Value (Late Blight) Accumulations will be posted at our website and available in the weekly newsletters. Thanks to Ben Bradford, UW-Madison Entomology for supporting this effort and providing a summary reference table: https://agweather.cals.wisc.edu/thermal-models/potato. A Potato Physiological Day or P-Day value of ≥300 indicates the threshold for early blight risk and triggers preventative fungicide application. A Disease Severity Value or DSV of ≥18 indicates the threshold for late blight risk and triggers preventative fungicide application. Data from the modeling source: https://agweather.cals.wisc.edu/vdifn are used to generate these risk values in the table below. I've estimated early, mid-, and late planting dates by region based on communications with stakeholders. These are intended to help in determining optimum times for preventative fungicide applications to limit early/late blight in WI.

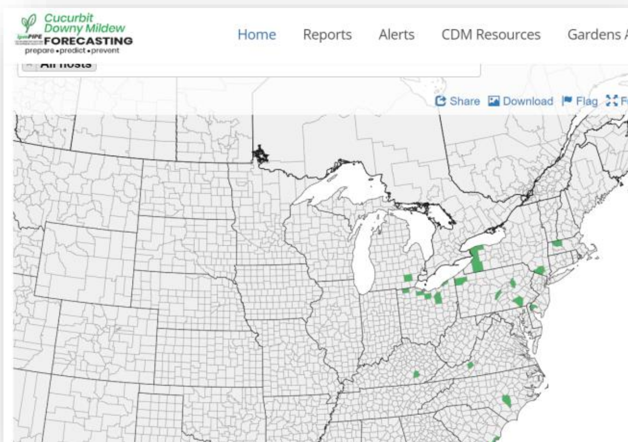
	Planting Date		**50% Emergence Date**	**Disease Severity Values (DSVs)** *through 8/17/2024*	**Potato Physiological Days (P-Days)** *through 8/17/2024*
Spring Green	**Early**	Apr 3	May 9	**57**	**843**
	Mid	Apr 17	May 12	**57**	**826**
	Late	May 10	May 25	**52**	**724**
Arlington	**Early**	Apr 5	May 10	**29**	**840**
	Mid	Apr 20	May 15	**29**	**809**
	Late	May 12	May 25	**27**	**730**
Grand Marsh	**Early**	Apr 5	May 10	**51**	**814**
	Mid	Apr 20	May 15	**51**	**786**
	Late	May 12	May 25	**44**	**712**
Hancock	**Early**	Apr 10	May 17	**60**	**768**
	Mid	Apr 22	May 21	**58**	**738**
	Late	May 14	June 2	**53**	**658**
Plover	**Early**	Apr 14	May 18	**50**	**770**
	Mid	Apr 24	May 22	**46**	**732**
	Late	May 19	June 7	**42**	**616**
Antigo	**Early**	May 1	May 24	**50**	**671**
	Mid	May 15	June 1	**50**	**633**
	Late	June 1	June 15	**37**	**530**
Rhinelander	**Early**	May 7	May 25	**26**	**658**
	Mid	May 18	June 8	**25**	**563**
	Late	June 2	June 16	**25**	**515**

Late blight of potato/tomato. Late blight diagnostics are available at no cost to WI growers and gardeners. Dr. Brian Hudelson of our UW Plant Disease Diagnostic Clinic and Dr. Amanda Gevens of UW-Potato & Vegetable Pathology can offer confirmation of the pathogen. Dr. Gevens will also offer strain typing of the pathogen. The usablight.org website (https://usablight.org/map/) indicates reports of late blight from the US so far in 2024 including NY tomato (from GH earlier in the spring) and MI (US-23 from potato). Please keep in mind that the site is not comprehensive. Outside of this site, I'm aware of US-23 late blight on potato in Maine, 2 Ontario Canada confirmations of potato and tomato late blight (US-23), and a Florida late blight sample from potato (March 2024).

We accumulated 5-10 Blitecast Disease Severity Values over the past week in WI. **All WI locations are above the threshold for late blight disease severity values and should receive preventative fungicide application to reduce the risk of disease.** An updated listing of fungicides for WI potato late blight management for 2024 can be found at the link below. Base protectants such as chlorothalonil and mancozeb offer broad-spectrum control of fungal and oomycete (water mold – like late blight) pathogens. https://vegpath.plantpath.wisc.edu/wp-content/uploads/sites/210/2022/07/2024-Potato-Late-Blight-Fungicides.pdf

Early blight of potato. All areas of production have reached the threshold for the application of foliar fungicides to limit early blight. Temperatures were optimal this past week for promoting early blight. https://vegpath.plantpath.wisc.edu/diseases/potato-early-blight/

Cucurbit Downy Mildew: Michigan confirmed downy mildew on **cucumber** in 17 counties so far this season (Washtenaw, Saginaw, Tuscola, Ingham, Bay, Iosco, Arenac, Muskegon, Sanilac, Midland, Clinton, Livingston, Allegan, Van Buren, Newaygo, Berrien, and Lapeer). To date, downy mildew field findings have been caused by Clade 2 - cucumber and cantaloupe strain type. No field disease confirmations were made in Wisconsin.



Confirmed reports of cucumber downy mildew this past week. In red, US counties with reports of cucurbit downy mildew during the past 7 days. Green counties indicate a former report of the disease greater than 7 days ago. From: https://cdm.ipmpipe.org/

Management information can be sourced here: https://vegpath.plantpath.wisc.edu/2022/07/03/update-10-july-3-2022/

Potato Aerial Stem Rot – caused by pectolytic bacteria, primarily *Pectobacterium* spp. has been abundant in fields in Wisconsin over the past week or so. Samples processed through our UW Plant Disease Diagnostic Clinic have resulted in findings of *Pectobacterium atrosepticum* and *Pectobacterium parmentieri* primarily. Other pathogens that can be associated with these symptoms can include *Pectobacterium carotovora* supsp. *carotovora* and *Dickeya* spp. *The content below includes some elements from Dr. Amy Charkowski of Colorado State Univ., Dr. Phillip Wharton of Univ. of Idaho & a Blackleg, aerial stem rot, and tuber soft rot fact sheet from Michigan State Univ.).*

Left: Blackleg symptoms on potato (image by Gevens UW Plant Pathology). **Right:** Aerial stem rot on potato (by Wharton Univ. of Idaho).

Disease Background: The primary bacterial pathogens that cause aerial stem rot, potato blackleg and tuber soft rot are *Pectobacterium atrosepticum, P. carotovorum, P. wasabiae, P. parmentieri,* 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 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. This summer, so far in Wisconsin, has yielded blackleg and aerial stem rot primarily caused by Pectobacterium spp.

Under the right environmental conditions, infection of seed with blackleg pathogens can result in symptoms including poor emergence, chlorosis, wilting, leaf curling, 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.

Aerial stem rot, blackleg and soft rot bacterial diseases are typically 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 disinfesting 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 less than 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 (internal inoculum) cannot be reversed with applications of fungicides or bacteriacides, spread of the bacterial pathogen from infected to healthy plants and aerial stem rot (following damage to plants) may be managed in the field with fungicide tank-mixes that contain copper. In 10 years of field trials in Idaho (under the direction of Dr. Phillip Wharton of Univ. of Idaho) evaluating weekly applications of copper-containing fungicides, aerial stem rot was most effectively controlled with Previsto (reduced disease incidence and severity by 25 and 18% respectively). Previsto is a Gowan product with 5% copper hydroxide. Badge also significantly reduced aerial stem rot when applied weekly (reduced disease incidence and severity by 18 and 14% respectively). Badge is also a Gowan product with 16.81% copper oxychloride and 15.36% copper hydroxide. Most often, conditions that favor plant-to-plant spread include high winds and driving rains or heavy overhead irrigation. Cultivars vary in susceptibility and some can have a tendency for lower canopy leaf scarring providing infection sites for stem rotting bacteria.

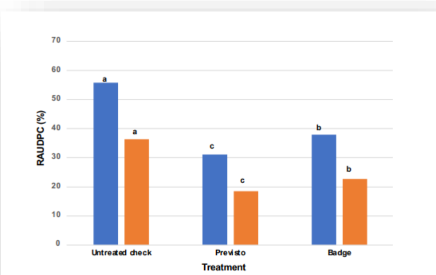


Figure 3. Factorial analysis of variance means by treatment for the relative area under the disease progress curve (RAUDPC) for incidence (■) and severity (■) of aerial stem rot. Treatment with copper fungicides Previsto and Badge significantly reduced the incidence and severity of ASR compared to the untreated check. Means followed by same letter or symbol do not significantly differ (P=0.05, Tukey's HSD).

Evaluation of fungicide programs for the management of aerial stem rot in potato. Poster offered at the International Congress of Plant Pathology in 2023. Authored by: Alan L. Malek, Katie L. Malek, George D. Newberry, Phillip S. Wharton.

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 surpass DSVs of 18 at this time offers an appropriate program for control of both diseases.

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. *Dickeya* is not a good soil survivor (generally <2 years) and rotation out of potato for at least 3 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. Tuber soft rot, from either pathogen, ranges from a slight vascular discoloration to complete decay. Affected tuber tissue is cream to tan 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 25ºC (77ºF), while *Pectobacterium* predominate below 25ºC.Recent studies showed that *Dickeya* spp., particularly at temperatures of 27ºC (80ºF) or above, cause more severe rots than *P. atrosepticum* and are more likely to produce a creamier, cheesy rot.

Dickeya dianthicola, the relatively newer blackleg pathogen, 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.

Cutting seed will spread *Pectobacterium* within a seed lot. After several years of specific testing, *Dickeya* has been found to NOT spread by standard cutting approaches. 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 to mitigate pathogen spread (for several other pathogens). 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.

Testing for *Dickeya* and *Pectobacterium* is available using new standard polymerase chain reaction (PCR) assays. Our UW Plant Disease Diagnostic Clinic can provide these tests.

Grower Checklist for Managing *Pectobacterium* & *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 disinfest 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.

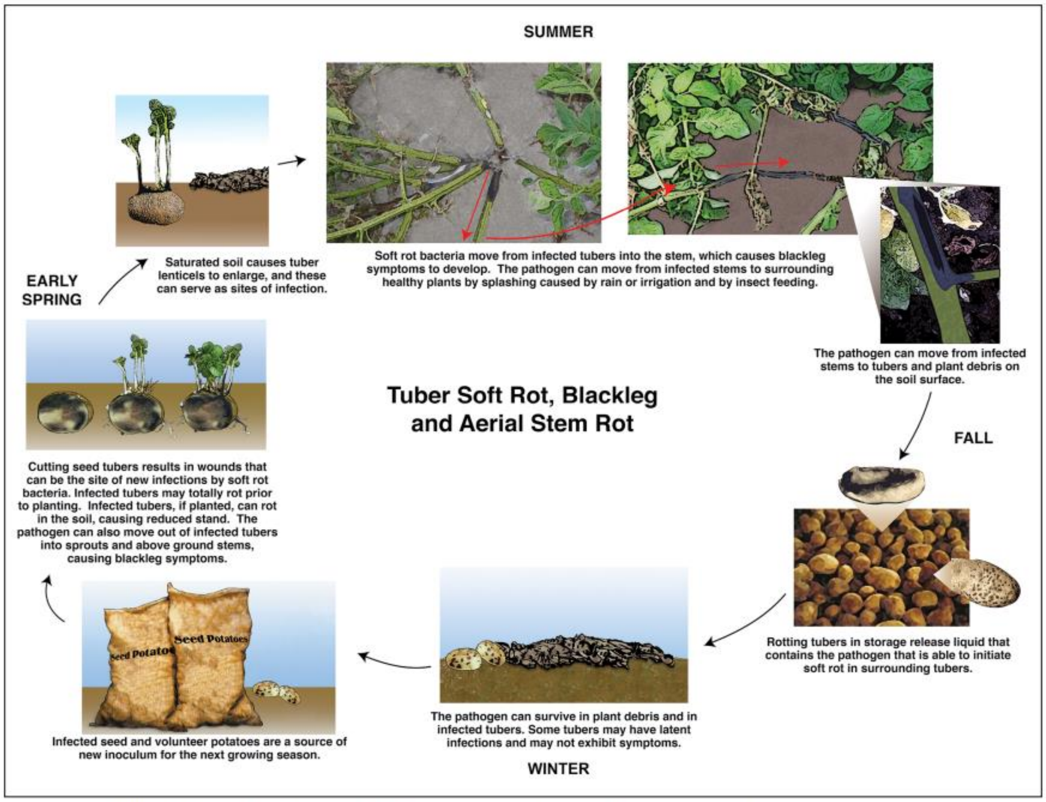


Figure 5. *Disease cycle of tuber soft rot, blackleg and aerial stem rot. (Marlene Cameron, Michigan State University)*

https://www.canr.msu.edu/uploads/resources/pdfs/e-3339_tuber_soft_rot_wcag_2.0.pdf