# Vegetable Crop Update

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

**No. 8 – June 10, 2017**

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## Calendar of Events

**July 20, 2017 –** UW-Hancock ARS Field Day, Hancock, WI
**July 27, 2017** – UWEX Langlade County Airport Research Station Field Day, Antigo, WI
**August 4, 2017** – UW-Lelah Starks Elite Foundation Seed Potato Farm Field Day, Rhinelander, WI (10AM to Noon Lunch to Follow)
**January 21-23, 2018** – Wisconsin Fresh Fruit & Vegetable Conference, Wisconsin Dells, WI
**February 6-8, 2018** – UWEX & WPVGA Grower Education Conference, Stevens Point, WI

**Amanda J. Gevens, Associate Professor & Extension Vegetable Plant Pathologist, Interim Co-Director of Wisconsin Seed Potato Certification Program, UW-Madison, Dept. of Plant Pathology, 608-890-3072 (office), Email: gevens@wisc.edu. Webpage: www.plantpath.wisc.edu/wivegdis/**

**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/weather_%20list_2017.html

| ***Location*** | Planting Date | 50% Emergence | P-Day Cumulative | Disease Severity Value | Date of DSV Generation | Increase in DSV from 6/3 |
|---|---|---|---|---|---|---|
| ***Antigo*** | Early 5/3 | 5/25 | 56 | 3 | 6/9 | - |
| | Mid 5/15 | 6/1 | 56 | 3 | 6/9 | - |
| | Late 6/1 | 6/15 | - | - | - | - |
| ***Grand Marsh*** | Early 4/10 | 5/15 | 134 | 11 | 6/9 | 1 |
| | Mid 5/1 | 5/22 | 127 | 9 | 6/9 | 1 |
| | Late 5/17 | 6/1 | 64 | 1 | 6/9 | - |
| ***Hancock*** | Early 4/15 | 5/18 | 137 | 10 | 6/9 | 0 |
| | Mid 5/5 | 5/30 | 74 | 0 | 6/9 | 0 |
| | Late 5/20 | 6/5 | 36 | 0 | 6/9 | - |
| ***Plover*** | Early 4/20 | 5/20 | 138 | 12 | 6/9 | 0 |
| | Mid 5/8 | 5/25 | 113 | 1 | 6/9 | 0 |
| | Late 5/25 | 6/8 | 16 | 0 | 6/9 | - |

**Summary:** Disease Severity Values (DSVs) and Late Blight Blitecast: All potatoes with the exception of late-planted in the Antigo location are at 50% emergence or greater. The calculations of DSVs from the earliest emerged potatoes were 3 DSVs for Antigo, 11 for Grand Marsh, 10 for Hancock, and 12 for Plover. Mid-planted potatoes were 3 for Antigo, 9 for Grand Marsh, 0 for Hancock, and 1 for Plover.

Late-planted potatoes were 1 DSV for Grand Marsh, and 0 DSV both for Hancock and Plover. There were no accumulations of DSVs for most sites and emergence dates, with the exception of just 1 accumulated DSV at the Grand Marsh location. Recall the maximum number of DSVs that one day can accumulate is 4. Once thresholds of 18 DSVs have been met, routine, protection of susceptible tomato and potato crops is recommended. Wisconsin commercial conventional fungicides for potato late blight control can be found at: http://www.plantpath.wisc.edu/wivegdis/pdf/2017/May%2022,%202017.pdf

P-Days indicating early blight risk have not yet reached threshold for Wisconsin potatoes. Recall the threshold is 300 P-Days. We are at 56 for early- and mid-planted potatoes in Antigo; 134, 127 and 64 for early-, mid-, and late-planted potatoes in Grand Marsh; 137, 74, and 36 for early-, mid-, and late-potatoes in Hancock; and 138, 113, and 16 for the three planting dates in Plover. In commercial fields planted in mid-April in southern/central Wisconsin, the first early blight lesions have been noted.

**National Late Blight Updates: http://usablight.org** is a useful resource for the detection and characterization of late blight on tomato and potato crops from the U.S. No new reports of late blight in the US have been reported at the site during recent weeks. However, reports of late blight were confirmed from parts of NC and VA last week. No clonal lineage/strain types have yet been described. Already this year, late blight has been confirmed on potato and tomato in southwestern Florida. In all reported cases, the pathogen genotype was US-23. This has been the predominant genotype in Wisconsin, and across the U.S., in recent years. US-23 can still generally be managed well with use of phenylamide fungicides.

**National Cucurbit Downy Mildew Updates: http://cdm.ipmpipe.org/** offers information on the detection and characterization of the cucurbit downy mildew pathogen from the U.S. (and often Canada). In this past week, confirmations of downy mildew have come from SC (cucumber), NC (cucumber), and GA (watermelon, cucumber). Prior confirmations were from FL, GA, and TX on a variety of cucurbits.

**Considering Phostrol (and other like fungicides) for Potato Disease Control?:**

How do the phosphorous acid fungicides differ from phosphoric acid compounds?
Both phosphor**ic** acid ($H_3PO_4$) and phosphor**ous** acid ($H_3PO_3$) are agrochemicals useful in crop production. Under normal plant growth conditions, both agrochemicals dissociate and exist as corresponding anions, **phosphate** and **phosphite**, consecutively. **The distinction between the two: phosphate is a nutrient source of P essential for plants, and phosphite helps control diseases caused by oomycetes** (water mold pathogens). Phosphate and phosphite are not equivalent inside the plant. Phosphoric acid or phosphate cannot function as phosphorous acid or phosphite and *vice versa*. Since phosphites are systemic and very stable in plants, they should not be applied frequently. To manage the development of phosphite-resistant oomycetes, care should be taken to alternate or mix phosphites with other effective fungicides. The fungicide labels for phosphorous acids typically do not provide a season limit per acre/crop because they are exempt from the requirement of tolerances.

How do phosphorous acids work as fungicides?
Phosphorous acids can control diseases caused by Oomycete (water mold) pathogens such as *Phytophthora erythroseptica* (pink rot) and *Phytophthora infestans* (late blight). Pythium is typically not controlled with phosphorous acids. These pathogens are fungus-like but differ in their cell wall structure and nuclear contents of cell walls. **Phosphorous acid has both direct and indirect effects on oomycetes.** It directly inhibits a particular process in the metabolism of oomycetes; it indirectly stimulates the plant's natural defense response against pathogen attack in a systemic (xylem and phloem) manner. It should be noted, however, that even though this group of fungicides is considered at low risk for resistance development in the pathogens (FRAC Group 33), that phosphonate-resistant oomycetes have been reported. **Phosphorous acid compounds including Phostrol, Prophyt, Rampart,**

**FungiPhite, K-Phite, Fosphite, Phiticide (Crop-phite), Confine Extra, and Alude can be very effective in managing pink rot and late blight of potato,** especially in the case of Ridomil-resistant (mefenoxam/metalaxyl-resistant) late blight or pink rot strains. I provided 2 figures, below, from Dr. Jeff Miller's research farm (2010) which demonstrated pink rot control and yield preservation with use of phosphorous acid fungicides applied at dime-size (DS) tuber and in 2 subsequent applications (DS + 2 weeks and DS + 4 weeks). In my own research with Phostrol at the UW-Hancock ARS, we have never seen yield reductions with use as a foliar fungicide. We have tested various timings (single applications up to 10 applications) and rates (up to 10 pint/acre for each application) of Phostrol for observation of plant health and post-harvest oomycete disease control. In summary of results, a 3 to 5 treatment program, initiating at DS tuber, followed by treatments every subsequent 2 weeks, at rates between 7.5-10 pt/acre were successful in limiting tuber late blight and pink rot.

In our post-harvest treatment trials with Phostrol at the UW Hancock Storage Research Facility, we have consistently seen strong control of late blight, pink rot, and silver scurf. It is critical that the treatment is applied in as little carrier water as possible (at most 0.5 gal/ton tubers) so that the tubers do not appear wet, but rather just lightly misted with the phosphorous acid fungicide. Results can be found throughout the Wisconsin Potato Educational Conference Proceedings from recent years (link following).
http://www.plantpath.wisc.edu/wivegdis/#

**Figure 1. Effect of fungicide programs in controlling pink rot on potato tubers.** Miller, Miller, Taysom, & Anderson, Managing Pink Rot, Online Powerpoint from 2012 IPC Pink Rot Miller Research LLC. Note: Crop-phite and Phostrol are phosphorous acid fungicides.

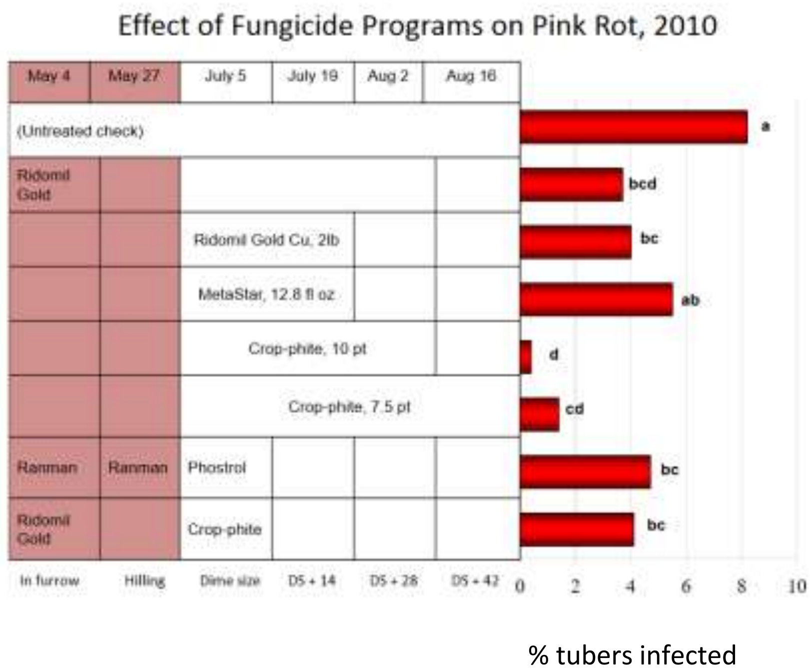
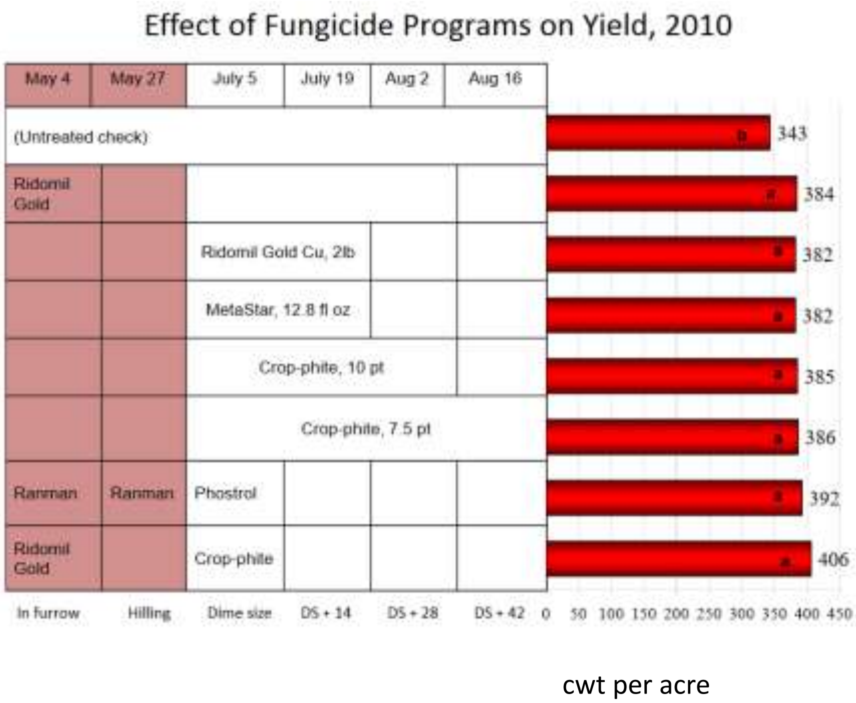


**Figure 2. Effect of fungicide programs on yield.** Miller, Miller, Taysom, & Anderson, Managing Pink Rot, Online Powerpoint from 2012 IPC Pink Rot Miller Research LLC. Note: Crop-phite and Phostrol are phosphorous acid fungicides.




<u>What are the concerns with using phosphorous acid fungicides?</u>
Phosphorous acid fungicides are not great contact fungicides and their use does need to be accompanied by application of a base protectant (mancozeb or chlorothalonil) or other fungicide to target control of early blight and late blight.

There have been reports of phytotoxicity from phosphorous acid use. This has been a challenging condition to recreate in research plots. In my UW-Hancock ARS trials with Phostrol, spanning 3 years, we saw phytotoxity only **once** under conditions of heavy leaf wetness followed by very intense sunshine/US (no clouds in sky). In Idaho, Dr. Miller has attempted to recreate phytotoxicity through various application approaches and mixes and his results indicated lack of consistency in the resulting condition. However, he noted that he has only seen phytoxicity occur with early morning phosphorous acid applications and not at all with chemigated applications.

Post-harvest applications can be highly effective in managing late blight, pink rot, and silver scurf. Studies have indicated that treatment on seed potatoes entering storage is safe and does not change seed performance. Phosphorous acids should not be applied to short dormancy varieties that may be sprouting at the time of harvest. The treatment can burn the growth points and result in tuber wounds that are susceptible to secondary infection and breakdown in the pile.

**Useful documents for more information:**
Brunings, Guodong, Simonne, Zhang, Li, Datnoff. Are Phosphorous and Phosphoric Acids Equal Phosphorous Sources for Plant Growth. University of Florida IFAS Extension.
**http://edis.ifas.ufl.edu/hs254**

Miller, Miller, Taysom, Anderson. Managing Pink Rot. Power Point Presentation from Miller Research LLC. (2012 IPC Pink Rot). **www.millerresearch.com**

Miller, Olsen. Top Ten Things to Know About Phosphorous Acid. Power Point Presentation offered through Oregon State University Hermiston Website. **http://oregonstate.edu/dept/hermiston/sites/default/files/miller_hermistonx.pdf**

**Potato Blackleg-Dickeya Updates:** *Dickeya dianthicola* has been detected in a few commercial production potato fields this past week. The fields were sampled for *Dickeya* testing because they were expressing symptoms consistent with seedborne blackleg including poor emergence, wilting, stem rot and darkened, black stems – some of which have been slimy, some of which have been somewhat dry with hollow stem centers. Pictures of symptoms can be seen in our May 2017 newsletter article which reviewed both *Pectobacterium* and *Dickeya* (link following). http://www.plantpath.wisc.edu/wivegdis/pdf/2017/May%207%202017.pdf

*Dickeya dianthicola*, the new 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.

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.

<u>What can you do to manage blackleg caused by *Dickeya dianthicola*</u>? 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.

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 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.

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.

<u>How does *Dickeya* spread long distances?</u> The most important means of dissemination for *Dickey*a 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. This bacterial disease does **not** move long distances via an airborne spore, like the late blight pathogen.

<u>Can *Dickeya* spread within a field or between adjacent fields? This question requires further research and field observations.</u> Observations from ME in recent years suggest that in-field spread is limited within the production season, however, increase in the disease in commercial production fields within the season has been noted by growers. Both *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. *Dickeya* may be managed through biosecurity measures and on-farm precautions such as decontamination of farm machinery, and eliminating plant debris and alternative hosts. *Dickeya* has a relatively short life span in the soil compared to *Pectobacterium*. **Consider known-infected fields be worked (cultivation, pesticide application) last in the day and that machinery be disinfested between use in the infected field and other healthy-appearing fields.**

**Considerations for Mitigating *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. Coordinate field activities/use of field implements so that infected fields are worked last in the day and are disinfested before moving to other, healthy fields to limit pathogen movement.
12. Delay harvest until skin set is complete (up to 21 days after top-kill).
13. Avoid wet conditions during harvest to prevent soil from sticking to tuber skins.
14. Store contaminated potato lots separately.
15. Provide adequate ventilation in storage.

16. Check storages regularly for temperature increase and odors. If problems are detected, hot-spot fans can be used to cool the pile.
17. Dry potatoes before storage or shipping.

**The 2017 A3422 Commercial Vegetable Production in Wisconsin Guide is now available** for 2017. As in past years, the guide can be downloaded for free (link below) or a hard copy can be purchased from UWEX Learning Store for $10. **https://learningstore.uwex.edu/Assets/pdfs/A3422.pdf**