Vegetable Crop Update

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

No. 21 – August 27, 2018

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Calendar of Events

November 27-29, 2018 – Processing Crops Conference & MWFPA Annual Convention, Wisconsin Dells, WI
January 15-17, 2019 – Wisconsin Agribusiness Classic, Alliant Energy Center, Madison, WI
January 27-29, 2019 – Wisconsin Fresh Fruit & Vegetable Conference, Kalahari Conference Center, Wisconsin Dells, WI
February 5-7, 2019 – UWEX & WPVGA Grower Education Conference, Stevens Point, WI

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Late blight risk for Wisconsin, based on accumulation of DSVs for 8/19-8/25/18

Date	Grand Marsh	Hancock	Plover	Antigo
8/19/18	2.0	1.0	1.0	2.0
8/20/18	4.0	4.0	3.0	3.0
8/21/18	3.0	2.0	1.0	1.0
8/22/18	1.0	1.0	0	0
8/23/18	0	0	0	0
8/24/18	3.0	4.0	3.0	3.0
8/25/18	3.0	3.0	2.0	2.0
Weekly Total	**16.0**	**15.0**	**10.0**	**11.0**

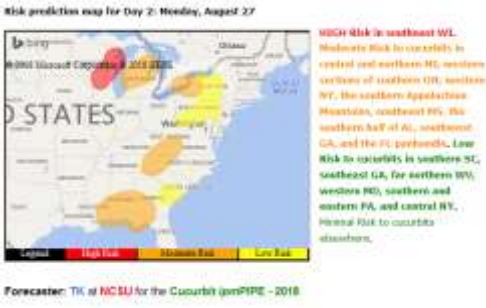
Severity legend: very high severity risk for late blight indicates a weekly accumulation of ≥20 DSVs, high indicates accumulation of 15-20 DSVs, medium indicates 10-15, low indicates 5-10, and very low indicates <5 DSVs. Values available with select dates/locations at: https://agweather.cals.wisc.edu/vdifn/maps

WI Potato Disease Risk Updates: All commercial potato plantings have surpassed 18 DSVs and with presence of the disease in WI, I recommend that fields of susceptible potato and tomato be routinely receiving preventative fungicide applications to limit disease. 7-day programs should be appropriate unless field is proximal to known infection. With close proximity to infection, programs should shift to 5-day intervals with fungicides known to have both curative and anti-sporulant activities.

A **list of registered fungicides for late blight in potato for Wisconsin** can be found in past Vegetable Crop Updates Newsletter #6 (May 20, 2018) and at link below:
http://www.plantpath.wisc.edu/wivegdis/pdf/2018/2018%20Potato%20Late%20Blight%20Fungicides.pdf
Further **information on fungicides** and other vegetable crop management inputs in the 2018 Commercial Vegetable Production in Wisconsin guide (A3422): http://learningstore.uwex.edu/Assets/pdfs/A3422.pdf

Late blight on potato was confirmed in Waushara County WI this past week. Since the first find 3 weeks ago in Adams and Marquette Cos., few additional detections have been made through our UW Plant Disease Diagnostic Clinic or the Potato & Vegetable Pathology Lab. Additional confirmations were reported at the usablight.org website from NC and NY. NY has identified a new strain type, US-25, which has, to this point, been found only on tomato. Dr. Chris Smart at Cornell Univ. has been keeping pathologists informed of this new type which is now known to be mefenoxam resistant and of the A2 mating type; under lab setting US-25 will infect potato as well as tomato. All samples tested from WI, IL, and MI to date, were US-23. The MN tomato late blight report from several weeks back was not genotyped. Prior to that, reports had come from PA, NY, and FL. US-23 has been the predominant genotype in WI, and across the U.S., in recent years. US-23 can still generally be managed well with use of phenylamide fungicides such as mefenoxam. However, a potato sample from northeastern FL was sent to my lab earlier this spring and was the US-8 genotype.

There were reports of cucumber downy mildew from Columbia, Dane, Ozaukee, and Portage Counties, WI during this past week. These findings represent sentinel plot detections as well as commercial pickling cucumber and commercial fresh market cucumbers. No downy mildew on cucurbits in our UW Hancock Agricultural Research Station sentinel plots this past week. New reports were abundant in the US this past week with detections in AL, IN, KY, MA, NY, PA, VA, WI, and WV based on the reporting and forecasting site: http://cdm.ipmpipe.org/ . Previous reports this 2018 season have come from: AL, DE, FL, GA, IN, KY, MA, MD, MI, NC, NJ, NY, OH, ON Canada, PA, SC, TN, VA, WI, and WV on various cucurbit crops. A map showing forecasted movement of the downy mildew pathogen from active sources of inoculum is provided, below. Significant risk of movement around central WI. Preventative fungicides are recommended to limit cucumber downy mildew development and spread. While fungicide info was posted in last week's newsletter, I included it in this newsletter again for easy reference/access. A photo of foliar symptoms of cucumber downy mildew is included below.



Basil downy mildew was confirmed this past week in Rock County. Symptoms include yellowing of foliage often in an angular pattern (along veins). Dark gray to purple fuzzy sporulation is often noted on leaf undersides when humidity is high. Management can be very difficult with fungicides; varieties have different disease responses but most of the sweet basils are susceptible. Picture of symptoms below.

Considerations for Cucurbit Downy Mildew Prevention: Based on replicated research conducted by Dr. Mary Hausbeck of Michigan State University, a 7-day interval fungicide program is recommended for cucumber crops before disease is confirmed (but when inoculum is likely in the region). The program should tighten up to a 5-day program after disease is confirmed. In other vine crops (cantaloupe, melon, zucchini, squash, pumpkin, and gourd), a 7 to 10 day program is recommended before disease, with a tightening up of the program to a 7-day interval after disease is confirmed.

In Dr. Hausbeck's 2016 field trials on pickling cucumbers (link to 2016 report at end of this paragraph and depicted in Table 2, below), the following fungicides provided the best downy mildew control: Ranman 3.6SC (0 day PHI), Omega SC (PHI), Orondis Opti SC, Orondis Ultra SC, Zampro 4.4SC (0 day PHI), and Gavel 75DF (5 day PHI). I will also include Zing! (0 day PHI) in this group as it has the zoxamide component as Gavel but with a chlorothalonil pre-mix rather than mancozeb. The previously listed fungicides should be alternated and tank-mixed with either mancozeb or chlorothalonil (unless one of these protectants is in a pre-mix formulation such as Zing! or Gavel).
http://glexpo.com/summaries/2016summaries/PicklingCucumber.pdf

Fungicides that used to manage downy mildew well, but were not highly effective in the 2016 Michigan study included: Previcur Flex 6SC (2 day PHI), Presidio 4FL (2 day PHI), Tanos DF (3 day PHI), Curzate DG (3 day PHI), Revus SC (0 day PHI), and Forum SC (0 day PHI). These data suggest that the downy mildew pathogen may have developed resistance to these fungicide active ingredients, rendering them less effective in controlling disease.

Table 2. Foliar downy mildew severity of pickling cucumbers treated preventively with fungicides.

Treatment and rate/acre, applied at 7-day intervals	Disease severity* 9/6	9/22
Untreated control	6.0a**	9.3a
Bravo WeatherStik SC 2 pt	3.3 de	6.0 de
Koverall DG 2 lb	5.3a-c	7.5 c
Cueva SC 2 qt	5.5ab	8.0 bc
Presidio SC 0.25 pt	4.5 bc	8.0 bc
Previcur Flex SL 1.2 pt	5.0a-c	8.8ab
Ranman SC 0.17 pt	2.3 e	4.3 fg
Zampro SC 0.88 pt	2.8 e	5.5 de
Gavel DF 2 lb	4.3 cd	5.0 ef
Tanos DF 0.5 lb	4.8 bc	7.8 bc
Curzate DG 5 oz	4.8 bc	8.3a-c
Omega SC 1 pt	2.3 e	3.5 gh
Revus SC 8 fl oz	6.0a	8.8ab
Forum SC 6 fl oz	5.3a-c	8.8ab
Orondis Opti SC 34.2 fl oz	1.0 f	2.0 i
Orondis Ultra SC 9.64 fl oz	1.0 f	2.8 hi
V-10208 SC 8 fl oz	2.5 e	6.3 d
Priaxor SC 8 fl oz	5.3a-c	8.0 bc

*Rated on the Horsfall-Barratt scale of 1 to 12, where 1=0% plant area diseased, 2=>0 to 3%, 3=>3 to 6%, 4=>6 to 12%, 5=>12 to 25%, 6=>25 to 50%, 7=>50 to 75%, 8=>75 to 87%, 9=>87 to 94%, 10=>94 to 97%, 11=>97 to <100%, 12=100% plant area diseased.
**Column means with a letter in common are not statistically different (LSD t Test; P=0.05).

The phosphites and salts of phosphorous acid for downy mildew control in cucurbits provide some control, but have not provided equivalent control to the previously mentioned water mold-specific conventional fungicides. Generally, the phosphites reduced foliar disease by about half, when compared to a non-treated control. However, highly effective fungicides reduced disease down to less than 25% of non-treated controls. In looking into the potential benefits of phosphites as tank-mixes with other effective fungicides, I didn't see a significant benefit in disease control or yield gain with this approach. In theory, the use of phosphites can upregulate disease resistance within the plant while other fungicides can directly limit pathogen infection on/in foliar tissues. In several crops, phosphites significantly add to the disease management program overall (ie: hop downy mildew), but this doesn't appear to be the case for cucurbit downy mildew.

Preferred downy mildew fungicides for cucurbits, M. K. Hausbeck, Downy mildew found in Michigan cucumbers in 2018, Downy mildew confirmed in Berrien County for the 2018 season, MSUE Newsletter July 25, 2018.

Product	Active ingredient	FRAC	Comment (maximum applications/season)
*Orondis Opti	oxathiapiprolin/ chlorothalonil	49/ M05	Do not use for more than 1/3 of the total foliar fungicide applications. (6)
*Elumin SC	ethaboxam	22	Mix with chlorothalonil or mancozeb. (2)
*Ranman 4SC	cyazofamid	21	Mix with chlorothalonil or mancozeb. (6)
Gavel 75DF	mancozeb/ zoxamide	M03/ 22	Mix with chlorothalonil or other downy mildew fungicide. (8)
Zampro 4.4SC	ametoctradin/ dimethomorph	45/40	Apply as a foliar spray. Mix with chlorothalonil or mancozeb. (3)
Zing! SC	zoxamide/ chlorothalonil	22/ M05	Mix with mancozeb or other downy mildew fungicide. (8)

*These products have performed exceptionally well in Michigan trials. Follow label recommendations for resistance management.

For more information on symptoms, disease cycle, and general management, please visit: http://learningstore.uwex.edu/Assets/pdfs/A3978.pdf

The 2018 A3422 Commercial Vegetable Production in Wisconsin Guide is now available for 2018. 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. http://learningstore.uwex.edu/Assets/pdfs/A3422.pdf

Phoma in Hops. Dr. Michelle Marks, UW-Potato and Vegetable Pathology and Amanda Gevens.

Over the last several weeks, the Vegetable Pathology Lab and the Plant Disease Diagnostic Clinic have received numerous hop leaf samples exhibiting discrete, circular, tan-brown spots 1-3 cm in diameter. Hops plants with leaf spot symptoms were also often described as exhibiting cone browning and, in some cases, wilt symptoms. Samples have been received from South Central and North Central Wisconsin, on several hop varieties including 'Tahoma' and 'Magnum'. The pathogen isolated from leaf spots has been identified as of the genus *Phoma*, a relatively common fungus with a broad host range. It has generally been considered to be a pathogen of minor importance on hops in the literature, and little information about this disease, including its life cycle in hop yards, is available.

Symptoms: *Phoma exigua* is the most frequently documented species infecting hop, and has been demonstrated to cause leaf spots and cone necrosis in Europe, and canker and wilt symptoms in Europe, New Zealand, and China. Leaf spot symptoms may first appear as small chlorotic spots that then progress into the relatively large, circular or oval, gray-brown lesions pictured below. These lesions may have a "bullseye" appearance with concentric rings visible. Cone infection is characterized by reddish-brown necrosis first on the tips of bracts and bracteoles that may then progress to the rest of the cone. Diseased plants may also be comparably unthrifty and wilt completely.

Management: Few investigations have focused exclusively on managing this disease in hop yards. This pathogen likely survives in or on infested hop debris or other decaying organic matter and is dispersed by splashing water or wind. Hop yard sanitation and the removal of plant debris may help mitigate this disease. As this pathogen is a "true" fungus similar to hop powdery mildew, fungicides with action against powdery mildew likely also have activity against *Phoma*. **It should be noted that fungicides that control hop downy mildew exclusively will *not* be effective for this disease.** The best fungicides for Phoma are: tebuconazole (ie: Folicur, Monsoon, Orius, Toledo, Onset), trifloxystrobin (ie: Flint), fosetyl Al (ie: Aliette, Linebacker), and copper hydroxide (ie: Champ).

Why now? Where has this pathogen come from and why is it proving to be such an issue for some growers this year? *P. exigua* is found to cause disease on at least 35 other plant hosts in addition to hops, and it likely common within the environment as a result of having such a broad host range. We have had confirmations of *Phoma* infection in the past in hop yards, so this pathogen can be reasonably expected to persist in hop yards or other nearby plant hosts. It may also be possible, though there is no research on this specific pathogen to substantiate this claim, that the longer a hop yard has been established, the incidence and severity of diseases such as *Phoma* may increase as buildup of pathogen occurs over time. Another likely possibility is that the environment for disease development has been particularly conducive this year. This summer has been characterized by relatively long dry periods punctuated by short periods of wetness. These conditions are favorable for the development of other fungal pathogens such as hop powdery mildew, and may also favor *Phoma* disease development.

Are you seeing similar symptoms within your hop yard on leaves or cones? Want to know if you're dealing with *Phoma* or something else? We are interested in learning more about this disease and invite you to send suspicious samples to us here in the Vegetable Pathology lab or to the Plant Disease Diagnostic Clinic for diagnosis free-of-charge. Please describe the symptoms you are seeing on affected plants (leaf spots, cone browning, and/or wilting), the hop variety, and where you are located.

Phoma leaf symptoms. Gray-brown lesions start small but can grow to approximately 1-3 cm in diameter. Lesions are typically circular or oval in shape.

Reddish-brown lesions on cones caused by *Phoma exigua*. Browning often occurs first on the tips of bracts/bracteoles (right) and may progress throughout the entire cone (left). Photo credit: S. Radisek.

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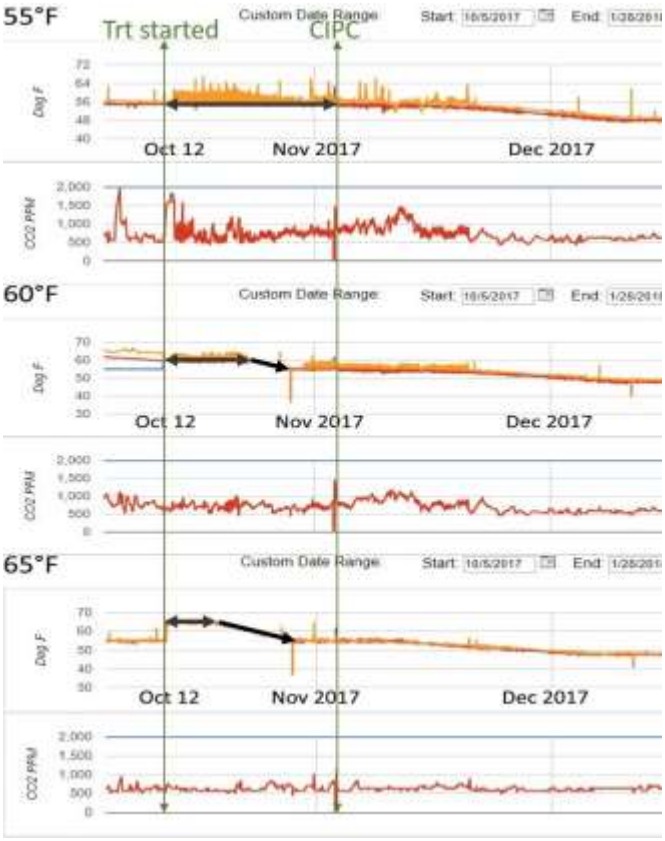
This week I am providing some updates on our 2017-2018 storage trial conducted at the Hancock Potato Storage Research Facility.

Last year in early October, we put three varieties (Russet Burbank, Snowden, and Hodag) into each of the three wound healing regimes:

- Regime 1: *wound healing at 55°F for 30 days* and then ramped down to holding temperature (48°F) at a rate of 0.3°F/day;
- Regime 2: *wound healing at 60°F for 10 days*, ramped down to 55°F at a rate of 1°F/day, and then ramped down to holding temperature (48°F) at a rate of 0.3°F/day;
- Regime 3: *wound healing at 65°F for 5 days*, ramped down to 55°F at a rate of 1°F/day, and then ramped down to holding temperature (48°F) at a rate of 0.3°F/day.

The figure below shows our three treatments:



We measured weight loss of whole tubers, sugar and fry color, and common storage disease incidence and severity on a monthly basis from at harvest to June, 2019. Below is a quick summary of our results.

Overall Snowden (11.6%) has the highest total weight loss compared to the other two varieties (RB 6.9% and Hodag 6.6%) during the 9 months of long-term storage. Across the three varieties, total weight loss under 55°F (9.8%) is significantly higher than under 60°F (8%) and 65°F (7.3%) for wound healing. For each variety, Hodag and Russet Burbank has significantly higher weight loss under 55°F wound healing

than under 60°F and 65°F, but the difference is not significant on Snowden (Figure 1). For Snowden, total weight loss over the 9-month storage season has always been higher than 11%, no matter what wound healing conditions the tubers were under.

Figure 1, different letters indicate significant difference

For glucose and fry color, Hodag is featured with its consistently low glucose content and light fry color during the entire 9-mo. storage period (Figure 2a), regardless of the wound healing conditions. This is one of the biggest reasons for Hodag's popularity.

For Snowden, no difference can be observed until May, when senescence sweetening started to show up. Senescence sweetening is a problem that penalizes Snowden's long-term storability. In May and June, tubers under 55°F and 60°F wound healing showed substantially higher levels of glucose than under 65°F wound healing (Figure 2b). In other words, wound healing at 65°F after harvest can mitigate Snowden's senescence sweetening issue (Figure 3).

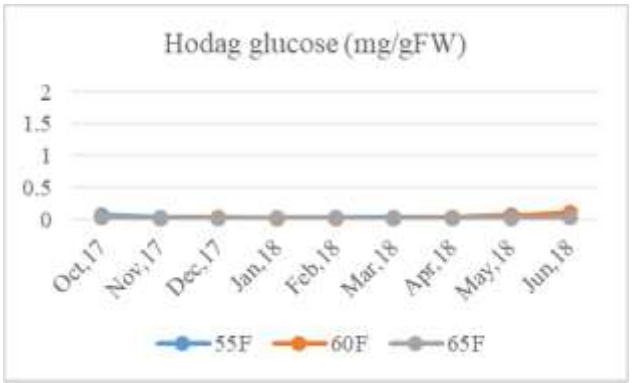


Figure 2a

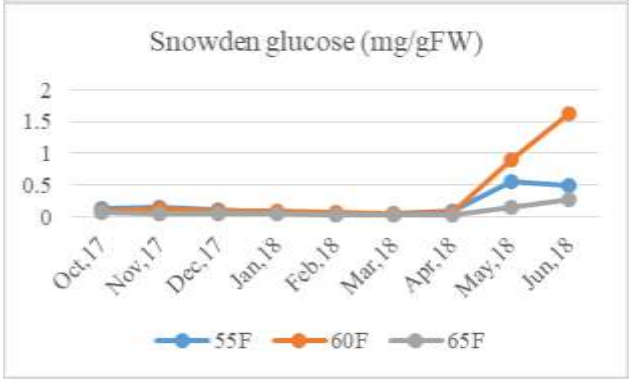


Figure 2b

55°F April

55°F May

55°F June

60°F April 60°F May 60°F June

65°F April 65°F May 65°F June

Figure 3

For Russet Burbank, wound healing at 65°F can result in the lightest fry color on both bud and stem ends (Table below, please notice that higher number means lighter fry color, different letters following the numbers indicate significant difference).

Wound healing conditions	**Stem end fry color**	**Bud end fry color**
55°F	24.6 B	32.1 B
60°F	23.5 B	32.6 B
65°F	26.9 A	34.6 A

With regards to diseases, Hodag and Snowden showed very mild storage disease problems, regardless of the wound healing conditions. Russet Burbank was not in a good shape out of the field. A lot of pink eye / misshaped tubers were observed at harvest last fall. Therefore, Russet Burbank piles in storage always have more “hot spots” with soft rot, dry rot, and Pythium leak issues, compared to the two chipping varieties. However, we were not able to differentiate the size of the hot spots under different wound healing treatments. Future research needs to be done to investigate a better approach of evaluating the size of hot spots during potato storage.

In summary, wound healing at higher temperatures (60 and 65°F compared to the 55°F standard practice) do have some benefits, and those benefits are variety dependent:

For Hodag, characterized by its low sugar level and light fry color during storage, benefits from the increased wound healing temperature by losing less tuber weight at the end of the 9 month storage period;

For Snowden, which tends to show the highest weight loss during storage, benefits from the higher wound healing temperature at 65°F by showing mitigated senescence sweetening symptoms;

For Russet Burbank, increased wound healing temperature, particularly at 65°F, can help with total weight loss reduction and fry color improvement.

The other take-home message is that tuber health at harvest does affect their long-term post-harvest storability.

We are repeating this study this year, stay tuned.