Vegetable Crop Update

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

Division of Extension
University of Wisconsin-Madison

No. 6 – June 2, 2019

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Calendar of Events

July 18, 2019 – UW-Hancock Agricultural Research Station Field Day, Hancock, WI
July 25, 2019 – UWEX Langlade County Airport Research Station Field Day, Antigo, WI
August 2, 2019 – UW-Lelah Starks Elite Foundation Seed Potato Farm Field Day, Rhinelander, WI
December 3-5, 2019 – Midwest Food Producers Association Annual Convention/Processing Crops Conference, Wisconsin Dells, WI
January 26-28, 2020 – WI Fresh Fruit & Vegetable Growers Conference, Wisconsin Dells, WI
February 4-6, 2020 – UWEX & WPVGA Grower Education Conference, Stevens Point, WI

Vegetable Insect Update – Russell L. Groves, Professor and Extension Specialist, UW-Madison, Department of Entomology, 608-262-3229 (office), (608) 698-2434 (cell), or e-mail: groves@entomology.wisc.edu.

Colorado potato beetle – Initial overwintering Colorado potato beetle (CPB) adults continue to emerge in southern Wisconsin at the Arlington Agricultural Experiment Station, and at the Hancock Agricultural Experiment Station in central Wisconsin (http://labs.russell.wisc.edu/vegento/pests/colorado-potato-beetle/). In the next few weeks, as early planted potato has emerged from hilling, beetles will start to colonize emerging plants and begin to deposit eggs. When not controlled, CPB can completely defoliate plants resulting in serious yield losses or even plant death. Beetles prefer to feed on potato, but will also use eggplant and other solanaceous crops and weeds. Both larval and adult life stages commonly cause damage to plants throughout the growing season. CPB is a persistent pest annually, once an infestation occurs beetle populations tend to increase annually.

CPB overwinter as adults in Wisconsin. Typically overwintering adults will burrow 10-30 cm into the soil, often choosing protected areas near trees or in grassy edges surrounding gardens or fields. Adults emerge in the spring, at about the time potato breaks ground. Overwintered adults often colonize crops first along field edges. Border planted crops are often the first places to begin scouting for beetle infestations. Larvae hatch from the eggs in 4-9 days depending upon ambient air temperature. The larvae will molt three successive times before pupating. Each immature life stage (stadium) between molts is called an instar, totaling 4 instars. First instar larvae are blackish-brown in color and very small, approximately the size of a pinhead. Once hatched first instar larvae prefer to feed upon newly expanded foliage at the crown of the plant. Because of their small size feeding damage is minimal. Second instar larvae assume a deep crimson coloring, leaf consumption increases two-fold from first instars. Third and fourth instars have bright red abdomens with black head capsules and legs. The last two larval instars consume increasingly more foliage and result in the majority of economic damage to solanaceous crops. After passing through four instars over 2-3 weeks, larvae return to the soil to pupate. Within 7-10 days the second generation of adult beetles emerge.

Potato plants can tolerate varying levels of defoliation before they will suffer yield losses. The level of tolerance depends on the plant's growth stage. Flowering plants can tolerate the least defoliation, only 5-10% of total leaf area. Post-flower potato is able to withstand a slightly greater amount of defoliation (up

to 10%), but since this is a critical point for tuber formation and bulking growers should limit the amount of feeding done by CPB.

Aster Leafhoppers – Early season (late April) sweeps for Aster leafhoppers (ALHs), the insect vector of Aster Yellows phytoplasma (AYp), revealed low numbers on areas of eastern Oklahoma, and southeastern Kansas (http://labs.russell.wisc.edu/vegento/pests/aster-leafhopper/). The ALH can be a serious pest of many plants in the upper Midwest because of its ability to spread AYp. Leafhoppers prefer lettuce, carrots, celery, and small grains for feeding and breeding, while other crops such as potatoes and onions provide a temporary source of food and refuge. Only adults use these temporary sites; immature leafhoppers fail to develop on these plants. Early season surveys of these insects at multiple sites in the southern US suggested very low populations, especially given the slow accumulation of degree days through the Midwest over the past 6-8 weeks.

The first adult ALH that appear in early May do not overwinter in Wisconsin. They overwinter as eggs on grain crops in portions of the mid-southern US (eg. KS, OK, AR, TX), and migrate northward as adults each spring on warm, southerly winds. The migrant leafhopper population is important because of the potential for the migrants to already be infected with the AYp pathogen when they arrive. The migrant females lay eggs in the plant tissues of early grain crops, weeds and susceptible carrot, and celery.

Low numbers of ALH have now been detected in portions of southern Wisconsin, suggesting that few migratory insects have arrived. Samples taken in late May from the Arlington Agricultural Research Station resulted in an average of 2.5 adult ALH/100 sweeps in emergent wheat crops. Infectivity levels of the AYp within insects were estimated to be below 1%. These few infected adults do not pose much early season risk for newly emerged and highly susceptible crops such as lettuce, celery, susceptible carrot varieties, as the computed the Aster Yellows Index (AYI) values are are far less than the threshold of 25 (http://labs.russell.wisc.edu/vegento/files/2012/05/Aster-yellows-index.pdf). Migrant leafhoppers could continue to arrive in the state over the next 2-3 weeks with southerly winds that precede cold fronts moving westerly across the Midwest and into the Lake States.

Seed Maggots - The emergence and flights of the second generation of seed corn maggot flies is approaching southern Wisconsin (**Fig. 1**), and with forecast moderate temperatures, would be expected in the coming week to 10 days in southern Wisconsin (http://labs.russell.wisc.edu/vegento/pests/seedcorn-maggot/). This insect has a base developmental temperature of 39°F and the emergence of adult fly populations are expected at accumulated degree days of 360, 1,080 and 1,800 degree days. The first generation of adult flies (360 DD_{39}) has already passed throughout much of the state, and is still only present in very northern portions of the state. Adult flies will become very active in the coming week to 10 days and begin to lay eggs at the base of susceptible (young) plants, where larvae tunnel into underground portions.

The first generation of onion maggots (http://labs.russell.wisc.edu/vegento/pests/onion-maggot/), is very active throughout central Wisconsin where degree day totals of 680_{40} degree days (spring), have been reached using a slightly different base temperature of 40°F. The first generation peak of egg-laying adults is now present in central portions of the state. As onions mature, they are less susceptible to onion maggot infestation unless they are damaged by cultivation equipment. Soil applications of Verimark or Lorsban can be used to control onion maggot in dry bulb onions and the seed treatments of Supresto or FarMore DI500 are available to minimize damage. The preventative soil insecticide applications are recommended for the control of the first generation larvae if you have previously documented damage from the previous year's crop which exceeds 5 to 10%.

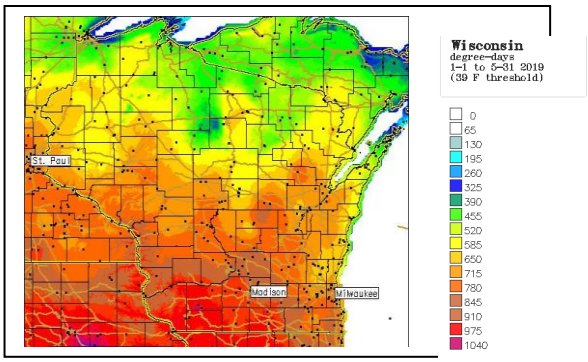

Figure 1. Degree day accumulations from 1 Jan to 31 May 2019 over the state of Wisconsin using a base temperature of 39ºF (http://uspest.org/cgi-bin/usmapmaker.pl).

Vegetable Entomology Webpage: http://www.entomology.wisc.edu/vegento/index.html

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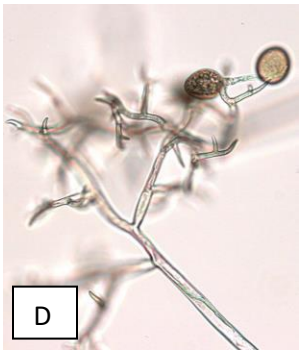
Current P-Day (Early Blight) and Disease Severity Value (Late Blight) Accumulations (Many thanks to Ben Bradford, UW-Madison Entomology; Stephen Jordan, John Hammel, & Samuel Meyer, UW-Madison Plant Pathology). A P-Day value of ≥300 indicates the threshold for early blight risk and triggers preventative fungicide application. A DSV of ≥18 indicates the threshold for late blight risk and triggers preventative fungicide application. Red text in table indicates threshold has been met/surpassed. TBD indicates that data is To Be Determined as time progresses. Weather data used in these calculations comes from weather stations that are placed in potato fields in each of the four locations. **New this year!** Data are available in graphical format for each weather station at: **https://wivegdis.plantpath.wisc.edu/dsv/#grand-marsh**

Location	*Planting Date*		**Emergence Date (50%)**	**Disease Severity Values (DSVs) 5/31/19**	**Potato Physiological Days (P-Days) 5/31/19**
Grand Marsh	Early	Apr 10	May 20	2	77.26
	Mid	May 1	June 1	0	6.87
	Late	May 20	TBD	TBD	TBD
Hancock	Early	Apr 10	May 22	2	72.83
	Mid	Apr 25	May 27	1	36.93
	Late	May 15	TBD	TBD	TBD
Plover	Early	Apr 22	May 27	0	34.90
	Mid	May 1	June 1	0	7.45
	Late	May 29	TBD	TBD	TBD
Antigo	Early	May 14	May 29	1	TBD
	Mid	May 24	TBD	TBD	TBD
	Late	Jun 1	TBD	TBD	TBD

Downy mildew confirmed this week on **hop plants** from Dane County (UW-Plant Disease Diagnostic Clinic) and on **basil plants** from several home garden centers in Dane County. The pathogens are unique to each crop, but similar weather favors their onset and development.

Basil downy mildew is not new to Wisconsin; 2010 was the first year in which the disease was confirmed in our state on basil. Since that time, we've seen the disease in our state with sporadic occurrence. It is not uncommon to see symptoms on nursery plants for sale. The pathogen can be seedborne and development of the disease is at high risk when plants are maintained under high humid, and moderate temperatures with limited airflow. Basil downy mildew made headlines nationally as a new disease in North America as well as Europe. First reported in FL in 2007, basil downy mildew was later found in field and greenhouse in Canada, Argentina, and in the US states of NC, PA, NJ, NY, MA, NC, KS, and MO in 2008. Reports continued in 2009 in the US.



Basil downy mildew symptoms and signs. **A**. Topside of leaf (note yellowing or chlorosis and brown, dead lesions. **B**. Underside of leaf (note patches of gray-purple fuzzy pathogen sporulation). **C**. Portion of whole plant infected with downy mildew (note yellowing and curling of lower leaves, along with brown lesions). **D**. Branched sporangiophore (spore tree) and sporangia (spore) of basil downy mildew under 200X magnification.

Basil downy mildew is caused by the fungus-like pathogen *Peronospora belbahrii* and can be transmitted on seed, infected plant parts, and on the wind. This particular downy mildew can both ornamental and basil varieties grown as herbs. It is suspected that basil downy mildew has moved geographically on contaminated seed or leaves. The spores of basil downy mildew are produced on leaf underside prolifically and can be aerially dispersed long distances.

The management of basil downy mildew includes planting 'clean' basil seed, selecting resistant or tolerant varieties, and applying fungicides when environmental conditions favor disease. More information on Rutgers University's recent resistant basil varieties can be found here: https://vegetablegrowersnews.com/news/downy-mildew-resistant-basil-varieties-now-available/

Minimizing leaf wetness and humidity will aid in downy mildew management as the pathogen is favored by moist conditions. It is known that sweet basil varieties are more susceptible than other basil species.

Basil varieties susceptible to downy mildew	
Aroma 2	Italian Large Leaf
Genovese	Magical Micheal

Genoveser Martina	Mariden
Nufar	Opal Purple Variegated
Queenette	Poppy Joe's
Superbo	
Basil varieties tolerant to downy mildew	
Amethyst Imp	Mrs. Burns Lemon
Red Rubin	Red Leaf
Sweet Adin	Lemon
Lemon standard	Lemon Mrs. Burns
Lemona	Lime
Basil varieties resistant to downy mildew	
Spice	Blue Spice
Blue Spice Fil	Rutgers Obsession, Devotion, Thunderstruck, Passion

Applying fungicides frequently and starting before first symptoms are considered necessary to control downy mildew effectively. Few fungicides are currently labeled for this new disease. Actinovate AG and OxiDate are OMRI-listed fungicide labeled for use on herbs and for suppressing foliar diseases including downy mildew. OxiDate is labeled for use outdoors and in greenhouses. The Actinovate label does not have a statement prohibiting use in greenhouses. There are two phosphorous acid fungicides, ProPhyt and K-Phite, that have downy mildew under herbs on the current label. These fungicides were effective in fungicide efficacy experiments with applications started before or after initial symptoms were found. Greenhouse use is not prohibited. Amistar and Quadris are labeled for use on basil but not specifically for downy mildew; they have the same active ingredient, which has been shown to be effective for this downy mildew. Greenhouse use is not permitted with Amistar and Quadris. Other fungicides are expected to be labeled for basil downy mildew in the future.

To determine when to initiate a fungicide program and also when it is warranted to consider harvesting early to avoid losses to downy mildew, growers should not only routinely check the on-line spreadsheet to determine when downy mildew is occurring on basil nearby, but also regularly inspect their crop for symptoms. The cucurbit downy mildew forecasting web site (http://cdm.ipmpipe.org) might be useful for predicting when conditions are favorable for basil downy mildew since both pathogens likely have similar requirements for successful wind dispersal long distances (e.g. overcast skies) and subsequent infection (e.g. wet leaves). Summer is not a time to forget about this disease: unlike most other downy mildew pathogens, e.g. the ones affecting lettuce and cruciferous crops, which stop developing in summer, the basil downy mildew pathogen seems to develop best under moderate to warm temperatures while also tolerating cool temperatures. Basil crops should be disked under or otherwise destroyed as soon as possible after last harvest, or when abandoned because of disease, to eliminate this source of inoculum.

Hop Downy Mildew Identification and Control in Wisconsin

Downy mildew caused by *Pseudoperonospora humili*, is a common disease on hop in Wisconsin. Once established in a hop yard, the disease can be persistent, overwintering in the below-ground plant parts. Earliest symptoms include downcurling of often brittle leaves, pale green-yellow foliage, and presence of dark gray-purple pathogen sporulation on leaf undersides. Early management of hop downy mildew is critical for limiting inoculum for the rest of the production season. While the pathogen will not likely be eradicated from the yard, sound management enables a healthy production season with less inoculum for late season when cones are forming. Further, reducing disease and inoculum in this season, limits the amount of pathogen that will remain with your hop plants for future years. Cool, wet weather is most favorable for downy mildew and may require weekly applications of fungicides for disease management. Hot, dry weather provides great conditions for limiting disease – often enabling 10-14 day fungicide application intervals for disease management. For further information on use of fungicides in

management of hop downy mildew, please see the document link, below (from 2016 but registrations still current). Additionally, I provided the registered fungicide list for Wisconsin hop downy mildew control. **https://ipcm.wisc.edu/download/misc/Considerations-for-disease-control-in-Wisconsin-hop-production-2016.pdf**

Disease control in hops

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew (*Pseudoperonospora humili*)	ametoctradin + dimethomorph	11.0–14.0 fl oz Zampro	7	Do not apply more than 40.0 fl oz/a per season. Make no more than 3 applications per season. Do not make more than 2 sequential applications before alternating to a labeled fungicide with a different mode of action.
	Bacillus pumilis strain QST 2808	2.0–4.0 qt/100 gal spray volume of Sonata	0	Use when conditions favor disease and apply at 7- to 14-day intervals as needed. OMRI approved.
	basic copper sulfate	1.0–1.25 lb Cuprofix Ultra 40 Disperss	14	Apply after pruning but before training. Apply again as needed on a 10-day basis after training.
	copper ammonium complex	2.0 qt Copper Count N	14	Apply after pruning but before training. Apply again as needed on a 10-day basis after training.
	copper hydroxide	1.33 lb Champ Dry Prill 1.33 lb Champ Formula 2 Flowable 1.06 lb Champ WG 0.75–1.5 lb Kocide 3000 1.5 lb Kocide 2000 2.0 lb Kentan DF 1.33–2.67 pt NuCop 3L	14	Apply after pruning but before training. Apply again as needed on a 10-day basis after training.
	copper octanoate	0.5–2.0 gal Cueva in 100 gal water	0	Apply soon after training vines.
	copper oxychloride + basic copper sulfate	4.0–6.0 lb C-O-C-S WDG	14	Apply soon after training vines.
	cuprous oxide	2.0 lb Nordox	14	Apply after pruning but before training. Apply again as needed on a 10-day basis after training.
	cyazofamid	2.1–2.75 fl oz Ranman	3	Apply prior to or at first sign of disease. Follow resistance management guidelines. Rainfast.
	cyflufenamid	6.0–8.0 oz Torino	6	Do not make more than 2 applications per year. Treat at first sign of disease.
	cymoxanil	3.2 oz Curzate DF	7	Apply with a protectant fungicide such as copper hydroxide. Rainfast in 2 hours.
	dimethomorph	6.0 fl oz Forum	7	Do not make more than 3 applications per season. Addition of an adjuvant to spray mix is recommended. Good antisporulant. Rainfast.
	famoxadone + cymoxanil	8.0 oz Tanos	7	Use with a tank-mix partner. Apply preventatively and on a 6- to 8-day spray schedule. Follow resistance management guidelines. Excellent curative activity. Good leaf protectant. Rainfast.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	14	Suppression of downy mildew only. Do not exceed 4 applications per year.

fosetyl-al	2.5 lb Aliette 5.0 lb/100 gal spray volume Linebacker	24	Do not tank mix with coppers. Initiate application when weather conditions favor disease (warm and humid). Avoid mixing with foliar fertilizers or surfactants.
mandipropamid	8.0 fl oz Revus	7	A non-ionic surfactant is recommended with use of this product. Follow resistance management guidelines.
mefenoxam	0.5 pt Ridomil Gold SL	45	Label allows drench and foliar applications. Follow resistance management guidelines. Can be highly effective and is a two-way systemic. However, downy mildew pathogen may have resistance.
monopotassium phosphate and monopotassium phosphite	2.0–4.0 qt Phorcephite 1.0–3.0 qt in 20 gal of water Rampart	0	Apply when conditions favor disease when shoots are 6–12 inches high, after training at 5–6 ft tall, about 3 weeks after second application, and during bloom.
mono- and dipotassium salts of phosphorous acid	1.0–3.0 qt in 20 gal water Confine Extra 1.0–3.0 qt/100 gal water Fosphite 1.0–2.0 qt/a in a spray volume of 25 gal water Fungi-phite 2.0–4.0 pt Helena Prophyt 2.5 pt Phostrol	0	Apply at 2- to 3-week intervals. Do not apply at an interval less than 3 days. Apply when conditions favor disease when shoots are 6–12 inches high, after training at 5–6 ft tall, about 3 weeks after second application, and during bloom.
potassium bicarbonate	2.5–5.0 lb/100 gal spray volume Armicarb 100	0	Do not exceed mix rate of 5.0 lb/100 gal of water. Do not store unused portion of spray for more than 12 hours prior to use.
pyraclostrobin + boscalid	14.0 oz/100 gal spray volume Pristine	14	Use preventatively and apply at 14- to 21-day intervals as needed. Follow resistance management guidelines.
extract of *Reynoutria sachalinensis*	1.0–4.0 qt Regalia	0	Use preventatively and apply at 7-day intervals as needed. **Emergence to wire-touch:** 1.0–2.0 qt recommended. **Wire-touch through harvest:** 2.0–4.0 qt. OMRI approved. Has some contact fungicidal activity.

Accessing the 2019 University of Wisconsin Madison Extension Commercial Vegetable Crop Production Management Guide: Our production guide is updated every October with release of a new guide in January. The book can be downloaded for free as a pdf at the link below, or can be purchased online for $12.50. **https://learningstore.uwex.edu/Assets/pdfs/A3422.pdf**