Vegetable Crop Update

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

No. 3 – April 28, 2014

In This Issue

Calendar of Events

July 22– UW-Hancock Agricultural Research Station Field Day, Hancock, WI
August 12-14 – Farm Technology Days, Stevens Point, WI

Vegetable Disease Update – Amanda J. Gevens, Assistant Professor & Extension Vegetable Plant Pathologist, UW-Madison, Dept. of Plant Pathology, 608-890-3072 (office), Email: gevens@wisc.edu.

Vegetable Pathology Webpage: http://www.plantpath.wisc.edu/wivegdis/

Please note – Spanish versions of our UWEX Veg Crop Updates Newsletter are now available at our Vegetable Pathology website: http://www.plantpath.wisc.edu/wivegdis/pdf/2014/Newsletter%20No%202%202014%20%20en%20espanol.pdf

and on facebook: https://www.facebook.com/UniversityOfWisconsinPotatoVegetablePathology

Thank you to Amilcar Sanchez Perez, Graduate Student in UW-Plant Pathology, for translation! Most newsletters and newsletter components will be translated and posted to our website/facebook page within 3 days of English posting.

Early Season Hop Update (written with Michelle Marks, Graduate Research Assistant, UW-Plant Pathology): The snows have finally receded (for the most part) here in Wisconsin and for us at the University, it's time to get out into the hop yards and start thinking about summer. Our first field trips have revealed that hops of multiple varieties (ie: Sterling, Nugget, Chinook, Horizon, Glacier, Perle, Columbus, Santiam) have emerged in several areas of the state. Plants in the southern regions are generally more advanced.

As the early season progresses, it is important to keep an eye out for signs of spring diseases, with downy mildew being one of chief concern. If underground plant parts are infected with the pathogen, systemically infected shoots emerging from the crown, called "basal spikes" are the

first signs of the disease. Basal spikes often appear yellow-green and chlorotic, and are stunted with down-curling leaves. As the disease advances, plant tissues will start to appear brown and necrotic from the ground up. Keeping records of when basal spikes first appear at your location can help you better understand your disease overall downy mildew risk. Additionally, this information would be of great use to us in our research efforts.

If you observe abnormal plant material and are unsure of the cause, our lab is happy to receive samples for diagnosis. Additionally, the University of Wisconsin Plant Disease Diagnostic Clinic here on campus at the UW-Madison is fully equipped to receive and analyze plant samples of all types for a small fee. Samples can be sent to:

Plant Disease Diagnostics Clinic
Department of Plant Pathology
University of Wisconsin-Madison
1630 Linden Drive
Madison, WI 53706-1598

For full sample collection/packaging instructions and additional information please visit the clinic website at http://labs.russell.wisc.edu/pddc/ or contact Dr. Brian Hudelson at 608-262-286.

Those who attended the Hop Production Meeting in Wausau in early March know that there is now a UW-Madison Plant Pathology graduate student fully dedicated to hops (Michelle Marks), and several generous growers from around the state have opened their farms to us for scouting and research purposes. Our objectives for this summer will include focusing on the topics of disease forecasting, downy mildew, and the status of hop diseases in Wisconsin. Specifically, we will be validating models for predicting basal spike emergence based on degree-days originally formulated for the Pacific Northwest. And, we will be examining whether such models can be used to initiate fungicide programs for downy mildew. Multiple fungicide programs and strategies for disease control will be evaluated for efficacy on Wisconsin commercial farms. Examination of the relationship between degree-days and hop physiological status and the overall state of hop diseases/management in WI are other topics under consideration. We look forward to sharing what we learn with you this summer and in the upcoming years.

Hop Fungicides for Downy and Powdery Mildew Control: Fungicides can be important for continued control of downy mildew. Early season applications may limit the amount of initial inoculum that can become available to the developing crop as the season progresses. The start of a preventative fungicide program for downy mildew may begin at spike emergence. This timing is based on temperature or growing degree days, aligning with growing degree days (GDD) of 111.3. Notes below provide further explanation and directions for determining this number for your location.

Based on David Gent's recent work in Oregon, the time to initiate a fungicide program for preventative downy mildew control in hops is at predicted spike emergence (emergence of basal shoots in spring, growing degree day 111.3 air temperature). This is calculated using growing degree days starting from February 1 (base 6.5°C). To get to this emergence date, there is a GDD calculator (http://www.weather.com/outdoors/agriculture/growing-degree-days/53706:4) that can be used with your specific zip code. Base 6.5°C can be defaulted to 40°F to simplify. With this tool, you select current day's date for 'end'. For example, today April 25, 2014, in Madison, we are at GDD 197. As you move northward in the state, GDD accumulate more slowly. I ran a few

additional cities to demonstrate the difference in expected spike emergence dates based on GDD across the state.

WI City	GDD (base 6.5°C, start Feb 1, end April 25)
Janesville	240
Madison	197
Stevens Point	58
Antigo	30
Rhinelander	35
Superior	24

The tool should indicate a crop physiological status (emergence). Emergence can simply be observed, however, emergence is progressive and spans a period of time for 'complete emergence'. In theory, the tool enables you to identify the earliest phase of emergence and as such aids in timing of early/preventative downy mildew control which may include a copper application or, in southern WI, early pruning.

When to follow up with fungicide sprays for downy mildew?: This will vary depending upon the weather. There is a disease risk index utilized by some Pacific northwestern hop growers that has not yet been validated for WI. The premise is that the more rainfall and relative humidity present under moderate temperatures (46-86°F) the greater the disease pressure. Under high pressure times, fungicides should be applied on a 5-7 day spray program. When rainfall is reduced, relative humidity is low and we experience either temps cooler than 46 or higher than 86°F, disease pressure is low and fungicides should be applied on a 10-14 day program.

Many growers may be unsure as to what diseases are active in the yard, or when to be on critical look out. I recognize that fungicides, to date, have been used on a limited basis on WI hops due to multiple factors. In this and upcoming years, additional research/extension programming is planned to support our understanding of hop disease and timing/efficacy of fungicides. Below, please find information which is intended to provide suggested fungicide programs for control of downy and, if present and necessary, powdery mildew.

A good fungicide for use in a 14-day calendar program is fosetyl aluminum or Aliette/Linebacker. Phostrol also provides similar extended control as it believed to upregulate disease defense in the plant. Use of an 'Aliette' type product alternated with a tank mix of copper hydroxide plus cymoxanil (Curzate) creates a sound program. Western states also alternate with copper hydroxide (ie: Kocide) and trifloxystrobin (Flint) in control of powdery mildew.

Below, I have outlined a general foliar fungicide program by calendar for Wisconsin hop yards with additional notes in the right-hand column. If you raise other crops and have familiarity with common base protectant fungicides, remember that **you cannot use captan, chlorothalonil, or mancozeb on hops.** These fungicides do not have EPA Section 2 or any other special labeling to permit their use on this crop. The only base protectant, broad spectrum fungicide for hops is copper (or copper containing formulations such as Kocide).

Time of application	**Fungicide selection** **Active ingredient (trade name examples)**	**Comments**
Spray 1: Spike emergence (or GDD 111.3, 40C base, Feb 1 start)	Fosetyl aluminum (Aliette, Linebacker) Salts of phosphorous acids (Phostrol)	The Aliette program is used in the Pacific northwest with good results. Fosetyl aluminum products cannot be tank mixed with coppers. Phostrol has similar activity as Aliette. Be careful with spray volume and rate – as concentrated Phostrol can potentially be

		phytotoxic.
Spray 2: 2 weeks after Spray 1	Cymoxanil (Curzate) Copper hydroxide (Kocide) Dimethomorph (Forum) Cyazofamid (Ranman) Pyraclostrobin + Boscalid (Pristine) Famoxadone + Cymoxanil (Tanos) Mandipropamid (Revus) Mefenoxam (Ridomil Gold SL)	The Curzate + Kocide tank-mix program is used in the Pacific northwest with good results. Curzate and Kocide are good downy mildew fungicides across multiple vegetable crops. Pre-mixes that have good downy mildew and powdery mildew control are: Pristine and Tanos. Price point and availability of products in this list may influence selection. All listed have performed well on downy mildews of various crops.
Spray 3: 2 weeks after Spray 2	Fosetyl aluminum (Aliette, Linebacker) Salts of phosphorous acids (Phostrol)	The Aliette program is used in the Pacific northwest with good results. Fosetyl aluminum products cannot be tank mixed with coppers. Phostrol has similar activity as Aliette. Be careful with spray volume and rate – as concentrated Phostrol can potentially be phytotoxic.
Spray 4: 2 weeks after Spray 3	Cymoxanil (Curzate) Copper hydroxide (Kocide) Dimethomorph (Forum) Cyazofamid (Ranman) Pyraclostrobin + Boscalid (Pristine) Famoxadone + Cymoxanil (Tanos) Mandipropamid (Revus) Mefenoxam (Ridomil Gold SL)	The Curzate + Kocide tank-mix program is used in the Pacific northwest with good results. Curzate and Kocide are good downy mildew fungicides across multiple vegetable crops. Pre-mixes that have good downy mildew and powdery mildew control are: Pristine and Tanos. Price point and availability of products in this list may influence selection. All listed have performed well on downy mildews of various crops.
Spray 5: 2 weeks after Spray 4	Fosetyl aluminum (Aliette, Linebacker) Salts of phosphorous acids (Phostrol)	The Aliette program is used in the Pacific northwest with good results. Fosetyl aluminum products cannot be tank mixed with coppers. Phostrol has similar activity as Aliette. Be careful with spray volume and rate – as concentrated Phostrol can potentially be phytotoxic.
Spray 6: 2 weeks after Spray 5	*For Powdery and Downy mildew control:* Pyraclostrobin + Boscalid (Pristine) Famoxadone + Cymoxanil (Tanos) *For Powdery mildew control:* Trifloxystrobin (Flint) Tebuconazole (Tebuzol, Orius, Toledo, Monsoon, ONSET, Tebustar) Myclobutanil (Rally, formerly Nova) Quinoxyfen (Quintec) Triflumizole (Procure) Neem oil *For Downy mildew control:* Cymoxanil (Curzate) Dimethomorph (Forum) Cyazofamid (Ranman)	Powdery mildew (PM), if present, may be problematic at this time of the year. We often see PM on cucurbits and other crops at this time (earlier in hot years). Pristine and Tanos are good pre-mix selections for both PM and Downy mildew. Products with individual disease activity can be tank-mixed. If you have primarily or just a PM problem, good selections include: Flint, Tebustar, Rally, Quintec, Procure. Neem oil and other horticultural oils are good choices for PM control on organic hops. If you have primarily or just a Downy mildew problem, good selections include: Curzate, Forum, Ranman, Revus, or Ridomil Gold SL. As you start to use a reduced risk, single site fungicide multiple times over the production season, keep in mind that some fungicide labels restrict total # of applications per season (ie: Forum, do not apply more than 3X per season).

	Mandipropamid (Revus) Mefenoxam (Ridomil Gold SL)	
Spray 7: 2 weeks after Spray 6	Fosetyl aluminum (Aliette, Linebacker) Salts of phosphorous acids (Phostrol)	If needed – follow alternation pattern as needed based on status of disease in crop.

Controlling Late Blight in Organic: From national (and WI) disease reports in 2013, and current reports from FL in 2014, the predominant strain of *Phytophthora infestans* has been type US-23 which is known to be aggressive on potato and tomato, and is of the mating type A1. In our research, we have demonstrated that the US-23 type will infect tomato, potato, hairy nightshade, black nightshade, and petunia; select cultivars of eggplant, pepper, and tomatillo did not become infected. US-23 produces roughly twice as many spores per lesion as other late blight genotypes and has great potential to rapidly reproduce and spread. Some cultivars have resistance to late blight and are listed in Table 1 (below). Note cultivars containing both *Ph-2* and *Ph-3* resistance genes are most resistant. While not listed, the newly released 'Iron Lady' has even more robust resistance due to the fact that the resistance genes are coming from both breeding parents, rather than single sources. Several heirloom varieties also exhibit some resistance including 'Pruden's Purple' and 'Matt's Wild Cherry.' Potato cultivars with some resistance to late blight include 'Jacqueline Lee', 'Defender', and 'Satina.'

The disease forecasting tool (Blitecast) indicates risk times for late blight activity and can aid in identifying critical times for preventative fungicide applications. To access Blitecast information for Wisconsin, please go to: http://www.plantpath.wisc.edu/wivegdis/index.htm. Once late blight has moved into a region, it is critical that tomato and potato plants be protected. Fungicides must be present on foliage in order to have a protective, disease-limiting effect. Because new growth is not protected and fungicides can wash off, repeat sprays are necessary. Little disease control can be had when fungicide applications are made only after disease onset. A 2007 study compared copper and non-copper containing organic-approved fungicides (such as Sonata, Serenade, and Oxidate) for late blight control on potato. Results from replicated trials showed that the best organic-approved fungicide for potato late blight control was copper (Dorn, et al. 2007. Control of late blight in organic potato production: evaluation of copper-free preparations under field, growth chamber, and laboratory conditions. Eur. Journal of Plant Pathology 119:217-240). Copper containing fungicides have provided some of the best preventative control against late blight in multiple U.S. trials in recent years as well. Table 2, below, lists some of the certified organic copper formulations.

In the past 2 years, we've been investigating efficacy of non-copper organic fungicides and have demonstrated good control of tomato late blight with EF-400 under laboratory conditions. Dr. William Kirk of Michigan State University has conducted field trials with EF-400 plus ExCit (now BacStop) on potatoes and corroborated our laboratory efficacy results. Good field control of potato late blight was demonstrated with weekly applications of EF-400 + ExCit for 8 weeks. Further information on these organic products can be found at: http://usagritech.com/msds.html.

Fungicides have the best chance of effectively managing disease when applied before disease starts – this is true for all fungicides, conventional and organic. Late blight can be managed in an

organic system, but control measures need to be proactive. In the circumstance when late blight gets out of control, early harvest and crop destruct options must be considered to limit development of inoculum that could pose heightened risk for area producers. This is a community disease – management by all growers of susceptible crops is necessary.

Table 1. Tomato cultivars tested for late blight resistance against the US-22, US-23, and US-24 clonal lineages of *Phytophthora infestans* and their resistance/susceptibility response.

Cultivar[v]	Selection Parameter[w]	AUDPC Lesion Length[x]			AUDPC Pathogen Growth[y]		
		US-22	US-23	US-24	US-22	US-23	US-24
Wapsipinicon	Field observation	80.5a[z]	116.2a	12.6a	72.5a	155.0bcd	0.0a
Mountain Magic	*Ph-2* and *Ph-3*	96.1ab	67.1a	49.8ab	73.8a	22.5a	27.5ab
Matt's Wild Cherry	Seed company	87.6ab	128.7ab	22.2ab	70.0a	118.8ab	10.0a
Pruden's Purple	Other research	177.0abc	153.0ab	48.4ab	180.0ab	136.3abc	20.0ab
Legend	*Ph-2*	213.6cd	161.5abc	79.2abc	271.3bc	201bcde	96.3abcd
Plum Regal	*Ph-3*	243.9cde	137.5ab	110.6bc	206.3b	147.5bcd	106.3abcd
Juliet	Seed company	180.0bc	214.0bcd	108.2abc	228.8b	246.3cdef	150.0cd
Roma	Field observation	257.3cde	251.8cd	81.7abc	272.5bc	261.3def	48.8abc
Slava	Other research	249.3cde	277.1d	100.5abc	271.3bc	293.8ef	136.3bcd
Green Zebra	Other research	321.0e	295.5d	114.9bc	365.0c	322.5f	152.5cd
Brandywine Red	Susceptible control	293.7de	304.1d	160.9c	268.8bc	285.0ef	205.0d

[v] Mountain Magic, Plum Regal, and Juliet are hybrids. Legend was bred to contain *Ph-2* resistance, but is open pollinated, so is considered an heirloom by some. The remaining cultivars are heirlooms.
[w] Cultivars were selected based on anecdotal field observations from 2009, claims by seed companies of late blight resistance, field trials using other *P. infestans* clonal lineages (12, 32) or the presence of resistance genes *Ph-2* and/or *Ph-3*.
[x] Lesion length was measured at 0, 5, 7, and 9 days after inoculation and area under the disease progress curve (AUDPC) was calculated.
[y] Percent leaf coverage of pathogen growth was determined at 0, 5, 7, and 9 days after inoculation and area under the disease progress curve (AUDPC) was calculated.
[z] Values in each column followed by the same letter are not significantly different (Tukey test, P=0.05).

Table 2. List of OMRI approved copper fungicides. Please note that this list is not comprehensive, but rather represents those most commonly used and likely available copper formulations. And, the list is subject to change. **Check with your certifying agency for approval of your copper selection.**

Copper product (OMRI approved)	**Manufacturer**
Champ WG	NuFarm Americas, Inc.
COC WP	Albaugh, Inc.
Cueva Fungicide Concentrate	W Neudorff GmbH KG
Cueva Fungicide Ready-To-Use	W Neudorff GmbH KG
Nordox® 75 WG	Nordox AS
Nu Cop® 50 WP	Albaugh, Inc.
PHT Copper Sulfur Dust	J.R. Simplot Company
Basic Copper 53	Albaugh, Inc.
Copper Sulfate Crystals	Chem One, Ltd.
Quimag Quimicos Aguila Copper Sulfate Crystal	Fabrica de Sulfato El Aguila, S.A. de C.V.

For a current map of the late blight outbreaks in 2014, please go to: http://usablight.org/

At this site, you will also find a webinar which was recorded on 14 January 2014 on "*Late Blight of Tomato and Potato: Recent Occurrences and Management Experiences."* The webinar was presented by members of the USABlight extension team (Meg McGrath, Chris Smart, Beth Gugino, Amanda Gevens, and Pam Roberts) and hosted by eOrganic. While geared for organic farmers, the webinar contains information relevant for all users.

Wisconsin fungicide information can be found in the University of Wisconsin Extension Publication entitled "Commercial Vegetable Production in Wisconsin," publication number A3422 (http://learningstore.uwex.edu/assets/pdfs/A3422.PDF) and additional information is provided in weekly newsletters during the growing season (provided at the vegetable pathology website: http://www.plantpath.wisc.edu/wivegdis/).

Hoop House Management Workshops Scheduled at Several WI Locations this Sat. and next week: The workshops will be taught in English, Spanish, and Hmong. One will take place near Jefferson, the other near Wausau. Programs are sponsored by the Farley Center.

Hoop House Management Workshop

In Hmong, Spanish, and English.

Free!

Learn how to manage a hoop house for maximum capacity and profitability.

10AM - 3 PM, May 3, 2014.

The workshop includes lunch and a field trip to Stoney Acres farm near Athens, WI.

Wausau Area Hmong Mutual Association, 1109 6th St., Wausau, WI (715 842 8390)

Taught by experienced farmers and educators, the workshop begins at the WAHMA and then moves to a working farm where you will have lunch, tour a hoop house and observe a demonstration planting. The workshop will cover transplants, bed preparation, irrigation, pest & weed management, soil building and more.

♦ **Please Contact Us With Any Questions & to Register!**

Muaj Lus Nug Dab Tsi? Yimmuaj Yang (608 622-2667)

Preguntas? Mariela Quesada Centeno (608 228-8761)

Questions? Keefe Keeley (608 632-2719)

or

to Register for the Workshop: Peter (715 842 8390)

FARLEY CENTER

Linda and Gene Farley Center for Peace Justice & Sustainability

www.farleycenter.org/

This project was supported by the Beginning Farmer and Rancher Development Program of the National Institute of Food and Agriculture, USDA, Grant # 2011-49400-31216. To find more resources and programs for beginning farmers and ranchers please visit www.Start2Farm.gov, a component of the Beginning Farmer and Rancher Development Program.