Vegetable Crop Update

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

UW Extension

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Calendar of Events

August 23 – UW-Langlade County Ag Res Station Field Day Antigo, 10:00AM – NEW DATE & TIME
October 24&25 – Hancock ARS-Storage Research Facility, Potato Variety Harvest Expo, 8AM-4:30PM

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/

We reported the first finds of late blight in Wisconsin potato fields yesterday in Barron and Adams Counties. There is an additional report out of Portage County as of this morning. It is possible that there was aerial movement and rain deposition of the late blight pathogen approximately one week to ten days ago (based on lesion status). Much of Wisconsin received isolated storm systems out of the west that have sporadically provided precious rainfall. As such, a large geographical area of Wisconsin is potentially at risk for late blight.

Our Blitecast forecasting tool indicated Disease Severity Values well above the threshold of 18 for just about all of Wisconsin's potato crop (as of 31 July). Late emerging potatoes in the Hancock area do not yet have values over 18, however, we know the pathogen is present in the area, trumping the tool. At this time, potatoes should be treated with late blight specific fungicides plus a base protectant of chlorothalonil or mancozeb (or metiram) on a 7 day schedule. Fields with positive detects should be considered separately – with crop destruction for heavily infected plants and a more intensive 5 day spray schedule for the remaining plants in the field. A list of fungicides with registrations for late blight control was included in yesterday's newsletter supplement and can be accessed at my website: http://www.plantpath.wisc.edu/wivegdis/.

Keep in mind the season long label limitations for chlorothalonil (16 lb a.i. for long season WI potatoes, 24c special local needs registration). Mancozeb is also a good tank mix partner and base protectant at this point in the season. In the Hancock potato early blight trials of the past 3 years and in several years of Dr. Walt Stevenson's trialing at the same site prior to 2009, tank mixes with mancozeb provided numerically higher yield and lower disease than similar programs with chlorothalonil in **late season sprays**.

Again, we don't yet know the genotype(s) of the late blight pathogen here in Wisconsin, but we should have this data in the next day or so and we will share in this newsletter outlet.

In order to help better understand the epidemic at hand, please submit samples to my lab or work through your county agent and request that they send to me for genotyping. All we need to know is the county of sample origin, we do not need to have specific field or grower information associated with the sample. Identification of genotype at the county level would be very helpful in improving our understanding of this epidemic and potential future risks. Lab address is: Amanda Gevens, 1630 Linden Dr, Room 689, Plant Pathology Dept., University of Wisconsin, Madison, WI 53706. Please send infected leaves in a slightly inflated ziplock bag with no paper towel. Overnight shipping is best.

Current P-Day (Early Blight) and Severity Value (Late Blight) Accumulations

Location	Planted	50% Emergence	P-Day Cumulative	DSV Cumulative	Calculation Date
Antigo Area	Early 5/1	5/30	428	33	7/30
	Mid 5/10	6/6	391	33	7/30
	Late 6/1	6/16	324	33	7/30
Grand Marsh Area	Early 4/3	5/8	567	28	7/30
	Mid 4/15	5/16	521	28	7/30
	Late 4/30	NA	465	27	7/30
Hancock Area	Early 4/1	5/1	630	20	7/30
	Mid 4/15	5/10	573	14	7/30
	Late 5/1	5/17	529	14	7/30
Plover Area	Early 4/3	5/17	572	28	7/30
	Mid 4/19	5/18	507	28	7/30
	Late 5/1	5/27	444	24	7/30

P-Days and Early Blight: All plantings of potatoes in WI have P-Day values exceeding the threshold of 300 of this time. Fungicides for early blight control should be applied on all cultivars of potato at this time. An accumulation of 300 P-Day values indicates a time at which early blight is favored and first infection may occur. I have seen classic, bull's eye dark brown early blight lesions in lower potato canopies, as well as smaller flecked lesions with slight bull's eye patterning on upper canopies.

DSVs and Late Blight: **All potato plantings in Wisconsin, with the exception of late emerging potatoes in the Hancock area, have exceeded the threshold with 20-33 DSVs.** An accumulated DSV of 18 indicates time to initiate fungicide applications for late blight control. While this season has generally been hot and dry, isolated storms have been dropping precipitation across several WI regions creating conditions favorable for disease.

In addition to WI, this past week there were a few new late blight reports from MA (tomato), NH (potato), NY (tomato), PA (tomato), and VT (tomato). To date this production year, late blight has been reported in CA, CT, FL, MA, ME, NC, NH, NJ, NY, PA, VA, VT, and WI. The website: http://www.usablight.org/ indicates location of positive reports of late blight in the U.S. and provides further information on disease characteristics and management.

Cucurbit Downy Mildew**:** has not been identified in Wisconsin at this time in commercial fields, home gardens, or our sentinel monitoring plots. Several states have reported cucurbit downy mildew this season across a wide range of cucurbit hosts in AL, CT, DE, FL, GA, IN, LA, MD, MI, NC, NJ, NY, OH, PA, SC, VA, and Ontario Canada. **The newest reports within the past 7 days have been primarily on cucumber with closest detects in northwestern IN (South Bend area) on cucumber.** I will be keeping tabs on disease reports in the region as it seems the disease is rounding Lake Michigan and will provide updates in this newsletter. No forecasted risk of movement of spores from states reporting detects to Wisconsin at this time. Disease forecaster, Tom Keever of North Carolina State University reports, "HIGH Risk for cucurbits in AL / GA/ FL panhandle. Moderate Risk in a broad swath along the Eastern Seaboard into the lower Lakes ... from northern GA and SC through the mid-Atlantic states into central and western NY, southern ON, eastern MI, northern OH, and northwest PA. Low Risk for southwest MI / northern IN, far southeast ON, the DelMarVa peninsula into NJ / extreme eastern PA, and central and southern FL. Minimal Risk to cucurbits otherwise.." The website: http://cdm.ipmpipe.org/ offers up to date reports of cucurbit downy mildew and disease forecasting information.

For further information on any fungicides that may be mentioned in this newsletter, please see the 2012 Commercial Vegetable Production in Wisconsin Guide A3422. An online pdf can be found at the link below or a hard copy can be ordered through the UWEX Learning Store.
http://learningstore.uwex.edu/assets/pdfs/A3422.PDF

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Why are my cucumbers so bitter this year? The bitter flavor in cucumber is caused by a compound called cucurbitacin which is commonly influenced by heat or water stress.

The cucumber is a member of the large cucurbit family that also includes muskmelon, squash, pumpkin, and watermelon. All cucurbit plants naturally produce cucurbitacins, which can make a person sick when consumed in large quantities. There are different kinds of cucurbitacins. Cucurbitacin B and cucurbitacin C are the main compounds which cause bitterness in cucumber varieties grown in the U.S. Wild cucumbers, which are extremely bitter, may contain a number of other related compounds. Cucurbitacin can be present in all parts of a plant including the stem, foliage and fruit. Bitterness does not accumulate uniformly. It may vary from fruit to fruit on the same plant, as well as within individual fruits. In the fruit, bitterness is found in or just under the skin but not deep in the fleshy portion. The compounds are in general more concentrated at the stem end than at the blossom end of the fruit.

Most modern commercial cucumbers are bitterfree. However, because accumulation of cucurbitacin is heavily influenced by growing conditions, you may still get bitter cucumbers, especially when the cucumbers are under stress. With the extended long, hot and dry summer of this year, bitter cucumbers may become a concern. Understanding what causes bitter cucumber can help in preventing the unwanted condition.

Genetics: It is known that the bitterness in cucumber is controlled by a few genes. Different varieties of cucumbers vary widely in their tendency to be bitter. Most recent commercial pickling cucumber hybrids or slicers are bitterfree. For home gardeners, you may choose cultivars which historically have little or no record of bitterness developing in the fruit. Two such examples are 'Ashley' and 'Lemon' cucumbers. One additional benefit of bitterfree cucumbers is that these plants are also resistant to the bacterial wilt disease. The causal pathogen of bacterial wilt is spread primarily by cucumber beetles, which are apparently attracted by cucurbitacins in the plant. Bitterfree cucumbers have less cucurbitacins and are less attractive to cucumber beetles, thus reducing the incidence of bacterial wilt.

Temperature: Heat stress is one of the most common reasons why a cucumber is bitter. If a plant is stressed due to heat it may start producing bitter cucumbers. If the temperature fluctuates dramatically from one extreme to another over an extended period of time, the fruits are more likely to become bitter. You may also expect bitter cucumbers during a cool growing season due to cold stress. So for home gardeners, use best practices to grow your cucumber. Keep cucumbers in an even temperature. Plant the cucumber so that it gets the right kind of sun for your climate (sunnier areas in cool climates, morning and afternoon sun only in hotter climates).

Water: Cucumber is a tropical crop, and requires a lot of water to grow. Your cucumbers will more likely taste bitter when the plants are under water stress. Often the cucumber tends to turn bitter most frequently at the end of the summer when it's hot and there's a drought drying out your plants. When a cucumber goes through alternating periods of drought and overwatering, it will also start producing bitter fruits. So water your plants evenly and regularly, especially in times of drought and you should have better results.

What can you do to reduce the bitter taste if you do want the cucumber in your salad? You can chop off the ends and peel off the skin. Peel more deeply at the stem end, since this is where bitter compounds accumulate most deeply. Your cucumber might still be tasty and edible underneath.

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Ruark Extension Web site: http://www.soils.wisc.edu/extension/
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Field level evaluation of ESN® on potato (written by Matt Ruark and Mack Naber, Associate Research Specialist in Soil Science): As part of our Conservation Innovation Grant (CIG) that was funded through the NRCS, we have been conducting half-pivot field trials to evaluate the benefit of controlled release polymer coated urea (PCU), specifically ESN®. The half-pivot trial on potato had two treatments:

- PCU based: 275 lb/ac of N applied as 20 lb/ac of N as starter and 77 lb-N/ac 32% UAN, 132 lb-N/ac as ESN® and 46 lb-N/ac as urea applied at emergence
- Conventional application: 275 lb/ac of N applied as 20 lb/ac of N as starter and the remaining N applied over four application timings

Petiole nitrate concentrations have been monitored during the 2012 growing season. As previously reported, petiole nitrate concentrations were not different between the treatments at 30 and 45 days after emergence (DAE). At 60 DAE, the conventional application had received a total of 254 lb/ac of N and had an average petiole nitrate concentration of 0.56% while the PCU based application had an average petiole nitrate concentration of 0.50%. These concentrations are both less than the optimum nitrate concentration range at 60 DAE (0.8 to 1.1 at 60 DAE). This highlights an important issue this year when interpreting petiole nitrate concentrations. In a previous email, the issue was raised on how to interpret petiole nitrate concentrations when potatoes were developmentally advanced. An appropriate method would be to manage N toward the high end of the optimum range, or manage nitrate concentrations in the optimum range from a "younger" DAE (e.g. if you are at 60 DAE, use the 50 DAE optimum range as a guide). But environmental factors affect petiole nitrate concentrations as well. For example, it has been shown that time of day is important to interpretation, as warmer temperatures typically cause nitrate concentrations to increase. However, above 90°F, hot conditions can cause a decrease in petiole nitrate concentrations, especially if irrigation has not occurred that day. So we have two factors that can confound our ability to interpret petiole nitrate concentrations this year – advanced plant development and prolonged daily temperatures above 90°F. After petiole sampling at 60 DAE concentrations, the conventional practice had 21 lb/ac of N applied. Then at 75 DAE, the petiole nitrate concentration for the conventional application increased to 1.24%, and the PCU based application also increased to 0.84%. So, two things likely happened here: (1) the applied N (and the N conserved in the polymer-coating) supplied N to the potato and increased petiole concentrations and (2) slightly cooler temperatures caused petiole concentrations to be closer to "typical" growing conditions – which is preferable for interpretation. The optimum range at 70 DAE is 0.5 to 0.8, so both halves of the pivot are above the optimum range, which is ideal for management this year. So, based on petiole sampling as an indicator of the N status of the growing potato crop, ESN has performed similar to conventional. If this trend translates into similar yields, then this would show that use of ESN would reduce the need for application of N after emergence. Yields will be collected from both half-pivots at the end of the year.

Topdressing dry fertilizer and risk of fertilizer burn (written by Matt Ruark): There is always a risk of leaf burning when applying nitrogen fertilizer to a standing crop. However there are some management options to follow to minimize the risk of fertilizer burn. If available, apply the fertilizer (liquid or dry) with a drop nozzle between rows. This obviously minimizes the contact between the fertilizer and plant tissue. Dry fertilizers have less potential for burning leaf tissue of a standing crop compared to liquid fertilizers, but there are situations where burning can occur. Do not apply dry fertilizer when the foliage is damp or wet. This can cause the granules to stick to the plant tissue. If the dew or moisture causes the granule to dissolve this creates a concentrated area with a high salt concentration, which leads to the burning. Also, make sure the dry fertilizer has not accumulated moisture. Wet granules will also stick to leaf tissue, and cause burn quickly (Figure 1A). In general, urea will have less burning impact compared to ammonium fertilizers (ammonium nitrate, ammonium sulfate, UAN solutions) since urea has to be converted to ammonium fertilizer first, providing more opportunity for irrigation or rainfall to wash the fertilizer off of the leaf tissue.

If applying large applications of UAN, immediately irrigate or apply before rainfall to wash the fertilizer off of the leaves. This will minimize any burning effects. For corn, the rule of thumb is not to apply UAN after the V7 leaf stage in order to avoid burning. Figure 1B shows the result of a foliar application of 28% UAN (10 gal/ac or 30 lb/ac of N) on corn at the V8 growth stage (Arlington Research Station), which is moderate to severe leaf burn. No rainfall occurred for one week after application. However, new leaf development occurred with no burn symptoms. Application of UAN to corn earlier in the growing season will have less of an impact on burning, and it give the plant time to recover without a set-back in yield. Also, further dilution of UAN would results in less severe symptoms. If applying N in-season as a “rescue” application, consider the relative benefit of the application to the potential damage to the plant. It is possible that any benefit of N application, if applied incorrectly, could cause damage that would negate any yield benefit.

Figure 1. A. Fertilizer burn resulting from “damp” ammonium nitrate applied to snap bean at 100 lb/ac broadcast applied above the canopy. **B.** Corn canopy after foliar application of 28% UAN on July 12, 2011 (picture taken July 19, 2011).

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

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

Colorado potato beetle (CPB): Emergence of the 2nd generation of Colorado potato beetle (CPB) seems to have increased in the past 7-10 days in portions of central Wisconsin with new egg laying and the appearance of early to mid-stage larvae. We were anticipating the bulk of the 2nd generation summer adult emergence in early to mid-July, but populations remained quiescent (resting during unfavorable conditions) for around 2 weeks. At the Hancock Agricultural Research Station, populations of adult insects remained in the soil for approximately 2.5 weeks longer than expected, likely due to the excess heat earlier in the month. This phenomenon is not unexpected for the CPB, and this behavior has been reported previously in other regions of the US with higher summertime temperatures. The physiology of quiescence in the Colorado potato beetle has been studied previously, and the two most important factors influencing this condition in young 'teneral' adults is temperature and host quality. Specifically, higher temperatures reduce the beetle's sensitivity to photoperiod, so that under warmer temperatures a period of 'resting', or quiescence can occur.

Corn earworm: Recent flights of the corn earworm continue to be detected using the pheromone-baited, Hartstack Traps' around the state. As reported by the Wisconsin DATCP's, Pest Bulletin (http://datcpservices.wisconsin.gov/pb/), adult moth captures ranging between 50-150 have been registered in many locations throughout southern and central portions of the state. And trap captures exceeding 10 or more moths for two consecutive nights indicates the need for protective treatment of silking sweet corn fields.

Soybean aphid: Over the past decade, soybean aphid populations have traditionally increased substantially in size during mid to late July and into early August. And it is at this time that weekly scouting of soybeans is recommended for soybean producers to avoid direct damage. In soybeans, an insecticide application is recommended if the average number of aphids exceeds 250 per plant with an increasing population anticipated. Very low, or even declining populations, have been for late July this season. Populations at the Arlington Agricultural Experiment Station have remained quite low averaging < 2.5 aphids / plant. To date, a large flight of this insect is not anticipated to occur, and this event seems to happen after several (local) soybean fields have reached or exceeded the established action threshold. However, other competent aphid species (aphids capable of transmitting several non-persistent viruses) remain active in the state and these data can be obtained from the North Central Regional Soybean Suction Trap Network (http://www.ncipmc.org/traps/).

For cucurbit, snap bean, pepper, and potato growers, remember that these other aphid flights have posed an elevated risk for transmission of plant viruses including alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), watermelon mosaic virus (WMV), and zucchini yellow mosaic virus (ZYMV), and potato virus Y (PVY). Aphids transmit these viruses in a non-persistent, stylet-borne manner, which means that viruses are acquired from infected plants and spread to other plants within only a matter of seconds. Specifically, the aphids carry the virus particles on the very tip of their mouthparts (stylets), and release these particles almost immediately after they probe a potential host plant in an effort to feed. These aphids spread CMV into pepper and other vegetable crops after they acquire the pathogens from other local inoculums sources (e.g. forage crops or non-crop weeds). In potato, aphids most often acquire PVY from infected plants already present in the field. Applications of insecticides to kill these aphids before they spread these viruses to other plants do not often work effectively. In high-value vegetable crops, management of viruses can be achieved through field sanitation, clean seed, and prophylactic, mineral oil sprays to interfere with aphid probing. The performance of oil applications is directly related to the extent of the spray coverage. In the case of virus control, spray application to all leaf surfaces is essential. This is because winged aphids land on the upper leaf surface then immediately probe to determine if the plant is a host or non-host. If the plant is a host the aphid walks to the under leaf surface where it begins to feed; if the plant is a non-host it flies off in search of a host. Thorough coverage of all leaf surfaces is necessary for optimum performance and can be achieved by maintaining a constant sprayer speed, checking nozzles for wear, avoiding excess drift at higher wind speeds (e.g. > 12 mph), and using appropriate pressures and application gallonage.

Jed Colquhoun, Professor of Weed Science, UW-Madison, Department of Horticulture, 333 Horticulture, Phone: 608-890-0980, E-mail: colquhoun@wisc.edu.

Herbicides, feed crops and vegetables: The drought in parts of Wisconsin and neighboring states has stimulated an interest and some discussion on whether bypassed vegetable crops or plant materials left after harvest could be fed to animals, and whether feed crops could be planted as a double-crop after vegetable harvest. There are obviously many aspects to consider in such an approach – production and transport cost, bypass considerations, feed safety, season length, etc. In terms of herbicides, there are two key pieces of information that should also be considered:

1. If considering a bypassed vegetable field for feed, do the labels for the herbicides (and other pesticides) used in that crop allow the crop plant material to be harvested for feed or grazed? If so, what is the pre-harvest interval for such uses? Pesticide tolerances are required for plant materials that are fed to animals not only to protect the animals but also to reduce the risk of residues in the animal products finished for human consumption. In many cases, crops that are not typically used for animal feed or grazed have no animal feed tolerance established and the crop cannot be fed to animals. This will be reflected in label language such as: "do not graze or feed forage from treated areas or possible illegal residues may result".
2. If considering double-cropping after vegetables with a feed crop, do the labels for herbicides used in prior crops on that ground allow rotation to the feed crop of choice? This can be very challenging with many herbicide-crop combinations, where crop rotation intervals are based not only on the subsequent crop injury risk but also the potential for illegal herbicide residue in the following crop. Also, keep in mind that precipitation has been minimal in many areas, thus decreasing herbicide breakdown and increasing the potential for carryover.

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Supplement 3 – July 31, 2012

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/

Late blight has been confirmed in potatoes in two Wisconsin counties today, July 31, 2012.
Today, Dr. Brian Hudelson of the UW-Madison Plant Disease Diagnostic Clinic confirmed the presence of *Phytophthora infestans*, causal agent of late blight, on potato foliage from Barron County. I, too, confirmed late blight on potato foliage today from Adams County. Barron County is in northwestern WI. Adams County is in central WI. Lesions appear to be 3-7 days old given their size (diameter of a quarter at the largest) and sporulation status. Affected fields in both counties are showing lesions on upper leaves of plants. Sporulation appears to be very light on plants from Adams County. My laboratory is currently working to determine the genotype (also referred to as race or clonal lineage) from both counties. Genotype characterization will help us associate the late blight with mefenoxam resistance and can aid in possibly tracking potential sources.

To date, most of the late blight identified in the U.S. has US-23. This lineage is a dynamo at producing sporangia. In a recent study in my lab, it produced more sporangia per area of infected tomato leaf than US-22 or US-24. The table below provides further information on US-23 in comparison to the other lineages that have been present in Wisconsin over the past 3 years.

Clonal lineage	**Mating type**	**Optimum growth temp**	**Host comments**	**Years found in WI**	**Resistance to mefenoxam**
US-22	A2	24ºC	Tomato and potato, poor pathogen on pepper, eggplant, tomatillo	2009, 2010	sensitive
US-23	**A1**	**18ºC**	**Tomato and potato**	**2010, 2011**	**Intermediately resistant**
US-24	A1	20ºC	potato	2010, 2011	Resistant (variability among isolates)

Preventative fungicide sprays are critical at this time for all potatoes in Wisconsin. The geographical pattern of detects and presentation of lesions on upper leaves indicates that there has likely been aerial movement of the late blight pathogen over northwestern and central Wisconsin in the past week. Our disease forecasting tool (updated table below) indicates that all potato growing locations but for late planting potatoes in the Hancock area have exceeded the threshold for preventative sprays. To aid in your fungicide selections, I've included tables of information at the end of this newsletter supplement.

If you have any questions on symptoms, control, or fungicide resistance, please contact your county agent, crop consultant, the diagnostic clinic, or myself at UW-Plant Pathology. For further information on any fungicides that may be mentioned in this newsletter, please see the 2012 Commercial Vegetable Production in Wisconsin Guide A3422. An online pdf can be found at the link below or a hard copy can be ordered through the UWEX Learning Store.
http://learningstore.uwex.edu/assets/pdfs/A3422.PDF

Intensified scouting of potato fields is critical. The best place to scout for potato late blight is in field corners and areas of fields that are sheltered by tree lines, or are often inaccessible to aerial pesticide application. If late blight is found, infected sections of the field should be killed with a defoliant such as Reglone. Healthy-appearing potatoes surrounding the infected area should also be killed to try to isolate and destroy any potential late blight-infected plants. The field should then be treated with fungicides that are effective in managing late blight. Such products are listed in the table below. Now that late blight is on potatoes in WI it is critical that all plantings be protected with effective fungicides. Some fields may already be receiving vine-kill applications. It may be of value to consider vine-killing early to limit foliar infections which may increase risk of tuber infections. Allow 2-3 weeks between complete vine kill and harvest. Fungicide applications should be continued until vines are dead. When foliage dies, spores of the late blight fungus that remain on the foliage also die. This practice will prevent infection of tubers during harvest and development of late blight in storage.

If late blight is identified in your potatoes at harvest or beyond, do not make cull piles. Such piles are a significant source of spores and centers of large piles may not be subject to freezing/killing winter temperatures which serve to kill tuber tissue and the pathogen. Culls should be spread on fields not intended for potato production the following year in time that they will freeze completely and be destroyed during the winter. Potato culls can also be destroyed in some other way such as chopping, burial, burning or feeding to livestock.

For conventional potato and tomato operations, it is advisable to go to a 5 day spray program with effective chemistries. For potatoes, we have Tanos, Reason, Curzate, Revus Top, Gavel, Ranman, Forum, Presidio, Previcur Flex and Omega. These are all specific late blight products. All should be tank mixed with a protectant such as chlorothalonil, mancozeb or metiram (potato). The strobilurins will work but at high rates and this may not be cost effective. For tomatoes, we have Curzate, Tanos, Ranman, Forum, Presidio, Reason, Revus Top, Previcur Flex and Gavel. A complete table of fungicides for potato late blight accompanies this newsletter. More information specific to tomato will come later this week. See tables below for further detail.

For organic operations, coppers are the only materials consistently effective for late blight control. Coppers can only slow the epidemic and will not stop the progress of late blight. My program has been evaluating organic-approved fungicides for late blight control on detached leaves in the laboratory. Our results indicate high variability in control with materials such as EF400 and Mycostat. Materials offering little to no control included Oxidate, Serenade, and Regalia. In our test, we inoculated leaves with the pathogen and then applied the fungicide.

Some fungicides have antisporulant activity, such as Oxidate, which may be helpful in a field setting in addition to copper, but did not limit progress of the pathogen when applied prior to sporulation. For a severely infected tomato or potato field, crop destruction may be the only option to limit further spread. Please check with your certifying agency for fungicides permitted for late blight control.

Compilation of fungicides registered for potato late blight control in Wisconsin
A.J. Gevens, UW-Plant Pathology, July 31, 2012 (this list omits fungicides labeled for seed or in-furrow use only

Trade Name (rate/A)	Active Ingredient(s)	PHI	REI	FRAC #	Comments
Agri Tin, Super Tin 4L, Super Tin 80WP (4-6 fl oz)	triphenyltin hydroxide	7 days	48 hours	30	Restricted use pesticide. 3 fl oz rate can be used if material is tank-mixed with another fungicide.
Alude (1.25 qt in 90 gal water)	mono and dipotassium salts of phosphorous acid	0 days	4 hours	33	Foliar application
Fosphite, Rampart (1-4 qt in at least 20 gal water/A)	potassium phosphite	0 days	4 hours	33	Foliar post-emergence spray and post harvest spray for control in storage.
Fungi-Phite (Foliar: 2 qt/A Seed trt: 15% volume to volume-2 ton in 1 gal solution)	potassium phosphite	0 days	4 hours	33	Seed piece spray and foliar post-emergence spray. Tank-mix with another effective fungicide is recommended and use high label rate for late blight control.
Badge SC (1-3 pt at 7-10 day interval)	copper hydroxide, copper oxychloride	0 days	24 hours	M1	Protectant activity only.
Bravo Ultrex (.7 then .9 to 1.36 lb) Bravo WeatherStik (.75 then 1-1.5 pt) Bravo Zn (1 1/8 then 1 1/5 to 2 ¼ pt)	chlorothalonil	7 days	12 hours	M5	WI has a 24c Special Label for long season potatoes extending max a.i. from 11.25 lb to 16 lb a.i./acre (expires Dec 31, 2012).
Cabrio Plus (2.9 lb)	pyraclostrobin+metiram	3 days	24 hours	11+M3	17.4 lb/acre maximum per season. Do not apply more than 2 sequential applications.
Equus 720 SST, Initiate 720, Chlorothalonil 720 SC (.75 then 1-1.5 pt) Equus 500 Zn, Initiate Zn (1.125 then 1.5-2.25 pt)	chlorothalonil	7 days	12 hours	M5	11.25 lb a.i./acre maximum.

Equus DF (.7 then .9 to 1.36 lb) Echo 90DF (5/8 then 7/8 to 1 ¼ lb)					
Echo 720 (.75 then 1-1.5 pt) Echo Zn (1 pt to 2.125 pt)	chlorothalonil	7 days	12 hours	M5	WI has a 24c Special Label for long season potatoes extending max a.i. from 11.25 lb to 16 lb a.i./acre (expires Dec 31, 2014).
Champ WG (1 to 1.5 lb 3 to 4 lb in severe areas) Champ Formula 2 Flowable (2/3 to 2 2/3 pt) Champ DP Dry Prill (2/3 to 1 lb 2 to 2 2/3 lb when disease is severe) Kentan DF (1-2.5 lb 4 lb when severe) Kocide 2000, Kocide 3000 (.73- 3 lb .5-1.75 lb) Nu-Cop 3L (2/3 to 2 pt 2 to 4 pt if severe) Nu-Cop 50DF (1-1.5 lb 3-4 lb if severe)	copper hydroxide copper hydroxide	0 days 0 days	24 hours 24 hours	M1 M1	Use high label rates for foliar late blight protection. Use high label rates for foliar late blight protection.
C-O-C-S WDG (1.5- 4 lb)	copper oxychloride, basic copper sulfate	0 days	24 hours	M1	Use high label rates for foliar late blight protection.
Curzate 60DF (3.2 oz foliar)	cymoxanil	14 days	12 hours	27	Locally-systemic fungicide. Must be tank-mixed with a protectant fungicide. Rainfast within 2 hours.
Dithane F45 Rainshield (.4 to 1.6 qt Seed trt: 1 qt per 50 gal water) Dithane M45 (.5 to 2 lb Seed treatment: 1.25 lb per 50 gal water) Dithane DF (1 -2 lb Seed treatment1.25 lb per 50 gal water)	mancozeb	24 hours	3 days	M3	Max rate per acre/season is 11.2 lb a.i. Plant as soon as possible after seed treatment.

Evito 480SC (3.8 fl oz)	fluoxastrobin	7 days	12 hours	11	Follow label for resistance management.
Forum (Foliar and tuber control: 6 oz)	dimethomorph	4 days	12 hours	40	May be tank-mixed with another effective fungicide for enhanced management. An adjuvant may enhance management. Can be applied after vine kill.
Gavel 75DF (1.5 to 2 lb)	zoxamide+mancoze b	3 days	48 hours	22+M3	Do not make >6 applications/crop. Contact fungicide.
Gem 500SC (3.8 fl oz)	trifloxystrobin	7 days	12 hours	11	Follow label for resistance management.
Headline (6 to 12 fl oz)	pyraclostrobin	3 days	12 hours	11	Follow label for resistance management.
ManKocide (1.5 to 2 then 4-5 lb)	mancozeb+copper hydroxide	3 days	24 hours	M3+M1	Not labeled as a seed trt for potatoes.
Omega 500F (5.5 fl oz)	fluazinam	14 days	48 hours	29	REI is 4 days for high exposure activities. New special local need label 24c in April 2011.
Omega Top MP (5.5 fl oz) – individual label for Omega sold in co-pack with Top MP (difenoconazole)	fluazinam	14 days	48 hours	29	Can be applied aerially. REi is 4 days for high exposure activities.
Oxidate (40 to 120 fl oz to 100 gal water, 30-100 gal solution per acre	hydrogen dioxide	0 days	1 hour	NC	Foliar spray for late blight. Frequent applications (5-day intervals) can limit sporulation.
Penncozeb 80WP, Penncozeb 75DF (.5 to 2 lb) Penncozeb 4FL, Manzate flowable (.4 to 1.6 qt) Manzate Pro-Stick (1 to 2 lb, seed trt: 1.25 lb/50 gal water)	mancozeb	3 days	24 hours	M3	Do not exceed 11.2 lb a.i./acre/year.
Phostrol (2.5 to 10 pt) (Post harvest trt: 1 gal/ton in .5 gal water)	mono- and di-basic sodium, potassium, and ammonium phosphites	0 days	4 hours	33	Can be applied as a foliar for late blight, pink rot, and Pythium leak. Can be applied post-harvest for storage disease control.
Polyram 80DF (1.5 to 2 lb in 15 gal water/acre minimum)	metiram	3 days	24 hours	M3	Metiram is an EBDC, like mancozeb (M3). Total amount of a.i. per year/acre must include all EBDCs.
Presidio (4 fl oz)	fluopicolide	7 days	12 hours	43	Tank-mix with another fungicide with a different mode of action. Apply 20-50 gal of spray mixture by ground and no less than 5 gal by air.

Previcur Flex (.7 to 1.2 pt)	propamocarb hydrochloride	14 days	12 hours	F	Apply in a tank-mix with protectant. Can be applied as a broadcast or banded application over the row, post-emergence.
Quadris (6 to 15.5 fl oz)	azoxystrobin	14 days	4 hours	11	Alternate away from Group 11 fungicides to manage resistance.
Quadris Opti (1.6 pt)	azoxystrobin+chlorothalonil	14 days	12 hours	11+M5	Alternate away from Group 11 fungicides to manage resistance.
Ranman (1.4 to 2.75 fl oz)	cyazofamid	7 days	12 hours	21	Follow label for resistance management.
Reason (5.5 to 8.2 fl oz)	fenamidone	14 days	12 hours	11	Follow label for resistance management.
Revus (5.5 to 8 fl oz)	mandipropamid	14 days	4 hours	40	Addition of an adjuvant is recommended.
Revus Top (5.5 to 7 fl oz)	mandipropamid+difenoconazole	14 days	12 hours	40+3	Addition of an adjuvant is recommended.
Tanos (8 to 10 oz)	cymoxanil + famoxadone	14 days	12 hours	27+11	Must be tank-mixed with an effective protectant fungicide.
Ridomil Gold SL (1 to 2 pt)	mefenoxam	14 days	48 hours	4	Do not apply beyond the at-planting stage.
Ridomil Gold Bravo SC (2.5 pt)	mefenoxam+chlorothalonil	14 days	48 hours	4+M5	Follow label for resistance management.
Ridomil Gold Copper (2 lb/A)	mefenoxam+copper hydroxide	14 days	48 hours	4+M1	Tank-mix with an effective protectant.
Ridomil Gold MZ WG (2.5 lb/A)	mefenoxam+mancozeb	3 days	48 hours	4+M3	Follow label for resistance management.

Comparison of Late Blight Fungicides (highest rates registered)
Provided by Dr. Steve Johnson, University of Maine Cooperative Extension

	Effectiveness				Mode of action							
Product	**Leaf blight**	**New growth**	**Stem blight**	**Tuber blight**	**Protectant**	**Curative**	**Anti-sporulant**	**Rainfastness**	**Mobility in the plant**	**FRAC #**	**REI**	**PHI**
Bravo etc	G	No	P	No	G	No	No	G	contact	M5	12 hrs	7 days
Curzate + Dithane etc	G	?	F	No	G	E	P	G	translaminar + contact	27 + M3	24 hrs	14 days
Dithane etc	G	No	P	No	G	No	No	F	contact	M3	24 hrs	3 days
Forum + Dithane	G	?	F	F	G	P	G	G	translaminar + contact	40 + M3	24 hrs	4 days
Gavel	E	No	P	F	E	No	No	G	contact + contact	22	48 hrs	3 days
Kocide etc	P	No	P	No	F	No	No	P	contact	M1	24 hrs	0 days
Omega	E	No	P	G	E	No	No	G	contact	29	48 hrs	14 days
Previcur Flex + Dithane etc	G	G	G	No	G	G	G	E	systemic + contact	28 + M3	24 hrs	14 days
Ranman	E	No	P	E	E	No	No	E	contact	21	12 hrs	7 days
Tanos	G	?	F	No	G	E	P	G	translaminar + contact	11	12 hrs	14 days
Revus Top	E	?	F	G	E	P	F	E	translaminar + contact	40 + 3	12 hrs	14 days
Tin	E	No	E	E	G	No	E	F	contact	M1	48 hrs	7 days

No=No effect; P=Poor; F=Fair; G=Good; E=Excellent; ?=Unknown.

DSVs and Late Blight: **All potato plantings in Wisconsin, with the exception of late planted potatoes in the Hancock area, have exceeded the threshold with 20-33 DSVs.** An accumulated DSV of 18 indicates time to initiate fungicide applications for late blight control. While this season has generally been hot and dry, isolated storms have been dropping precipitation across several WI regions creating conditions favorable for disease. And, irrigation provides the moisture necessary for pathogen progress. This is a tool to aid in preventative fungicide decision-making. **Since we know late blight is in Central WI, it is critical that potato fields be treated for late blight at this time.**

Current P-Day (Early Blight) and Severity Value (Late Blight) Accumulations

Location	Planted	50% Emergence	P-Day Cumulative	DSV Cumulative	Calculation Date
Antigo Area	Early 5/1	5/30	428	33	7/30
	Mid 5/10	6/6	391	33	7/30
	Late 6/1	6/16	324	33	7/30
Grand Marsh Area	Early 4/3	5/8	567	28	7/30
	Mid 4/15	5/16	521	28	7/30
	Late 4/30	NA	465	27	7/30
Hancock Area	Early 4/1	5/1	630	20	7/30
	Mid 4/15	5/10	573	14	7/30
	Late 5/1	5/17	529	14	7/30
Plover Area	Early 4/3	5/17	572	28	7/30
	Mid 4/19	5/18	507	28	7/30
	Late 5/1	5/27	444	24	7/30