Vegetable Crop Update

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

Extension
UNIVERSITY OF WISCONSIN-MADISON

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Calendar of Events:

July 31, 2024 – UW-Madison Rhinelander Agricultural Research Station Potato Breeding Farm Field Day, Rhinelander, WI (contact Becky Eddy)
December 3-5, 2024 – Midwest Food Producers Assoc. Processing Crops Conference, Kalahari Convention Center
January 13-14, 2025 – Wisconsin Agribusiness Classic, Alliant Energy Center, Madison, WI
February 4-6, 2025 – UW-Madison Div. of Extension & WPVGA Grower Education Conference & Industry Show, Stevens Point, WI

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

Vegetable Entomology Webpage: https://vegento.russell.wisc.edu/

Potato virus Y and management. Potato virus Y (PVY) is an aphid-transmitted virus that causes disease in numerous solanaceous crops including tomato, pepper, tobacco, and potato. In potato, PVY can be a yield-limiting pathogen that can cause yield loss in heavily infected commercial lots and in selected, susceptible varieties. The virus may also cause post-harvest losses due to tuber necrosis and reduced storage quality. PVY has been managed in Wisconsin for decades, but in recent years it has re-emerged as a potentially serious disease problem. The emergence of new genetic recombinant strains of PVY that can cause mild disease symptoms, the over-wintering of potato-colonizing aphid species (green peach aphid, potato aphid), and the widespread adoption of potato varieties that express mild symptoms of PVY infection are all thought to contribute to the re-emergence of PVY in Wisconsin.

Both commercial and seed potato growers are at risk of direct yield loss due to PVY infection when levels exceed established tolerances. Commercial growers of fresh-market, processing, and chip potatoes are at risk of reduced yield and tuber storage quality if PVY-infected seed pieces are planted. Seed growers are at risk of having their lots downgraded or even rejected from certification due to PVY infection. (allowable tolerances for PVY infection in Wisconsin seed lots are 0.5 percent infected seed pieces for 'Foundation' class and 5.0 percent for 'Certified' class: Wisconsin ATCP 156).

The production season of 2024 has brought new challenges to our seed production area in north-central Wisconsin. First among these challenges is the amount of local inoculum we have replanted in the region that resulted from a challenging virus management season in 2023. This inoculum (many lots) will serve as a source for spread to other fields within the 2024 production season, and it is important to limit this movement of the virus. Another challenge for 2024 results from the presence and establishment of green peach aphid populations in the fields already. It will be critically important for producers to make efforts to limit potato-colonizing species from increasing in potato and spreading from these infested fields. The weather to date has brought significant rain which can limit access to fields for timely application of crop protectants.

For most aphid chemical management tools, timing of application occurs with the appearance of the first, small colonies of potato-colonizing aphids. Spraying for colonizing aphids can reduce the spread of PVY within the field. Spray only when scouting indicates aphid populations have become established and scouts can identify small colonies of apterous (wingless) aphids. Critical factors affecting the efficacy of these spray applications include timing, application conditions and coverage. The green peach aphid, potato aphid, and (to a lesser extent) buckthorn aphid will colonize and reproduce on potato and are efficient vectors of PVY. Systemic insecticides applied at planting are critical components of early generation seed potato protection, however, they lose efficacy by mid-season.

Green peach aphids (*Myzus persicae*) colonizing potato. Many aphids in the image do not have wings (apterous) and small colonies of wingless aphids in potato signify a colonizing species. Molted skins (white objects in image) of the aphids

Remember – most vectors of PVY do not colonize potato and their ability to transmit PVY to the plant will not be affected by systemic insecticides. In these instances, non-colonizing aphids (several species) will only intermittently move in and through potato over short durations. In these specific instances, we use anti-feedant compounds to include the paraffinic oils. Several species of non-colonizing aphids (e.g soybean aphid, corn leaf aphid, bird cherry-oat aphid, corn leaf aphid, English grain aphid and pea aphid) can be present moving through the seed crop and at predictable intervals through the season. The timing of these flights have been modeled as a collective, or cumulative risk model and for Wisconsin and the upper Midwest and these map-based projections are available daily at the Wisconsin Vegetable Disease and Insect Forecasting Network site. Once the model predicts the risk of non-colonizing aphids is moderate to high, producers are alerted to apply paraffinic oils on a 5-7 day reapplication interval.

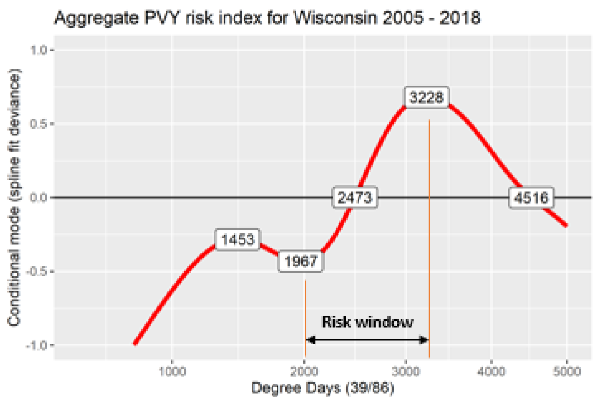
The Upper Midwest Aphid Suction Trap Network, developed and maintained out of the University of Illinois at Urbana-Champaign, has been in operation since 2005 (WI locations listed). Originally conceived to detect soybean aphid flights and provide timely information to growers, the wealth of data now available after 14 years of operation has enabled us to model flight patterns for a number of different species captured by these traps. These predictive models can also be aligned to degree-days rather than calendar days to control for site-to-site and annual climatic variations.

Wis. suction trap sites
Rhinelander
Antigo
Eau Claire
Seymour
Hancock
Arlington
Lancaster
Walworth

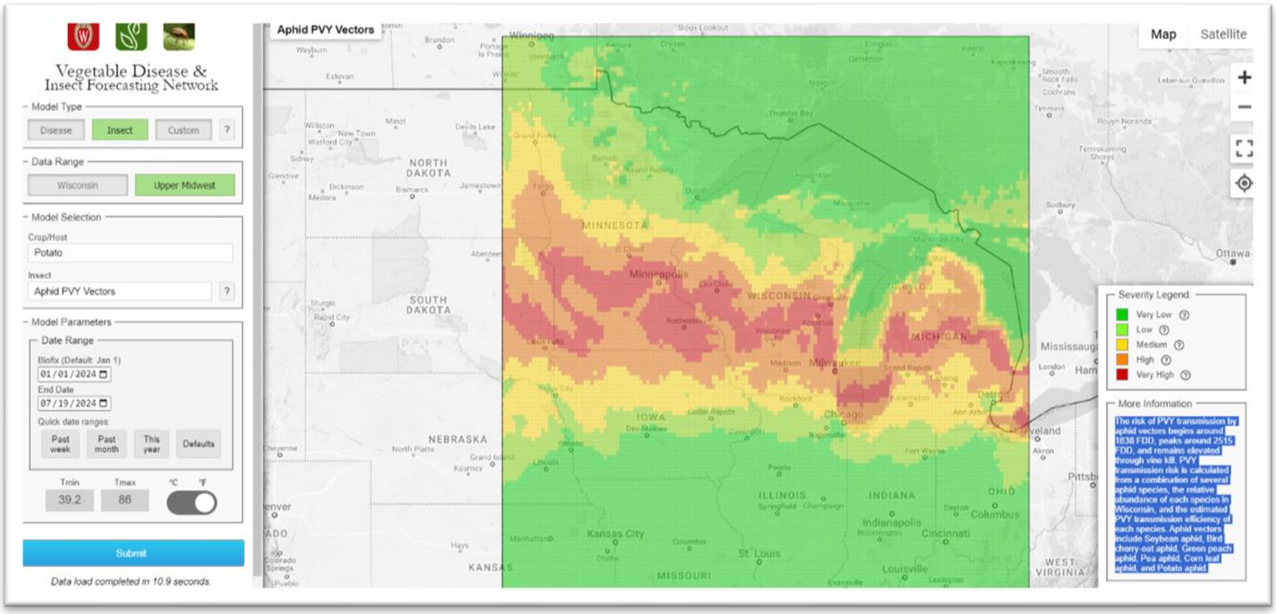
We have taken these species-specific models and incorporated published PVY transmission efficiency values to compute risk-adjusted counts for each species. These counts are then added, and a single model is generated from this aggregate risk value that indicates the PVY risk window in Wisconsin. The model output is a curve where the primary rising segment indicates the start, midpoint, and end of the flight event (for an individual species) or the risk window for the aggregate PVY risk model. This model incorporates all potential PVY aphid vectors and so is more useful than flight models generated for any one species.

Species Name	Common name	Transmission efficiency	Mean annual Wis. captures	Computed risk rank
Aphis glycines	Soybean aphid	14-75%	2400	1067.84
Rhopalosiphum padi	Bird cherry-oat aphid	2-12%	1526	103.73
Myzus persicae	Green peach aphid	8-83%	71	32.61
Acyrthosiphon pisum	Pea aphid	7-14%	187	19.67
Rhopalosiphum maidis	Corn leaf aphid	2%	896	17.91
Macrosiphum euphorbiae	Potato aphid	28%	25	7.06
Capitophorus elaeagni	Artichoke aphid	2%	199	3.99
Aphis craccivora	Cowpea aphid	4%	83	3.32
Sitobion avenae	English grain aphid	1%	88	0.88

Published transmission efficiencies and mean annual captures of the top 9 species in the Wisconsin portion of the suction trap network.



Based on the model illustrated here, the PVY risk window begins around 1967 degree-days (base 39°F, max 86°F), peaks around 2473 degree-days, and ends around 3228 degree-days. Any method for obtaining degree-day data for your location will work (such as a personal weather station), if the min and max parameters are entered correctly. At the VDIFN site, we offer a web-based model that illustrates the risk for any given date within the production season. The graphic below (July 19, 2024) illustrates where the risk is greatest in the medium to very high categories where the map colors range from orange to red.



The following management guidelines were developed specifically for the 2024 season.

Limit PVY Introductions.

- Do NOT replant seed potatoes with any measurable incidence of PVY. This is the absolute best defense. Relocate all lots with => 0.25% PVY off the farm. Locate these at least 3-5 miles from the farm and not on the windward side of the farm (e.g., S, SW, W borders)
- Rely only on laboratory testing for the estimates of disease incidence in lots from the Starks Farm – NOT visual.

Pre-Plant Considerations.

- Sanitize all cutting and planting equipment between seed lots.
- Properly destroy/devitalize all cull potatoes below the ground surface.
- Ensure NO volunteer potatoes emerge in previously planted fields (scout these fields in 2024!!)
- Ensure no other local/neighboring problems with respect to volunteers or local virus sources (e.g., weedy nightshades in rotation years).

Planting Configurations.

Arrange lots to be planted in long, parallel strips to facilitate spraying. Strips should be no wider than the 2X boom width. Ensure the boom reaches and has proper overlap.

Locate highly susceptible varieties in the northern and eastern reaches of a field. Locate less susceptible varieties in the southern and western reaches of a field. Note: On average, aphids migrate and fly into fields from the southwest.

Ensure all tractor spray alleys / strips are planted with a vigorous grass species. Spray grasses in spray alleys each time an insecticide/oil is applied to the main potato crop.

Consider placement of border crops (e.g., rye grass) around all lots. This may not be possible in all cases but should be considered. Spray grasses in spray alleys each time an insecticide/oil is applied to the main potato crop. Source seed for border crops that contain an at-plant seed treatments containing a neonicotinoid insecticide (e.g., Cruiser, Gaucho, Poncho, etc.).

In rotation years without potato, plant crops that contain at-plant seed treatments containing a neonicotinoid insecticide (e.g., Cruiser, Gaucho, Poncho, etc.). Source seed for these rotation crops that contain either:

thiamethoxam: CruiserMaxx Advanced (Soybean), CruiserMaxx Vibrance Pulses (Pea, Bean, Cowpea), CruiserMaxx Cereals (oat, barley, rye, wheat)
imidacloprid: Gaucho 600 (many crops)
clothianidin: Ponch0 600 (many crops and pearl millet!!)

In-Season Field Scouting.

Scout a sub-sample of all potato fields weekly during the production season for colonizing aphids. Twice monthly, scout all non-potato rotation crops for colonizing aphids.

1) Aphid populations are often aggregated in a field. Anticipate where to look for "hot spots" of aphid activity.

2) Migrating aphids often land./aggregate along southern, western, tree lines bordering fields. They often alight along field edges in more open fields. They often alight near drive rows within fields. Wind eddies are often created along edges and aphids will 'fall out' of the moving air in these eddies.

All aphids are soft-bodied and pear-shaped with a pair of cornicles, or little horns, projecting from the rear end of their abdomens. Adult aphids may or may not be winged. Visit the following site (https://blogs.cornell.edu/potatovirus/pvy/aphid-vectors-of-pvy/#vectors) to see images of many aphids: some will colonize potato (green peach aphid, potato aphid, buckthorn/melon aphid). Most aphids will not colonize potatoes. Another gallery of aphid images is available at Wisconsin Vegetable Entomology.

Because of the spotty nature of infestations, look for aphids on a number of plants in several areas of the field. Each week, examine a whole leaf (not just leaflets) from at least 25 consecutive plants. Take this leaf from the mid-canopy of 25 separate plants. Look carefully at both the top and bottom surface of leaves. Repeat this process at 10 locations within fields weekly.

Look carefully at the aphids found in potato and determine if they are winged (alate) or wingless (apterous). At the Wisconsin Vegetable Entomology site, scroll to the bottom of the aphid page and look at the images for corn leaf aphid (wingless) and green peach aphid (winged). If small groups (e.g., 3-6) of wingless aphids are observed in potato, then you undoubtedly have a highly problematic, potato colonizing species getting established in potato.

Examine your rotation crops in a comparable way for aphids. Do not be surprised to find aphids in these crops. As noted previously, attempt to source all rotation crops to contain an at-plant seed treatment containing a neonicotinoid insecticide (e.g., Cruiser, Gaucho, Poncho, etc.). If aphid numbers are observed to be increasing in any local rotation crop, it may be appropriate to spray. Do NOT spray an inexpensive pyrethroid insecticide on these rotation crops if you decide to spray. Apply a foliar neonicotinoid (e.g., Actara, Admire Pro, Assail, Belay, Scorpion, Venom).

Initiate applications of paraffinic oils 2 weeks after full emergence from hilling, or just prior to the beginning of risk illustrated on the VDIFN site. Use an approved paraffinic oil at labeled rates weekly through the production season. Apply oil (and any insecticides) only after an irrigation event – not in advance. If possible, apply oils/insecticides during late evening to limit the potential for phytotoxicity.

When you begin applications of paraffinic oils, also consider weekly applications of insecticides over the entire crop if you are finding colonizing aphids present. Following is a suggested list of insecticides (Mode of Action and maximum application rate) to accompany paraffinic oil applications and these can all be reviewed in the UW-Extension publication Commercial Vegetable Production in Wisconsin (A3422) for a list of registered insecticides and management recommendations.

Trade name	Chemical name	Mode of Action Class	Max labeled rate (single application)
Admire Pro	imidacloprid	Group 4A	1.3 fl oz/ac
Actara 25WG	thiamethoxam	Group 4A	3.0 oz/ac
Assail 30SG	acetamiprid	Group 4A	4.0 oz/ac
Belay	clothianadin	Group 4A	3.0 fl oz/ac
Beleaf 50SG	flonicamid	Group 29	2.8 oz/ac
Exirel 10SL	cyantraniliprole	Group 28	13.5 fl oz/ac
Fulfill 50WG	pymetrozine	Group 9B	5.5 oz/ac
Movento HL	spirotetramat	Group 23	2.5 fl oz/ac
PQZ	pyrifluquinizon	Group 9B	3.2 fl oz/ac
Sefina Inscalis	afidopyropen	Group 9D	6.0 fl oz/ac
Sivanto HL	flupyradifurone	Group 4D	7.0 fl oz/ac
Torac	tolfenpyrad	Group 21	21.0 fl oz/ac
Transform 50WG	sulfoxaflor	Group 4C	1.5 oz/ac
Venom 70SG	dinotefuran	Group 4A	1.5 oz/ac

Initiate applications after the appearance of colonizing aphids have become established in the crop. An initial foliar application should be applied to the entire field and followed by a second foliar application one week later. Only two successive applications of any compound should be implemented as a foliar option per crop season for control of colonizing aphids before rotation to a new mode-of-action. Continue to scout field throughout the time interval of the application series and consider rotation to another effective aphicide mode of action if colonizing aphids persist in the crop.

Should be applied with mild, penetrating surfactant and ensure the tank pH is not alkaline (pH < 7.0). Ground-application advised. Only two successive applications of Admire Pro should be implemented as a foliar option per crop season for control of colonizing aphids before rotation to a new mode-of-action.

All insecticide and paraffinic oil combinations should be delivered using extended range, air induction flat fans delivering a minimum of 25 gpa.

Always remember to introduce the products into the tank in the following order: (1) water soluble packets (WSP) (2) wettable powders (WP) (3) water dispersable granules (WDG) (4) flowable liquids (F, L) (5) emulsifiable concentrates (EC) and (6) adjuvants and/or oils. Always allow each product to fully disperse before adding the next product.

Each of the above can be mixed with common fungicides. Care not to add any foliar fertilizers or micronutrients as these compounds are often untested in terms of compatibility.

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Current P-Day (Early Blight) and Disease Severity Value (Late Blight) Accumulations will be posted at our website and available in the weekly newsletters. Thanks to Ben Bradford, UW-Madison Entomology for supporting this effort and providing a summary reference table: https://agweather.cals.wisc.edu/thermal-models/potato. A Potato Physiological Day or P-Day value of ≥300 indicates the threshold for early blight risk and triggers preventative fungicide application. A Disease Severity Value or DSV of ≥18 indicates the threshold for late blight risk and triggers preventative fungicide application. Data from the modeling source: https://agweather.cals.wisc.edu/vdifn are used to generate these risk values in the table below. I've estimated early, mid-, and late planting dates by region based on communications with stakeholders. These are intended to help in determining optimum times for preventative fungicide applications to limit early/late blight in WI.

	Planting Date		**50% Emergence Date**	**Disease Severity Values (DSVs)** *through 7/20/2024*	**Potato Physiological Days (P-Days)** *through 7/20/2024*
Spring Green	**Early**	Apr 3	May 9	**36**	**598**
	Mid	Apr 17	May 12	**36**	**581**
	Late	May 10	May 25	**31**	**479**
Arlington	**Early**	Apr 5	May 10	17	**592**
	Mid	Apr 20	May 15	17	**561**
	Late	May 12	May 25	15	**482**
Grand Marsh	**Early**	Apr 5	May 10	**33**	**571**
	Mid	Apr 20	May 15	**33**	**542**
	Late	May 12	May 25	**26**	**469**
Hancock	**Early**	Apr 10	May 17	**39**	**524**
	Mid	Apr 22	May 21	**37**	**494**
	Late	May 14	June 2	**32**	**414**
Plover	**Early**	Apr 14	May 18	**33**	**520**
	Mid	Apr 24	May 22	**29**	**486**
	Late	May 19	June 7	**25**	**372**
Antigo	**Early**	May 1	May 24	**30**	**443**
	Mid	May 15	June 1	**30**	**401**
	Late	June 1	June 15	**25**	**300**
Rhinelander	**Early**	May 7	May 25	13	**428**
	Mid	May 18	June 8	12	**333**
	Late	June 2	June 16	12	285

Late blight of potato/tomato. Late blight diagnostics are available at no cost to WI growers and gardeners. Dr. Brian Hudelson of our UW Plant Disease Diagnostic Clinic and Dr. Amanda Gevens of UW-Potato & Vegetable

Pathology can offer confirmation of the pathogen. Dr. Gevens will also offer strain typing of the pathogen. The usablight.org website (https://usablight.org/map/) indicates no reports of late blight from the US so far in 2024. Please keep in mind that the site is not comprehensive. Outside of this site, I'm aware of 2 Ontario Canada confirmations of potato and tomato late blight (US-23), a Florida late blight sample from potato (March 2024) and a NY tomato late blight sample (from greenhouse in early May) with the confirmed genotype of US-23. This genotype is generally still responsive to phenylamide fungicides meaning that Ridomil and Metastar fungicides (mefenoxam and metalaxyl) can still effectively control late blight caused by this type.

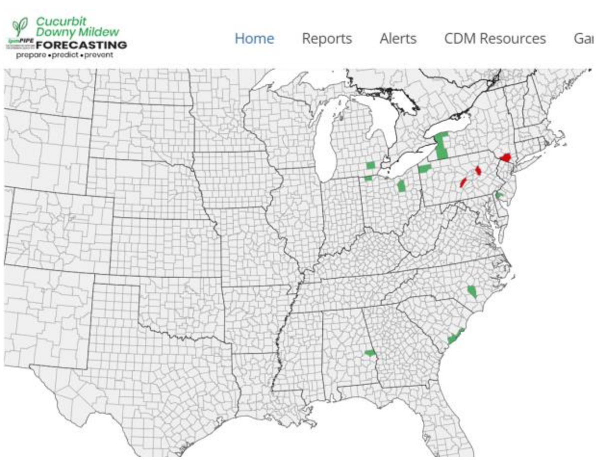
We accumulated just 0-3 Blitecast Disease Severity Values over the past week in WI. **All WI locations, with the exceptions of Arlington and Rhinelander, are above the threshold for late blight disease severity values and should receive preventative fungicide application to reduce the risk of disease.**

An updated listing of fungicides for WI potato late blight management for 2024 can be found at the link below. Base protectants such as chlorothalonil and mancozeb offer broad-spectrum control of fungal and oomycete (water mold – like late blight) pathogens. https://vegpath.plantpath.wisc.edu/wp-content/uploads/sites/210/2022/07/2024-Potato-Late-Blight-Fungicides.pdf

Early blight of potato. Antigo and southward, areas of production have reached the threshold for the application of foliar fungicides to limit early blight. Temperatures were optimal this past week for promoting early blight. https://vegpath.plantpath.wisc.edu/diseases/potato-early-blight/

Fungicides can provide good control of early blight in vegetables when applied early on in infection. Multiple applications of fungicide are often necessary to sustain disease management to time of harvest due to the typically high abundance of inoculum and susceptibility of most common cultivars. For Wisconsin-specific fungicide information, refer to the Commercial Vegetable Production in Wisconsin (A3422), a guide available through the UW Extension Learning Store website which is annually updated. https://learningstore.extension.wisc.edu/products/commercial-vegetable-production-in-wisconsin Or, for home garden fungicide recommendations, see Home Vegetable Garden Fungicides (D0062), a fact sheet available through the UW Plant Disease Diagnostic Clinic website. Always follow label directions carefully.

Cucurbit Downy Mildew: Michigan confirmed downy mildew on **cucumber** in 8 counties so far this season (Washtenaw, Saginaw, Tuscola, Ingham, Bay, Iosco, Arenac, Muskegon). These are primarily on the eastern side of the MI mitten and northward of the thumb. NY and PA also confirmed cucumber downy mildew this past week. To date, downy mildew field infections, and spores from air sampling in MI, have been of Clade 2 - cucumber and cantaloupe strain type. No field disease confirmations were made in Wisconsin.



Confirmed reports of cucumber downy mildew this past week in NY and PA. In red, US counties with reports of cucurbit downy mildew during the past 7 days. Green counties indicate a former report of the disease greater than 7 days ago. From: https://cdm.ipmpipe.org/

Management information can be sourced here: https://vegpath.plantpath.wisc.edu/2022/07/03/update-10-july-3-2022/

Fungicide Programs for Cucumber (Clade 2) DM

If program is initiated **before** disease onset: adhere to a **7-day** interval.
If program is initiated **after** disease onset: adhere to a **5-day** interval.

Recommendations based on multiple years of field research by Hausbeck, Michigan State Univ. & Quesada Ocampo at NCSU

SE U.S. and MI (2014) have noted resistance in the downy mildew pathogen to several fungicides

Bold indicates best in MI

Use of highest labeled rate of products is recommended	
Previcur Flex 6SC (2 day PHI), GH	propamocarb hydrochloride 28
Elumin SC (2 day PHI)	ethaboxam 22
Ranman 3.6SC (0 day PHI)	cyazofamid 21
Gavel 75WG (5 day PHI), GH	mancozeb M3 + zoxamide 22
Orondis Opti (0 day PHI)	oxathiapiprolin 49/chlorothalonil M5
Orondis Ultra (0 day PHI)	oxathiapiprolin 49/mandipropamid 40
Omega 500F (7 day PHI)	fluazinam 29
Zampro 4.4SC (day PHI)	ametoctradin 45/dimethomorph 40
Zing! SC (0 day PHI)	zoxamide 22 + chlorothalonil M05
Alternate products and mix each with either: Dithane (mancozeb) 3 lb 5 day PHI, M3, GH; or Bravo (chlorothalonil) 2 pt 0 day PHI, M5	

Cabbage/crucifer black rot. ***(Amanda Gevens, Andrew Pape (former student at UW-Madison), Brian Hudelson (UW Plant Disease Diagnostic Clinic).*** Black rot has been prevalent in WI crucifer crops over the past 2 weeks. Symptoms can be very typical (as described here) and/or can be puzzling depending upon crop type, cultivar, and environmental conditions promoting the disease. Black rot is a potentially lethal bacterial disease that affects cruciferous vegetables such as broccoli, Brussels sprouts, cabbage, cauliflower, kale, rutabaga and turnip, as well as cruciferous weeds such as shepherd's purse and wild mustard. Black rot occurs worldwide wherever cruciferous plants are grown and makes cruciferous vegetables unfit for the marketplace or the table.

What does black rot look like? Black rot symptoms may not develop for more than a month after cruciferous vegetables start to grow. Initial symptoms are irregular, dull, yellow blotches that appear on the edges of leaves. As the disease progresses, these blotches expand into V-shaped areas with the wide part of the "V" at the edge of the leaf and the point of the "V" toward the attachment point of the leaf to the plant. The V-shaped areas are initially yellow, but eventually become brown and necrotic (i.e., dead) in the center with a yellow border or halo.

Veins in affected areas are brown or black, forming a net-like pattern (often most visible when leaves are held up to the light). Later, interior stem tissue (specifically the water-conducting tissue) will also turn brown or black. At this point, affected plants tend to show symptoms of wilting. Black rot can also predispose vegetables to other rot diseases such as bacterial soft rot (see University of Wisconsin Garden Facts XHT1224 "Bacterial Soft Rot").

Where does black rot come from? Black rot of crucifers is caused by *Xanthomonas campestris* pv. *campestris* (Xcc). This bacterium is most often introduced into a production field or garden on or in seeds and transplants of susceptible vegetables. By some estimates, a single infected seed in 10,000 can lead to a severe outbreak of the disease if environmental conditions are favorable. Favorable conditions include warm temperatures (approximately 80°F) and high humidity. Once introduced into a field/garden, Xcc can survive in residues from susceptible vegetables or on weed hosts. Xcc can subsequently enter susceptible plants through roots, through natural openings in leaves or through wounds made by tools, rough handling, or insect feeding. Cruciferous plants grown near infected plants and healthy plants handled with the same tools as diseased plants are at highest risk of becoming infected.

There are no curative treatments available to combat black rot once the disease has occurred. However, when disease severity is low, copper-containing fungicides that are labeled for use on cruciferous vegetables may help limit additional disease development even though this disease is caused by a bacterium. Fungicides containing peroxyacetic acid and/or hydrogen peroxide (such as SaniDate) can help reduce viable inoculum when on the outside of plants. Reducing inoculum may minimize new infections. At harvest, vegetables with low levels of black rot may be salvageable. Remove symptomatic leaves (or other plant parts) and store the remaining parts of the vegetables in a cool, but not overly wet environment.

How do I avoid problems with black rot in the future? Prevent introduction of Xcc into your field/garden by using certified disease-free crucifer seeds and transplants. If certified disease-free seed is not available, use hot water seed treatments to eliminate Xcc. Treat seeds of Brussels sprouts, collards, and cabbage for 35 minutes in water that is 122oF. Treat seeds of broccoli, cauliflower, kale, kohlrabi, rutabaga, and turnips for 20 minutes in water that is 122°F. DO NOT plant cruciferous vegetables in the same area of your farm/garden every year; rotate (i.e., move) these vegetables to different locations, ideally every 3rd year.

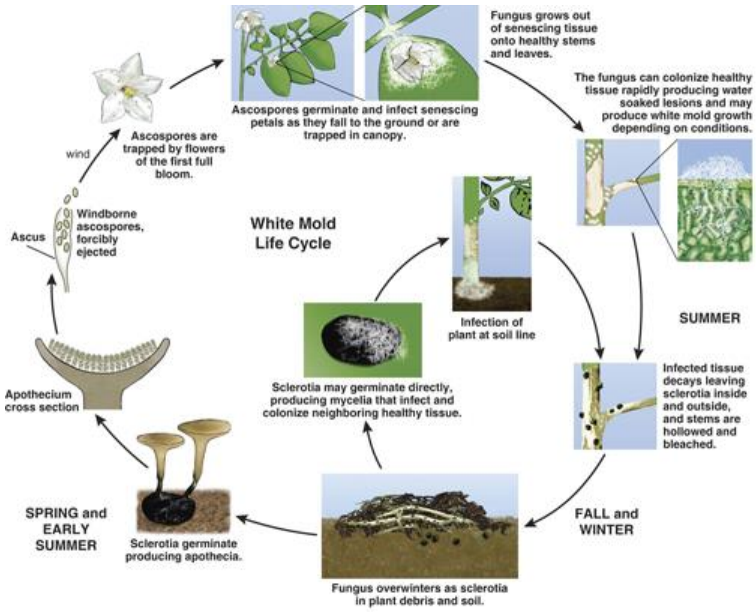
Once your cruciferous vegetables are growing, be sure to fertilize them appropriately. In particular, inadequate nitrogen can predispose plants to black rot. Also, be gentle with cruciferous vegetables to prevent any wounds that might serve as entry points for Xcc. Limiting overhead irrigation as possible can reduce likelihood of bacterial pathogen spread. Avoid working with plants when they are wet to help limit spread of Xcc. If severe black rot develops, promptly remove symptomatic plants as well as all cruciferous plants within a three to five foot radius. Dispose of these plants by burning (where allowed by local ordinance), burying or composting them. If you decide to compost, make sure your compost pile heats to a high enough temperature and that any infested material decomposes for at least one year before it is reincorporated into your garden. For more information on how to properly compost, contact your local county Extension office. Depending upon the scale of production, it may be possible to decontaminate any pots, tools, or other gardening items that have come into contact with Xcc-infected plants or Xcc-infested debris by treating them for at least 30 seconds with 10% bleach or 70% alcohol (preferable for metal tools because of its less corrosive properties). Rubbing alcohol and many spray disinfectants typically contain approximately 70% alcohol.

Potato White mold: description and management. White mold (sometimes called Sclerotinia stem rot) is a soilborne fungal disease caused by *Sclerotinia sclerotiorum* that impacts potatoes and many other broad-leaved crops (>400 plant species). The severity of the disease, and resulting yield/quality losses, can vary greatly and depend upon the quantity of inoculum in soils, environmental conditions, and planting factors including cultivar, crop rotational history, and plant spacing. Symptoms have been showing up over the past 2 weeks in central Wisconsin potatoes.

Photo courtesy: Left – Bayer CropScience https://www.cropscience.bayer.us/articles/bayer/white-mold-on-potato. Right – Jeff Miller of Miller Research in Rupert Idaho. https://millerresearch.com/research-library/white-mold-management/.

Symptoms develop first in the lower leaves and stems of the plant, typically ~2 weeks after row closure. Water-soaked lesions typically form at the stem branch points or where stems are in contact with the soil. In potato, floral infections can occur and lead to stem infections either from movement through the base of the flower, or through the senescing flower dropping onto other lower plant parts and spreading infected tissues. Based on my field observations over the past few years in Wisconsin, most infections initiate on stem branch points and in stem contact with the soil. Lesions are often covered in white, cottony fungal growth. Lesions can expand and girdle stems resulting in wilting of sections of plants or entire plants leading to plant death. Eventually, lesions turn light brown and nearly white in color once they've dried out. At this time, you can often crack open the stems and find the black, hard fungal structures referred to as sclerotia. During the progress of infection, any additional contact with other plant parts can result in the spread of infection.

Disease Cycle and Environmental Conditions Favoring Disease. The pathogen overwinters as sclerotia in the soil or in infested crop residue. Sclerotia can be moved in soil within a field during cultivation, in moving water, soilborne sclerotia form a mushroom structure under plant canopies, can move relatively short distances from where they're discharged (roughly 1 mile). The apothecial cups form earlier in the summer/late spring from the sclerotia in the top 2 inches of soil when we have cool temperatures (50-70°F), high relatively humidity (95-100%) and several days of moist soil. These conditions are typically met after canopies have closed and soil surfaces are shaded (and there is low air circulation). In many potato cultivars this aligns with 70-100% bloom. The movement is typically from the apothecial cup/mushroom to the plants immediately above/surrounding it. The soilborne sclerotia can also be moved to previously non-infested fields in soil and debris on contaminated equipment. There is little or no plant-to-plant spread of white mold during the growing season, with infections initiated from the overwintered sclerotia. The sclerotia can remain viable in the soil for roughly 5 years.



The disease cycle, above, is shared with credit to Dr. Phillip Wharton, currently with University of Idaho, and Dr. William Kirk, now retired, Plant Pathologist with Michigan State University.

Management. An integrated program of cultural practices and fungicide applications is necessary to manage white mold in potato. Currently, the application of fungicides is a primary management approach. The choice of fungicide, application method, and timing of application are important. Fungicide treatments should be initiated when plants reach the full bloom stage or at row closure, to help prevent the flower petals and stem junctions from becoming infected by ascospores. This timing also enhances coverage in the lower canopy to manage infections caused by limbs touching the soil and sclerotia directly. A listing of fungicides registered for white mold management in potato in WI is provided below (from A3422).

White mold *(Sclerotinia sclerotiorum)*	*Bacillus mycoides* isolate J	1.0–4.5 oz LifeGard WG	0	Maximum level of protection is induced within the plant at 3–5 days post application. Protection can last up to 18 days.
	boscalid	5.5–10.0 oz Endura WDG	30	Endura belongs to the Group 7 fungicide category. Do not exceed 2 sequential applications of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed 2 applications per season for white mold control. Do not exceed 20.5 oz/a Endura per season.
	Coniothyrium minitans	0.75–1.5 oz/1,000 sq ft Contans		Preplant or postharvest soil incorporation to reduce viability of pathogen sclerotia in soil. Can make up to 8 applications/a per season. This is a biological fungicide with specific activity only against white mold.
	fluazinam	5.5–8.0 fl oz Omega 500F	14	Application should begin prior to onset of disease. Do not apply more than 3.5 pt/a per season. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb.
	fluopyram	6.5 fl oz Velum Prime		Provides nematode, white mold, and early blight control. Follow resistance management guildelines.
	iprodione	2.0 lb Rovral 50WP 2.0 pt Rovral 4F, Iprodione 4L, Nevado 4F	14 14	Treat when warm, wet weather conditions favor disease development. Up to 4 applications at 7- to 10-day intervals may be made. Note crop rotation information on label. All crops on the Rovral label may be grown after treated potatoes. Root crops, cereal grains, soybeans, and tomatoes may be grown the year following treated potatoes.
	metconazole	4.0 oz Quash	1	Make first application prior to infection at row closure and 14 days later if conditions promote disease. Do not make more than 4 applications per season. Do not make more than 2 sequential applications. Do not apply more than 16.0 oz/a per season.
	picoxystrobin	6.0–12.0 fl oz Aproach	3	Follow label for fungicide resistance management strategies. Also labeled for early blight.
	pydiflumetofen + fludioxonil	11.4 fl oz Miravis Prime	14	Apply at or before row closure followed by a second application 14 days later. Do not apply more than 34.2 fl oz/a per year. Apply in a minimum volume of 10 gal/a for adequate coverage.
	thiophanate-methyl	1.0–1.5 lb Topsin M WSB, 70 WP 20.0–30.0 fl oz Topsin 4.5FL	21 21	Make first application just before row closure. Subsequent applications may be made at 7- to 14-day intervals if conditions warrant. Application at peak bloom provides best control. Do not apply more than 4.0 lb/a Topsin M WSB or 80.0 fl oz/a Topsin 4.5FL per season.

Several fungicides are labeled for the control of white mold on potato. Fluopyram, in the "Luna" fungicide series, is a systemic fungicide to protect buds, blooms, and new tissues. Luna Pro combines fluopyram with prothioconazole (FRAC 3). Luna Tranquility combines fluopyram (FRAC 7) with pyrimethanil (FRAC 9) for preventative and curative activity. Other fungicides recommended for controlling white mold include products containing the active ingredients boscalid (Endura), fludioxonil (ie: Miravis Prime with pydiflumetofen), fluazinam (ie: Omega), iprodione (ie: Rovral), penthiopyrad (Vertisan), and thiophanate-methyl (ie: Topsin).

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This year in our nitrogen-variety trial, we had two nitrogen treatments (100 vs. 300 lb/acre). From the aerial image that we collected today, we can clearly see that the plots under the 100 lb N/acre treatment are showing yellower canopy colors than those under the 300 lb N/acre treatment. This year we buried some nitrate-leaching monitoring sensors developed by our engineering department, and we will know the exact nitrate leaching amounts each time after we remove the sensors by the end of the season.

I dug one plant from each treatment yesterday, and we could see that lower N treatment resulted in smaller canopy size, lower tuber set, and lower yield compared to the higher N treatment. So far, the plants only received 5'' of irrigation water because of the high precipitation, and thus they haven't gotten too much extra N from the nitrate in the irrigation water.

100 lb N/acre 300 lb N/acre

Our snap beans are doing well so far, the plots especially under the highest N rate at 150 lb N/acre are showing vigorous growth and setting good-sized pods. Some folks told me the frequent heavy rainfall so far this year has caused water-clogging conditions in fields or parts of the fields with low elevations in the sands, and a portion of snap bean acreage has been badly impacted and will not be harvested.