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

No. 6 – June 23, 2024

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- Potato and vegetable disease forecasting updates – thresholds met for preventative applications of fungicides for early blight and late blight in some WI locations
- Cucurbit downy mildew
- Cucurbit powdery mildew

Calendar of Events:

July 11, 2024 – UW Agricultural Research Station Potato Field Day, Hancock, WI
July 18, 2024 – UW Langlade County Extension & WI Seed Potato Certification Program – Ag Research Station Field Day, Antigo, WI
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 Chair, 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/

Degree-day accumulations. (Wisconsin State Climatology Office) The state climatology office maintains statewide records of climate averages for a range of variables relevant to agriculture. Annual and daily climate information for Madison, Wisconsin are reported using data from the station at the Dane County Regional Airport. Charts available at the site show daily and total heating degree days for the current year or the season. These heating days also include comparisons with the 1991-2020 climate normals. As reported from the Dane County Regional airport, degree days are the difference between the average daily temperature and 50°F (for heating degree days). If the average temperature is above 50 degrees, it's a cooling degree day; if it's below 50, it's a heating degree day. The US Pest climate center reports (using Dane County Regional airport) that year-to-date accumulated degree days are 16 days ahead of 30 year normal for Madsion, WI and as much as 5 days ahead of 2022 and 2023 at this same time in previous years.

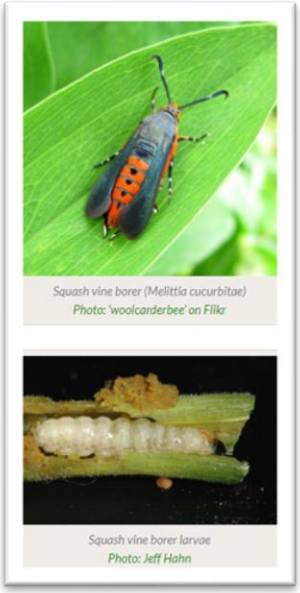
DD accumulation on 6-22-24: 1017. QA 100% ok

This year is about	versus	QA
5 days ahead	2023	ok
5 days ahead	2022	ok
16 days ahead	30-yr normal	ok

https://uspest.org/cgi-bin/ddmodel.us

Forecast using: NWS NDFD 7-day Forecast data
Extended Seasonal Forecast: NOAA NMME 7-month 1910 KMSN PRISM_rev1_4km 2012-2021

Squash vine borer - (https://vegento.russell.wisc.edu/pests/squash-vine-borer/) In southern Wisconsin we have just reached and exceeded the time for overwintering emergence of adult squash vine borers in susceptible cucurbits. Adult squash vine borer is a day-flying clearwing moth that is commonly confused with a large wasp. Forewings of the adults are dark-brown with iridescent green coloration while the hindwings are transparent with a fringe of reddish-brown hairs. The abdomen is a very obvious rusty orange with black spots along the dorsal margin. Hind legs are typically covered with tufts of orange and black hairs.


Squash vine borer (Melittia cucurbitae)
Photo: 'woolcarderbee' on Flikr

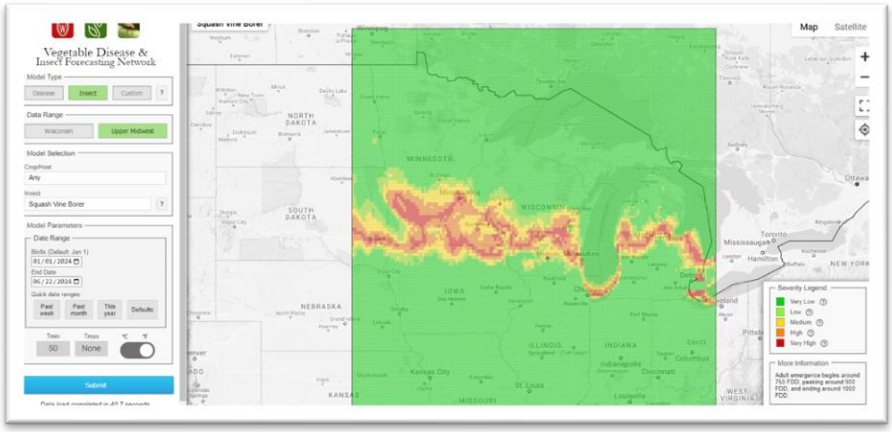
Squash vine borer larvae
Photo: Jeff Hahn

The squash vine borer is a sporadic pest of pumpkin and squash, meaning not every field will experience an infestation. If you have experienced damage from this insect in the past, it is very likely you could experience risk into the future. Resulting damage can be difficult to diagnose prior to the significant harm that can occur. In years of heavy infestation squash vine borer can become a significant economic pest and susceptibility to squash vine borer is variable among species of cucurbits. Varieties known to be suitable hosts are pumpkins and squashes. Commonly infested cultivars are pumpkin (standard and giant), zucchini, as well as crookneck, straight neck, acorn, patty pan, summer, banana, buttercup, and Hubbard squashes.

Beginning in late June to early July, adult vine borers emerge from the ground. In the Midwest the pest typically emerges after 1,000 growing degree-days (base 50°C) have been reached. This degree-day threshold has now been surpassed in much of southern Wisconsin and will be reached quickly across central and northern Wisconsin later this week. Newly emerged female moths quickly seek suitable hosts and begin laying small, brown eggs singly at the base of susceptible plants. Depending upon temperature, eggs will hatch within 4-5 days of being laid. Newly hatched larvae quickly bore into the vine stems to feed for four to six weeks.

Squash vine borer is very difficult to manage with chemical insecticides since older larvae are protected within the plant stem. The target life-stage for conventional chemical management is newly hatched larvae that have not yet entered the stem. Effective control requires insecticide residue to be in place before and during the egg-laying period (1,000-1,200 DD_{50}). Two to three successive applications of insecticide 5-7 days apart will adequately control most of the larval borers before entering the vines.

As the larvae feed, they leave behind characteristic light brown frass (insect feces) that resembles sawdust. Larvae typically feed at the center of host plant stems. This internal feeding greatly restricts the plant's ability to move water and nutrients. Fully-grown borers exit the stems and burrow into the soil to pupate. Squash vine borers produce one generation per year in Wisconsin.



Onion thrips – (https://vegento.russell.wisc.edu/pests/onion-thrips/) With recent warm temperatures, it is important to continue scouting for onion thrips populations in susceptible onion and cabbage crops. Heavy rains, however, do control larval populations and recent weather may have slowed population development. Although regions of the state received heavy rainfall over the late week and weekend, thrips populations can be expected to build with forecast warm temperatures.

Left: onion thrips (Thrips tabaci)
Right: western flower thrips (Frankliniella occidentalis)
Photo: Alton N. Sparks, Jr.

Control through insecticides is difficult because of thrips' protected location in plants. Direct sprays down the center of plants. Foliar insecticides should be applied in sufficient water with a spray additive to achieve penetration into the plant. Alternate with two or more materials to minimize potential for resistance. Effect control options for conventional producers include spinosad (Conserve), spinetoram (Radiant), abamectin (Agri-Mek), spirotetramat (Movento), and cyantraniliprole (Exirel). Organic producers can use spinosad (Entrust), azadirachtin (Aza-Direct), Chromobacterium spp. (Grandevo), pyrethrins (Azera, Pyganic), and Burkholderia (Venerate SC).

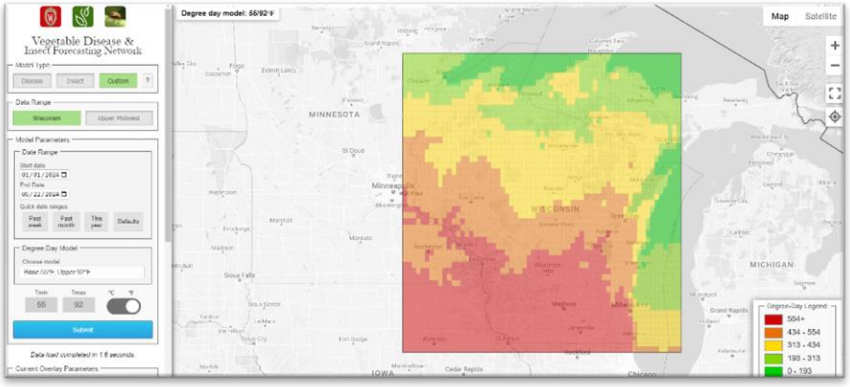
Squash bug – (https://vegento.russell.wisc.edu/pests/squash-bug/). Squash bugs are an emerging problem in Wisconsin. In recent years, these insects have become more prevalent, causing damage to vine crops in commercial fields and home gardens alike. The key to management is early detection. Squash bugs feed on all vine crops, but pumpkins and squash are the preferred hosts with gourds and melons favored next. Unmated adults overwinter in Wisconsin in protected areas. Eggs are laid in late June and early July when cucurbit vines begin to develop. Eggs hatch in about 10 days. The nymphal stage lasts 4-6 weeks and nymphs undergo 5 molts before reaching maturity. Adults appear in late July and early August.

Squash bug (Anasa tristis)
Photo: Jeffrey Hahn, Univ. of Minnesota

Squash bug nymphs
Photo: 'Pollinator' on Wikipedia

Squash bug eggs
Photo: 'Pollinator' on Wikipedia

Because they are protected by the lower surfaces of leaves, squash bugs may be difficult to control. Although it is unlikely to find large populations of the bugs early in the season, growers should check their transplants or new seedlings for the presence of adults. Using a base temperature of 58°F, eggs will appear at 193 DD and nymphs will emerge at 554 DD. The threshold for treatment is one egg mass per plant during flowering.



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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 and late blight in Wisconsin.

	Planting Date		50% Emergence Date	Disease Severity Values (DSVs) *through 6/22/2024*	Potato Physiological Days (P-Days) *through 6/22/2024*
Spring Green	**Early**	Apr 3	May 9	**19**	**350**
	Mid	Apr 17	May 12	**19**	**333**
	Late	May 10	May 25	15	231
Arlington	**Early**	Apr 5	May 10	11	**342**
	Mid	Apr 20	May 15	11	**311**
	Late	May 12	May 25	9	232
Grand Marsh	**Early**	Apr 5	May 10	**18**	**329**
	Mid	Apr 20	May 15	**18**	**300**
	Late	May 12	May 25	11	227
Hancock	**Early**	Apr 10	May 17	**21**	282
	Mid	Apr 22	May 21	**19**	252
	Late	May 14	June 2	14	172
Plover	**Early**	Apr 14	May 18	**21**	278
	Mid	Apr 24	May 22	14	246
	Late	May 19	June 7	10	131
Antigo	**Early**	May 1	May 24	13	212
	Mid	May 15	June 1	14	170
	Late	June 1	June 15	9	72
Rhinelander	**Early**	May 7	May 25	8	205
	Mid	May 18	June 8	6	110
	Late	June 2	June 16	6	62

Late blight of potato/tomato. The usablight.org website (https://usablight.org/map/) indicates no reports of late blight from the US so far in 2024. The site is not comprehensive. We accumulated 6-13 Blitecast Disease Severity Values over the past week in WI. **In the earlier plantings of potato in the**

Spring Green, Grand Marsh, Hancock, and Plover areas of production, we have reached the threshold for the recommendation of foliar fungicides for preventing late blight. I updated a listing of fungicides for WI potato late blight management for 2024 which 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. Spring Green, Arlington, and Grand Marsh areas of production have reached the threshold for the application of foliar fungicides to limit early blight. P-Day values will continue to amass (up to ~10 per day) and develop conditions optimum for early blight disease caused by *Alternaria solani*. Earliest inoculum typically comes from within a field and from nearby fields. Once established, early blight continues to create new infections due to its polycyclic nature – meaning spores create foliar infection and the resulting lesion on the plant can then produce new spores for ongoing new infections in the field and beyond. Early season management of early blight in potato can mitigate the disease for the rest of the season. 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. 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.

For custom values, please explore the UW Vegetable Disease and Insect Forecasting Network tool for P-Days and DSVs across the state (https://agweather.cals.wisc.edu/vdifn). This tool utilizes NOAA weather data. In using this tool, be sure to enter your model selections and parameters, then hit the blue submit button at the bottom of the parameter boxes. Once thresholds are met for risk of early blight and/or late blight, fungicides are recommended for optimum disease control. Fungicide details can be found in the 2024 Commercial Veg. Production in WI Extension Document A3422: https://learningstore.extension.wisc.edu/products/commercial-vegetable-production-in-wisconsin

Cucurbit Downy Mildew: During this past week, downy mildew spores were found in air sampling traps in three counties of Michigan (Muskegon, Monroe and Saginaw). No field disease confirmations were made. This suggests potential dispersal of cucurbit downy mildew pathogen in Michigan. Over the past week other reports came from just NJ on cucumber. Previously in this growing season, the disease was confirmed in: NC and SC. No findings of cucurbit downy mildew in our Wisconsin-based sentinel plots in Dane or Waushara Counties.

Cucurbit downy mildew is a water mold or oomycete disease of cucurbit crops caused by *Pseudoperonospora cubensis*. Symptoms first appear on the upper leaf surface as angular, vein-bounded, yellow to pale-green spots, turning brown and coalescing to turn entire leaves brown with disease progression. In very humid conditions, the underside of leaves may appear fuzzy as the pathogen produces numerous spores which enable the pathogen to spread. This foliar disease can very rapidly

destroy above ground plant parts reducing potential for yield and quality, and making fruit more susceptible to sunscald and secondary pathogen infection.

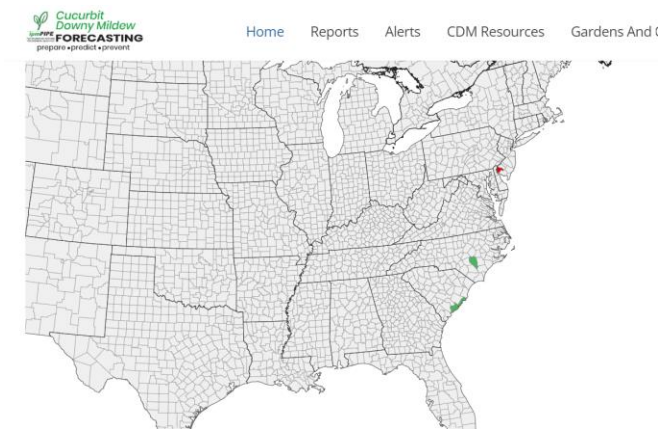
Primary Source: Living cucurbit plant tissue
Spread: Windborne spores, rain and irrigation splash, human spread on equipment and hands
Favorable Conditions: Very wet, humid conditions, moderate temperatures (59-68° F)

Infection & Disease Cycle. *Pseudoperonospora cubensis* does not overwinter on plant debris in Wisconsin, and can only survive on living plant tissue. No soilborne, long-term survival structures of the pathogen have been identified in our growing region. For this reason, the pathogen generally overwinters in warmer climates and in protected greenhouses. Spores spread northward on airborne spore-like structures called "sporangia". The pathogen infects cucurbit leaves, producing lesions that create more spores when leaf wetness and humidity are high. These spores spread to nearby plants via water splash and human spread, and can travel longer distances via wind currents. The pathogen does not directly infect cucurbit fruits. Currently, two types of the cucurbit downy mildew pathogen are known. One type will infect cucumber and melon ("Clade 2") and seems to be much more aggressive on these select cucurbit types. Clade 2 also has resistance to some currently used fungicides. The second type of downy mildew pathogen will infect pumpkin, watermelon, winter squash, bittermelon, and balsam apple ("Clade 1"). Clade 1 seems to arise a bit later in the production season than Clade 2.

Cultural Control. Scouting regularly allows early identification of disease before significant spread and damage. The following practices can also help prevent disease development:

- Plant resistant varieties when possible
- Avoid overhead irrigation
- Maintain proper spacing between plants
- Plant in areas with good airflow

Chemical Control. Keep track of locations of known cucurbit downy mildew infection, and the cucurbit types infected, to best understand your risk and prescriptively manage this disease. For many years this disease was tracked and field reports were used to generate a disease forecast: https://cdm.ipmpipe.org/forecasting/. While this service is currently suspended, the website offer useful resources for management. For Wisconsin-specific fungicide information, refer to the Commercial Vegetable Production in Wisconsin (A3422), a guide available through the UW Extension Learning Store website. 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.



Current US counties highlighted in red have had a positive cucurbit downy mildew report during the past 7 days. Green counties indicate a former report of the disease greater than 7 days ago. From: https://cdm.ipmpipe.org/

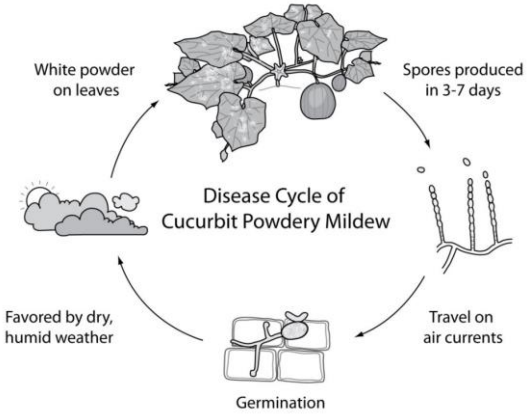
Based on the reports in the US so far this season, and the spores in the MI traps, it is likely that we will see Clade 2 in WI. Management of cucurbit downy mildew requires preventative fungicide applications as commercial cultivars are generally susceptible to current strains (Clades) of the pathogen. Management information can be sourced here: https://vegpath.plantpath.wisc.edu/2022/07/03/update-10-july-3-2022/

It is very important cucumber growers use proven downy mildew fungicides (shown below in alphabetical order). These fungicides were effective in Dr. Mary Hausbeck's Michigan State Univ. Plant Pathology 2021-23 research field plots and include:

- Elumin + chlorothalonil or mancozeb
- Omega (Orbus) + chlorothalonil or mancozeb
- *Orondis Opti (chlorothalonil is part of the premix)
- Previcur Flex + chlorothalonil or mancozeb
- *Ranman + chlorothalonil or mancozeb
- Zampro + chlorothalonil or mancozeb

Pictures above show downy mildew symptoms on cucumber foliage. The picture on the left is credited to Gerald Holmes (Strawberry Center, Cal Poly San Luis Obispo) and on the right to Rebecca Melanson (Mississippi State Univ. Extension).

Cucurbit Powdery Mildew: Cucurbits will soon show signs of powdery mildew in southern Wisconsin. This disease is typically caused by the fungal pathogen *Podosphaera xanthii* and we see it appear on most susceptible cucurbits first in mid to late July of most years; in recent years, this disease has been showing up a bit sooner and requiring management. While some cucurbits can tolerate powdery mildew infection, if the disease onsets early and on a highly susceptible variety, control may be necessary. There are several fungicides with effective control of powdery mildew (list provided below from the A3422 Commercial production guide for vegetables in Wisconsin). However, cucurbit powdery mildew pathogen populations in Wisconsin have resistance to the strobilurin fungicides which include azoxystrobin, pyraclostrobin, and trifloxystrobin. In our past field trials, Quintec (quinoxyfen) was most effective in alternation and tank-mixed with chlorothalonil. For multi-pick cucurbits, it's important to have a look at the allowable days to harvest. The images below show typical powdery mildew signs (talcum-like white spore production on foliage) and the disease cycle of powdery mildew on cucurbits. For organic producers, neem oil, sulfur, and copper have activity in limiting infection but treatments should be initiated early to reduce pressure. Powdery mildew is typically favored by warmer, drier weather (although initial infection does require moisture period).



Disease control in pumpkin and squash *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew	azoxystrobin	11.0–15.5 fl oz Aframe, AzoxyStar, Equation, Quadris Flowable, Satori	1	Equation, Quadris, Cabrio, and Flint belong to the Group 11 (strobilurin) category of fungicides. Quadris Opti contains a combination of Groups 11 and M5 fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per year. Do not exceed 64.0 oz/a Cabrio, 8.0 oz/a Flint, 1.92 qt/a Quadris or Equation, or 2 gal/a Quadris Opti per season. Do not tank mix Cabrio, Flint, Quadris, Equation, or Quadris Opti with additives or adjuvants.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	trifloxystrobin	1.5–2.0 oz Flint	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Group 7 and Group 11 (strobilurin) fungicide categories. Do not exceed 2 sequential applications before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 7 or 11 fungicides per season. Limit of 74.0 oz/a per season.
	clarified hydrophobic extract of neem oil	0.5–1.0% Trilogy in 25–100 gal water *or* 2.0 pt in at least 5 gal water	0	Do not apply more than 2 gal of Trilogy/a. OMRI-approved.
	cyflufenamid	3.4 oz Torino	0	Do not make more than 2 applications per year. Do not apply more than once every 7 days. Do not exceed total of 6.8 oz/a product per year.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	Do not apply more than 56.0 oz/a Switch per season. After 2 applications, alternate with a fungicide with a different mode of action for 2 applications.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Do not apply to greenhouse peppers. Do not apply more than 53.6 oz per year.
	fluopyram	6.5–6.84 fl oz Velum Prime	0	Also labeled for nematode suppression. Do not apply more than 13.7 fl oz of Velum Prime per acre per year. Fluopyram usage should be considered as total of soil and foliar applications (no more than 0.446 lb fluopyram).
	fluopyram + tebuconazole	6.0–17.0 fl oz Luna Experience	7	A mild yellowing on leaf margins is sometimes noted following application.
	fluopyram + trifloxystrobin	4.0–7.6 fl oz Luna Sensation	0	Do not apply more than 27.1 fl oz/a per season.
	flutriafol	10.0–14.0 fl oz Topguard	0	Follow resistance management guidelines.
	kresoxim-methyl	3.2–4.8 oz Sovran	0	Do not exceed 19.2 oz/a per season. Consult label for comments on adjuvant usage.
	metrafenone	15.4 fl oz Vivando	0	Make no more than 3 applications per year.
	myclobutanil	2.5–5.0 oz Rally 40WSP	0	Do not exceed 1.5 lb/a product (0.6 lb ai/a) per year. Observe a 30-day plantback interval between the last application and planting new crops. (Formerly Nova.) Resistance has been noted in WI.
	neem oil	0.5–1.0% Trilogy in 25–100 gal water	0	Has fungicide and miticide benefits. Organic (OMRI) approved.

Powdery mildew *(cont.)*	penthiopyrad	12.0–16.0 fl oz Fontelis	1	For disease control in greenhouse cucurbits, use at a rate range of 0.375–0.5 fl oz per gallon of spray per 1,360 sq ft. These rates equal field rates of 12.0–16.0 fl oz/a. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action. Do not apply more than 67.0 fl oz/a per year.
	potassium bicarbonate	2.5–5.0 lb Kaligreen	1	Use higher rates when disease pressure is high. Apply at first sign of disease for best results.
	quinoxyfen	4.0–6.0 fl oz Quintec	3	Do not apply more than 32.0 fl oz Quintec per calendar year. Under certain environmental conditions, Quintec may cause leaf spotting or chlorosis. If symptoms occur after applying Quintec, discontinue use.
	sulfur	various, depending on product and formulation	0	Do not apply to sensitive crops. Do not apply during hot weather. Do not use within 2 weeks of an oil treatment. Consult with processor prior to use.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo	7	Do not exceed 24.0 fl oz/a per season.
	thiophanate methyl	0.5 lb Topsin M 70W, Topsin M WSB 10.0 fl oz Topsin 4.5FL 0.2–0.4 lb Thiophanate methyl WDG	0 0	Apply when disease first appears and repeat if needed every 7–14 days.
	triflumizole	4.0–8.0 oz Procure 50WS 4.0–8.0 fl oz Procure 480 SC	0	Do not exceed 40.0 oz/a of Procure 50WS or 40.0 fl oz/a of Procure 480 SC per season. See product label for plantback restrictions for leafy vegetables (30 days), root vegetables (60 days), and all other crops (1 yr).