Cornell Cooperative Extension | Cornell Vegetable Program

VEGEdge

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Hot, Dry Weather = A Mite-y Big Problem

Caitlin Tucker, Cornell Cooperative Extension, Cornell Vegetable Program

Anyone out there with some rain to spare? Most of our region has been dry for some time. And warm. Dry + warm = perfect conditions for pest populations to explode. I want to focus on a pest that is not technically an insect – mites. These teeny, sometimes microscopic creatures are actually arachnids and more closely related to spiders. In fruit and vegetable production, we are primarily concerned with a select few species:

- Two-Spotted Spider Mite (TSSM)
  - Crops affected: tomato, cucurbits, eggplant, potato, beans
- Broad mite/Cyclamen Mite
  - Crops affected: tomato, cucurbits, eggplant, ornamentals
- Eriophyid Mites
  - Crops affected: onion, garlic, leek

All mites have piercing-sucking mouthparts, but the damage they cause to vegetable crops looks different depending on which species we're talking about. TSSM seems to be the most prevalent issue on farms currently, so let's focus in on that. Damage from TSSM shows up as a

TSSM damage may show up as a faint yellow patch on leaf surface. It's an indicator that you may have a two-spotted spider mite problem. *Photo by C. Tucker, CCE*

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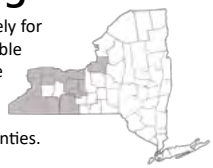
About VegEdge



VegEdge newsletter is exclusively for enrollees in the Cornell Vegetable Program, a Cornell Cooperative Extension partnership between Cornell University and CCE Associations in 14 counties.

The newsletter is a service to our enrollees and is intended for educational purposes, strengthening the relationship between our enrollees, the Cornell Vegetable Program team, and Cornell University.

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The next issue of VegEdge newsletter will be produced on July 7, 2021.

Accumulated Growing Degree Days

Julie Kikkert and Emma van der Heide, CCE Cornell Vegetable Program

Accumulated Growing Degree Days (AGDD)
Base 50°F: April 1 - June 28, 2021

Location**	2021	2020	2019
Albion	906	764	659
Arkport	739	657	619
Bergen	851	751	643
Brocton	890	773	676
Buffalo*	936	752	647
Burt	786	702	565
Ceres	739	636	684
Elba	810	729	613
Fairville	823	736	603
Farmington	858	762	627
Fulton*	820	760	591
Geneva	886	782	671
Hammondsport	829	743	637
Hanover	868	770	671
Lodi	792	810	707
Niagara Falls*	883	748	602
Penn Yan*	933	806	713
Rochester*	889	779	735
Sodus	912	728	590
South Bristol	850	750	637
Varick	943	835	729
Versailles	835	757	676
Williamson	803	715	567

* Airport stations
** For other locations: http://newa.cornell.edu

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faint stippling on the leaf as they begin to remove sap from your plants. Your attention may be drawn to a yellowing of the leaf surface. To confirm that you have TSSM, flip over the leaf and look closely. TSSM are just visible with the naked eye, but a 10X hand lens will help you to see them more clearly. They are yellowish-green and have two characteristic dark spots on their backs. If the TSSM population explodes, you may start to notice visible webbing on your leaves and/or fruit – hence the name "spider" mite. In dry, warm years, and especially in tunnels, these mites can quickly get out of control. As feeding increases, you will start to see significant browning of leaves followed by defoliation. Yield losses occur as a result, and your quality may be impacted by sunscald.

BIOLOGICAL CONTROL

- *Phytoseiulus persimilis* – a predatory mite. P. *persimilis* cannot live without a population of prey to feed upon, so you cannot release it before TSSM has shown up. They prefer temperatures between 68-78°F. At higher temperatures, they will stop seeking out prey and take shelter in the lower canopy. This species may not be suitable in high tunnel settings as a result. For more information on P. *persimilis* including compatibility with pesticides, visit https://entomology.ces.ncsu.edu/biological-control-of-spider-mites-in-tomatoes/
- *Amblyseius califonicus* – this predatory mite feeds more slowly but is a generalist and can feed on thrips or other mites, such as broad mite, if TSSM is not present. It can withstand higher temperatures above 86°F and is probably the best option for high tunnel systems.
- *Stethorus punctillum* (Spider Mite Destroyer) – the name says it all! This ladybeetle can efficiently find TSSM in greenhouse and field environments and can tolerate temperatures up to 90°F.

Tips

If you have a widespread infestation, satchets of mites may not be the best option. Instead, choose predatory mites that can be sprinkled over plants. Sticky trichomes (hairs) on tomato can interfere with biological controls. Repeat applications may be necessary!

You can find a more extensive list of biological controls at http://ipm.uconn.edu/documents/raw2/html/664.php?aid=664

CHEMICAL CONTROL

Mites produce fairly rapidly and because of that, resistance is a concern. Practice resistance management by following label instructions regarding number of applications per season! The following miticides are labeled for use on TSSM (approved crops):

- Acramite 50 WS (cucurbits, field grown tomatoes only, peppers)
- Agri-Mek SC (cucurbits, tomatoes, peppers)
- Endigo ZC (cucurbits, tomatoes)
- Gladiator EC (cucurbits, peppers)
- Portal XLO (cucurbits, tomatoes, peppers)
- Zeal SC (cucurbits)
- Insecticidal Soaps
- Horticultural Oils

Tips

- Make sure you get sufficient coverage on the undersides of leaves or on newer growth, where the mites tend to congregate.
- If webbing is visible, you may need to use a higher spray pressure to penetrate through to the adults and eggs.
- Small infestations may be managed through spot-treating. Flag out hot spots, treat, and continue checking to see if further action is needed.
- Some miticides will also kill beneficial mites and other predators. Check to see if they are selective against TSSM!

CULTURAL/MECHANICAL CONTROLS

Unfortunately many cultural/mechanical practices that can be used to manage TSSM, like increasing humidity or spraying down foliage, may result in other issues like disease development. Ensure that tunnels are vented properly to help maintain a lower temperature and reduce reproduction.

Melon leaves are shown with white stippling on the leaf surface, which is another sign that two-spotted spider mite may be present.

A suspicious tomato leaf has been turned over. A close look with a hand lens shows numerous adult spider mites with their characteristic two dark spots on their backs. Fun fact - the two dark spots on TSSM adults are an accumulation of body wastes.

A wooden stake used for tomato trellising is covered in a fine white web from spider mites. A closer look reveals orange predatory mites attempting to control the pest explosion. *Photos by C. Tucker, CCE CVP*

CROP Insights

Observations from the Field and Research-Based Recommendations

BEETS

Michigan reported their first Cercospora leaf spot (CLS) lesion this past week, and we are out in the field today looking for leaf diseases in western, NY. You should be too because now is the time to start monitoring your fields more closely for CLS. The CLS forecast can be found on the new beta site of NEWA at https://dev.newa.cornell.edu/beet-cercospora-leaf-spot. The June 29 to July 1 forecast is low for most of the stations in our beet growing areas, but is predicted to be moderate risk for Elba, Geneva (Bejo), and Lyndonville on July 1st. Beets that have closed in the rows are most at risk. Not all spots are CLS! See the general article on identification of spots (page 6) on beet leaves and as always call us if you need assistance. - JK

CUCUMBERS

The forecasting on the CDM IPM PIPE website for downy mildew risk is now up to date and includes the Ontario reports. Keep an eye on the forecasts, they are updated twice a week. Tuesday of this week had a high risk profile in the Niagara peninsula, forecast will be updated Wednesday.

Bacterial wilt is beginning to show up. Nothing to be done for infected plants at this point; can't stop the infection inside the vascular tissue. Bacterial wilt is transmitted by cucumber beetles, which is a solid reason to keep those pests under control. - EB

Bacterial wilt. *Photo by E. Buck, CCE*

Fusarium in garlic. *Photo by E. Buck, CCE*

GARLIC

Seeing a lot of excessive tip die back. This is widespread this year and in many cases can be attributed to the weather. At this stage it is quite beneficial to keep the crop well watered as droughty conditions during bulb sizing will rob you of yield. BTW, this is what fusarium in garlic can look like (see photo above). Brown and slashed outer wrappers, roots collapsing and turning brown or pink and falling off the basal plate, stunted and scrawny plants in the field. - EB

ONIONS

A week after the summer solstice and almost all of the fields in our scouting program are starting to bulb, at least in Elba and Wayne. It certainly feels like the crop is going to be early this year. As we close out the month of June, most fields have already had a double shot of Movento for onion thrips control, and IYSV and bacterial bulb decay have already been detected, at record-breaking early detections. The crop looks fantastic right now, although under stress from days of hot and windy weather. Botrytis leaf blight (BLB) halo lesions are generally declining or holding across the region, while BLB necrotic spots are beginning to show up. Stemphylium leaf blight (SLB) is just beginning to appear as a primary pathogen in some older fields. It is now apparent that SLB infection, spore and lesion development and leaf dieback may act independently. Our fungicide trial results show that some fungicides have activity on reducing SLB spores and spots, but do not have much activity on preventing leaf dieback, and vice versa. Fungicide resistance to FRAC 7 is now beyond repair in NY, and the FRAC 3s are slipping. Only FRAC 3 + 3 treatments provided very good control of SLB leaf dieback (e.g. kept plant foliage healthy and green). Now, our strategy is to use fungicides with activity on SLB spores and spots at early stages of and to use those with best activity against leaf dieback just prior to and during lodging. Fungicides for best activity on SLB spores and spots include Scala + Rovral (Elba only), Luna Tranquility, Miravis Prime and Gavel/Zing! See article on page 8 for much more information. Onion thrips pressure is increasing, but is being kept in check with Movento, with several fields now going into their second week of below 0.6 thrips per leaf with the "momentum of Movento". Thank you to all who came out to the Oswego Onion Growers Twilight Meeting last Thursday! - CH

PEAS

Harvest of the processing crop continues. Weather extremes this season have caused uneveness in set and pod development in some fields. "In peas, daytime temperatures exceeding 78°F at flowering and pod fill will significantly decrease yields. In addition, high temperatures near harvest will mature peas quickly resulting in a shortened harvest window." - S. Reiners, Cornell. Fields with poor root systems because of soil compaction and/or root disease will show signs of stress as indicated by yellowing and stunted growth. If you want to see what is happening, take a shovel out to the field and dig up sections that are poorly growing and compare the roots to better areas of the field. Plan to improve soil health for future crops. - JK

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POTATOES

Continue to scout fields for Colorado potato beetles, checking 10 sites per field and 5 plants per site. An insecticide application should be considered under these thresholds: 10% defoliation is observed, 200 small larvae, 75 large larvae, or 25 adults/50 plants. Potato leafhopper adults are present in fields and should be monitored. Insecticides applied at planting may continue to provide some control, though this may be wearing off in earlier planted fields. - ML

Late Blight Risk Chart, 6/30/21

Location	Blight Units 6/23-6/29	Blight Units 6/30-7/2	Location	Blight Units 6/23-6/29	Blight Units 6/30-7/2
Albion	0	14	Hammondsport	0	21
Arkport	6	21	Knowlesville	0	14
Baldwinsville	0	14	Lyndonville	0	14
Bergen	0	14	Medina	0	14
Buffalo	1	16	Niagara Falls	2	16
Burt	5	14	Penn Yan	6	18
Ceres	10	21	Rochester	1	17
Elba	2	14	Sodus	0	17
Fairville	0	17	Versailles	5	17
Farmington	6	17	Wellsville	13	21
Fulton	2	18	Williamson	6	14
Geneva	0	17			

Calculated using a May 26 crop emergence date, last fungicide application June 23

Simcast forecasting indicates that no weather stations have reached the 30 blight units (BU) needed to trigger a spray for late blight this week, though Ceres and Wellsville are forecasted to surpass this threshold in the next few days as indicated in red. If the weather station closest to you has not yet reached 30 BU and the forecast indicates that it will in the next 2-3 days, a spray is still recommended. All weather stations will exceed the Fungicide Units by the end of the week, indicating fungicide weathering and loss of residue. The chart assumes use of a susceptible potato variety Reba, and an application of chlorothalonil on June 23. Because weather conditions can vary depending on topography and altitude, the recent disease information and disease forecasts will be most accurate very close to the weather station used. For locations that are not close to a weather station, forecast information should only be used as a *general indication* of how favorable weather has been for late blight. Forecast BUs are subject to changes as the weather forecast changes, so check forecasting tools regularly to see if disease forecasts have changed. Information for other weather stations can be found at: http://newa.cornell.edu/index.php?page=potato-diseases. There are no reports of late blight on a national level. - ML

Be on the lookout for leafhoppers. As alfalfa starts to be harvested leafhoppers will move to other crops. These tiny insects feed on leaves leaving the characteristic “hopper burn” affect. Leaves will go from dark green to various shades of patchy yellow with tiny specks. See last week's article for more info, page 3. The Guidlines has a complete list of products but several of the ones listed for squash vine borer also are effective on leafhoppers. Read labels for mixing instructions. - RH

SNAP BEANS

The Cornell Climate Smart Farming group has a handy online Water Deficit Calculator to help you see the status of any field location available at http://climatesmartfarming.org/tools/csf-water-deficit-calculator/ . If you click on the video link and scroll down, you will find a tutorial video for this tool.

According to Y. Wang, Univ. of Wisconsin-Madison, the critical period to irrigate snap beans is during pollination, flowering and pod development. Blossoms may drop and pods may fail to enlarge if watering is inadequate. Dr. Wang suggests 1 gallon per foot of row, measured using a drip emitter and timer). In general, most vegetables require at least 1” of water per week during the growing season, which is about 27,000 gallons per acre. Watering to a depth of 5 to 6 inches encourages the growth of deeper roots. Avoid quick, shallow watering, which encourages shallow root growth and makes the plants more susceptible to damage by heat and sun. Dr. Wang recommends early morning irrigation to prepare the plants for the stress of mid-day heat. Dr. Reiners, Cornell says that beans prefer daytime temperatures of 70 to 80 F. Daytime temperatures over 86 F or night temperatures over 80 F at flowering can result in poor set. Moisture stress can also lead to problems in beans. Even outside the critical period of flowering and set, dry conditions when the crop has two trifoliate leaves can decrease later vegetative growth and affect flower initiation. This may result in lowered yields and uneven crop maturity. - JK

SQUASH

Now is the time to be on the lookout for squash vine borers. The larvae are hard to find after hatching until they are already causing damage to the vines. Since adults are flying, we must presume egg laying has begun. Directed sprays to the base of the plant is necessary to reach hatching larvae before they burrow into the plant. Several products are available such as Assail 30SG, Endigo ZC, Fastac CS, Gladiator EC. Agree WG and Entrust SC are also being used but the 2ee recommendation copy must be in possession of the person spraying at the time of application. Read directions carefully because specific requirements for days between applications and PHI need to be understood. Some organic growers have had reduction in borer populations by using repeated sprays of kaolin clay over the stems heavily applied at the base of the plants.

Squash bugs will soon be upon us as well. These are the insects that lay the copper-colored eggs usually on the underside of leaves. Gray juveniles swarm all over the leaves feeding heavily doing considerable damage to the leaves. Reduced foliage can cause sunburning of the squash skin and severe infestations will reduce foliage enough to have loss in yields. Some of the same products used for borer can also be used for squash bugs. Some other products include Neemix 4.5, Pounce 25WP Sivanto HL and Prime, and Warrior II. The key here is thorough coverage especially on the undersides of the leaves. - RH

Spot the Differences on Table Beet Leaves!

Sarah Pethybridge and Pratibha Sharma, Cornell AgriTech, Geneva, and Julie Kikkert, Cornell Cooperative Extension, Cornell Vegetable Program

There are four main diseases that cause similar leaf spots on table beet.

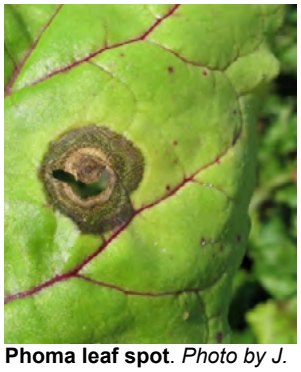
1. Bacterial leaf spot
2. Phoma leaf spot
3. Cercospora leaf spot
4. Alternaria leaf spot

As the name suggests, Bacterial leaf spot is caused by a bacterium, while Phoma, Cercospora, and Alternaria leaf spots are caused by fungi. Identifying the different types of leaf spots is important as best management practices differ between them. A hand lens (10X magnification) is useful to distinguish them. Here are some key differences to help spot the difference!

Distinguishing Characteristics of Leaf Spots on Beets

Characteristics	Bacterial leaf spot	Phoma leaf spot	Cercospora leaf spot	Alternaria leaf spot
Color	Black/brown	Tan	Gray	Brown
Shape	Circular to elliptical	Large, singular, and circular	Circular	Patchy
Location	Leaf margins (often) does not cross major veins	Can cross major veins	Does not cross major veins	Can cross major veins
Structures in lesion visible with hand lens?	None	Black, pin-head structures arranged in circles	Black, pin-head structures randomly distributed. Gray fuzz produced from black structures.	Dense, brown/black, fuzzy fungal growth across spots
Other	Associated with leaf puckering/deformation.	Lesion becomes papery and easily tears	Red margins in red cultivars. Brown margins in yellow and white cultivars	---

Bacterial leaf spot. *Photo by J. Kikkert, CCE*



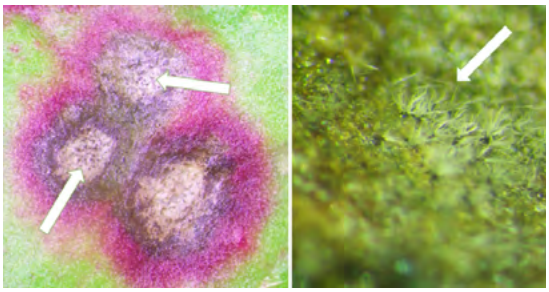
Phoma leaf spot. *Photo by J. Kikkert, CCE*

Cercospora leaf spot on 'Ruby Queen' table beets. *Photo by J. Kikkert, CCE*

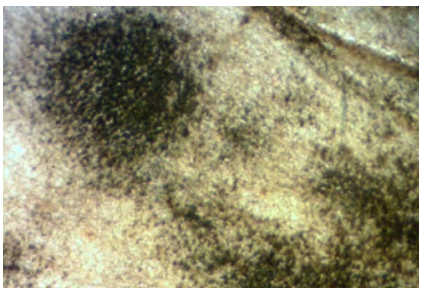
Alternaria leaf spot on sugar beet. *Photo by L. Hanson, USDA ARS*

Observing the spots with a hand lens is useful to confirm diagnoses:

- Bacterial leaf spots will not have black structures or fungal growth on the lesions.
- Phoma leaf spots will have pinhead, black structures, that hold fungal spores, arranged in circles in the lesions. Phoma leaf spot lesions will not have fungal, fuzzy growth on the surface.
- Cercospora leaf spot lesions will have pinhead, black structures randomly distributed across the spots (marked below in the left panel). In most cases, these black spots will give rise to white-gray fuzz which are the spores of the fungus.
- Alternaria leaf spot lesions will not have pinhead, black structures. However, the surface of the spots will be covered in brown and black fuzzy fungal growth.



Cercospora leaf spot on table beet. Close up on the left shows black pinhead structures in the center of the lesion. The 40x magnification with a stereomicroscope (right) provides further detail of the spores of the fungus. *Photo by Pethybridge Lab, Cornell*



Dark sporulation from Alternaria leaf spot on sugar beet at 15x magnification. Leaves were incubated in a moist chamber. *Photo by L. Hanson, USDA ARS*

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Another useful clue to identify leaf spots is crop growth stage and time of year.

Other Factors Helpful in Identifying Beet Leaf Spot Diseases

Factor	Bacterial leaf spot	Phoma leaf spot	Cercospora leaf spot	Alternaria leaf spot
Growth Stage	Up to 6 true leaves	Any	Any	Any
Time of Year	Infection begins early in the year	Late spring or early summer; more prevalent in organic fields	July onwards; rows filling in.	August onwards
Weather Conditions	Cool (45-60°F) and wet	Cool (57-65°F) and high humidity	Warm (75-80°F) with frequent rainfall or high humidity	Warm with frequent rainfall or high humidity

NY Sweet Corn Trap Network Report, 6/29/2021

Marion Zuefle, NYS IPM Program; from http://sweetcorn.nysipm.cornell.edu

Statewide, 28 sites reporting this week. European corn borer (ECB) numbers remain very low. Only three sites reported (ECB)-E and four sites caught ECB-Z and no hybrid ECB moths were caught this week. Based on the accumulated degree days (base 86/50), most sites are still in the first generation treatment period for the bivoltine ECB (see tables below) and are just beginning to accumulate enough degree days for the univoltine ECB to emerge.

Corn earworm was caught at thirteen sites with eight sites high enough to be on a 4, 5 or 6 day spray schedule (see table below). Still no fall armyworm (FAW) or western bean cutworm (WBC) caught this season.

Fields are in both the tassel emergence and silking stage. The thresholds when scouting differ for these two stages of corn. For tassel emergence corn the threshold is 15% infested plants. For silking corn the threshold drops to 5% infested plants. To help you scout your fields please view the video titled How to Scout Fresh Market Sweet Corn. This video will show you how and when to scout sweet corn using the Sweet Corn Scouting Form (pdf).

European corn borer (bivoltine) development estimated using a modified base 50F degree day calculation

Development Stage	Accumulated Degree Days
First Generation	
First spring moths	374
First eggs	450
Peak spring moths	631
First generation treatment period	800-1000
Second Generation	
First summer moths	1400
First eggs	1450
First egg hatch	1550
Peak summer moths	1733
Second generation treatment period	1550-2100

Degree-day model (modified base 50 F) for predicting moth emergence of univoltine European corn borers

Proportion of Moths Emerged	Accumulated Degree Days
10%	911
25%	986
50%	1,078
75%	1,177
90%	1,274

Degree-day model for univoltine ECB from North Dakota.

WNY Pheromone Trap Catches: June 29, 2021

Location	ECB-E	ECB-Z	ECB Hybrid	CEW	FAW	WBC	DD to Date
Batavia (Genesee)	0	0	NA	0	0	0	953
Bellona (Yates)	NA	NA	NA	NA	NA	NA	933
Brockport (Monroe)	4	0	NA	0	0	0	970
Collins (Erie)	NA	NA	NA	NA	NA	NA	904
Eden (Erie)	0	0	NA	2	0	0	947
Geneva (Ontario)	0	0	0	0	0	0	935
Hamlin (Monroe)	NA	NA	NA	NA	NA	NA	920
Leroy (Genesee)	0	0	NA	2	0	0	938
Lyndonville (Orleans)	0	0	NA	6	0	0	902
Oswego (Oswego)	0	0	NA	0	0	0	789
Panama (Chautauqua)	NA	NA	NA	NA	NA	NA	840
Penn Yan (Yates)	0	2	0	0	0	NA	897
Portville (Cattaraugus)	1	0	NA	0	0	0	839
Ransomville (Niagara)	0	0	NA	2	0	0	972
Seneca Castle (Ontario)	0	0	0	0	0	0	909
Williamson (Wayne)	0	0	NA	2	NA	NA	823

ECB: European Corn Borer; CEW: Corn Earworm; FAW: Fall Armyworm; WBC: Western Bean Cutworm; NA: not available; DD: Degree Day (base 86/50) April 1st accumulation Climate Smart Farming

Average Corn Earworm Catch			Days Between Sprays
Per Day	Per Five Days	Per Week	
<0.2	<1.0	<1.4	No spray (for CEW)
0.2-0.5	1.0-2.5	1.4-3.5	6 days
0.5-1.0	2.5-5.0	3.5-7.0	5 days
1-13	5-65	7-91	4 days
over 13	over 65	over 91	3 days

Add one day to the recommended spray interval if daily maximum temperatures are less than 80F for the previous 2-3 days.

Part I: Onion Fungicide Research Updates and New Recommendations for Control of Botrytis and Stemphylium Leaf Blights, 2021

Christy Hoepting, CCE Cornell Vegetable Program, and Frank Hay, Dept. of Plant Pathology, Cornell Agri-Tech

The new 2021 Onion Leaf Disease Fungicide Cheat Sheet is available: https://rvpadmin.cce.cornell.edu/uploads/doc_982.pdf

FIVE DIFFERENT CATEGORIES FOR DISEASE CONTROL

In 2020 on-farm fungicide trials, five categories for Botrytis leaf blight (BLB) and Stemphylium leaf blight (SLB) were assessed (Table 1). Differences in fungicide efficacy between BLB halos and spots, and among SLB infection (spores and target spots) and leaf dieback occurred. SLB produces toxins that result in leaf dieback, and apparently, **SLB infection and leaf dieback occur independently**. Sometimes, a fungicide reduced SLB infection (spores and spots), but did not prevent leaf dieback, or vice versa. **BLB halos and necrotic spots were often not controlled equally by the same fungicide** with the latter generally much harder to control. Since we now know that these differences occur, a **new strategy for managing these leaf diseases this year is to select fungicides based on their activity against relevant disease category**. Unfortunately, we did not find a single product that controlled all disease categories well.

Table 1. Five categories for Botrytis and Stemphylium leaf blight of onion.

	Botrytis Leaf Blight		Stemphylium Leaf Blight		
	BLB halos	**BLB necrotic spots**	**SLB leaf tip spore colonization "dirty tips"**	**SLB target spots**	**SLB leaf dieback**
Description	Tiny yellow necrotic spot surrounded by a silvery halo. Some spots only have the ghosty halos.	Round yellow or yellowish-white spots with a defined border, pin-prick to 3 mm in size. Not to be confused with old BLB halos.	Non-descript tan and/or black discoloration of necrotic tissue (leaf tips and outer leaves).	¼ to 2-inch target spots, tan, black or purplish. First appear on necrotic tissue, eventually on green tissue.	Greater than 30% leaf dieback/plant prior to lodging is considered excessive, and could result in yield reduction.
Timing	June & July, sometimes season long, especially in Wayne & Oswego Cos.	Appears to prefer older plants. Occurrence increases during second half of July and/or after bulbing, and usually is dominant in August.	As soon as tip burn and outer leaf dieback begins during bulbing.	Usually not until bulbing when tipburn and outer leaf dieback begins. Can also occur as a secondary pathogen on injured necrotic tissue at any time.	During bulbing. Usually not until second half of August.
Spray Threshold	1.0 BLB halos/leaf. 1st detection for mancozeb 1 lb	None established	Begin spraying at 0.5-1" bulb and early tip burn.		

RELATIVE FUNGICIDE PERFORMANCE BASED ON THREE ON-FARM RESEARCH TRIALS

SLB has been the major focus of on-farm fungicide trials for the past few years, for which the trial is evaluated after lodging when BLB is predominantly BLB necrotic spots. Therefore, most BLB efficacy data collected from 2017 to 2019 trials was of BLB necrotic spots. In 2020 trial in Oswego, we evaluated disease after every two fungicides sprays and obtained efficacy data on all five disease categories. Table 2 provides a brief summary of on-farm trial details of 2021 field trials. Results summaries for these trials were distributed at Oswego Co. Onion Twilight Meeting last week, and they will be published in Plant Disease Management Reports. Contact Christy if you would like this information.

Table 2. 2020 on-farm fungicide field trials for control of Botrytis and Stemphylium leaf blights.

	Date and Crop Stage of First Spray	**Disease at 1st spray**	**Total No. of weekly sprays until >50% lodging**
Oswego BLB/SLB	Jun 17 (3-4 leaf) – 6 trts Jun 25 (4-5 leaf) – 14 trts	1st detection of BLB 2.0 BLB halos/leaf	9 10
Elba SLB No. 1	Jul 10 (7-leaf/early bulb swell)	No SLB	8
Elba SLB No. 2	Jul 24 (8-10 leaf/1-1.5" bulbs, tipburn)	1st detection of SLB target spots	6

FRAC 3 + 3 BEST FOR SLB, FUNGICIDE RESISTANCE DEVELOPING

FRAC 3s slipped in the Elba trial. At the end of the season, Inspire Super, Quadris Top and Tilt were not significantly different than the untreated for leaf dieback, and these treatments had more SLB target spots and leaf tip spore colonization than they used to. Of these three fungicides, only Inspire Super was evaluated in the Oswego trial, where it had the second greenest foliage in the trial, and appeared to still have efficacy. The host farm of this trial only used one application of FRAC 3 in 2020, while the majority of growers use at least 3 apps of FRAC 3 per spray season.

Unfortunately, fungicide sensitivity testing was not completed for SLB isolates collected from across the state in 2020, so we do not know the variability in fungicide resistance among farms. Laboratory fungicide sensitivity testing of SLB isolates collected from one of the Elba field trials from the untreated control at the end of the spray season had 60% sensitive to difenaconazole

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(a.i in Inspire Super and Quadris Top). This represented an 18% decline in the proportion of sensitive isolates compared to the state average from SLB isolates collected in 2018 (82%), which were 16% lower than they were in 2016 (99%). Undoubtedly, **SLB is developing fungicide resistance to FRAC 3, and we recommend no more than 2 apps per FRAC 3 in 2021**. Note that co-application of FRAC 3 + 3 would count as 1 app of FRAC 3 allowing for another application of FRAC 3 + 3. Laboratory results also indicate cross-resistance between difenaconazole and propiconazole (e.g. Tilt). This means that rotating between these active ingredients does not delay or prevent SLB from developing fungicide resistance to FRAC 3.

The other active ingredient in FRAC 3 is tebuconazole. Viathon is comprised of tebuconazole + phosphorous acid (FRAC P07). **Viathon had the second-highest green foliage (e.g. least SLB leaf dieback) in the trial, next to Viathon + Tilt, which had significantly more green foliage than any other treatment in the trial. It actually lodged normally in the Elba trial (not trialed in Oswego).** These treatments also had good activity on SLB target spots and leaf tip spore colonization, but not as good as Quadris Top + Tilt. Whether cross-resistance is not occurring between tebuconazole and difenaconazole/propiconazole, or the phosphorous acid is contributing to the effectiveness of Viathon remains to be determined. However, the Luna Experience treatment, which had a slightly lower rate of tebuconazole than the Viathon treatment did not do as well at keeping the foliage green as the Viathon treatments did.

In general terms, **best results for SLB were using FRAC 3 + 3**, with Quadris Top + Tilt pacing third in the Elba trial and first in the Oswego trial. Essentially, since the resistance factor for FRAC 3 appears to be low, (at least much lower than it is for FRAC 7), increasing the rate has helped to stave off fungicide resistance. Theoretically, resistant isolates that would escape a low rate or single product application of FRAC 3 fungicide would be killed by a high rate or double product FRAC 3 fungicide application. Likely, FRAC 3 + FRAC 3 + FRAC 3 such as Quadris Top + Tilt + Viathon would be even better than either of these two. Interestingly, Quadris Top + Tilt and Viathon + Tilt were the only FRAC 3 + 3 combinations that resulted in significantly greener foliage then either of their counterparts. Inspire Super + Tilt was not significantly different than either alone.

FRAGILE FRAC 7S ARE BROKEN

Genetic analysis of SLB isolates that tested moderately insensitive or insensitive in fungicide sensitivity plate assays from SLB samples collected in 2020 revealed that almost 100% of them had gene mutations that are known to confer fungicide resistance to FRAC 7. Eleven different gene mutations were identified and **unfortunately, cross resistance among FRAC 7 subclasses 1 (fluopyram in Luna products), 2 (fluxapyroxad in Merivon) and 3 (boscalid in Endura/Pristine) exists**. This means that if all you ever used was Luna Tranquility, and then SLB developed resistance to it, that your SLB would also be resistant to Merivon and Endura. Interestingly, the various **gene mutations varied among muck onion growing regions, which means that some products may work better than others in some places**. It also demonstrates that even 1-2 applications of FRAC 7 per season was enough for SLB to develop fungicide resistance. This is the fastest downslide of a potent fungicide that we have ever seen!

In the Elba field trials (not evaluated in Oswego), **Merivon was not significantly different than the untreated for any of the SLB categories**. Luna Tranquility had significantly less leaf dieback/more green foliage than the untreated, but it was not as green as the best treatments (FRAC 3 + 3). **Despite not being able to keep foliage green like Luna products once did so well, they still appear to have activity on SLB leaf tip spore colonization and target spots.** Increasing the rates of Luna Tranquility and Merivon did not improve SLB control. A laboratory assay demonstrated that co-application of pyrimethanil (= Scala) with fluopyram (FRAC 7) in Luna Tranquility "guarded" against SLB development of fungicide insensitivity to fluopyram. Therefore, **we continue to recommend co-application of SLB fungicides when using FRAC 7, if possible, to "guard" against fungicide resistance.**

Miravis Prime, which belongs to another FRAC 7 subclass 4 kept plants slightly greener than Luna Tranquility, but was not as good as Quadris Top + Tilt. It was not quite as good as Luna Tranquility at reducing SLB target spots.

Luna Tranquility 16 fl oz + Rovral kept foliage as green as Quadris Top + Tilt, and better than either alone. It also had good activity on BLB necrotic spots, should control BLB halos well, was okay on SLB target spots, but failed to control SLB leaf tip spore colonization. It is suspected like some of this synergy may be due to FRAC 2 + 9 as we have seen with Scala + Rovral in the past.

SCALA (FRAC 9) AND ROVRAL (FRAC 2) VARY BY REGION

Individually, Scala and Rovral did not have much activity on SLB in either location, and especially was not able to keep the plants green. Interestingly, Scala + Rovral combination was one of the best treatments for SLB target spots in Elba, but did not have much activity in Oswego. This combination did not keep the foliage green like it once did. Increasing the rates in the Scala + Rovral combo from 9 fl oz + 1 pt to 18 fl oz + 1.5 pt increased green foliage slightly, but will likely not be worth the increased cost. Over the past few years, Scala + Rovral and Rovral has generally worked better against SLB in Elba than other muck onion growing regions.

SOME NEW TWISTS FOR BOTRYTIS LEAF BLIGHT CONTROL

- Most striking result for BLB was that **Inspire Super failed to control BLB halos, but was best treatment in trial for control of BLB necrotic spots.** Consequently, **it does not make sense to use Inspire Super early in season for BLB when halos are dominant.** FRAC 3s in general failed to control BLB halos (Viathon not evaluated), although Quadris Top + Tilt had some activity. Tilt failed to control BLB necrotic spots, while Quadris Top and Viathon had some activity, and Quadris Top + Tilt was very good.

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- **Miravis Prime was the best for control of BLB halos**. It was not as good against BLB necrotic spots.
- **Bravo 3 pt, mancozeb 3 lb, Scala + Rovral** and **Luna products** were **very good on BLB halos**.
  - Mancozeb 1 lb only worked at first detection under low pressure and is suited for first BLB halos sprays of the season.
  - Bravo can only be used when an insecticide is not being applied, because it interferes with the efficacy of insecticide.
  - Alternatively, Scala + Rovral, Miravis Prime or Luna Tranquility are well suited for co-application with insecticide.
  - Of these, only Bravo and the Luna products have good activity on BLB necrotic spots.
- **Mancozeb, Rovral, Scala, Tilt and Merivon failed to control BLB necrotic spots.**

OTHER FRAC GROUPS HAVE POTENTIAL

- **FRAC 22 Gavel/Zing!** (a.i. zoxamide) had very good activity on SLB target spots and leaf tip spore colonization and some activity on BLB necrotic spots. It failed to control SLB leaf dieback. It did not help to "guard" against fungicide resistance from FRAC 3. It has a low-medium risk for fungicide resistance and is more cost-effective than most other fungicides. It may have a nice fit in the spray program just as SLB is getting started.
- **FRAC 19 Oso** had good activity on SLB targets in the Oswego trial (not evaluated in Elba), as well as on both BLB halos and necrotic spots. It may have utility early in the season when SLB is just beginning, and may possibly be tank mixed with Gavel or Bravo for improved control of these categories. It will not prevent SLB leaf dieback later in the season.

Managing Cucurbit Powdery Mildew Conventionally in 2021

Margaret Tuttle McGrath, Plant Pathology and Plant-Microbe Biology Section, SIPS, Cornell University

1. Grow resistant varieties. They provide useful but variable suppression of powdery mildew from limited in pumpkin and squash to very high in cucumber.
2. Check upper and lower surfaces of at least 50 older leaves for symptoms weekly beginning at the start of fruit formation, which is a physiological stress that causes plants to become susceptible. Symptoms often appear first on lower surface.
3. Begin applying fungicides as soon as symptoms seen and continue on a weekly schedule. Conditions typically remain favorable throughout the growing season because powdery mildew develops when it is dry; a prolonged period of rain is unfavorable.
4. The most effective fungicides are those able to move into leaf tissue and thereby redistribute to the lower surface where powdery mildew develops best. They can do so without affecting the plant because they have single-site mode of action targeted to the pathogen. Unfortunately, this also means these fungicides are at risk for resistance developing in the pathogen and rendering them ineffective. The cucurbit powdery mildew pathogen has proven very adept at developing resistance.
5. Fungicides that were very effective in the past are no longer effective because of resistance. These are Topsin M (FRAC code 1) and QoI fungicides (Cabrio, Flint, Quadris, etc.) (11); almost all pathogen isolates are resistant. Other fungicides providing poor to moderate control, depending on frequency of resistance in the pathogen population in a crop, are Endura, Pristine, and Merivon (7) and Torino (U6). Resistance has also been detected to Quintec (13); so far slightly less frequently.
6. When resistance has rendered ineffective one fungicide used in a program applied to a commercial crop, this might not be obvious when the other fungicides used are effective because the reduction in control might not be substantial and thus noticeable.
7. Isolates of the powdery mildew pathogen have been detected with resistance to multiple fungicides, most notably with resistance to Quintec, Torino, and Endura/Pristine. This means applying one of these fungicides can select for resistance to all.
8. Currently recommended fungicides include those not affected by resistance yet: Vivando (50) and Gatten† (U13). Other SDHI fungicides (7) and DMI fungicides (3) exhibit variable efficacy reflecting differences among the fungicides in how they bind to the target site or multiple genes being involved in resistance. Recommended DMI fungicides are Proline, Procure, Luna Experience†, and Rhyme†. Recommended SDHI fungicides are Aprovia Top (FRAC 3 + 7), Luna Experience† (3 + 7), and Miravis Prime† (7 + 12). These 3 have a different SDHI active ingredient (AI). The second AI in Miravis Prime (FRAC 12) does not have activity for powdery mildew, in contrast with Aprovia Top and Luna Experience.
9. Fungicide resistance is dynamic. Expect this pathogen to develop resistance to additional fungicides and thus fungicide recommendations to continue to change.
10. Within a week of the last application, look at severity of powdery mildew on the lower surfaces of leaves to assess degree of control obtained.

† not labeled for use on Long Island.

Example recommended targeted fungicide programs. (There are other good combinations.) Including a contact, protectant fungicide with each application is recommended.

- Proline, Vivando, Proline, Vivando, Luna Experience, Vivando (6 applications total). Proline was most effective fungicide tested at LIHREC in 2020. This program has maximum number of applications of Proline and Vivando permitted to a crop.
- Proline, Vivando, Proline, Vivando, Procure, Vivando, Procure (7 applications total) (can be used on Long Island).
- Proline, Vivando, Proline, Vivando, Aprovia Top, Vivando (can be used on Long Island).
- Proline, Vivando, Gatten, Proline, Vivando, Gatten, Procure, Vivando (8 applications total). 2 is maximum number of applications of Gatten.

Contact fungicides include sulfur (do not use on melons), chlorothalonil, mineral oil, and biopesticides (see https://www.vegetables.cornell.edu/ipm/diseases/biopesticides/).

Managing Cucurbit Powdery Mildew Organically – Key Points for Success

Margaret Tuttle McGrath, Plant Pathology and Plant-Microbe Biology Section, SIPS, Cornell University

1. Grow resistant varieties. They provide useful but variable suppression of powdery mildew from limited in pumpkin and squash to very high in cucumber.
2. Check upper and lower surfaces of at least 50 older leaves for symptoms weekly beginning at the start of fruit formation, which is a physiological stress that causes plants to become susceptible. Symptoms often appear first on lower surface.
3. Begin applying fungicides as soon as symptoms are seen and continue on a weekly schedule. Conditions typically remain favorable throughout the growing season because powdery mildew develops when it is dry; a prolonged period of rain is unfavorable. Getting spray deposited on the underside of leaves is important for optimizing control but challenging due to the large size of cucurbit leaves and density of foliage.
4. There are many organic fungicides for powdery mildew. Sulfur is the most effective. It can be phytotoxic to cantaloupe, especially under high temperatures (above 80 F); there are sulfur-tolerant varieties. There are several biopesticides labeled for powdery mildew on cucurbits. Using at least two products with different modes of action is a recommended strategy. For information to help with selecting biopesticides see https://www.vegetables.cornell.edu/ipm/diseases/biopesticides/. At this webpage there is a list of biopesticides labeled for use on cucurbits. Search for 'powdery' to see which ones are labeled for powdery mildew. The list includes active ingredient to help with selecting different products. There is an excel spreadsheet with efficacy results from evaluations of biopesticides for diseases of vegetable crops (and basil) conducted at universities and published in PDMR. Results were used to calculate % control. If you download the file to look for results, best to hide columns H – U as most important information is whether treatment was effective and % control achieved which are in columns V – Y. There are 2 tables with summary results from solo product evaluations in the database. These are also at the webpage.
5. Within a week of the last application, look at severity of powdery mildew on leaves to assess degree of control obtained.

There is additional information about this disease and its management at https://www.vegetables.cornell.edu/pest-management/disease-factsheets/cucurbit-powdery-mildew/

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