Cornell Cooperative Extension | Cornell Vegetable Program

VEGEdge

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Mobile Conventional Fungicides for Managing Powdery Mildew, Downy Mildew, and Phytophthora Blight in Cucurbits

Meg McGrath, Professor of Plant Pathology, Cornell University; edited by Elizabeth Buck, Cornell Vegetable Program

[Downy mildew is present in at least Erie and Niagara Counties and has been reported in Onondaga County (Syracuse area). Most of the CVP area has likely been exposed to cucurbit downy mildew spores. Powdery is here right on time, corresponding to zucchini harvest. Phytophthora Blight was damaging plantings despite the dry weather and the recent rains has increased the severity of those outbreaks. Meg McGrath has an excellent table of effective conventional control materials for these three diseases, current as of late May this year. ***Be sure to read the foot notes!!! They are detailed and will help improve your control of these diseases.*** *Several notes on organic controls is content added to Meg's article. ed. E. Buck, CCE CVP]*

FUNGICIDES NO LONGER RECOMMENDED DUE TO RESISTANCE CONCERNS

- Downy Mildew: Ridomil, Previcur Flex, and Group 11 fungicides (ex: Amistar, Cabrio, Quadris, Flint)
- Powdery Mildew: Endura, Pristine, and Group 11 fungicides. Resistant pathogen isolates have been found commonly every year on Long Island.

GENERALLY, HOW SHOULD I USE THESE FUNGICIDES?

- Tank-mix each of these fungicides with a protectant, with the exception of Zing! or Gavel, which are formulated with chlorothalonil or mancozeb. Need to tank-mix is specified in use directions on many labels.
- Apply fungicides for a particular disease in alternation to manage resistance (in the use directions on many labels; typically 1 or 2 consecutive spray maximum) and to ensure effective control if resistance develops.

Powdery mildew on squash leaf.
Photo by Caitlin Tucker, CCE CVP

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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.

We're interested in your comments. Contact us at:
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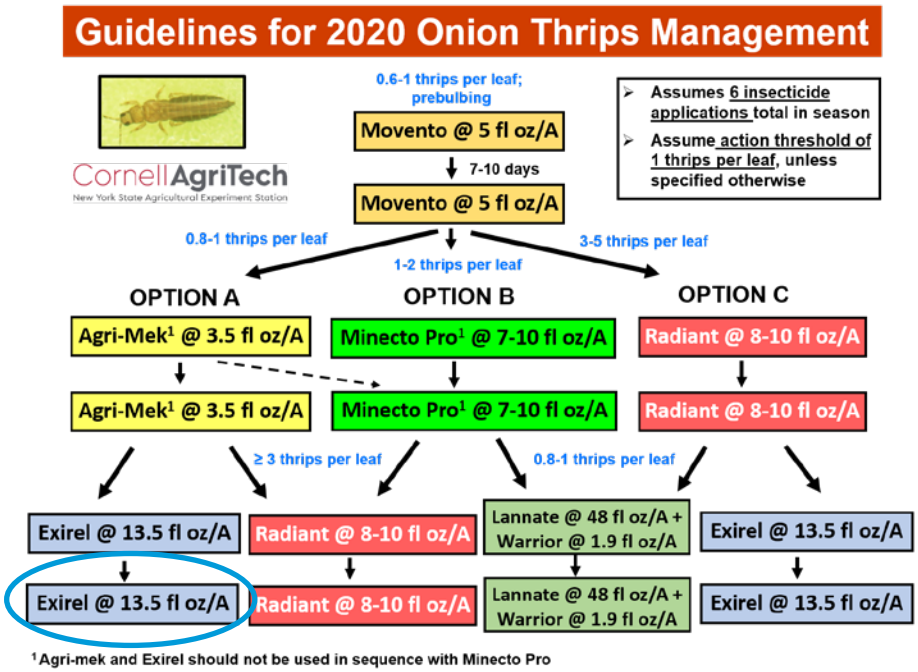
Help us serve you better by telling us what you think. Email us at *cce-cvp@cornell.edu* or write to us at Cornell Vegetable Program, 480 North Main Street, Canandaigua, NY 14424.

Contents

The next issue of VegEdge newsletter will be produced on July 22, 2020.

Correction to Guidelines for 2020 Onion Thrips Management Flow Chart Graphic

A copy/paste error was made in the flow chart image used in last week's article, ***Insecticide Programs to Consider for Onion Thrips Control in Onion in 2020***. Under Option A, the second application of Exirel was not depicted in the graphic as it should have been (but was listed in the outline below the graphic correctly).



A PDF of the Guidelines for 2020 Onion Thrips Management in Onion can be found on our website cvp.cce.cornell.edu

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WHAT PROTECTANTS SHOULD BE USED BEFORE MY CROP IS AT RISK OF DEVELOPING THESE DISEASES?

- Chlorothalonil and copper have broad-spectrum activity.
- Mancozeb is recommended when only downy mildew is occurring.
- Copper applied as a protectant will also be effective for bacterial diseases.

ORGANIC CONTROL OPTIONS

- Powdery mildew: sulfur is very effective. Milstop or oils (botanical and mineral) are good choices.
- Downy mildew: Use resistant varieties. Copper is the only well-tested, effective preventative treatment. Copper can slow but not stop an active infection. Some limited trialing has shown efficacy slowing disease development when applications of Actinovate and Double Nickle began prior to infection.
- Phythophthora Blight: No effective treatments. Avoid introducing disease and rely on cultural controls.

FOR ADDITIONAL INFORMATION ABOUT THESE DISEASES AND THEIR MANAGEMENT

http://vegetablemdonline.ppath.cornell.edu/NewsArticles/NewsList.htm

http://blogs.cornell.edu/livegpath

https://www.vegetables.cornell.edu/pest-management/disease-fact-sheets/

or contact one of the Fresh Market Specialists on the CCE Cornell Vegetable Program team.

Fungicide	FRAC Code	Disease(s)	Recommended Rate/A (labeled)	REI	PHI	Seasonal Limits
Vivando [a]	U6	Powdery mildew	15.4 fl oz	12 h	0 d	3 sprays [l]
Proline [c]	3	Powdery mildew	5.7 fl oz	12 h	7 d	2 sprays
*Procure [c]	3	Powdery mildew	8 fl oz (4-8)	12 h	0 d	40 fl oz [l]
*Gatten [†]	U13	Powdery mildew	8 fl oz (6-8)	12 h	0 d	2 sprays
*Luna Experience [†]	7 + 3	Powdery mildew	10-17 fl oz (6-17)	12 h	7 d	34 fl oz [l]
*Aprovia Top [a]	7 + 3	Powdery mildew	13.5 oz (10.5-13.5)	12 h	0 d	4 sprays [l]
*Miravis Prime [†]	7 + 12	Powdery mildew	11.4 oz (9.2-11.4)	12 h	1 d	2 sprays [l]
Quintec [b, c]	13	Powdery mildew	6 fl oz (4-6)	12 h	3 d	24 fl oz [l]
Torino [c]	U8	Powdery mildew	3.4 oz	4 h	0 d	2 sprays
Orondis Ultra [i]	49+40	Blight, Downy mildew	5.5 - 8.0 fl oz	12 h	0 d	4 sprays or 33% of all sprays
Orondis Opti [i]	49+M5	Downy mildew	1.75 – 2.5 pt	12 h	0 d	
Orondis Gold [i]	49+4	Blight	2.4 - 19.2 fl oz	12 h	0 d	At planting
Ridomil Gold SL [j]	4	Blight	1-2 pt to soil	48 h	5 d	2 pt
Ranman [a]	21	Blight, Downy mildew	2.75 fl oz blight 2.1-2.75 fl oz downy	12 h	0 d	6 sprays [d]
*Omega	29	Blight, Downy mildew	0.75 – 1.5 pt	12 h	7/30 [e]	4-7 sprays
*Zampro [†]	40+45	Blight, Downy mildew	14 fl oz	12 h	0 d	3 sprays [l]
*Gavel	22+M3	Blight, Downy mildew	1.5 – 2 lb	48 h	5 d	8 sprays
Tanos [h]	27+11	Blight, Downy mildew	8 oz	12 h	3 d	4 sprays [m]
Forum [a, k]	40	Blight, Downy mildew [k]	6 fl oz	12 h	0 d	5 sprays [m]
Revus [a, c, k]	40	Blight, Downy mildew [k]	8 fl oz	12 h	0 d	4 sprays [m]
*Presidio [g, k]	43	Blight, Downy mildew [k]	4 fl oz (3 – 4)	12 h	2 d	2 sprays (new label)
*Previcur Flex [k]	28	Downy mildew [k]	1.2 pt	12 h	2 d	5 sprays
K-Phite, etc. [f]	33	Blight	2.5 – 5 pt	4 h	0 d	7 sprays
*Zing!	22+M5	Downy mildew	36 fl oz	12 h	0 d	8 sprays [m]
Curzate [h]	27	Downy mildew	5 oz (3.2 - 5)	12 h	3 d	6 sprays

* Restricted Use Material

† NOT permitted used on Long Island. Seasonal limit for Gatten in NY is less than in other states.

[a] Organosilicone and/or non-ionic surfactant recommended or required (Revus).

[b] Quintec is labeled for use on non-edible-peel cucurbits (melon, pumpkin, winter squash, gourd). 10-14 day spray interval.

[c] Limited use recommended - resistance could reduce efficacy, especially when applied often. No more than one application of Torino is recommended – apply early in powdery mildew program if it is to be included.

[d] Can be applied up to 3 times consecutively, which must be followed by at least the same number of applications of fungicide(s) with different FRAC code.

[e] PHI is 30 days for cucumbers and melons; 7 days for other crops.

[f] Other phosphorous acid fungicides include ProPhyt and Fosphite. Rate and seasonal limits vary a little among products. Recommended tank mixed with other fungicides. Note that there are also phosphate fertilizers, which are not fungicides.

[g] New Presidio label has only 2, not sequential applications. Plant-back restriction for most non-labeled crops is 18-month.

[h] Short residual; apply another fungicide within 5 days.

[i] When at least 3 applications made, Orondis fungicides can be no more than 33% of the applications, or a maximum of 4 applications per planting, whichever is fewer. Orondis Opti is labeled for several other diseases because it contains chlorothalonil. It is only recommended used for these diseases when downy mildew is also present. Orondis Gold is labeled for application to soil at planting for Phytophthora blight. Its use in a crop prohibits foliar application of Orondis Opti and Orondis Ultra.

[j] Ridomil Gold SL is recommended for Phytophthora blight only on farms where Ridomil fungicides were not used over several presiding years on other labeled crops (ex. pepper) as resistance may have developed already. Apply to soil at planting and/or through drip.

[k] Resistance has been found mostly in isolates from cucumber or with seedling bioassays using cucumber. Might be effective for downy mildew on other cucurbit crops. Limit use.

[l] No more than 2 consecutive applications permitted before rotating to a fungicide with a different FRAC code.

[m] No consecutive applications permitted before rotating to fungicide with different FRAC code.

NY Sweet Corn Trap Network Report, 7/14/2020

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

Thirty-four sites reported this week. Eleven of the sites had European corn borer (ECB)-E and three sites had ECB-Z. Eighteen sites reported corn earworm (CEW) with eleven high enough to be on a 5 or 6 day spray interval (see table at bottom of post). Fall armyworm (FAW) moths were caught at five sites and Western bean cutworm (WBC) was caught at eight sites. The hybrid ECB moth was caught at both the Hurley and Geneva site.

Western bean cutworm numbers are beginning to go up this week with peak flight expected late July into early August. It is important to begin scouting for egg masses even if cumulative trap catches have not reached 100, as egg masses have been found when cumulative trap catched were still in the single digits. WBC will usually lay eggs on the upper side of the top 1-3 leaves of pre-tassel corn, close to the leaf base. After tasseling has finished WBC seek out younger corn or dry beans. To scout for egg masses check the top 3 leaves of ten corn plants in ten locations throughout the field. The eggs are easy to observe if you view the leaf while holding it towards the sun. The egg mass will appear as a distinct shadow.

It takes between 5-7 days for eggs to hatch. It is critical that sprays are timed before the larvae have a chance to enter the ear. The egg mass will become purple in color approximately 24 hours before egg hatch.

Degree day accumulations in relation to percent WBC moth emergence (begin May 1, base 50°F)

Accumulated Degree Days	% Moth Emergence
1319	25%
1422	50%
1536	75%

Data from University of Nebraska

WBC emergence is forecast to be at 25% when 1319 degree days (base 50°F) have accumulated beginning on May 1st (see table below). The degree day accumulation (May 1st, base 50°F) for sweet corn trap network sites ranges from 869-1193.

WNY Pheromone Trap Catches: July 14, 2020

Location	ECB-E	ECB-Z	ECB Hybrid	CEW	FAW	WBC	DD to Date
Batavia (Genesee)	0	0	NA	1	0	0	1123
Bellona (Yates)	0	0	NA	1	3	0	1132
Brockport (Monroe)	0	0	NA	0	0	0	1150
Eden (Erie)	0	0	NA	1	0	0	1108
Farmington (Ontario)	NA	0	0	0	0	0	1174
Geneva (Ontario)	1	0	12	2	0	0	1144
Hamlin (Monroe)	3	0	NA	3	0	0	1077
Kennedy (Chautauqua)	NA	NA	NA	NA	NA	NA	1015
Leroy (Genesee)	NA	NA	NA	NA	NA	NA	1118
Lyndonville (Orleans)	0	0	NA	1	0	0	1042
Oswego (Oswego)	0	0	NA	0	0	4	981
Panama (Chautauqua)	0	0	NA	0	0	0	939
Penn Yan (Yates)	0	0	0	0	0	0	1081
Portville (Cattaraugus)	2	0	NA	0	0	2	889
Ransomville (Niagara)	0	0	NA	0	0	0	1121
Seneca Castle (Ontario)	0	0	0	0	1	0	1116
Williamson (Wayne)	0	0	NA	5	0	1	1010

ECB: European Corn Borer; CEW: Corn Earworm; FAW: Fall Armyworm; WBC: Western Bean Cutworm; NA: not available; DD: Degree Day (mod. base 50F) accumulation

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.

Western Bean Cutworm Report – Trap Counts are Low

Margie Lund, Cornell Cooperative Extension, Cornell Vegetable Program

Western Bean Cutworm (WBC) traps were set up adjacent to dry bean fields across the western NY region around the first of July, and have been monitored over the past two weeks. Both Caledonia locations have yet to trap any WBC adults, with low cumulative numbers at Avoca (1), Geneva (2), Riga (1), Stafford (2), and Wayland (2). Historically, peak flight for WBC is in the last week of July. Both the trap reports and scouting corn in fields near dry beans can help determine the risk. Growers should scout adjacent corn fields when cumulative WBC have reached >50 moths per trap. Dry bean pod scouting should begin 7 to 10 days after peak emergence, regardless of cumulative WBC trap catch, and especially where WBC has been found in bean pods/seeds in recent years. This scouting should continue for three weeks.

To scout for WBC, inspect 50 plants per field (10 stops, 5 plants per stop), looking at all pods present on the plant for holes. WBC chew directly into the pod and eat the seed. It can be difficult to scout dry beans for egg masses or caterpillars, since the caterpillars move from the pods to the soil during the daytime, so looking for signs of damage is the best strategy. European corn borer damage (ECB) may be similar to WBC, but an ECB larva would likely still be present in the pod when inspected. If damage into the pod and seed is found with no larva present, it is possible this is WBC. A spray is recommended if dry bean pod damage is found. In addition, to the WBC traps listed in the sweet corn report, the following dry bean trap sites are being monitored this year (project funded by the NYS Dry Bean Endowment and led by Margie Lund, CVP).

CROP INSIGHTS

BEETS

Now that most of our area received rain over the past weekend and some continued showers, plantings with thick foliage are remaining moist underneath the canopy, which creates a more favorable environment for leaf diseases. Diagnosis of spots on leaves early in the season is tricky because there are several possible pathogens. Cercospora leaf spot (CLS) is the major leaf disease we are concerned with because it can lead to complete defoliation in severe cases. CLS has not been prevalent so far, I believe because of the drought stress we were under. Leaf samples brought into the laboratory have also revealed other pathogens causing leaf spots at low incidence, such as Phoma, Alternaria and bacterial leaf spot. If you have a field you are unsure about, we would be happy to collect or receive samples for inspection under a microscope. Sometimes a well taken photo can also help rule out CLS. That being said, the threshold for CLS is one lesion per leaf on average. Based on our research, Tilt or Miravis Prime are the recommended the first spray. Make sure to use good fungicide rotation practices by alternating Fungicide Resistance Groups (FRAC group) so that we can preserve the effectiveness of registered products. Refer to the general article in the July 1 issue of VegEdge. The forecast for CLS based on relative humidity and temperature is high to moderate for July 17 and moderate for July 18 for most of our region. For a copy of the CLS Decision Support Manual, contact Julie Kikkert. - JK

COLE CROPS

Broccoli heads had a hard time with the series of warm, humid nights we've had lately. Many plantings have had their heads distorted or rendered unmarketable. There is little to do about this aside from using more heat tolerant varieties for the late spring plantings. - EB

CUCURBITS

Squash Vine Borer adults are out in full swing and hovering around the base of squash plants to lay their eggs. Once larvae have bored inside the stem, insecticide applications will have little control so applications should be aligned with the first sight of adult activity. If you're unsure about the presence of SVB on your farm, check the volunteer milkweed – they'll likely be spotted feeding on it. Squash bug eggs and nymphs have been spotted as well. Seeing numerous squash, cucumber, and melon plants succumbing to wilt spread by cucumber beetles.

Squash vine borer adult.
Photo: C. Tucker, CVP

Alternaria leaf blight on melons.
Photo: C. Tucker, CVP

A number of cantaloupe and watermelon plantings across the region are showing signs of Alternaria leaf blight – small, circular, pale spots that may enlarge to show a target like pattern. The threshold for treating Alternaria is when symptoms are found on one leaf per 25 to 50 leaves sampled. Once that threshold has been reached, spray on a 7 to 10 day schedule. Fruit infection is not common, but if left unchecked can cause severe defoliation leading to sunscald of fruit. Some fungicide options include: Quadris F (1 D PHI, group 11) , Endura (0 D PHI, group 7) , Inspire Super (7 D PHI, groups 3 and 9) , Tanos (3 D PHI, groups 11 and 27) , Copper (OMRI versions available, Re-entry interval may be longer than PHI). Don't forget to rotate to another fungicide group! - CT

Wilted squash plant. It's too early for Squash Vine Borer damage (left). Squash stem upon closer inspection (right). White, bacterial ooze is seeping out of the stem. The bacteria clogs up the vascular system. This is bacterial wilt in squash. *Photo: C. Tucker, CVP*

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Seeing a large amount of virus in cucurbit plantings along Lake Ontario. CMV has been positively identified and results are pending on several other samples, believed to be non-CMV, primarily cucurbit infecting viruses. Aphids are the main vector for most cucurbit viruses. Full article next week once all the results are back. - EB

DRY BEANS

Mexican bean beetles are starting to make their way into dry beans this week. Adult beetles will appear in fields first, and soon after lay eggs on bean leaves. Both adults and larvae feed on dry bean foliage, including leaves and pods. Plants can manage around 10-20% defoliation before causing yield losses.

Mexican bean beetle adults. Photo: M. Lund

Mexican bean beetle larva. *Photo: M. Lund*

GARLIC

Be on the lookout for garlic white rot when harvesting. The leaves of the plants would have been yellow for several weeks probably in mid-May through June. Some plants would have had leaf wilting and die back. The older leaves would rot along the base then collapsing.

White mold on garlic bulbs. *Photo from UC IPM Pest Management Guidelines: Onion and Garlic UC ANR Publication*

Roots start to rot as well making it real easy to pull bulbs from the ground. As the disease advances, white stringy mold would form. Later still, the mold may dissipate but small black pepper-corn sized sclerotia would be found attached in and around the base and basal plate. It is through these sclerotia that the disease spreads and becomes established in a field.

Destroy any bulbs with these symptoms. Please contact the CVP if you think you have found any bulbs like this. We would like to examine it and have samples for the lab. The grower information will be kept private. Look for an upcoming article on garlic white mold in VegEdge. - RH

LETTUCE AND GREENS

Seeing a second round of leaf miner activity in chard and beet greens.

ONIONS

Onions are bulbing! Most direct seeded fields are in the 7-8 leaf stage and bulbing has begun. Much needed rain arrived over the weekend to areas that had been very dry. Although much appreciated, irrigation continues during this critical time during bulbing. Despite last week's heat wave, there generally has not been a spike in onion thrips pressure. Thrips remain under control in fields treated with Movento with most not yet reaching next spray threshold. However, strong edge effects have occurred in some locations. An edge effect is characterized by very high numbers of thrips (sometimes over 100 thrips/plant) at the edge of the onion field where the thrips have migrated in from an external source, while thrips counts remain low within the field. When feasible, a border or edge spray (e.g. single sprayer/boom width) with Radiant 8-10 fl oz/A to clean up these high populations can be very effective. This way, the remainder of the field does not have to be sprayed and may continue on the "ride with the momentum of Movento". A few fields have already had successful border sprays this season.

During bulbing, tip burn begins to set in and the crop canopy closes in resulting in reduced aeration, both of which makes the crop more vulnerable to Stemphylium leaf blight (SLB) as this disease initially targets necrotic leaf tissue. Thus far, we have only observed minor SLB colonization of necrotic leaf tip and outer leaf tissue, and only the odd tan-colored "target-spot" lesions, although SLB tends to be more progressed in transplants, especially if they have 2+ inch bulbs. Growers have done great so far keeping SLB and Botrytis leaf blight (BLB) in check with Bravo and the odd SLB fungicide, but now it is starting to get more complicated to not overuse individual FRAC groups as we strive for best management practices for fungicide resistance. The FRAC 7 fungicides are especially precarious - see article on page 8. Also, see June 24 and July 1 issues of VegEdge for latest onion fungicide recommendations and onion section of CVP website for more information. - CH

PEPPERS

Aphid and thrips pressures were building through the hot weather. Aphids will be underneath leaves and in the growing tips. Thrips will be in the flowers and can be gently tapped out onto a white piece of paper. In each scouted field with increasing aphid pressure there were also rising and diverse populations of natural enemies like lady beetles and larvae, lacewing eggs and others. Spraying in these cases is uncessary and would wipe out these beneficials. Continuing to monitor aphid and beneficial populations to ensure that the two populations are remaining in balance is important. Treatment with non-pyrethroid

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products that are gentler on beneficials (such as BeLeaf) would be an appropriate course of action should aphid populations begin to spike. - EB

POTATOES

This week, stations that have surpassed 30 blight units (BU) are Albion, Arkport, Baldwinsville, Ceres, Elba, Fairville, Farmington, Fulton, Hammondsport, Medina, Niagara Falls, Penn Yan, Rochester, Versaille, Wellsville, and Williamson, while Bergen and Rochester are within 2 BUs of reaching the threshold for the forecast period. A BU of 30+ indicates the need to spray for late blight. The chart assumes use of a susceptible potato variety, and an application of chlorothalonil. 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. On a national level, no new late blight confirmations have been reported, and has still only been confirmed in FL and AL. No late blight has yet to be reported in NYS. - ML and JG

New Late Blight Risk Chart, 7/14/20

Location	Blight Units[1] 7/08-7/14	Blight Units[2] 7/15-7/17	Location	Blight Units[1] 7/08-7/14	Blight Units[2] 7/15-7/17
Albion	18	12	Hammondsport	21	11
Arkport	18	19	Knowlesville	19	7
Baldwinsville	19	18	Lyndonville	17	8
Bergen	17	11	Medina	24	8
Buffalo	10	7	Niagara Falls	28	12
Burt	10	9	Penn Yan	16	12
Ceres	44	18	Rochester	20	12
Elba	19	16	Sodus	NA	NA
Fairville	23	12	Versailles	29	12
Farmington	29	13	Wellsville	48	18
Fulton	27	14	Williamson	18	13
Geneva	11	13			

[1] Past week Simcast Blight Units (BU)
[2] Three-day predicted Simcast Blight Units (BU)

SNAP BEANS

This is the time of year when we have snap beans in all stages from newly planted to harvest. The heat and dry conditions were stressful on beans and those in flower during the heat likely did not set well, but may recover after the rain and cooler conditions. Split sets are not favorable for the processing industry with the one-pass harvest. Beans in our area that received strong storms and hail over the past week could develop bacterial leaf disease (see article from July 24, 2019 VegEdge) and or fungal diseases such as Pythium. Moist canopies and humid conditions as we move forward with the season are favorable for white mold and gray mold. Insect pests that are present during this time are potato leaf hoppers, aphids, spider mites, Mexican bean beetle (see dry bean section above), flea beetles, and possible European corn borer which can burrow into pods. Viruses can cause puckered or mottled foliage as well. Many things to be on the lookout for during this time. - JK

SWEET CORN

I have received a reports of worm damaged corn in areas where trap counts have been low. Traps are a great tool for monitoring pest populations, but in some years it is apparent that they are only a snapshot of one field. The sweet corn article publishes Growing Degree Day counts for peak moth flights and egg/larvae development. I recommend using these degree day models in conjunction with the trap counts to time scouting and spraying. - EB

TOMATOES

Disease pressure has been relatively low on field tomatoes, however that will likely change now that the region has received some significant precipitation. There a few cases of early blight starting up in field tomatoes. Beginning to see spider mite populations building up in high tunnels - likely due to the warm, dry weather the region has experienced over the last couple of weeks. Consider releasing beneficial predatory mites like *Phytoseiulus persimilis* or *Neoseiulus californicus* to keep the population in check. - CT

Tomato leaf with pest damage (left). Turn the leaf over to find two-spotted spider mites on the underside of the leaf causing the damage. (You might need a hand lens to see them.) *Photos: C. Tucker, CVP*

Fragile FRAC 7 Fungicides: On the Brink of Losing Their Utility for Control of Stemphylium Leaf Blight in Onion Production in NY

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

At present we face a very tenuous situation to preserve any of the FRAC 7 fungicides for control of Stemphylium leaf blight (SLB) in onion in NY. Even with limited use of Luna Tranquility, it is quite possible that we will lose the FRAC 7 group to fungicide resistance within the next couple of seasons.

FUNGICIDE RESISTANCE AND FRAC

Fungicide resistance is the acquired, heritable reduction in sensitivity of a fungus to a specific fungicide. Unfortunately, SLB in onion is developing fungicide resistance at an alarming rate in New York (see previous articles in June 24 and July 1 issues of VegEdge). The FRAC code is a number assigned by the fungicide resistance action committee (FRAC) to group together fungicide active ingredients that have the same target site. The target site is the specific process and/or enzyme of the fungal pathogen, which the active ingredient of the fungicide is interfering with. Therefore, fungicide active ingredients with the same FRAC code are at risk for cross-resistance. For example, SLB has developed resistance to FRAC 11 fungicide active ingredient, azoxystrobin (= Quadris) and therefore FRAC 11 active ingredient pyraclostrobin (= Cabrio) and all other FRAC 11 active ingredients, are also ineffective at controlling SLB.

The relative risk of fungicide resistance (low, medium, high) takes into consideration how the fungicide interacts with the pathogen and how the pathogen responds. FRAC 11 fungicides are considered high risk, while FRAC 3 (e.g. difenaconazole in Inspire Super and Quadris Top, propiconazole in Tilt) and FRAC 9 (e.g. pyrimethanil in Scala and cyprodinil in Inspire Super) are medium risk. **FRAC 7 fungicides are considered medium to high risk for fungicide resistance**, and in onion include boscalid in Endura/Pristine, fluopyram in Luna products, fluxapyroxad in Merivon and pydiflumetofen in Miravis Prime. All of these FRAC 7 active ingredients belong to different sub-categories within the FRAC 7 group and unlike with FRAC 11, cross-resistance is not always conferred among them.

FRAC 7 FUNGICIDE RESISTANCE HAS DEVELOPED QUICKLY IN SLB

Also taken into consideration is the pathogen. The polycyclic nature of SLB (multiple life cycles/generations per season), its high fecundity (production of enormous numbers of spores), its potential for genetic variation through sexual reproduction, transmission over long distances and poor crop rotation (as the majority of onion production occurs in muck pockets) stack the deck for this pathogen's ability to develop fungicide resistance. Thus, FRAC 7 fungicides against SLB is using a medium to high risk group against a high-risk pathogen, and it is not surprising that FRAC 7 fungicide resistance has developed quickly in SLB.

KEEPING OUR FINGER ON THE PULSE OF FUNGICIDE RESISTANCE

SLB fungicide resistance is monitored in two ways: 1) on-farm fungicide efficacy field trials (Hoepting et. al.), and 2) SLB isolate fungicide sensitivity testing in the laboratory (Hay et. al.). Together, this information is used to keep our "finger on the pulse" of SLB development of fungicide resistance so that we can make responsible fungicide recommendations. Detection of fungicide resistance to a single product/active ingredient in growers' fields is tricky when a product is used 1-2 times as part of a program with other products. Our multi-faceted approach provides early detection of fungicide resistance so that we can protect against a fungicide failure due to fungicide resistance when disease pressure is high.

Every year, small-plot trials are conducted in commercial onion fields in Elba muck and on onion muck farms in Wayne and Oswego counties. In "product" trials, fungicide sprays begin in mid-July at first detection of SLB when onions are at early bulb swell stage, and continue weekly until 50 to 75% lodging for a total of 5 to 8 weeks. Each treatment is replicated at least four times. After the last spray, % leaf dieback/plant, % SLB colonization of necrotic dieback tissue/plant and total number of SLB target lesions/plant are assessed on 6-10 plants/plot. Also, % green foliage is visually estimated per plot as an indication of plant health. Usually, treatments with healthiest plants have the least SLB. Conducting fungicide trials in grower fields reflect real-world conditions and SLB fungicide (in)sensitivities.

Annually, in August, about 20 leaves per field with SLB lesions are collected from approximately 25 fields from 22 muck onion farms in Elba, Wayne, Oswego and Orange muck onion-growing regions. These samples are sent to Cornell Plant Pathologist, Frank Hay, who collects about 10 SLB isolates (colony grown from a single spore) per field. A sub-sample of SLB isolates per region are then grown on artificial media amended with a range of concentrations of each fungicide active ingredient. SLB isolates that exhibit growth inhibition of 50% at the lowest concentrations (EC50 < 1 ug/ml) in comparison to growth in the absence of fungicide are considered sensitive and expected to be controlled by field application rates of fungicide. SLB isolates in which growth is inhibited by 50% only at medium (EC50 1-10 ug/ml) and high (EC50 >10 ug/ml) concentrations are expected to be moderately insensitive and insensitive, respectively. If a high proportion of SLB isolates are found to be insensitive to a particular fungicide then there is potential that SLB will not to be controlled by field-applied rates of the fungicide. Furthermore if a shift in the proportion of SLB isolates occurs between years, with fewer sensitive isolates and more insensitive, then this indicates the fungicide is developing, or has developed field resistance.

FIRST DETECTION OF FRAC 7 FUNGICIDE RESISTANCE – ENDURA, 2016

From 2013 to 2015, all FRAC 7 fungicides including Endura, Pristine, Merivon and Luna Tranquility were the top performing treatments

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in on-farm field trials. In 2016 Wayne trial, Endura (a.i. boscalid) slipped to "middle-of-the-pack" and was not significantly as good as Luna Tranquility and Merivon. In 2017 Elba trial and 2018 Oswego trial, Endura was "significantly better than untreated, but not great". In 2016, laboratory testing demonstrated that 50% of SLB isolates were insensitive to boscalid (Table 1, page 10). The good news at this time was that over 90% of SLB isolates were sensitive to fluopyram (a.i. in Luna Tranquility) and fluxapyroxad (a.i. in Merivon), with none of the SLB isolates being insensitive (Table 1). At that time, we discontinued recommendation of Endura for SLB. Due to the disparities in efficacy between boscalid and the other two FRAC 7 active ingredients (and sub-categories), we concluded that cross-resistance was not conferred, and that some FRAC 7's other than boscalid could still be recommended.

THE DOWNWARD SPIRAL OF MERIVON, 2017-2019

In 2017 Elba trial, field performance of Merivon (FRAC 7 a.i fluxapyroxad) slipped to second place and was significantly not as good as Luna Tranquility. In 2018 Oswego field trial, it was significantly not as good as Luna Tranquility and more "middle-of-the-pack" in terms of efficacy, and in 2019 in Elba and Wayne field trials, it was not significantly different than the untreated. Laboratory testing showed that in just two years, insensitive SLB isolates increased from 0% (2016) to 47.1% (2018) (Table 1). It is expected that the level of insensitivity in grower fields in 2020 is going to be substantially higher, given another two years of fungicide use and selection pressure. Consequently, Merivon is no longer recommended.

LUNA TRANQUILITY SLIPPED IN 2019, BUT STILL HOLDING ON…

Luna Tranquility 16 fl oz (FRAC 7 a.i fluopyram) has consistently been a top performer from 2013 to 2018 in on-farm field trials with no differences between 16 fl oz, 12 fl oz and 8 fl oz rates in six trials in 2017 and 2018. For the first time in 2019 Elba and Wayne trials, Luna Tranquility 16 fl oz was either not a top performer and/or the 16 fl oz rate was significantly better than the 12 fl oz and 8 fl oz rates. Similar to fluxapyroxad, insensitive SLB isolates to fluopyram increased from 0% (2016) to 45.0% (2018) in just two years.

A couple of theories as to why Luna Tranquility has better field performance than Merivon, and has taken longer (by 2 years) to show reduced efficacy in field trials: 1) fluopyram is a more potent molecule on SLB, and 2) Luna Tranquility provides application of two modes of action (MOA) against SLB with fluopyram (FRAC 7) and pyrimethanil (FRAC 9). Since the FRAC 7 in Merivon is premixed with a FRAC 11, which has no activity, essentially, Merivon is a FRAC 7 alone. Since Luna Tranquility 16 fl oz continued to be effective in field trials in 2019, its use is recommended again in 2020. Although it must be used with great care: **Ideally, no more than one application of Luna Tranquility per growing season**, primarily as a rotation option to preserve the useful longevity of FRAC 3 SLB fungicides such as Inspire Super and Tilt.

FRAC 7 FIELD USE

In 2017, it was common for half or more of all fungicide applications to be FRAC 7 fungicides with 4 to 6 FRAC 7 fungicide apps per season, although some farms certainly used less FRAC 7. Although programs varied, use of Merivon was slightly more than double that of Luna Tranquility. Such use could explain the rapid shift in the proportion of FRAC 7 insensitive isolates in just two years. For 2018 growing season, we introduced "no more than 3 apps per FRAC" recommendation for improved fungicide resistance. Consequently, during 2018 and 2019, FRAC 7 fungicide use dropped to 25 to 33% or less of total fungicide applications per season, which typically ranged from 2-4 FRAC 7 fungicide applications per growing season. Although it varied from region to region, overall, use of Luna Tranquility exceeded that of Merivon.

BRAND NEW FRAC 7 ALSO NOT A TOP PERFORMER

Miravis Prime (FRAC 7 a.i. pydiflumetofen) is a forth sub-class within FRAC 7 that is available for the first time in onion in New York for 2020 onion growing region. Unfortunately, in 2019 field trials, it was most often not different than the untreated for % SLB colonization of dieback tissue and SLB target lesion counts. However, it scored higher points for green foliage, which makes the results confusing. It certainly did not perform as expected for a brand new FRAC 7. At present we have no laboratory data to indicate whether SLB is sensitive or insensitive to pydiflumetofen. Thus, we are hesitant to recommend it, although there could be some value in using it to rotate with FRAC 3 SLB fungicides.

FRAC 7 IS A COMPLICATED GROUP

FRAC 7 group is complicated and cross-resistance among sub-classes is not well understood. There are different gene mutations that can occur in SLB that will confer fungicide resistance to FRAC 7 fungicides, and not all result in cross-resistance among sub-classes. Currently, Frank Hay's lab is working towards identifying the gene mutations that have occurred in NY SLB isolates, so that we can understand which active ingredients confer cross-resistance to each other. This will help to identify subclasses of FRAC 7's which might still be efficacious. Of course, FRAC 7 fungicides will again be tested in on-farm field trials in 2020.

BEST FUNGICIDE RESISTANCE MANAGEMENT PRACTICES

Fungicides with multi-site mode of action, belonging to FRAC groups M3 (a.i. mancozeb) and M5 (a.i. chlorothalonil = Bravo) have very low risk of fungicide resistance. Aside from these, best fungicide resistance management practices should be followed for all medium to high risk fungicides:

- No more than 2 apps per FRAC before rotating to another FRAC group (some labels specify rotation to another FRAC group after a single application)
- No more than 3 apps per FRAC per season
    - No more than 1 app of FRAC 7 Luna Tranquility
- Use highest label rates for all FRAC 3 fungicides
- Use minimum of 16 fl oz/A for Luna Tranquility
- Rotate among sub-classes of FRAC 7 and active ingredients within FRAC groups when possible
- Co-apply two FRAC groups per disease when feasible

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Table 1. Results summary of FRAC 7 fungicide sensitivity bioassay testing of Stemphylium leaf blight of onion in muck-onion production regions of New York.

Region	Total No. Isolates Tested[1]	% of 2018 SLB Isolates Tested			Verdict[1]
		Sensitive	Moderately Insensitive	Insensitive	
Boscalid – FRAC 7(3) in Endura/Pristine					
2016 – All Regions	46	30.4	19.6	50.0	Slipping
2018 – All Regions	78	10.3	28.2	61.5	Resistant
Elba 2018	17	5.9	52.9	41.2	Resistant
Oswego 2018	27	0.0	22.2	77.8	Resistant
Orange 2018	34	20.6	20.6	58.8	Resistant
Fluopyram – FRAC 7(1) in Luna products					
2016 – All Regions	46	93.5	6.5	0	Potential
2018 – All Regions	120	20.0	35.0	45.0	Slipping
Elba 2018	28	28.6	25.0	46.4	Slipping
Wayne 2018	25	20.0	48.0	36.0	Slipping
Oswego 2018	36	13.9	25.0	61.1	Slipping
Orange 2018	30	20.0	46.7	33.3	Slipping
Fluxapyroxad – FRAC 7(2) in Merivon					
2016 – All Regions	46	93.5	6.5	0	Potential
2018 – All Regions	119	25.2	27.7	47.1	Resistant
Elba 2018	28	32.1	28.6	39.3	Resistant
Wayne 2018	25	16.0	44.0	40.0	Resistant
Oswego 2018	36	13.9	19.4	66.7	Resistant
Orange 2018	30	40.0	23.3	36.7	Resistant

[1] Symptomatic leaf samples collected from onion fields as part of CVP onion scouting program and represent samples from multiple farms per region.

Resistant	>35% of isolates tested were insensitive. Very poor performance in field trial.
Slipping	Insensitive isolates detected. Reduced field performance in trial.
Potential	Greater than 80% sensitive isolates detected with some moderately insensitive isolates detected. Field performance is normal. Development of resistance is possible.

Guidance for Essential Workers Arriving in NY from U.S. States with Significant Community Spread

Cornell Agricultural Workforce Development

On June 24, 2020 the NY State Department of Health (NYSDOH) issued Interim Guidance for Quarantine Restrictions on Travelers Arriving in New York State Following Out of State Travel. This was in response to the high rates of COVID-19 infection now occuring in many southern U.S. states. NYSDOH is providing a regularly updated list of the restricted states (currently 22 states). The NYSDOH Guidance requires anyone entering NY from those states to quarantine for 14 days. The June 24 NYSDOH Guidance contains the following language specific to long-term, essential workers:

Long Term – for essential workers traveling to New York State for a period of greater than 36 hours, requiring them to stay several days. This includes instances such as an essential worker working on longer projects, fulfilling extended employment obligations, and other longer duration activities.

- Essential workers should seek diagnostic testing for COVID-19 as soon as possible upon arrival (within 24 hours) to ensure they are not positive.
- Essential workers should monitor temperature and signs of symptoms, wear a face covering when in public, maintain social distancing, clean and disinfect workspaces for a minimum of 14 days.
- Essential workers, to the extent possible, are required to avoid extended periods in public, contact with strangers, and large congregate settings for a period of, at least, 7 days.

Farm employees continue to be classified as "essential workers," this means that farm employees can work during their quarantine period. They are required to maintain a strict routine while at work and employers are well-advised to support and reinforce this working quarantine in order to protect others employees. NYSDOH and NYS Dept of Ag and Markets clearly described the working quarantine protocol in the Interim Guidance for Prevention and Response of COVID-19 at Farms issued on May 27, 2020.

Workers who are considered essential personnel, as described in the Department's Health Advisory: Protocols for Essential Personnel to Return to Work Following COVID-19 Exposure or Infection, who meet quarantine criteria described above, may be allowed to work in accordance with the Department's Health Advisory and if they:

- Remain asymptomatic.
- Remain in quarantine when not at work. Workers may be quarantined in their own home or at a location designated by the operator that meets LHD (local health department) quarantine requirements.
- If it is difficult to provide for 6 foot separation between essential workers while in quarantine, essential workers may be quarantined in a recreational vehicle, a motel/hotel room, at home in their own room, etc.
- Rely on LHDs and employers to provide essential needs such as healthcare, food, medications, and laundry.
- Undergo temperature monitoring and symptom checks upon arrival to work, and at least every 12 hours thereafter while at work, and self-monitor (i.e. take temperature, assess for symptoms) twice a day when not at work. Operators must have thermometers on site to perform temperature checks.
- Wear a face covering while in the presence of any other individual.
- Immediately stop work and notify their supervisor if they develop ANY symptoms consistent with COVID-19. The LHD may be consulted on next steps as outlined below.
- Testing should be prioritized for essential personnel with symptoms.

COVID-19 diagnostic testing is available for all essential personnel. Contact your local health department for details about how to get the test.

Weather Charts

John Gibbons, CCE Cornell Vegetable Program

WEEKLY WEATHER SUMMARY: 7/7/20 - 7/13/2020

	Rainfall (inch)		Temperature (°F)	
Location**	Week	Month July	Max	Min
Albion	1.79	1.79	96	64
Arkport	1.38	1.38	94	59
Bergen	2.18	2.18	96	64
Brocton	2.40	2.40	94	61
Buffalo*	1.68	1.68	97	65
Burt	0.50	0.50	90	64
Ceres	0.79	0.79	91	54
Elba	1.04	1.04	95	63
Fairville	0.95	0.95	96	62
Farmington	2.43	2.45	97	62
Fulton*	2.55	2.55	95	66
Geneva	1.47	1.48	94	64
Hammondsport	1.05	1.05	95	61
Hanover	1.05	1.05	95	61
Lodi	1.23	1.23	92	62
Niagara Falls*	0.91	0.91	94	62
Penn Yan*	2.30	2.30	94	65
Rochester*	3.21	3.36	95	64
Sodus	NA	NA	NA	NA
South Bristol	2.04	2.04	92	72
Varick	NA	NA	94	64
Versailles	0.80	0.80	93	61
Williamson	1.30	1.30	95	63

ACCUMULATED GROWING DEGREE DAYS (AGDD) BASE 50°F: APRIL 1 - JULY 13, 2020

Location**	2020	2019	2018
Albion	1174	999	1258
Arkport	1002	933	1310
Bergen	1143	965	1184
Brocton	1131	1001	NA
Buffalo*	1179	991	1326
Burt	1076	877	1123
Ceres	966	999	1105
Elba	1106	928	1199
Fairville	1110	913	1136
Farmington	1141	943	1178
Fulton*	1146	908	1155
Geneva	1171	1001	1219
Hammondsport	1115	959	1162
Hanover	1136	998	1245
Lodi	1178	1037	1256
Niagara Falls*	1143	939	1419
Penn Yan*	1206	1054	1276
Rochester*	1177	1082	1351
Sodus	NA	895	1229
South Bristol	1121	947	1181
Varick	1228	1072	1276
Versailles	1106	992	1225
Williamson	1081	873	1102

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

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VegEdge is the highly regarded newsletter produced by the Cornell Vegetable Program. It provides readers with information on upcoming meetings, pesticide updates, pest management strategies, cultural practices, marketing ideas and research results from Cornell University and Cornell Cooperative Extension. VegEdge is produced every few weeks, with frequency increasing leading up to and during the growing season.

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