Vegetable Crop Update

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

UW Extension

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Calendar of Events

July 10-12, 2018 – Farm Technology Days, Sternweis & Weber's Farms, Marshfield, WI
July 19, 2018 – UW-Hancock Agricultural Research Station Field Day, Hancock, WI
July 26, 2018 – UWEX Langlade County Field Day & Potato Virus Y Detection Training Workshop, Antigo, WI
August 2, 2018 – UW-Rhinelander Field Day, Rhinelander Agricultural Research Station, WI
November 27-29, 2018 – Processing Crops Conference & MWFPA Annual Convention, Wisconsin Dells, WI
January 15-17, 2019 – Wisconsin Agribusiness Classic, Alliant Energy Center, Madison, WI
January 27-29, 2019 – Wisconsin Fresh Fruit & Vegetable Conference, Kalahari Conference Center, Wisconsin Dells, WI
February 5-7, 2019 – UWEX & WPVGA Grower Education Conference, Stevens Point, WI

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Current P-Day (Early Blight) and Severity Value (Late Blight) Accumulations (with assistance from R.V. James, UW-Plant Pathology/R.V. James Designs, S.A. Jordan, & J. Hammel, UW-Plant Pathology): A P-Day value of ≥ 300 indicates the threshold for early blight risk and triggers preventative fungicide application. A DSV of ≥ 18 indicates the threshold for late blight risk and triggers preventative fungicide application. Red text in table below indicates threshold has been met/surpassed. "-" indicates that information is not yet available. Blitecast and P-Day values for actual potato field weather from Grand Marsh, Hancock, Plover, and Antigo are now posted at the UW Veg Path website at the tab "P-Days and Severity Values." www.plantpath.wisc.edu/wivegdis/contents_pages/pday_sevval_2018.html Asterisks indicate values generated from weather data sourced from NOAA (link below to interactive tool for accessing site specific DSVs). https://agweather.cals.wisc.edu/vdifn/maps

Location	Planting Date	50% Emergence	Disease Severity Value	P-Day	Date of DSV/P-Day Generation
Antigo	Early 5/12	5/28	20*	-	6/22
	Mid 5/25	6/7	13*	-	6/22
	Late 6/9	6/22	-	-	6/22
Grand Marsh	Early 5/1	5/15	59	272	6/22
	Mid 5/15	5/28	52	194	6/22
	Late 6/1	6/12	32	84	6/22
Hancock	Early 5/2	5/16	26*	-	6/22
	Mid 5/17	5/30	24*	-	6/22
	Late 6/1	6/14	15	-	6/22
Plover	Early 5/7	5/18	23	269	6/22
	Mid 5/20	6/1	12	177	6/22
	Late 6/2	6/15	8	66	6/22

WI Potato Disease Risk Updates: We have had weather very conducive to disease in the past week, this has resulted in a substantial increase in **Disease Severity Values** for potatoes across the state. All early plantings have surpassed 18 DSVs and I recommend that they should be receiving preventative fungicide applications to limit initial late blight infection. Moving northward of Plover in the state, the DSV accumulations are still under threshold for mid and late plantings, but with wet and warm weather these values will likely reach threshold over the next several days. With that said, it is just about that time when all potatoes should be on management programs for late blight.

PDay values are gradually accumulating and I would suspect that Grand Marsh and possibly Hancock early plantings will reach the 300 threshold during the next week. This threshold indicates a time at which the early blight pathogen is active and initial infection of *Alternaria solani* can be limited by preventative fungicides. Many farms have already made applications for late blight prevention and depending upon the fungicide selection, this treatment may doubling to manage early blight. PDay of 300 thresholds typically align with row closure and so the timing of an initial fungicide spray just prior to PDay 300 can help to access lower canopies for improved delivery of contact fungicides. I have not yet seen any early blight symptoms in our Hancock Ag. Research Station early blight fungicide trials.

National Late Blight Updates: http://usablight.org Tomato late blight was reported in Susequehanna Co. PA on 6/20 (observed ~6/5; genotype is not known). Prior to this, and the previously reported NY tomato late blight case (new genotype reported last week), most cases reported to the usablight website in 2018 have been the US-23 pathogen genotype. US-23 has been the predominant genotype in Wisconsin, and across the U.S., in recent years. US-23 can still generally be managed well with use of phenylamide fungicides such as mefenoxam and metalaxyl (ie: Ridomil). However, a potato sample from northeastern FL was sent to my lab earlier this spring and was the US-8 genotype. This information does pose some additional concern for management as US-8 cannot be managed with phenylamide fungicides as isolates are resistant to the fungicide.

A **list of registered fungicides for late blight in potato for Wisconsin** can be found in past Vegetable Crop Updates Newsletter #6 (May 20, 2018) and at link below:
http://www.plantpath.wisc.edu/wivegdis/pdf/2018/2018%20Potato%20Late%20Blight%20Fungicides.pdf

Further **information on fungicides** and other vegetable crop management inputs in the 2018 Commercial Vegetable Production in Wisconsin guide (A3422): http://learningstore.uwex.edu/Assets/pdfs/A3422.pdf

Cucurbit downy mildew reporting and forecasting site http://cdm.ipmpipe.org/ indicated no new confirmations of downy mildew in cucurbit crops during the past week. In 2018 so far, the site has documented confirmations of downy mildew in FL, GA, MD, NC, and SC on primarily cucumber, acorn squash, and cantaloupe.

Differentiating potato tuber silver scurf and black dot (A.J. Gevens, S. Macchiavelli Giron, J. Crane, UW-Madison Plant Pathology): Silver scurf and black dot are potato blemish diseases that are growing in prevalence and economic importance. Both diseases cause tuber discoloration that makes infected tubers unmarketable. Unfortunately, there are large gaps in our understanding of both diseases and how to best manage them, although research on these diseases has been intensifying in recent years. Silver scurf and black dot are caused by separate fungal pathogens that have distinct life cycles. Management strategies mostly consist of cultural and chemical controls, and are hindered by the lack of commercially available resistant cultivars. These ever-present diseases are challenging to control and require an integrated effort to reduce their impact on potato production. In this article I will focus on visual distinctions between the two diseases, and offer some additional information regarding the character of the two diseases.

Symptoms Pictures Above: Top row: Black Dot (photos courtesy of Dr. Phillip Wharton, Univ. of ID); Bottom row: Silver Scurf (photos from Gevens Lab, UW-Madison):

Black dot caused by *Colletotrichum coccodes* produces symptoms that appear brown to gray in color and typically lesions cover large areas of a tuber with less lesion edge definition. Black dot lesions can be a bit darker in color than silver scurf and often are slight raised above the periderm surface. The black dot pathogen also causes foliar and stem symptoms similar to early dying and can play a part in the potato early dying disease complex.
Silver scurf caused by *Helminthosporium solani* typically creates symptoms that are tan to silver-gray and shiny in color. They can be circular in shape with defined borders early in infection, but can coalesce to cover entire tuber with discoloration and, under the right conditions, black pathogen sporulation. Symptoms are most typically seen on the stolon end of tuber with a field infection.

Black dot and silver scurf symptoms are very similar, and in many cases microscopic or molecular diagnostic analysis is needed to differentiate between the two diseases. Additionally, both diseases may be present on individual tubers, further complicating the diagnosis.

These diseases are typically cosmetic and affect just the tuber skin, although they may lead to tuber shrinkage and yield loss, particularly in storage. Infected fresh market tubers are frequently rejected, since tubers with these diseases lesions are unappealing to consumers. Diseased processing tubers may also be rejected, since chips produced from infected tubers often have burnt edges due to a hardening of the tuber skin.

Black dot disease cycle: The main source of inoculum is from pathogen spores produced from fungal structures that survived the winter on debris, infected tubers, or in the soil. These structures can survive for several years in the soil in a dormant state. An additional but lesser source of inoculum is from infected seed tubers. Infections can occur on above-ground and below-ground plant parts, and spread to new plants throughout the season via wind and water splashing. Poor soil and warm temperatures contribute to infections. Conditions that stress plants appear to increase susceptibility. Surprisingly, day length may affect black dot severity, which could explain some of the conflicting reports on the importance of this disease. Black dot is more severe under short days than long days. Unlike silver scurf, black dot does not spread easily in potato warehouses. However, storage conditions may promote symptom development on tubers that had asymptomatic field infections at time of harvest.

Silver scurf disease cycle: Initial silver scurf infection occurs in the field. The largest source of inoculum is from infected seed tubers, although inoculum may also come from soil or crop debris. The role of soil inoculum is greatest in fields with a history of silver scurf, or where there are shorter rotations between potatoes (less than three years). The fungus grows on the developing tubers, but the majority of symptom development occurs after vine kill. Dry conditions can cause severe symptoms even on young tubers. Significant secondary infection can occur in storage, through direct contact between tubers and the spread of pathogen spores through storage ventilation systems.

Management: A combination of strategies will provide optimal control of both diseases. In general, silver scurf management focuses on reducing seed-borne inoculum, although management of inoculum from debris or soil is more important in fields with a history of disease, or when short (<3 years) crop rotations are used. Black dot management focuses on reducing inoculum from infested debris, tubers, and soil. An additional focus of managing both diseases involves reducing the length of tuber exposure to inoculum- through early harvest or selection of late-maturing cultivars. Finally, using good sanitation and overall plant health management practices will decrease the risk of both diseases. As mentioned previously, these methods focus on field management of silver scurf and black dot; additional steps should be taken for managing these diseases in storage.

Cultural control:
Management options include:

1. Field selection- Do not plant into plots with a history of severe disease.
2. Seed selection- Plant disease-free seed.
3. Sanitize field equipment.
4. Rotate-
   a. Silver scurf- Increase the length of rotations to at least three years. Even longer rotations will reduce the incidence of this disease. Rotate with non-host crops such as sweet potato, red clover, carrots, parsnips, beets, or turnips. One study demonstrated success with a barley (undersown with red clover), red clover, potato rotation. Avoid alfalfa, sorghum, rye, oats, corn, and wheat.
   b. Black dot- Rotations likely have less impact than for silver scurf, but may be beneficial, particularly if rotations are long. Rotate with non-hosts such as barley, rye, or maize. Avoid non-hosts like solanaceous crops, yellow mustard, soybean, and spring canola.
5. Maintain high overall plant health.
6. Dig representative samples prior to harvest and have them evaluated to estimate incidence of disease. This info can be used to help decide where and how long to store the harvested tubers.
7. Harvest tubers early- soon after vine kill.
8. Do not spread or dump infested tubers on future potato fields, since they will serve as an inoculum source.

Other options for silver scurf include:

1. Use a lower planting density.
2. Plant smaller seed pieces.
3. Plant seed of a lower generation.

Other options for black dot include:

1. Control weeds, particularly velvetleaf and solanaceous weeds like nightshade.
2. Monitor soil fertility; very high or low levels of nitrogen may increase disease severity.
3. Perform pre-plant solarization/tarping, or mouldboard ploughing to a depth of 30cm.
4. Avoid planting into poorly drained soils.
5. Good plant health is particularly important.

Biocontrol: Multiple biocontrol microbes have been tested for control of silver scurf with mixed results, thus these biocontrol microbes do not appear to provide consistent control of silver scurf. However, Dr. Neil Gudmestad, NDSU, has demonstrated benefit of Serenade ASO (in furrow) for black dot control in canopy.
http://www.mbpotatodays.ca/assets/2018presentations/Gudmestad%20Black%20Dot%20MB%20Conference%202018.pdf

Chemical control:
Several at-planting products are labeled in Wisconsin for silver scurf and black dot control. See table below for registered fungicides for at-planting. Phostrol (and other like phos acid materials) as well as Stadium (azoxystrobin+difenoconazole+fludioxonil) have been effective in limiting post-harvest development and spread of silver scurf. *Remember to use only products labeled for silver scurf or black dot and follow all label directions when using the product.*

Fungicide(s), FRAC	**Application, formulation**	**Active ingredient**	**Diseases controlled**
		Strobilurins-FRAC Group 11	
Dynasty, 11	Seed, liq slurry	azoxystrobin	Black Dot, Rhizoctonia, Silver scurf
Equation; Equation SC; Quadris; Satori; Willowood Azoxy 25C, 11	In-furrow and banded	azoxystrobin	Black Dot, Rhizoctonia, Silver scurf
Evito 480 SC, 11	In-furrow and banded	fluoxastrobin	Black Dot, Rhizoctonia, Silver scurf
Elatus 11 + 7	In-furrow	azoxystrobin + benzovindiflupyr	Black Dot, Rhizoctonia, Silver Scurf
		Phenylpyrroles-FRAC Group 12	
Cruiser Maxx potato, 12, 4A insecticide	Seed, liq	fludioxonil, thiamethoxam	Rhizoctonia, Fusarium, Silver scurf
CruiserMaxx Potato Extreme, 12, 3, 4A insecticide	Seed, liq	thiamethoxam, fludioxonil, difenoconazole	Rhizoctonia, Fusarium, Silver scurf,
Maxim 4FS; Spirato 480FS, 12	Seed, liq	fludioxonil	Rhizoctonia, Fusarium, Silver scurf
Maxim MZ, 12, M3	Seed, dust	fludioxonil, mancozeb	Rhizoctonia, Fusarium, Silver scurf

Maxim PSP, 12	Seed, dust	fludioxonil	Rhizoctonia, Fusarium, Silver scurf
Dithio-carbamates- FRAC Group M3			
Dithane-F45 Rainshield, Dithane-M45, Koverall, Roper DF Rainshield, M3	Seedpiece, Liquid for creating slurry	mancozeb	Fusarium, Late blight, Common scab, Rhizoctonia, Silver scurf
Phenyl-benzamides- FRAC Group 7			
Emesto Silver, 7, 3	Seed, liq	penflufen, prothioconazole	Rhizoctonia, Fusarium, Silver scurf, Black Scurf
Moncoat MZ, 7, M3	Seed, dust	flutolanil, mancozeb, contains alder bark	Late blight, Rhizoctonia, Fusarium, Silver scurf
Elatus 11 + 7	In-furrow	azoxystrobin + benzovindiflupyr	Black Dot, Rhizoctonia, Silver scurf
Thiophanates- FRAC Group 1			
Evolve, 1, M3, 27	Seedpiece, dust	thiophanate methyl, mancozeb, cymoxanil	Silver scurf, Fusarium, Rhizoctonia
Tops MZ, 1, M3	Seed, dust	thiophanate methyl, mancozeb	Fusarium, Rhizoctonia, Silver scurf, Late Blight
Tops-MZ-Gaucho, 1, M3, 4A insecticide	Seed, dust	thiophanate methyl, mancozeb, imidaclopid	Fusarium, Rhizoctonia, Silver scurf, Late Blight

Resistant varieties: No commercial cultivars are completely resistant to black dot or silver scurf, although cultivars vary in the amount of spores produced or in the visibility of the symptoms on the tuber. In general, later maturing cultivars perform better against both diseases, probably because tubers are exposed to pathogen inoculum for a shorter period of time prior to harvest. Tolerance to silver scurf been found in wild potato species, and the Verticillium resistant line C287 may also have useful tolerance to silver scurf. Research in this area is on-going.

Detection, diagnosis, and identification: Both pathogens can cause latent infections that can develop into symptoms at a later point, making detection important even on tubers that do not appear to be infected. Silver scurf symptoms are very similar to black dot symptoms, but there are no other common tuber diseases easily mistaken for either of these diseases. Because of the similarity between silver scurf and black dot symptoms, microscopic or molecular diagnostic analysis is often needed to distinguish them. One challenge facing silver scurf and black dot diagnostics is that both pathogens are often observed on the same tubers, making it difficult to determine which pathogen was the primary culprit. An additional challenge in the detection of silver scurf, is that the pathogen may take over a month to grow on tuber surfaces, and can be hidden by faster-growing molds. Molecular diagnostic primers have been developed for both pathogens, and may aid in rapid and comprehensive diagnoses. Research is currently being performed in this area at UW-Madison.

SILVER SCURF AND BLACK DOT SUMMARY

	Silver scurf	Black dot
Pathogen	A fungus, *Helminthosporium solani*	A fungus, *Colletotrichum coccodes*
Inoculum source (major contributor underlined)	Seed, soil/crop debris	Seed, soil/crop debris, weeds
Other plant hosts	Potato is main host, but can survive on debris of several other plants	Many hosts, especially Solanaceous crops and weeds
Infects above-ground plant tissues	No	Yes
Symptoms	Grey/silver lesions, defined margins, lesions not raised, lesions begin small but may grow together	Lesions darker and larger than silver scurf, raised and in irregular patches, black dots may be visible
Frequency of latent or asymptomatic infections	Likely high	Likely high
Potential for spread in storage	Yes	No
Management focus	Reducing inoculum from seed	Reducing inoculum from soil/debris
Season length influence	More disease with later harvest	More disease with later harvest
Crop rotation	Beneficial (>3 years)	Less beneficial
Other cultural strategies	Among others- seed and field selection, planting density	Among others - field selection and preparation, weed control, drainage
Resistant cultivars	No completely resistant commercial varieties available	No completely resistant commercial varieties available
Biological control	No consistently effective organisms identified	No consistently effective organisms identified
Chemical control	Effective seed/in-furrow products	Possibly less effective

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There is an old Chinese joke that says "we only have two rain events this week – one lasts for three days and the other lasts for four". I think it is a perfect description of what we have experienced this past week. Some fields in Central Wisconsin got more than 8 inches of rain between June 16th and 19th.

With the high amount of precipitation, nitrate leaching is considered to be a problem for most potato growers in the area. For potatoes, peak N demand and uptake occurs between 20 and 60 days after emergence, so right now is a critical time for fertility management. Depending on petiole nitrate readings and varieties, some folks did their regular spoon feeding one week earlier than scheduled, some supplemented 20 to 50 units of N/acre to make up for the leaching loss, and others will do more frequent petiole tests to monitor the N status in the crop. At Hancock, we airflowed 119 units of N/acre on June 6th. We received about 5.5'' of rain between June 16th and 19th. The petiole samples that were collected on June 20th showed that our nitrate levels are still pretty high, making us realize that another round of petiole test is needed early next week. Typically petiole samples collected right after a N application or leaching event are not informative. Wait at least four days. Table below shows the expected ranges of petiole nitrate-N at three growth stages.

Nitrate-Nitrogen	Expected range (%)
Tuber Initiation	1.70 to 2.20
Tuber Bulking	1.10 to 1.50
Maturation	0.60 to 0.90

Another challenge that big rainfall events can cause is the “enlarged lenticel” problem on the tuber surface (Figure 1).

Figure 1. Enlarged lenticels, looking like “whitish cauliflower”, are a result of excessive soil moist.

Lenticels are breathing pores that appear as tiny slits on the tuber surface. They are the gateway for gas exchange (primarily to take in O_2 and exhale CO_2) during tuber growth and development. When the tubers sit in waterlogged soil for an extended period of time, the lenticels will become enlarged and consist of numerous **whitish outgrowths** (“cauliflower” lenticels on the surface of the tuber) (Figure 1), which will then dry out and suberize to form brown dots measuring 0.04 to 0.12’’ in diameter (appear as small scab lesions, Figure 2).

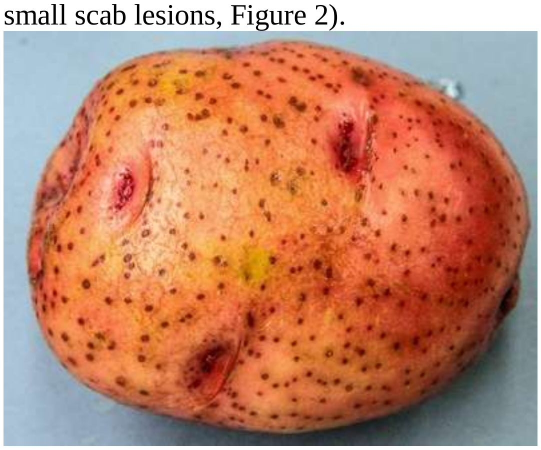

Figure 2. Small brown lesions after enlarged lenticel dried out (Source: A. Robinson)

Enlarged lenticels can provide entry points for pathogens such as Pectobacterium, and possibly Dickeya species.

During the growing season when there is heavy rainfall, storms in particular, the enlarged lenticel disorder is hard to avoid completely, especially in a poorly drained spot/area within the field. It is important to:

- monitor the soil moisture status all through the growing season;
- do not irrigate excessively, keep soil moisture lower than 90% of field capacity;
- ensure a good soil structure and efficient drainage in the field.