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Wisconsin Fruit News

Volume 4, Issue 5 – June 7, 2019

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General Information

UW-Madison/Extension
Plant Disease Diagnostic Clinic (PDDC) update

By: Brian Hudelson, Sue Lueloff, Alex Mikus and Ann Joy

The PDDC receives samples of many plant and soil samples from around the state. The following diseases/disorders have been identified at the PDDC from June 1, 2019 through June 7, 2019.

Plant/Sample Type	Disease/Disorder	Pathogen	County
Fruit Crops			
Apple	Black Rot	*Diplodia* sp.	Dane
	Phomopsis Canker	*Phomopsis* sp.	Dane
	Root Rot	*Phytophthora* sp.	Dane
Cherry	Bacterial Canker	*Phomopsis* sp.	Dane
Pear	Cold Injury	none	Dunn

For additional information on plant diseases and their control, visit the PDDC website at pddc.wisc.edu.
Follow the clinic on Facebook and Twitter @UWPDDC.

UW-Madison/Extension Insect Diagnostic Lab update

By: PJ Liesch, UW Insect Diagnostic Lab

The caseload at the UW Insect Diagnostic Lab (IDL) has started to pick up recently with warmer temperatures, although much of the state still lags behind in terms of average accumulated growing degree days for this time of the year. Reports of fruit crop insect activity submitted to the IDL from the last two weeks are summarized below:

Tarnished plant bugs have been reported from several locations in southern Wisconsin. These insects can feed on a wide range of fruit crops ranging from strawberries to tree fruit. With multiple generations per year, this insect can be encountered during much of the growing season.

Slugs are likely thriving with the rainy conditions in many parts of the state, and recent reports have come into the UW Insect Diagnostic Lab from southern and west-central Wisconsin. Slugs can feed on a variety of plants, including many landscape plants. Low-growing fruit crops, like strawberries, can also be attacked. Slugs are most active on overcast days or at night, so if slug damage is suspected, scouting after dark can sometimes be helpful.

Gypsy moth caterpillars have recently been reported in southern and central Wisconsin, although many of the submitted caterpillars have been small (~ ½" long) due to slower development with our cooler temperatures. As caterpillars mature and become larger, damage will become more noticeable.

Black Stem Borer (*Xylosandrus germanus*) was recently confirmed from an apple tree in southwestern Wisconsin. This non-native borer attacks a wide range of hardwood trees, including fruit trees. This species has technically been detected in prior surveys in over a dozen Wisconsin counties, but reports of fruit tree damage are rare in the state. Some areas of the northeastern U.S. have had issues with this particular borer in orchard settings.

Pesticide effectiveness in the field affected by spray water chemistry & turbidity

By: Brian R. Smith, UW-River Falls

I think we can all agree most pesticides are costly and that nobody likes having to apply them. However, since pesticides are a necessary part of growing fruit crops effectively, then having maximum effectiveness at the labeled rates is of paramount importance. If one has sprayed pesticides for any length of time, it is known that such variables as correct calibration and additives like crop oil or special specific adjuvants make all the difference when trying to achieve proper results.

However, some of the most basic steps are often overlooked, with number one being spray water chemistry. For example, although many pesticides are quite stabile over a wide range of water pH (acidity or alkalinity), some are not and can lose their effectiveness quickly if dissolved/dispersed in the wrong spray water environment. Applicators not familiar with this fact might easily conclude that if the pest was not properly controlled, the pesticide used was substandard, blame it on the weather or complicate things more by next time using a tank mix or increasing to the max rate.

Especially, if you are using pesticides at the lower end of the rate scale, water quality will play the most critical role in pesticide effectiveness but will always have a significant effect no matter what rate you use. Water is typically ≥ 95% of the spray solution, so let's take a look in more depth at how and why water can impact your pesticide application effectiveness:

Water pH- The pH value is the acidity (concentration of hydrogen ions) or alkalinity rating of any solution and ranges from 0-14, with < 7.0 being acid (low), 7= neutral and > 7.0 alkaline (high) pH. The pH scale is set up on a 10X logarithmic scale, with a pH of 6 being 10X more acidic than 7 and a pH of even 2 being 100X more acidic than pH 4.0. Likewise, a pH of 13 is 100X more alkaline than pH 11. Pesticides are typically formulated as mildly alkaline-neutral-mildly acidic and perform best in spray water of pH 4-6.5. There are a few, however, that are most effective at slightly above 7.0.

With spray water falling outside the correct range for your pesticide, pesticide effectiveness is reduced. One of the most common occurrences is known as "alkaline hydrolysis" in which the pesticide can rapidly breakdown and/or precipitate out of solution (process usually accelerates with warmer spray water temps.).

Over 9,000 households in Wisconsin rely on private wells and data has been collected on water quality from these wells. Water quality interactive maps from UW-Stevens Point/UW-Extension (Center for Watershed Science and Education) indicate that as expected, there is much variation among the wells but there are distinct overall trends by county. For example, the worst counties for high pH are St. Croix, Douglas, Ashland, Columbia, Sheboygan and Kenosha, all averaging over a pH of 8.0 and ranges spanning within counties from 5.9 to 9.8! Ashland and Sheboygan counties all have over 72% of the wells with pH over 8.0. Even though Jackson and Juneau counties have the lowest averages in the state of 6.8 and 6.7, respectively, the range of individual well readings is still 4.6-9.7.

Water Hardness – Typically caused by dissolved minerals such as iron, calcium and magnesium and "hardness" is measured by the total amount of calcium and magnesium ions in water. Total hardness is typically measured in ppm (parts per million) or grains of calcium and magnesium/gal. of water. Hard water would be > 342 ppm and "soft" water would be < 114 ppm. The positively charged ions of iron, calcium and magnesium bind with the negatively-charged pesticide molecules in your spray solution and activity drops.

UW-Stevens Point/UW-Extension data on wells relating to hardness reports in mg of calcium carbonate equivalent/liter of water (<60 considered "soft"; 60-120 mg/l moderately hard; > 180 mg/l very hard), with Dodge, Winnebago and Calumet counties being the worst, averaging over 404 mg $CaCO_3$/L and range for the 3 counties of 16-1760! Over 48% of the wells have readings over 401. The suggested upper limit for water hardness in pesticide sprays is 300 mg/L. Hard water not only affects the pesticides used but can also affect the properties of wetting agents, emulsifiers and surfactants.

Turbidity or Suspended Solids – This occurs when your spray water contains suspended clay, silt or organic matter (like algae). High levels of algae not only clog filters and act as a binding site for chemicals but also can increase the alkalinity of spray water. Pesticide molecules(negatively-charged) can bind with these soil/organic particles (+ charged), which lessens the actual amount of pesticide that is available to do the intended job. This would most likely happen when an applicator uses water from a lake, irrigation pond, ditch or other murky source. Make sure proper filtration is in place on your sprayer or water outlet used for your sprayer! Pesticides actually have indexes known as the soil organic carbon sorption coefficient (Koc) and the soil sorption coefficient (Kd). Both of these values will indicate how pesticides are inactivated as they bind or adsorb to suspended solids.

Testing spray water

Since most growers will typically use the same source of water for all spraying, it would make sense to have that water tested by a water-testing service. If you are using a surface water source, it can change quite drastically throughout the season, with spring rains, runoff, flooding and algae growth but wells and tap water from cities are likely to change much less over the year, thus making your job easier trying to plan for adjusting your spray water for a particular set of pesticides typically used. Just remember, that just because municipalities or any well might have completely safe water for drinking, does not mean it is chemically desirable for spray use!
Test kits are also available and can be quite accurate if you don't buy the really cheap ones! Sensitive paper that indicates a color change are used for water hardness, iron levels and pH; follow directions completely, making note of need to filter many surface waters before testing.

Your spray water has been tested, now what?

Make a list of your pesticides and any requirements indicated for spray water chemistry for each (refer to label); you may have to change strategies, depending on the pesticide you are planning to apply. Most pesticide manufacturers formulate their product to be able to remain close to full activity for 24 hrs. if in water that is between pH 6-7. However, generalities aside, there are many exceptions, and most pesticides will break down eventually in any water. If your spray water deviates from the water standards specified for the pesticide, then you will need to condition the water. Granulated food grade citric acid is a convenient and inexpensive acidifying material; adding 2 oz./100 gal (¼ cup, slightly rounded) can reduce clean water from pH 8.3 down to 5.4. We can also judge how critical this conditioning is based on the pesticide half-life, or the number of hours/days it takes for half of the active ingredient to be rendered inactive. Table 1 is a short list of pesticide sensitivity to water quality factors and reveals a few striking results!

Table 1: Stability of Some Pesticides in Regard to Water Quality Factors

Active ingredient	Typical Trade Name	Chemical or Pesticide type	Label mixing notes/comments
Bacillus thuringiensis	Dipel	Insecticide	Use acidifying/buffering agent when water > 8.0
Carbaryl	Sevin	Insecticide	Do not mix w/ Lime Sulfur, Bordeaux mix or other alkaline materials. ½ life= 1 day @ pH 9; reduce pH to 6
phosmet	Imidan	Insecticide	½ life @ pH 8 = 4 hrs.; reduce pH to 5

Dimethyl dithiophosphate	Malathion	Insecticide	½ life of 5 hrs. @ pH 9; lower to pH 7 with acidifying/ buffering agent
acetamiprid	Assail	Insecticide	Unstable outside the realm of pH 4-7; keep pH @ 5-6
clofentezine	Apollo	Miticide	½ life 4.8 hrs. @ pH 9.2; lower pH to 6-7
2,4-D (amine form)	Amine 4	Herbicide	Sensitive to upper levels of hardness and alkalinity (hardness > 600 ppm and 500 mg/L $CaCO_3$
Diquat, paraquat	Gramoxone	Herbicide	should be free of clay, silt, algae. Alkaline hydrolysis common; not stable @ pH > 7. Koc (mg/L) = 1,000,000
Glyphosate	Roundup	Herbicide	Water must not be hard; should be clean and free of soil particles; use acidifying/buffering agents to adjust pH; Koc (mg/L) = 24,000
sethoxydim	Poast	Herbicide	pH optimal @ 3-4
prohexadione calcium	Apogee	Growth regulator	If mix in hard water, add 1 lb of spray-grade ammonium sulfate for each lb. of Apogee
Gibberellic acid	Promalin	Growth regulator	Do not mix in water with pH >8
Iprodione	Rovral	Fungicide	Unstable in water pH of $\geq$7.0; use buffering agent to lower
Captan	Captan	Fungicide	**At pH 8, ½ life= 10 min**; pH 7 is 8 hrs. reduce pH to 5
Phosphorus acid	AgriFos, Prophyt	Fungicide	Do not try to acidify these solutions
Bordeaux mixture		Fungicide	Do not try to acidify these solutions
Fixed copper, other copper compounds	Kocide 2000	Fungicide/ bacteriacide	Do not try to acidify these solutions
Fosetyl-Al	Aliette	Fungicide	Stable between pH of 4-8; use acidifying/buffering agents outside this range

Water conditioners vary in efficacy just like pesticides do, even with the same conditioning objective (ask the vendor for proof that the conditioner actually works!). Most water conditioners are used to adjust water hardness and pH buffers are used to lower or raise the pH. Typical examples of buffering agents include Spray-Aide, Buffer-X, Buffercide, while AMS (ammonium sulfate) is used to improve efficacy of many herbicides mixed in hard water. Some pesticides already have water conditioners in the formulations and others perform better when special adjuvants are used to modify water quality.

When in doubt as to whether to condition your water or in a certain way, there are a few guidelines that can be used:

1. Pesticide label recommends use
2. Label indicates specific water quality parameters
3. A weak acid herbicide like glyphosate is used and water hardness exceeds 150 ppm
4. Use completely clear water when the Koc of the pesticide's product > 800 (also especially true of glyphosate), 5. Iron levels > 25 ppm and hardness + iron are > 400, with most herbicides
5. If pH is outside the normal range of 4-7, generally for most pesticides.

Typically, the water should be conditioned first and then the pesticide is added. Remember that there is also a recommended order to adding different formulations in a tank mix and usually starts with adding wettable powders and dry flowables with agitation running, then liquids and flowables, next, emulsifiable concentrates followed by microencapsulates and finally, surfactants.

Berry Crops

Spring insects: Eastern flower thrips, tarnished plant bug, and spittle bug

By: Christelle Guédot, UW-Madison

Eastern flower thrips (EFT) have been spotted in strawberry and apple per DATCP's pest bulletin of 5/30/19. Berry growers should monitor for EFT by shaking/tapping 10 blossoms per site in a white bowl or tray, looking at 10 or more sites per variety. Chemical control is warranted with populations between 2-10 thrips per blossom or small berry, depending on your level of tolerance (for more info see previous article on EFT here). For insecticide recommendations once you reach this threshold, please refer to the 2019-2020 Midwest Fruit Pest Management Guide.

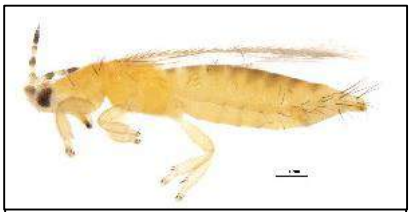


Figure 1. Eastern flower thrips, *Frankliniella tritici.* BIOUG03211-B05CBG. Photography Group, Centre for Biodiversity Genomics. Creative Commons.

Figure 2. Tarnished plant bug adult feeding in the most characteristic way on strawberry. Photo courtesy of Dan Mahr, UW-Madison

Tarnished plant bugs (TPB)
Though I did not see any TPB at the farm I visited last week in Dane county, TPB should be active in strawberry and the next generation should start appearing soon. Plants are blooming now and sampling should happen at least once a week. Look for adults and nymphs as both feed on strawberry plants and can cause damage. Chemical control should be implemented when you find four adults per 20 sweeps or one nymph in four flower clusters. Please refer to the 2019-2020 Midwest Fruit Pest Management Guide for insecticide recommendations. More info on TPB can be found in this previous article.

Spittle bug

Visiting a strawberry farm last week in Dane county, I observed quite a few spittle masses among strawberry plants. Spittle bug seldom causes damage to strawberry and should be treated if there are more than a few spittle bug nymphs (without frothy masses) per square feet when blossom clusters begin to separate. Spittle bug usually feed on broad leaf plants amongst the strawberry plants, thus controlling weeds in the planting will help reduce the number of spittle masses on strawberry plants. Frothy masses themselves are not damaging and can be washed off with water.

Figure 3. Spittle bug adult. Photo courtesy of Cheryl Moorehead, Bugwood.org

Happy growing season!

Strawberry angular leaf spot

By: Patty McManus, UW-Madison Department of Plant Pathology

Angular leaf spot is a sporadic but potentially serious disease of strawberry in Wisconsin. Our relatively cool climate is conducive to disease development. Angular leaf spot is caused by a bacterium (*Xanthomonas fragariae*), which distinguishes it from other strawberry diseases in Wisconsin, most of which are caused by fungi. As such, angular leaf spot cannot be controlled with the fungicides commonly used on other leaf diseases. Accurate identification of angular leaf spot is important so that appropriate control measures can be taken.

Identifying angular leaf spot

As the name implies, angular leaf spot affects leaves, which leads to decreased plant vigor. However, direct yield losses occur when the infected calyx (leafy fruit cap) becomes black and dry or when peduncles (fruit stems) are diseased. Symptoms vary depending on how long the disease has been developing and on weather conditions. Anecdotal evidence suggests that symptoms also vary among cultivars (e.g., certain cultivars may be more prone to calyx rather than leaf infection), but this has not been well documented.

Leaf spots first appear on the lower surfaces of leaves as tiny, water-soaked lesions that are delimited by veins (Figure 1). The angular spots appear yellow to pale green and translucent when held up to light, but dark green and opaque when viewed from above. Under wet conditions, a slimy white film, which consists of masses of bacteria, oozes from the spots. Upon drying, this film becomes scaly and can easily be scraped from the leaves. As the disease progresses, spots become more numerous, merge, and become visible on the upper surfaces of leaves as reddish-brown dead areas (Figure 2). The edges of leaves may appear ragged as dead tissue breaks off. At such advanced stages, angular leaf spot is difficult to distinguish from fungal leaf-spotting diseases (e.g., leaf

blight, leaf scorch, and common leaf spot). Therefore, it is important to scout for angular leaf spot when leaves still look healthy. Be sure to look at the undersides of leaves to detect symptoms at their earliest stages.

Figure 1. Angular leaf spot symptoms on lower leaf surface viewed with incident light (left and center) and held up to light (right).

An infected calyx initially appears dark green, water-soaked, and limp, but then it quickly dries and turns black (Figure 3). Usually if the calyx is diseased, the peduncles will also be dark and wilted. Usually the berry flesh is not affected, but the blackened calyx makes the fruit unmarketable. *X. fragariae* can become systemic, affecting vascular tissue in all parts of the plant including the crown and roots. Severe infection of the crown can cause sudden wilting and collapse of the plant, although this is not a common occurrence in Wisconsin.

Figure 2. At late stages, angular leaf spot resembles other leaf diseases.

Disease origins and spread

X. fragariae is introduced into commercial plantings on infected but health-appearing plants. While most nurseries take measures to control angular leaf spot, they often cannot eliminate the pathogen. In established plantings where angular leaf spot has occurred, the pathogen can overwinter in infected leaf debris and persist in plant crowns. *X. fragariae* apparently does not survive on plants other than strawberry. Disease development is highly dependent on the environment, although the precise conditions required for angular leaf spot are not known. Angular leaf spot is favored by cool to moderate daytime temperatures (65-70 ^{o}F), high relative humidity, and wet conditions brought on by rain, irrigation, or heavy dew. These conditions describe the recent weather in many part of Wisconsin, and in fact, middle May to early June is when we typically see angular leaf spot. Nevertheless, this disease sometimes is absent or goes unnoticed early in the season but then quickly develops after rainy periods later in the summer, especially on new growth after renovation.

After symptoms develop, bacteria in a slimy white matrix ooze from stomata (breathing pores on leaves) onto the leaf surface. From there the bacteria are easily splashed about the planting by rain or irrigation water. The bacteria-laden slime can also get carried across a field on equipment or feet. *X. fragariae* infects strawberry tissues through stomata and perhaps hydathodes (small openings on the margins of leaves) and tiny wounds caused by abrasion from blowing sand.

Control

As with any disease of strawberry, control begins before you put the plants in the ground. Bacterial diseases, however, are notoriously difficult to control. Unlike fungal diseases for which there are many effective fungicides, angular leaf spot is difficult to control by spraying. Nevertheless, there are things you can do to minimize losses from angular leaf spot.

- **Site.** Choose well-drained sites with good air circulation and exposure to sunshine. This will minimize the time that plants are wet and should reduce the incidence and severity of all diseases.
- **Rotation.** Because *X. fragariae* survives in leaf debris, do not establish a new planting in soil containing old strawberry leaves, especially where there is a past history of angular leaf spot. If you are on a 3- to 4-year rotation with other crops, this should not be a problem because once leaf debris decomposes, the pathogen cannot survive in the soil.
- **Weed control.** Control weeds and maintain alleys between rows to improve air circulation.
- **Nitrogen.** Use nitrogen fertilizers sparingly. The soft, succulent tissues that result after heavy nitrogen application are especially susceptible to angular leaf spot.
- **Copper.** Copper-based fungicides (e.g., Champ, Kocide, COCS) and newer copper-based products (e.g., BadgeX2, Cueva, Magna-Bon) have shown various levels of control in trials. These may help prevent infection of new tissues when the pathogen is splashed about, but they will not control growth of bacteria that are already inside plants. To prevent new infection, copper-based products should be applied as early in the spring as permitted on product labels, when plants are rapidly growing. The main purpose of springtime sprays is to prevent infection of the calyx, which can make fruit unmarketable. When re-growth occurs after renovation, the benefits of copper are questionable. At this point the weather is usually not favorable for angular leaf spot, and it's not clear that leaf injury from angular leaf spot is economically important.

Unfortunately, copper can be toxic to strawberry leaves after 4 to 5 applications. If this occurs, quit using it—the risks outweigh the benefits at this point.

- **"Soft" chemistries.** Copper-based products are the most-tested for angular leaf spot control. However, in trials in Florida, the plant resistance activator Actigard has shown some efficacy. In one report from Michigan where disease pressure was low, Regalia, Serenade Optimum, and Double Nickel controlled angular leaf spot. I am not comfortable recommending these products, however, because very little research data has been reported.
- **Cultivars.** Unfortunately, cultivars highly resistant to angular leaf spot are not commercially available. The most popular cultivars in Wisconsin, including Annapolis, Cavendish, Honeoye, Jewel, Kent, Sable, and Winona, are all highly susceptible. Tristar has shown tolerance (gets symptoms but without much impact on the plant) to angular leaf spot in Wisconsin.

Figure 3. Symptoms on calyx tissue make berries unmarketable.

Grapes

Grape variety development stages: June 4, 2019

By: Andi Nelson, Jacob Scharfetter, Annie Deutsch, and Amaya Atucha

At the West Madison Agricultural Research Station (WMARS) in Madison, WI, shoot development across most cultivars' buds were in E-L* stage 11 ("4 leaves separated") through E-L stage 14 ("7 leaves separated"), with some more vigorous shoots in E-L stage 16 ("10 leaves separated"). Currently, vines are behind in development compared to 2017 and 2018 seasons due to the cooler spring. However, we have seen an accelerated shoot growth in the last week due to the warmer temperatures we have experienced. At the Peninsular Agricultural Research Station (PARS), all varieties are at E-L stages 6 ("leaf tips visible") through 9 ("2 to 3 leaves separated; shoots 2-4 cm long").

Following photos were taken on June 4, at West Madison Agricultural Research Station

Brianna
"5 leaves separated"
E-L stage 12

Crimson Pearl
"6 leaves separated"
E-L stage 13

Frontenac
"6 leaves separated"
E-L stage 12

Itasca
"5 leaves separated"
E-L stage 12

La Crescent
"6 leaves separated"
E-L stage 13

Marquette
"5 leaves separated"
E-L stage 12

Petite Pearl
"5 leaves separated"
E-L stage 12

Following photos were taken on June 3, at Peninsular Agricultural Research Station

Brianna
"leaf tips visible"
E-L stage 6

Frontenac
"2 to 3 leaves separated"
E-L stage 9

La Crosse
"2 to 3 leaves separated"
E-L stage 9

Marquette
"2 to 3 leaves separated"
E-L stage 9

St. Croix
"2 to 3 leaves separated"
E-L stage 9

Date: April 1 – June 7, 2019 Growing Degree Days (Base 50°F)

	2019	2018	2017
Location: WMARS	389	593	412
Location: PARS	139	277	193

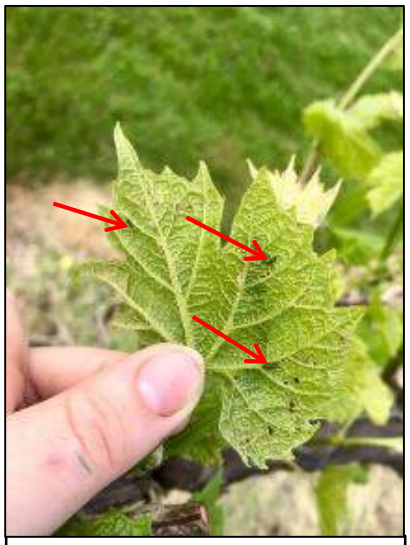
Growing degree-day accumulation from April 1 to May 10 for the past three seasons. Currently, the 2019 season is running behind in GDD accumulation compared to 2017 and 2018 seasons. Degree-days were calculated using a base 50°F, starting on April 1 as a biofix. We calculated degree days using the NEWA website, and you can visit their "About degree days" page to learn more about the degree days and the formulas used for their respective calculations (http://newa.cornell.edu/index.php?page=about-degree-days).

**E-L stands for Eichhorn-Lorenz Phenological stages to describe grapevine development*

Grape phylloxera galls starting to show

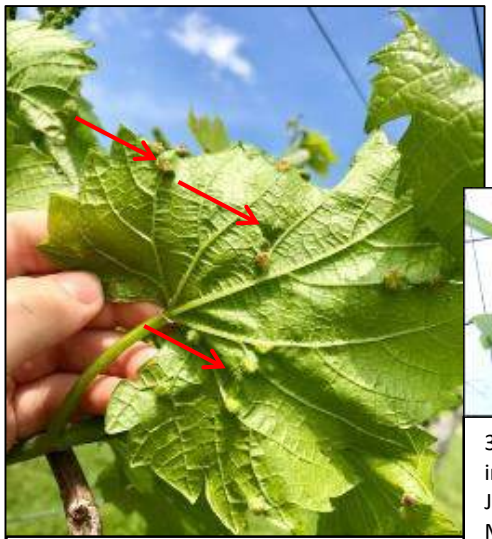
By: Christelle Guédot, UW-Madison Department of Entomology

Grape flea beetle adults are no longer a problem at most vineyards as grape buds have now expanded (see article on Grape Variety Developmental Stages in this issue for more info). Scouting on 6/4/19 at the West Madison Research Station (WMARS) vineyard revealed the presence of flea beetle larvae on the underside of leaves (Figure 1). Larvae do not cause any economic damage on grape as they feed to a limited extent and exclusively on leaves. As of 6/03/19, no grape flea beetle or any other insect were observed at the Peninsular Agricultural Research Station.



1. Flea beetle larvae feeding on a grape leaf (red arrows). Photo credit: Andi Nelson, UW-Madison.

We observed the first galls caused by grape phylloxera at the WMARS on 5/29/19 (figure 2). Numbers range from less than 1% to about 10% infestation on grape leaves. Galls were observed on most cultivars present with some differences amongst cultivars that should be further studied. While grape leaves do not get damaged from developing galls in response to the feeding by grape phylloxera, high densities of galls can cause the leaf to curl and thus not be efficient at photosynthesis (Figure 3). This can in turn result in delayed ripening, reduced crop quality and may predispose vines to winter injury. Leaf galls begin to form when the shoots reach 5 inches long and multiple generations continue to make galls near the shoot tips throughout the summer. Monitoring for galls in May-June when the first generation of adults form galls is very important, since each gall contains a female who will produce many offspring.



2. Grape phylloxera galls (red arrows showing a subset of galls) on a grape leaf. Photo credit: Andi Nelson, UW-Madison.

3. Severe grape phylloxera infestation. Photo credit: Janet van Zoeren, UW-Madison

Assail, Danitol, and Movento are registered to control grape phylloxera. Spray as soon as possible if there are walking yellow crawlers inside the galls or if you see immature galls forming on terminal leaves. Timing sprays when phylloxera larvae from the first generation are exposed while climbing to the new foliage at the shoot ends is important. According to Don Johnson at the University of Arkansas, Danitol and Movento worked well with one application against second generation crawlers, whereas Assail (and Danitol) worked when applied twice at a 15day interval (Johnson et al., 2008). Admire Pro is also registered for grape phylloxera management and should be applied from bud swell until the first leaf is fully expanded as a soil drench or side-dress, especially in areas which have shown previously high phylloxera infestations.

Thanks to Andi Nelson and Annie Deutsch for scouting at the research stations.

Happy growing season!

Johnson, D.T., B. Lewis and S. Sleezer. 2008. Chemical evaluation and timing of applications against foliar form of grape phylloxera, 2006. *Arthropod Management Tests* 33:C11.

Grape downy mildew

By: Patty McManus, UW-Madison Department of Plant Pathology

Conditions across much of Wisconsin have been ideal for downy mildew on grapes. The downy mildew pathogen makes its spores on the undersides of leaves, sometimes in discrete patches but sometimes in a diffuse spread across the leaf (see photos). Additionally, we have found that some of the cold-climate cultivars can have sporulation on leaf undersides without the yellowish "oil spots" on the tops of leaves that are often also associated with this pathogen. For more on the range of downy mildew symptoms, see our scouting guide, "Photo Guide to Disease Management of Cold Climate Grapes," on the Wisconsin Fruit web site.

Information on fungicides and their timing is available in the Midwest Fruit Pest Management Guide, available at the UW-Madison Extension Learning Store: https://learningstore.uwex.edu/Midwest-Fruit-Pest-Management-Guide20192020-P1785.aspx

Some highlights and reminders regarding fungicides and downy mildew:

- Mancozeb controls not just downy mildew, but also black rot, anthracnose, and Phomopsis. However, the 66-day pre-harvest interval restricts its use to early season.
- Captan controls downy mildew and Phomopsis but NOT black rot. Early in the season through about 3-4 weeks post bloom, you need to also control black rot.
- Products containing phosphorous acid are effective on downy mildew and are relatively inexpensive, but they do not control other fungal diseases. They are a good choice for later in the season when the threat of black rot has passed but leaves remain susceptible to downy mildew.
- Ridomil Gold MZ and Ridomil Gold Copper provide excellent downy mildew control, but their uses are restricted by 60- and 66-day pre-harvest intervals, similar to mancozeb.
- Strobilurin fungicides used as protectants (such as Sovran and Abound) provide good control with additional effectiveness against black rot and powdery mildew, but some strobilurin-based fungicides (such as Flint and Pristine) can be phytotoxic. Check labels for phytotoxicity warnings.
- Copper-based fungicides are effective on downy mildew, and some formulations are approved for organic production. However, in our research on sensitivity of cold-climate cultivars to copper, Brianna was highly sensitive, sometimes showing injury after just one application. Several other varieties (Fontenac, Frontenac gris, La Crescent, Leon Millot, Marechal Foch, Marquette, and St. Croix) showed leaf injury in some trials, but only after four to six consecutive applications. Those varieties might be safely treated with copper if fewer sprays are made and not back-to-back.

- Sterol demethylation fungicides (e.g., Rally/Nova, Inspire Super, Mettle) are good for black rot and powdery mildew control, but they are NOT effective on downy mildew.

Discrete downy mildew lesions on leaf underside (Dave Jones photo).

Diffuse downy mildew spread across leaf underside.

Downy mildew on a shoot

Photo guide for disease ID on cold-climate grapes

By: Patty McManus, UW-Madison Department of Plant Pathology

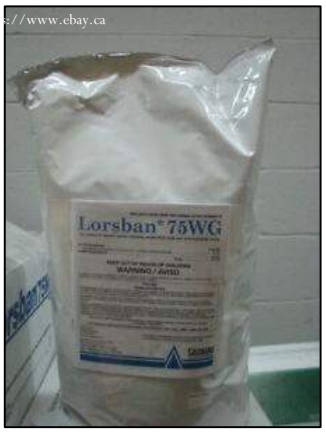
If you are reading this newsletter, then you are probably aware of the Wisconsin Fruit web site (fruit.wisc.edu). But if not, be sure to visit the site for links to dozens of useful publications and presentations. Two years ago, we posted a guide to identifying the most common diseases affecting cold-climate grapes. From the home page, click on "Grapes," then "Disease Management," then "Photo Guide to Disease Management of Cold Climate Grapes." Former graduate student David Jones took hundreds of photos to document disease development on 11 different cultivars throughout the growing season, and the online guide includes a small subset of those photos.

Disease symptoms can look different on different varieties and throughout the growing season. Most existing extension literature is based on *Vitis vinifera*, but we have noted that disease symptoms on some cold-hardy hybrids look different from "textbook" symptoms. This is especially true for downy mildew, and I know firsthand that some growers have confused late-season downy mildew with anthracnose and black rot. Powdery mildew on leaves is common, but do you know what it looks like on shoots, rachises, and berries? Do you know what Rupestris speckle looks like or which cold climate varieties get it? Check out the photo guide for answers to these questions and other hints on identifying diseases in the field.

Tree Fruits

Chlorpyrifos update

By: Christelle Guédot, UW-Madison



Chlorpyrifos, the active ingredient in Lorsban (Dow/DuPont) and other products, is an organophosphate (IRAC group 1B) that has been under scrutiny in recent years by EPA. Lorsban is registered on many crops, including cranberry, grape, strawberry, and tree fruits. In grape, a single application is allowed per season. In cranberry and strawberry, two applications per season, and in sour cherry, eight applications per season are allowed. In apple, Lorsban is limited to one application per season either as a foliar or trunk spray. Foliar sprays usually target San Jose scale, beetles (including borers and plum curculio), rosy apple aphid, lepidopteran and plant bugs while trunk sprays are applied to the lower 4 ft. of the tree to manage trunk borers, such as dogwood borer.

In 2017 along with other states, we provided feedback to EPA for continuing the registration of chlorpyrifos on fruit crops in Wisconsin and EPA maintained all tolerances for this active ingredient at that time.

This month, California and New York both announced that they were canceling the registration of chlorpyrifos. In New York, legislators approved Senate and Assembly bills to ban chlorpyrifos in NY beginning in 2021 (Peter Jentsch, Cornell University, Scaffolds Vol 28, No. 8 May 13, 2019). While this legislation still requires the approval of the NY governor to put the new law into effect, it would ban all use of chlorpyrifos except for on apple tree trunks by Jan. 1, 2021, and would completely ban chlorpyrifos by December 2021. Hawaii was the first state to ban chlorpyrifos in 2018 with an effective date of 2022. Oregon, Connecticut and New Jersey all have bills on the table to ban chlorpyrifos.

Chlorpyrifos is fully registered in Wisconsin and we have not heard anything from our legislators on plans to ban chlorpyrifos in Wisconsin anytime soon. Stay tuned for more information on the registration status of chlorpyrifos.

Happy growing season!

Apple thinning update

By: Amaya Atucha, UW-Madison Department Horticulture

After a really cool spring, and a lot of waiting, the thinning time has arrived. There are a couple of new resources for those of you using the NEWA carbohydrate model. There is an update version of the model which

appears in the same menu as the first version under the name of "Apple CHO Thinning v2019". This new version allows you to include the percentage of flowering spurs as another piece of information that will provide more precise thinning recommendations for a particular block. This is a great addition, specially this year because of the highly variable blossom density we are seeing. In addition to the updated version of the carbohydrate model in NEWA, there is also the MaluSim app, which I wrote about in a previous article, but I want to share with you a blog post (Malusim-step by step) and YouTube video(Using MaluSim in the orchard) by Jon Clements from UMass explaining step by step how to use the new Malusim app available for thinning.

I have summarized some of the recommendation for thinning Gala and Honeycrisp developed by researchers at Cornell University, which can be useful to plan your spray programs:

Spray and Timing Options for Precision Thinning of MATURE Gala:	
1) Apply a Bloom Spray NAA (4oz/100 gal TRV dilute basis - see below for TRV)	THIS STEP CAN BE SKIPPED IF YOU DON'T WANT TO THIN DURING BLOOM
2) Apply a Petal Fall Spray (5mm) NAA (3oz/100 gal TRV dilute basis) +Sevin (1pt/100 gal TRV dilute basis) Or Maxcel (64oz/100 gal TRV dilute basis) +Sevin (1pt/100 gal TRV dilute basis)	
3) Apply a 12 mm Spray Maxcel (64oz/100 gal TRV dilute basis) +Sevin (1pt/100 gal TRV dilute basis)	
4) Apply an 18 mm spray (if needed) Maxcel (64oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis) + Oil (1pt/100gal water) **don't concentrate oil** (directed to the upper part of the tree)	
Spray and Timing Options for Precision Thinning of MATURE Honeycrisp:	
Apply a Bloom Spray NAA (4oz/100 gal TRV dilute basis - see below for TRV)	THIS STEP CAN BE SKIPPED IF YOU DON'T WANT TO THIN DURING BLOOM
Apply a Petal Fall Spray (5mm) NAA (3oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)	
Apply a 12 mm Spray NAA (3oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)	
Apply an 18 mm spray (if needed) Sevin (1pt/100= gal TRV dilute basis) + Oil (1pt/100gal water) **don't concentrate oil** (directed to the upper part of the tree)	

*TRV = Tree row volume. Here's a link to an excellent resource from the Cornell Cooperative Extension on **Spray Mixing Instructions Considering Tree Row Volume – TRV.**

Door County Fruit Pest Reports for June 4

By: Annie Deutsch, Agriculture Educator, Extension Door County

Apples are at king bloom to full bloom and cherries are at petal fall. On average, grapes have 2-3" shoots and the first leaves separating from shoot tips.

Weather the last week has been all over the board. At the Sturgeon Bay Enviroweather station, temperatures reached a high of 86ºF on May 31, and two days later, reached a low of 32ºF.

For apples and tart cherries at full bloom, critical temperatures for **10% flower bud kill are at 28ºF** or **90% flower bud kill are at 25ºF.** Click the link below for more information on tree fruit crop bud cold temperature injury.

Tree Fruit – Critical Temperatures

Below is a degree day comparison of the last five years. We are still about a week behind average.

Date 6/3	2015	2016	2017	2018	**2019**	5 yr avg
Base 50	254	279	196	351	**145**	261

INSECT & DISEASE CONTROL

APPLE

Disease Pressure – Apple scab infection periods continue to occur at all the stations. With temperatures in the mid-50s to 60s, there will be an infection period if leaves are wet for 9- 11 hours. Apple scab spray programs should be ongoing to protect apple scab susceptible varieties through the end of primary scab season; typically, mid to end of June in Northeast WI (it likely will be a bit later this year).

Apples are susceptible to fire blight if blossoms are open and temperatures are over 60ºF. Any wetting (rain, fog or dew) can then trigger an infection. Protectant applications of a bactericide should be made every 4-5 days during the bloom period.

Insect Pressure – Do NOT use insecticides during bloom that harm pollinators. A light spotted tentiform leafminer is continuing, but no other insects were caught last week (coding moth, plum curculio, green fruitworm, or obliqubanded leafroller). Continue to scout for green fruitworm and obliquebanded leafroller damage through petal fall as there has been some light blossom feeding being observed.
Plum curculio emergence is determined by moisture and temperature. We have had enough rain this year, so temperature is likely the limiting factor. We could expect to see plum curculio emerge if 1) average temperatures between 55 and 60ºF for three to four days, 2) average temperatures above 60 F for three days, and 3) maximum temperatures of 75ºF for two consecutive days. Keep in mind that these are average temperatures, not highs, so we are likely behind normal emergence.

At full bloom, consider crop load and use flower and fruit thinners as needed. There has been substantial information about precision thinning tools in the Wisconsin Fruit News which can be found here: https://fruit.wisc.edu/crop-management-newsletters/

CHERRY

Disease Pressure – – Cherries are now susceptible to cherry leaf spot, so fungicide programs should be ongoing. The risk for European Brown Rot has decreased with warmer temperatures, but could be an issue if trees are in full bloom and we get more cool, wet weather.

Insect Pressure – So far there haven't been any plum curculio adults or spotted wing drosophila flies caught in traps. Continue to scout for green fruitworm and obliquebanded leafroller damage through petal fall. Michigan State University recently published an article, "**Low spray programs for tart cherry**." Just make sure to check that any product you use is registered for Wisconsin.

GRAPE

Mark your calendar for July 18, 3-5pm, for the 2019 Vineyard Walk at the Peninsular Ag Research Station!

Disease Pressure – Fungicide applications can begin around 4" – 6" growth

Insect Pressure – Buds that haven't burst could still be susceptible to grape flea beetle damage. Numbers at the Peninsular Station were very low.

Calendar of Events

June 7 –UW Extension Vineyard Walk
Sunset Orchard
Richland Center, WI 53581.
Featuring UW–Extension specialist Christelle Guedot

June 11 – WGGA Vineyard Walk
Whistler's Knoll
Hortonville, WI 54944
https://www.wigrapes.org/

July 11 – WAGA and UW Extension Apple Summer Field Day
Bushel & a Peck Market
Chippewa Falls, WI
https://www.waga.org/

July 18 – WGGA and UW Extension Vineyard Walk

Peninsular Agriculture Research Station
4312 Hwy 42 North
Sturgeon Bay, WI 54235
hosted by Annie Deutsch, Door County Ag Agent with a discussion on disease management with Professor Patty McManus, UW-Extension Fruit Crops Specialist

August 14 – Cranberry Summer Field Day

Dubey Cranberry
Junction City, WI

August 19-21 – NACREW conference

Vancouver, BC, Canada

Useful Links:

Wisconsin Fruit Website: https://fruit.wisc.edu/

You can purchase ($10) the 2019 Midwest Fruit Pest Management Guide:
https://ag.purdue.edu/hla/hort/documents/id- 465.pdf

Insect Diagnostics Lab: http://labs.russell.wisc.edu/insectlab/

Plant Disease Clinic: http://labs.russell.wisc.edu/pddc/

Soil and Forage Analysis Lab: https://uwlab.soils.wisc.edu/

Weed Identification Tool: http://weedid.wisc.edu/weedid.php

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