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General Information

Soil-borne diseases of fruit crops: Introduction

By: Sara Thomas-Sharma and Patricia McManus

The soil is a major source of plant pathogens – fungi, nematodes, and bacteria – that cause a variety of diseases in fruit crops (Fig. 1, following page). Soil-borne diseases can also be 'disease complexes', caused by a combination of pathogens and specific soil conditions, and some soil-borne pathogens such as nematodes can additionally vector viruses. Soil-borne pathogens often have:

- A wide host range, infecting multiple crops
- Ability to survive as non-pathogens in organic debris
- Hardy survival structures (in the soil or on the plant) that can withstand temperature differences, dry conditions, and long periods without a plant host.
- A preference for specific soil/water conditions (e.g., nematodes prefer sandy soils and Phytophthora prefers waterlogged soils).

Symptoms associated with soil-borne diseases can be aboveground and/or belowground. Aboveground symptoms (Fig. 1 A, B) such as wilting, stunting, and yellowing are more readily observed, and call attention to an underlying problem. On the other hand, it is only when infected plants are uprooted (Fig. 1 C, D), that belowground symptoms such as root/crown rot, discoloration of vascular system, etc. can be observed.

Where do they come from?

Soil-borne pathogens are naturally present in the soil. The history of the site (crop/woodland previously present) and soil characteristics (sandy, water logged) can predispose the field to specific pathogens. New pathogens can be introduced into a field through infested field equipment, irrigation water, and soil on nursery plants.

Where do they survive?

Soil-borne pathogens are usually found in the top 10" of the soil, where host plant roots and organic debris are abundant. They are often aggregated in a field, especially around susceptible crops. Some pathogens, such as Phytophthora, may also be present in irrigation ponds.

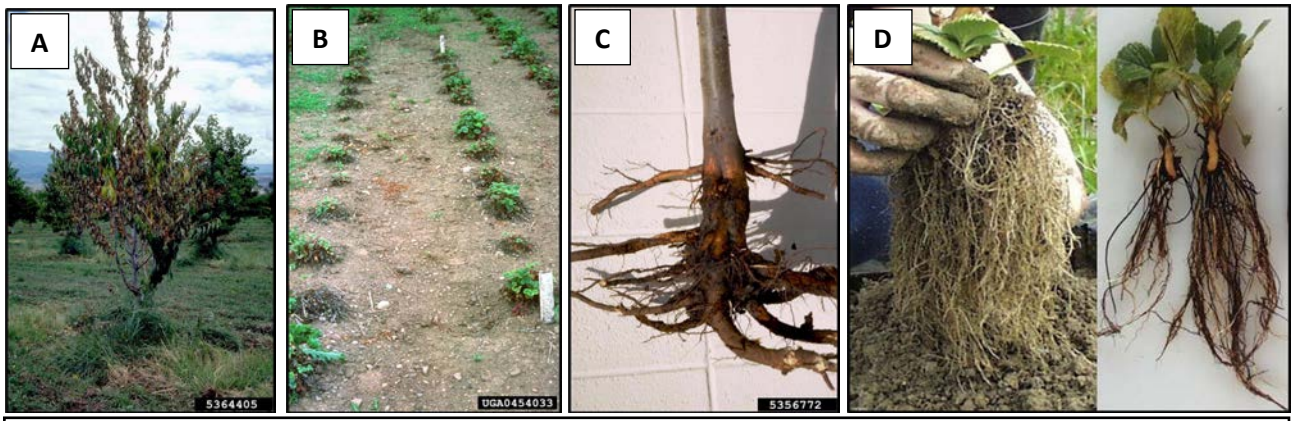


Fig. 1. Some examples of soil-borne diseases of fruit crops. (A) Verticillium wilt of sweet cherry (photo: H.J. Larsen, Bugwood.org), (B) Red stele root rot of strawberry (photo: SCRI-Dundee Archive, Scottish Crop Research Institute, Bugwood.org), (C) Phytophthora crown and root rot on a young apple tree (photo: William M. Brown Jr., Bugwood.org), and (D) Black root rot of strawberry (photo: ces.ncsu.edu).

Management recommendations

In general, reducing plant stress and maintaining healthy nutrition of the plant can prevent or minimize many diseases. For soil-borne pathogens,

- Preventing pathogens from entering the field is key to management. Since the movement of infested equipment, soil, and water, can cause long-distance spread of soil-borne pathogens, minimizing this movement from sites with known infestation is critical.
- An integrated approach is usually necessary to manage diseases since there are few highly effective chemical control options for soil-borne diseases.
- Pre-plant soil fumigation is sometimes recommended for management of certain soil-borne diseases. This method however, does not differentiate between organisms in the soil and often the bad organisms tend to rebound more quickly than good ones.

Management of soil-borne diseases is specific to the pathogen. Therefore, identification of cause(s) of the problem is the first step for successful management. In the next newsletter, we describe some soil-borne pathogens commonly found in fruit crops.

IPM: Monitoring pest populations and action thresholds

By: Christelle Guédot, Fruit Crop Entomology UW-Madison

Proper identification and detection of insect pests is the basis of deciding when to apply a pest management tactic. It is essential to the basic principle of IPM to take action against a pest only when 1) the pest is known to be present and 2) the pest is at a level that may cause economic damage.

Fig 1. Codling moth pheromone trap

Monitoring pest populations is important to determine the onset of the pest in the crop being protected, seasonal patterns of the pest population, movement of the pest in the crop, life stage of the pest, abundance and distribution of the pest in the crop, and finally to assess the effectiveness of management tactics. Different methods can be used to monitor populations, including direct in situ counts (i.e. Japanese beetle); soil extraction (i.e. weevil

larvae); beat trays (psyllids); sweep nets (i.e. cranberry fruitworm larvae); pitfall traps (i.e. ground-dwelling beetles); attractive traps for flying insects using pheromone (i.e. codling moth; Fig 1); feeding attractants (i.e. spotted wing drosophila); visual cues (i.e. apple maggot; Fig 2); lights (many nocturnal flying insects), among others. For some insects, it is sometimes best to monitor for the characteristic damage symptoms, for example with plum curculio and its crescent-shaped oviposition scars (Fig 3).

Fig 3. Plum curculio oviposition scar

Fig 2. Apple maggot red sticky sphere

It is also important to monitor temperature to record daily low and daily high temperatures to determine heat accumulation in the form of degree days. Insects being cold blooded, their development is tightly linked to the ambient temperature, thus it is more appropriate to rely on degree days than calendar dates for tracking insect development. For numerous pest species, degree day models based on temperature have been established and help predict phenological stages of the pest of concern. For example, using temperature data from the NEWA weather station at the West Madison Agricultural Research Station (see previous issue for more detail on how to access and use the NEWA information), we are able to make informed decisions on when to apply a management strategy for specific life stages of the specific pest.

Once the pest of concern has been identified and is being monitored, population densities can be assessed and used to determine when a chemical control strategy should be applied. Economic thresholds also known as action thresholds are available for many insect pest species and are based on the economic-injury level (EIL) concept. The EIL is defined as the lowest number of insects that will cause economic damage. The economic threshold is the density of pest population at which a management practice should be implemented to prevent the population from reaching the economic injury level. It is important to remember that in many cases, plants can tolerate some injury without incurring a significant reduction in yield. A lot of research goes into establishing EILs and economic thresholds for specific pest species and EILs can be dynamic as they take into account market value of the commodity, management costs, environmental conditions, and changes in plant susceptibility (e.g. new cultivars that are more or less susceptible). An action threshold is an important decision rule that is used for managing numerous insect pest species. For example, the action threshold for apple maggot monitored with red sticky spheres is one fly per week on unbaited spheres or five flies per week on spheres baited with a chemical lure. In some cases, the pest is too detrimental and no threshold is established, e.g. spotted wing drosophila, and once the pest is detected, management strategies need to be implemented.

In practicing IPM, we thrive to know the biology of the pest of concern, how to identify and monitor for the pest, calculate degree days, and apply chemical control when the most susceptible phenological stage of the pest is present and we reach the established economic threshold.

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

By: Brian Hudelson, Sean Toporek, and Ann Joy

The PDDC receives samples of many plant and soil samples from around the state. There have been no reports of fruit diseases turned in to the PDDC from May 6, 2017 through May 19, 2017.

For additional information on plant diseases and their control, visit the PDDC website at pddc.wisc.edu.

UW-Madison/Extension Insect Diagnostic Lab update

By: PJ Liesch

There is a lot of insect activity to report coming into the Insect Diagnostic Lab over the past two weeks. Many fruit insects are active or will be in the near future. Watch out of the following:

Caterpillars have been quite active lately. Reports of species capable of damaging fruit trees have been noted in the state, including **oblique-banded leafroller**, **green fruitworms**, and **Eastern tent caterpillars**.

Eastern tent caterpillar in a ginger gold apple tree at the West Madison Agricultural Research Station. Photo by Janet van Zoeren.

Green Pug Caterpillars. A caterpillar sample from Door county has been tentatively identified as the "Green Pug". These insects are originally native to Europe (arrived in New England in 1970) and have a broad host range, including fruit trees. Early season damage can appear similar to other leafroller caterpillars. An important clue lies in the anatomy of these insects: green pug caterpillars only have two pairs of abdominal prolegs and walk in an inchworm-like manner. Most other caterpillars have 4-5 sets of abdominal prolegs when viewed under magnification. Caterpillars of this species also tend to have a reddish stripe running down the middle of their back. I'm currently attempting to rear out adults at the UW Insect Diagnostic Lab to get a definitive species ID. Luckily there's only one generation of these insects per year and damage should just about be done for the season.

Pearleaf Blister Mite. Several pear samples from backyard fruit trees have come in to the UW Insect Diagnostic Lab recently with reddish, scab-like patches on the leaves caused by the pearleaf blister mite. Once these reddish patches have begun forming for the year, curative control is difficult. In places where a history of these mites occurs, chemical controls are most effective when used to target overwintering mites on twigs and branches in the fall or early spring. Luckily, damage seems to be cosmetic in most cases.

Rose Chafer. No cases of the rose chafer have come in to the UW Insect Diagnostic Lab yet this year, but we're quickly approaching peak season for those insects. Rose chafers are associated with parts of the state having sandy soils and can feed on a variety of landscape plants and fruit crops ranging from tree fruits to grapes. Growers with a history of this insect pest should be on alert in the next few weeks.

White Grubs. of the Japanese beetle have been submitted recently from a number of areas of the state, including a strawberry farm in south central Wisconsin. These grubs are most problematic in turfgrass areas, but occasionally are present in strawberry fields. Larger plants can tolerate some damage and the risk of damage is highest in fields where new plants are being established. Adult Japanese beetles have not been spotted yet for the year and likely won't start emerging in force for another 4-5 weeks.

Spotted wing drosophila forecast for 2017

By: Christelle Guédot, Fruit Crop Entomology UW-Madison

Spotted wing drosophila (SWD) was detected in Michigan organic blueberry during the first week of May this year. This is the earliest detection in the upper Midwest on record. This follows the second earliest detection last year of June 6th, 2016 in Door County. We are monitoring for SWD both in Dane and Door counties and we will keep you informed when we first detect SWD in our traps in Wisconsin. Berry growers are advised to set out monitoring traps at this time. Strawberry is susceptible to SWD and if SWD populations begin to coincide with strawberry ripening and harvest, growers should be prepared to implement management strategies. You can find general management recommendations for SWD in strawberry, including how to build your own trap and identify SWD. I will provide more updated recommendations for strawberry growers in a following issue if we start catching SWD in our monitoring traps during the strawberry season. The same advice to start monitoring applies to other berry growers, as blueberry, raspberry, and blackberry are highly susceptible to SWD.

Stay tuned and happy growing season!

Strawberry root weevil and Black vine weevil

By: Christelle Guédot, UW – Madison Fruit Crop Entomology and Extension

Common Names: Strawberry root weevil and black vine weevil
Order: Coleoptera
Family: Curculionidae
Scientific Name: *Otiorhynchus ovatus* and *Otiorhynchus sulcatus*

Fig 1. Strawberry root weevil. BugGuide. Photo credit: Harvey Schmidt

Fig 2. Black vine weevil. BugGuide. Photo credit: metrioptera

Strawberry root weevil (SRW; Fig 1) and black vine weevil (BVW; Fig 2) can be found in strawberry in Wisconsin. SRW adults are 1/5" long, shiny black to light brown with rows of small pits along their back, and a prominent blunt snout (Fig 1). BVW adults are larger than SRW, a little less than ½" long, dull black with yellow small flecks on the back (Fig 2).

Larvae of both weevils are quite similar: they are C-shaped cream-colored legless grubs with a brown head, about 12 mm long. BVW is native to Europe and was first introduced to the US in the early 1900s. In both species, the adults cannot fly; they walk or get carried on plant material or equipment from one location to another. Adults feed at night and remain in the soil or leaf litter at the base of the plant during the day and climb up to feed on leaves at night. BVW adults are polyphagous and feed on over 150 plants.

Another insect feeding on roots is the strawberry rootworm, which was discussed last summer in Wisconsin Fruit News Issue 10. Please, refer to that article for identification, damage symptoms, and management recommendations.

Life Cycle

Adult females lay eggs in the soil where larvae develop, feeding on plant roots. BVW adults feed for 21-28 days on foliage prior to producing eggs. Interestingly, all adults are females that are capable of laying eggs through parthenogenesis (asexual reproduction). Females lay eggs in clusters of ~30 eggs in or on the soil from June to September. As soon as the eggs hatch after 10-14 days, larvae (Fig 3) wiggle down into the soil and start feeding on roots. Larvae will then overwinter

in the soil. From April to June, larvae pupate, and adult begin to emerge. Adults move slowly and should not be confused with swifter predacious ground beetles. There is only one generation per year of each species.

Fig 3. Strawberry root weevil larva. Oregon State University © Ken Gray Insect Image Collection.

Fig 4. Strawberry root weevil damage to roots. Oregon State University © Ken Gray Insect Image Collection.

Fig 5. Strawberry root weevil damage to leaves. Oregon State University © Ken Gray Insect Image Collection.

Damage

The main damage is caused primarily by the larvae feeding on the root system (Fig 4) in early spring. Damaged plants are weakened, stunted, more susceptible to winter injury and diseases, and may see a decrease in yield. Severe infestation may cause the plants to die. While adult weevils chew characteristic notches from the edges of leaves (Fig 5), their feeding is usually minor and does not result in economic loss.

Monitoring

Look at plantings in the spring for smaller, less vigorous plants and examine the roots for grub presence. In early summer, when adults begin to emerge, inspect leaves for leaf notching from adult feeding, especially on sucker growth near the ground. The presence of adults on top of foliage can be confirmed after dark on warm calm nights using a flashlight. You can also look for adults in plant debris at the base of the plant during the day. Laying a small piece of cardboard next to strawberry plants provides a refuge that can be checked easily in the early morning for the presence of adults. In the fall, you can look for areas with weak growth that redden prematurely. Although an old threshold, for BVW, between 2-8 larvae per strawberry plant (20x20cm soil sample including damaged plants) was determined to cause economic damage. If grubs are found in the spring, insecticides should be applied after harvest, when adult weevils emerge and start feeding but before egg laying occurs.

Biological control

Nematodes, such as *Heterorhabditis* spp. and *Steinernema* spp., may provide some control of weevil larvae when applied as a drench (following label directions) in the root zone where grubs are present.

Cultural control

Cultivation of the soil in early spring before planting can eliminate overwintering larvae. Cereal cover crops can be planted in rotation, as small grains are not hosts for root weevils.

Chemical control

If the use of an insecticide is warranted, for optimal control it is best to spray at night, between dusk and midnight, on warm, calm evenings when adult weevils are the most active feeding on foliage. For BVW, because adults require foliage feeding for 3-4 weeks before laying eggs, the first foliar application targeting adults should be made three weeks after detection of the first adult. Adults do not all emerge at the same time, thus a second foliar spray should be applied three weeks after the first one.

A list of available insecticides to control weevils in strawberry is provided in the following table. This is not an exhaustive list of insecticides. For other fruit crops, be sure to read the label to make sure they are registered for that specific crop in Wisconsin. There are many other tradenames available, and we do not recommend these that are listed

above other options. All product recommendations can be found in the 2017 Midwest Fruit Pest Management Guide. Additionally, you should always fully read and follow the label before spraying any pesticide.

Class (IRAC code)	Trade name	Active ingredient	PHI* (days)	Effectiveness
Neonicotinoids (4A)	Platinum	thiamethoxam	50	Good on grubs and adults
	Admire Pro	Imidacloprid	14	Excellent on grubs
Organophosphate (1B)	Lorsban	Chlorpyrifos	21**	Good on grubs and adults

***Pre-Harvest Interval (PHI)**
****Restrictions vary, check the label for details.**

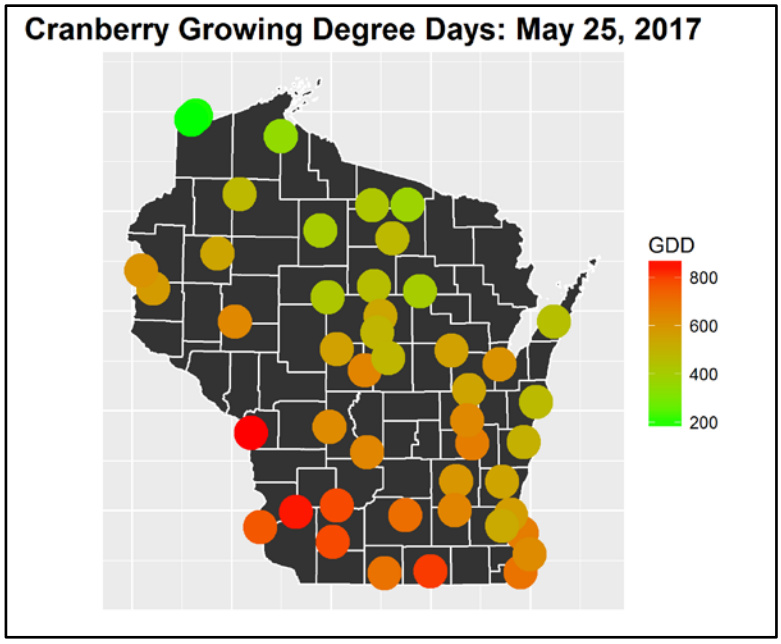
Cranberries

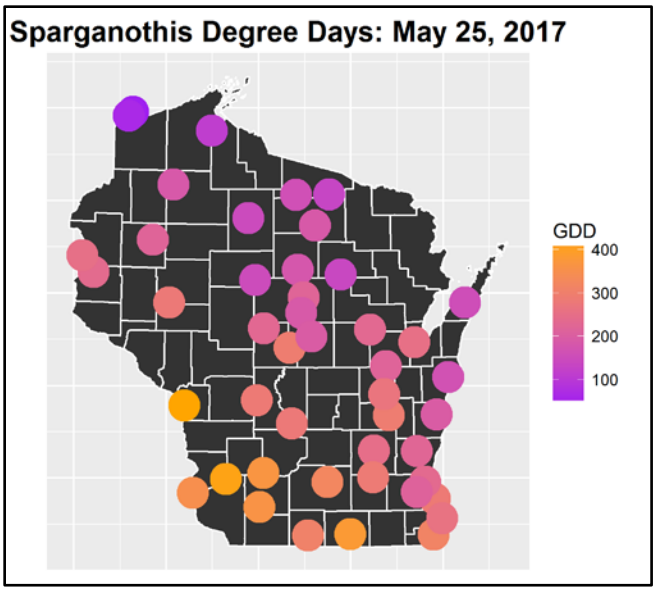
Cranberry plant and pest degree-days: May 25, 2017

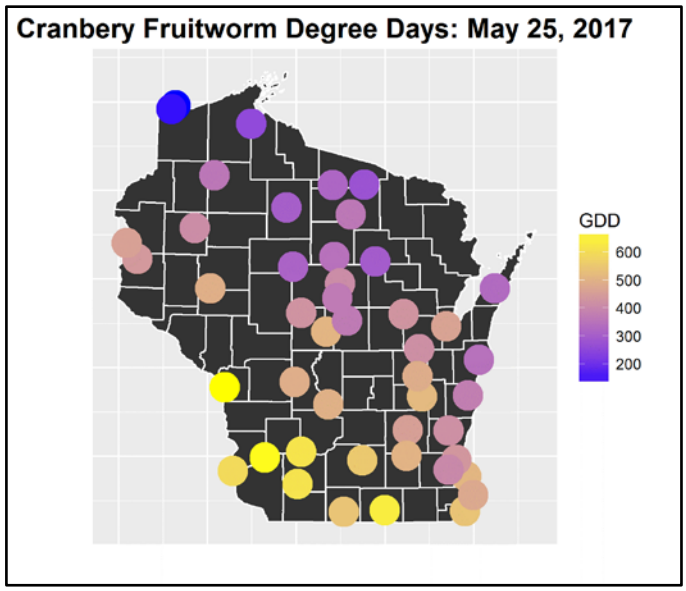
By: Elissa Chasen and Shawn Steffan, USDA-ARS and UW Entomology

The maps below show how spring is progressing across Wisconsin. Developmental thresholds for each are: cranberry plant - 41 and 85°F; sparganothis fruitworm - 50 and 86°F; and cranberry fruitworm - 44 and 87°F.

Interactive maps are posted online. The interactive feature allows you to click on the map locations, prompting a pop-up that names the location and gives exact degree-days. These are available through the Steffan lab website (http://labs.russell.wisc.edu/steffan/cranberry-growing-degree-days/). Once on the website, follow the link to the interactive maps.







The table below allows for comparison of degree-days over the last three years. This spring is just a little slower to develop than the previous couple of years, and this difference is more pronounced in the northern cranberry growing areas than the southern cranberry growing areas. This should delay the first flight of each of the major moth pests, as well as the development of the plant in relation to the last couple of years by anywhere from a couple of days to a little over a week. Sparganothis flight should begin around 600 Sparg DDs and observations from last year show that CFW flight should begin around 960 CFW DDs.

May 25	Cranberry DDs			Sparg DDs			CFW DDs		
	2015	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Northern WI (Minocqua)	558.6	538.8	423.9	257	248.2	160.5	441.9	424.1	317.5
Central WI (Wisconsin Rapids)	781.5	702.3	650.4	400.5	340.7	294.3	638.3	559	513.2

Grapes

Controlling vine vigor by shoot thinning

By: Amaya Atucha, UW-Extension fruit Crop State Specialist

Cold climate hybrids are intrinsically high vigor cultivars, which added to Wisconsin's fertile soils and high rainfall during spring, intensifies the vine's natural vigor resulting in high-density canopies that can favor higher disease pressure and low quality fruit. Shoot thinning is probably the first canopy management technique that we can apply during the growing season to control some of this vigor and allow a better airflow and light exposure of the canopy. In addition, shoot thinning can also be used to adjust fruit load (by removing shoot that otherwise would carry clusters). In our research vineyards at West Madison Agriculture Station (WMARS) we have noticed that by reducing the number of shoots we carry in some less vigorous cultivars (i.e., Marechal Foch, Petite Pearl) we have been able to achieve higher yields and have shoots of better quality for next year's production. When we keep too many shoots in less vigorous cultivars we end up with poor shoot growth and fruit that takes much longer to ripe. On the contrary, on very vigorous cultivars such as Marquette, we aim for a higher density of shoots per foot of trellis, so that the fruit can help "calm down" the vine and control the production of lateral shoots.

The best timing for shoot thinning is pre-bloom when shoots are 5 to 10 inches long. At this stage, the shoots can easily be removed by snapping them from the base; if you wait longer you will need pruners to remove them from the cordon, and shoots will develop tendrils and will get attached to the trellis or other shoots, making it very difficult to access the canopy. In addition, it is much easier to make the decision of which shoots to remove when the shoots are shorter and you can visualize how the shoots are distributed along the cordon. Shoots growing from non-spur positions or from the trunk can be removed at this time, except if they will be used to renew a spur or a cordon. When thinning it is important to keep in mid the spur position, and avoid removing all the basal shoots because these basal shoots will allow us to keep spur relatively short, specially in VSP systems (Figure 1).

The general rule is to achieve an average density of 5 to 6 shoots per foot of canopy for VSP, high cordon training system can accommodate more shoots. Based on our research observations at WMARS, we recommend a density of 5 to 6 shoots per foot of canopy for less vigorous cultivars, such as Marechal Foch, 6 to 7 shoots per foot canopy for Frontenac and La Crescent, and 7-9 for Marquette. This is a general recommendation for mature vines, and you will have to adjust it depending on the specific conditions of your vineyard.

Figure 1. Before (left) and after (right) shoot thinning. The picture on the left shows a spur of a vine trained in VSP with 4 shoots, when ideally, we would only have 2 shoots per spur in a VSP training. Shoot # 4 is a good, healthy, and fruitful shoot that we would normally leave. However, if we keep shoot #4, during next year's pruning the spur will "creep" further away from the cordon. It is important to keep these in consideration so that we do not end up with very long spurs. Shoot #1 was also removed, because it was a basal shoot that was not carrying an inflorescence.

Wine and Table Grape Developmental Stages

By: Janet van Zoeren, Annie Deutsch, Jean Riesterer-loper and Amaya Atucha, UW-Extension

At the West Madison Agricultural Research Station (WMARS) shoots are continuing to develop, ranging from stage E-L* developmental number 11 ("four leaves separated") to 13 ("six leaves separated"). At the Peninsular Agricultural Research Station (PARS), vines are 2 weeks behind WMARS, and vines are between E-L* developmental number 3 (wooly bud) to 4 (budburst).

At PARS, work in the vineyard this time of year should include scouting for flea beetle and cutworm and finishing winter pruning. At WMARS, it's time for shoot thinning. You can read more about the benefits of shoot thinning in the preceding article.

* *Eichhorn-Lorenz Phenological stages to describe grapevine development*

Following photos taken on May 22nd at West Madison Agricultural Research Station.

Brianna at WMARS; "Inflorescence clear" E-L number = 12

La Crescent at WMARS; "six leaves separated" E-L number = 13

La Crosse at WMARS; "four leaves separated" E-L number = 11

Marquette at WMARS; "four leaves separated" E-L number = 11

Frontenac at WMARS; "Inflorescence clear" E-L number = 12

St. Croix at WMARS; "four leaves separated" E-L number = 11

Somerset at WMARS; "six leaves seperated"
E-L number = 13

Einset at WMARS; "four leaves separated"
E-L number = 11

Following photos taken on April 24th at the Peninsular Agricultural Research Station.

Brianna at PARS; "wooly bud" E-L number = 3

La Crescent at PARS; "budburst" E-L number = 4

La Crosse at PARS; "budburst" E-L number = 4

Marquette at PARS; "budburst" E-L number = 4

Frontenac at PARS; "budburst" E-L number = 4

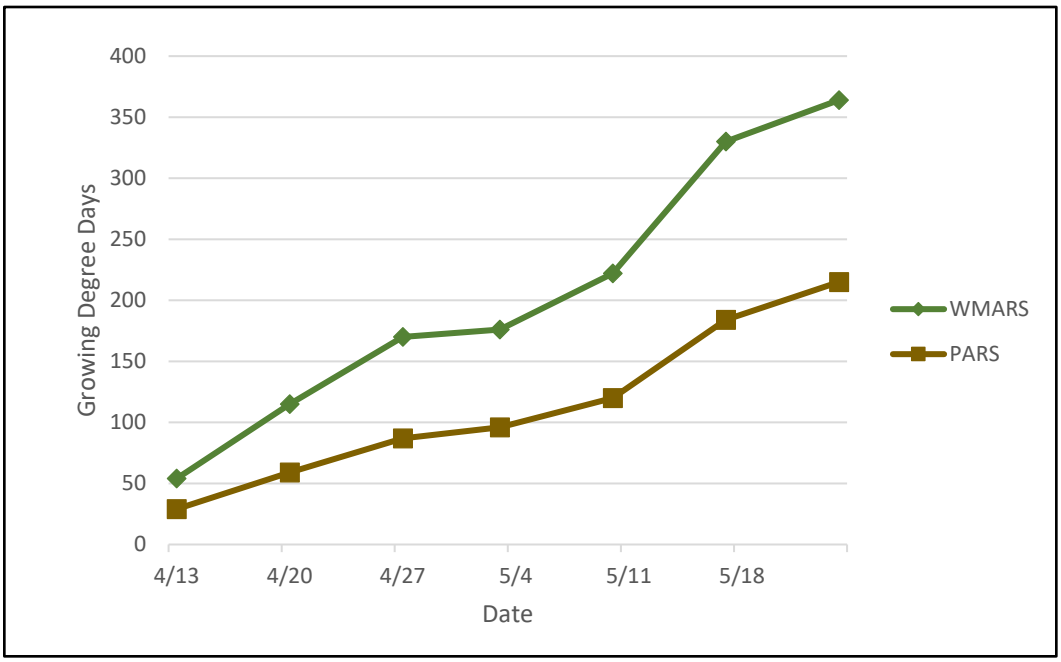
St Croix at PARS; "budburst" E-L number = 4

The growing degree day accumulations as of May 24th for this year are: 364 GDD at WMARS and 215 GDD at PARS. We are still behind the degree day accumulation from last year. Degree days are calculated using a base of 50°F.

Grape Growing Degree Days

April 1 - May 24, 2017

	2107	2016
WMARS	**364**	418
PARS	**215**	248



Grape insect scouting report – Grape Plume Moth

By: Janet van Zoeren, Annie Deutsch and Christelle Guédot, UW-Extension

Over the past two weeks, grape flea beetles have nearly disappeared from the vineyard at the West Madison Agricultural Research Station, as shoots are elongating and buds are no longer available for flea beetles to feed on. Instead, these past couple weeks the pest that has been most prevalent is the grape plume moth. Although not a pest every year or in every vineyard, this sporadic pest has shown especially high densities at WMARS this season as well as last season. Luckily, grape vines can tolerate quite a bit of grape plume moth damage without showing a decrease in yield. Even on the most damaged vines, where 10-15% of shoots showed signs of plume moth damage, we are still below the threshold recommended by researchers at Cornell (to spray if more than 20% of shoots show damage).

Grape plume moth larvae can be found inside webbed leaves and shoots at the growing tips of vine shoots. If you open up the webbing, you can recognize these caterpillars because they are light green with long white hairs (see image on the left below). We discussed grape plume moth identification, life cycle and management in issue 5 of the newsletter last year. It is interesting to note that damage did not get bad last year until mid-June, several weeks later than what we're seeing this year. If you experience severe infestations this season, Danitol and Pyganic could be applied to control grape plume moth populations.

Larval grape plume moth (at right) and webbing containing a grape plume moth larva (at left). Photos by Matt Kamiyama.

Similarly to trends seen last year, the vines at the Peninsular Agricultural Research Station (PARS) are developing about two weeks behind those at WMARS. This means the vines at PARS are now just right around budburst, which is that optimal time for flea beetles and cutworms to be able to feed on and damage the buds. As expected, we did see a few buds that could have been damaged by flea beetle while scouting at PARS this week. Further information about flea beetle and cutworm monitoring and control can be found in the previous issue of this newsletter.

Damage to a "wooly bud" stage grape bud at PARS, most likely due to flea beetle feeding.

Apple pest update – codling moth flight begins

By: Janet van Zoeren and Christelle Guédot, UW-Extension

Apple growers in Wisconsin have begun finding codling moth (CM) in pheromone-baited traps over the past two weeks.

Figure 1: Adult codling moth. Photo by Benjamin Jaffe.

Life Cycle and Identification

The codling moth overwinters as a last-instar larva, and pupates in early spring around first-pink. First-generation adults are starting to emerge now. Adults are light- to dark-grey, and around 3/8 inch long, with coppery tips (see Fig. 1). Adult flight will last for the next couple months, with eggs being laid singly on or near the developing fruit throughout this time period. Each egg hatches after approximately a week, and the tiny green caterpillars borrow in the fruit and feed near the surface for a short time before moving to the middle of the fruit to feed on the seeds for three to four weeks. At maturity, the caterpillar will be ½ to 5/8 inches long, and will exit the fruit, drop to the ground, and spin a cocoon. Codling moth have up to three generations per year in Wisconsin.

Monitoring and Management

Management for CM can take place either at the adult stage (mating disruption) or at the larval stage (chemical sprays). Mass trapping, an option for adult control currently under development, was discussed in a previous issue of this newsletter. Regardless of the CM control method being used, it is important to monitor for moths in the spring using pheromone-baited sticky traps. The specifics of how to set up those traps depend if you are using mating disruption to control CM in your orchard.

Using larvicides

Larval control is still an important aspect of codling moth IPM, and the effectiveness of a larvicide can be greatly increased by monitoring and using a degree day model to improve spray timing. If you are not using mating disruption this summer, you can monitor populations using a commercially available CM pheromone lure at a rate of one trap per ten acres. Traps ideally should have been set out prior to bloom, at about head height in the tree canopies. It is especially important to check the traps every few days until you find the first "sustained trap catch", or when there is on average at least one moth per trap per week for two consecutive weeks.

That point of first sustained trap catch is used for CM as a "biofix", or as the time when you begin accumulating degree days. First sustained trap catch represents the point at which moth flight begins, and therefore when egg laying begins. Approximately 250-300 degree days after this biofix the majority of the larvae will have hatched, but will not yet be inside an apple, which is the optimal time to spray a larvicide for CM. Degree days can be calculated using your own weather station data (see article explaining degree day calculations in the second issue of this newsletter), or a regional degree day accumulation can be found using the NEWA website and Cornell's CM model.

A list of available insecticides to control CM in apple is provided in the following table. There are many other tradenames available, and we do not recommend these that are listed above other options. All product recommendations can be found in the 2017 Midwest Fruit Pest Management Guide. Additionally, you should always fully read and follow the label before spraying any pesticide.

Class (IRAC code)	Tradename	Active ingredient	PHI (days)	Effectiveness
Physical deterrent (n/a)	Surround **(OMRI organic certified)**	Kaolin clay	0	Fair
Diamides (28)	Exirel **(Reduced risk)**	Cyantraniliprole	3	Excellent
	Altacor **(Reduced risk)**	Chlorantraniliprole	5	Excellent
Spinosyns (5)	Delegate **(Reduced risk)**	Spinetoram	7	Excellent
Benzoylureas (15)	Rimon	Novaluron	14	Excellent
Neonicotinoids (4A)	Assail	Acetamiprid	7	Excellent
Organophosphate (1B)	Imidan	Phosmet	7	Excellent

Using mating disruption

Mating disruption, as a quick refresher, involves permeating the orchard with the codling moth female sex pheromone, which prevents the male moths from being able to key into a specific mating pheromone plume to find the female. This pest control strategy has a couple very strong advantages: there is no residue left on the fruit, and the chemical is safe to non-target organisms. However, mating disruption is not effective in every situation, and is much less effective in small orchard blocks or when moth populations are very high.

In order to make sure the disruption is working in your orchard, monitoring can ensure the males are unable to find the females (or the lures), and can warn you if a spray is still necessary. A total trap catch of over ten CM during this first adult flight indicates the mating disruption is not working, and a back-up insecticide application should be applied. Because of the high prevalence of the mating pheromone, it is recommended to use a stronger lure (5 to 10 mg), to place more traps per acre (2 to 3), and to place the sticky traps higher in the canopy than if you were not using mating disruption.

Calendar of Events

June 1, 2017 – Berry Summer Field Day
Arnold's Strawberries, 343 County Hwy PP, Rudolph, WI

July 11-13, 2017 – Wisconsin Farm Technology Days
Ebert Enterprises, E5083 Co Rd K, Algoma, WI

July 18, 2017 – WAGA Summer Apple Field Days
Green's Pleasant Springs Orchard, 2722 Williams Dr, Stoughton, WI

Aug 3, 2017 – PARS Vineyard Walk
Peninsular Agricultural Research Station, 4312 Hwy 42 North, Sturgeon Bay, WI

Useful Links:

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

You can purchase ($10) the 2016 Midwest Fruit Pest Management Guide from the UW Learning Store: http://learningstore.uwex.edu/Midwest-Fruit-Pest-Management-Guide-2016-P1785.aspx

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

Plant Disease Clinic: https://pddc.wisc.edu/

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

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

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