Assessing Fungicide Resistance in Your Vineyard

Gabriel Torres, UCCE Tulare & Kings Counties

Powdery mildew (PM), is a globally important disease of grapes, which is caused by the fungus *Erisyphe necator*. This fungus only infects living cells and cannot be cultivated on artificial media which makes it difficult to study. It highjacks the plant's cells and diverts their food resources to the fungus. However, if the plant cells die, then the fungus colonizing those cells will also perish, which is why it is considered an "obligate parasite". In this way PM is different from many other fungi which first kill their host, and then feed on the dead material.

Table, wine, and raisin grapes are all vulnerable to PM. Powdery mildew infects all green tissues of the plant, including leaves, unlignified canes, the rachis, and unripe berries. Colonization of the berries can cause a range of damage depending on severity, and colonization of the rachis can inhibit ripening and diminish aesthetic quality of table grapes. Severe powdery mildew infections in berries before veraison can cause cracking and result in severe sour rot infections at maturation. Leaf infections can also lead to a reduction in the photosynthetic capability of the leaves. A PM infection can harm the grapevine and the grapes from a variety of different angles.

Sulfur has long been used to control PM, and it is still the most commonly used fungicide in California vineyards. In 2016 sulfur accounted for 61% of fungicides applied in the state (Figure 1). Copper (another broad spectrum fungicide) is the second most used, accounting for 13%. There are also various synthetic chemical fungicides available for use in California, including the following: myclobutanil (150,109 acres), quinoxyfen (133,192 acres), trifloxystrobin (126,015 acres), tebuconazole (118,240 acres), boscalid (112,279 acres) and pyraclostrobin (111,919 acres).

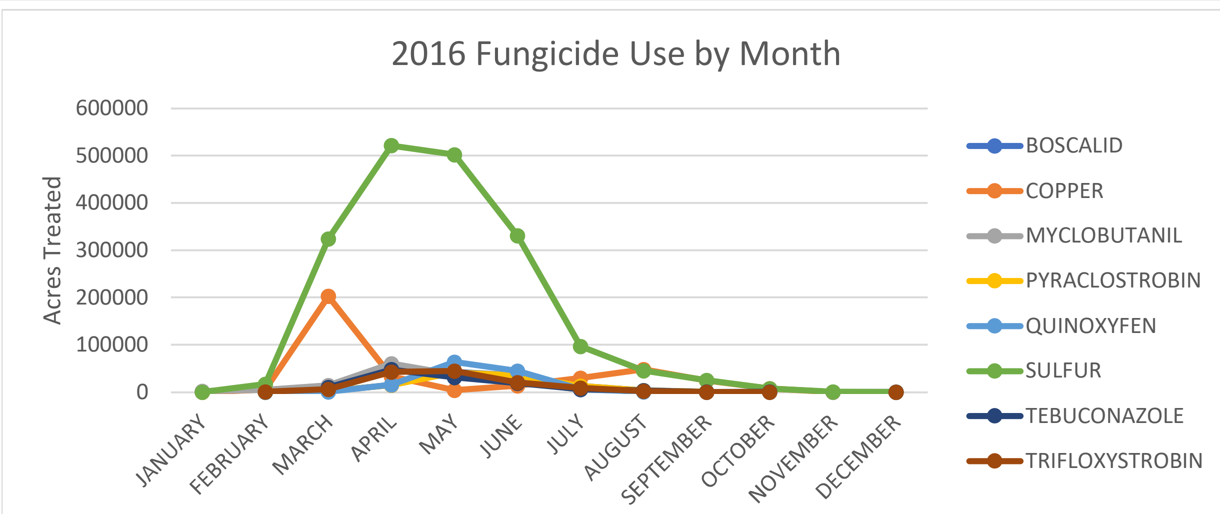


Figure 1. Most used fungicides for grapes in California in 2016 (Data Source: https://www.cdpr.ca.gov/).

When comparing synthetic fungicides to sulfur and copper based fungicides there are a couple major differences. Synthetic chemical fungicides can be more effective and longer lasting than sulfur and copper based fungicides. However, unlike sulfur and copper, synthetic fungicides work by interfering in a specific biochemical pathway. This means that if the PM has a new mutation in that pathway it can enable it to become partially or completely resistant to that fungicide. As this mutation allows the PM to better survive a fungicide treatment, it can quickly spread within a vineyard. Leading to the observable loss of the effectiveness of that fungicide.

This effect becomes compounded as many different synthetic fungicides can all target the same biochemical pathway. This means that a mutation leading to a loss of effectiveness in one fungicide often leads to the loss of effectiveness of many fungicides. This has led the Fungicide Resistance Action Committee (FRAC) to group together fungicides which demonstrate potential for cross resistance. These FRAC groups will be displayed on the label of all fungicides. Among the FRAC groups available for PM, resistance has been reported for FRAC 3, DeMethylation Inhibitors (DMIs); FRAC 7, SuccinateDeHydrogenase Inhibitors (SDHI); FRAC 11, strobilurines; and FRAC 13, azanaphthalenes. The most common and widespread resistance found in grape PM occurs in strobilurines.

In order to reduce fungicide resistance development, growers need to rotate among the different groups. The loss of one group can result in the necessity to use more intensively from the remaining groups. This led to an increased risk of developing resistance in the remaining groups. From 40 PM samples collected in the San Joaquin Valley in 2019, only 5% were sensitive to strobilurins (FRAC 11), meaning 95% had developed resistance. The 2019 data also showed how quickly resistance can spread within a vineyard. Thirteen samples had mixed populations, meaning some individuals within the vineyard had strobilurins resistance and some did not, before veraison. At harvest, all samples from previously mixed vineyards now only had strobilurins resistant powdery mildew. While these results are based on less than 50 samples, it does demonstrate the speed at which resistance can spread.

If you want to understand what PM resistances have developed in your vineyard and help your local UCCE viticulture advisors collect data on PM resistance across the SJV, we are looking for PM samples. In collaboration with the FRAME *Network* (Fungicide Resistance Assessment, Mitigation and Extension), your local UCCE viticulture advisors are evaluating PM samples from the SJV. The 2020 goal is to sample all counties in the SJV to have a better understanding of PM resistance across the Valley.

How can you contribute?

Three samples per year are suggested. The first sample should be collected before any spray against PM has been conducted, to have a baseline of the new growing season population. The second is recommended at bloom to see if resistant PM populations are increasing and implement corrective actions to reduce fungicide resistance at this stage. Finally, at veraison or at harvest to see the final population status and determine what to expect during the next season. Specific fields' results will be confidential and only provided to each grower. Individual results will be used to generate county wide data that will be made available to the public. These results will be used to track the extent and any expansion of fungicide resistance within the San Joaquin Valley and throughout CA.

Sample kits for the 2020 growing season will be free of charge to growers. The only cost associated is that of the sampling, as it needs to be done by each grower. This process is fast and only requires the use of disposable gloves (provided by the grower). With the gloves on, the sampler needs to rub the canopy and cluster zone with the gloves throughout the sampling row. The sampler should make sure to touch areas of the canopy where PM normally develops or has already started to develop. Without removing the glove, the sampler, or another individual, should swab the glove with the provided cotton swab. When done swabbing the glove, the cotton swab should be resealed in the provided container, and the gloves disposed of properly. Collected samples can be shipped directly to the USDA laboratory in Corvallis or sent to the UCCE office in Tulare, Fresno, or Madera.

Thank you for your support, cooperation, and contributions.

UC IPM Fresno/Madera Powdery Mildew Index

The UC IPM is currently redesigning its website to a more mobile friendly version, and Powdery Mildew Index (PMI) has not been updated in the old UC IPM site. Please refer to the new PMI index here: https://www2.ipm.ucanr.edu/weather/grape-powdery-mildew-risk-assessment-index/

Vit Tips Staff

Contributing Authors

Gabriel Torres, UCCE Viticulture Advisor Tulare & Kings Counties

559-684-3316, gabtorres@ucanr.edu

George Zhuang, UCCE Viticulture Advisor Fresno County

559-241-7515, gzhuang@ucanr.edu

Karl Lund, UCCE Viticulture Advisor Madera, Merced & Mariposa Counties

559-675-7879 ext. 7205, ktlund@ucanr.edu

Editors

Matthew Fidelibus, UC Davis Viticultural Extension Specialist Kearney AG Center

559-646-6510, mwfidelibus@ucdavis.edu

Karl Lund, UCCE Viticulture Advisor Madera, Merced & Mariposa Counties

559-675-7879 ext. 7205, ktlund@ucanr.edu

Phylloxera in the San Joaquin Valley

Karl Lund, UCCE Madera, Merced & Mariposa Counties

Grape phylloxera (*Daktulosphaira vitifoliae*) are an aphid-like insect parasite of grapes. During a farm visit in western Madera county during the fall of 2019 I observed phylloxera infesting the root system of own-rooted wine grapes. This is a good reminder that phylloxera are present in the San Joaquin Valley (SJV) and can be damaging. Therefore, it is important to have a basic understanding of Phylloxera, their effects on different types of grapevines, and how to identify them. Phylloxera feeding results in three distinctive signs: galls on the leaves, nodosities on young unlignified roots, and tuberosities on mature lignified roots. These different feeding types have a range of effects on the grapevine host. Different grapevine species also succumb to different feeding types.

The first items to understand about phylloxera is their size and basic reproduction (Image 1). While phylloxera are not microscopic, they are very small. Both phylloxera eggs and crawlers start off bright yellow in color before quickly fading and changing color to a dull orange. This color allows them to blend in with lighter colored roots and soils. Adult phylloxera can get to approximately 1 mm (0.04 inch) in length, while eggs are only 0.3 mm (0.01 inch) in length. The nymph stage, commonly called a crawler, start off the same size as an egg, but after a few molts and a couple weeks grows to their adult size. Between their size and color, it is recommended to use a small 10X to 20X hand lens to properly identify phylloxera. Lightly blowing on (living) phylloxera will cause them to wave their antenna around. This is a great final way to distinguish them from oddly shaped sand particles.

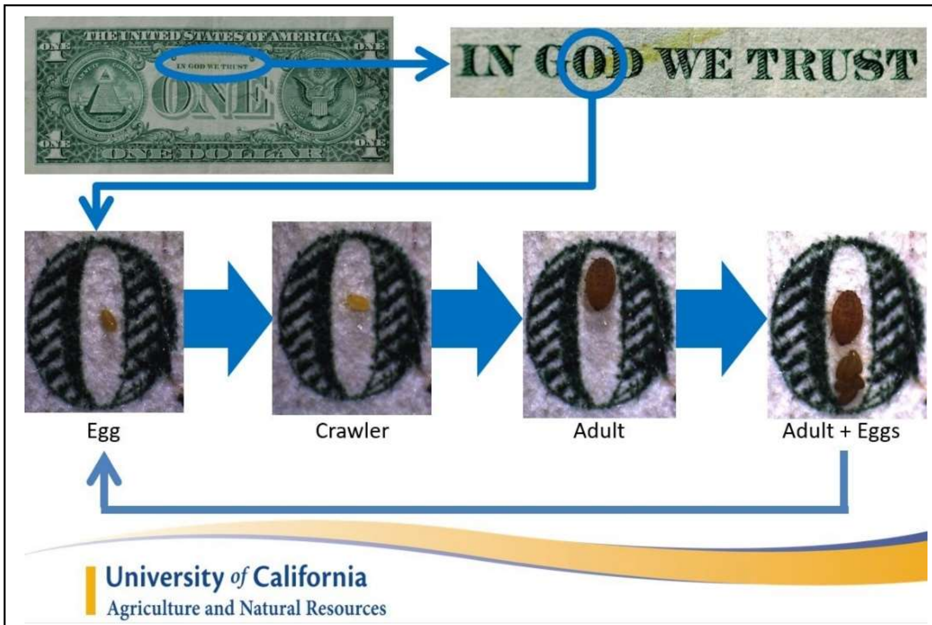


Image 1 Phylloxera reproductive cycle. The stages of the phylloxera reproductive cycle are shown from left to right. Starting off as an egg, that hatches to a nymph commonly called a crawler, which matures into a sedentary adult laying asexual (clonal) eggs. The phylloxera life cycle is placed on a one-dollar bill for size comparison.

Nodosities are the most common sign of phylloxera in California. Phylloxera feeding on young unlignified roots causes the roots to swell and often hook (Image 2). These hook galls can look similar to damage caused by the dagger nematode *Xiphinema index*. Therefore, it is advised to use a small hand lens to try and directly identify the phylloxera. These galls cause the root tip to prematurely die back, but do not affect the remainder of the root system. Unlignified roots are where grapevines uptake most of their water and nutrients from the soil. If phylloxera populations are large enough to drastically reduce the number of unlignified root segments across a whole vine, they can lower the plants ability to uptake water and nutrients, weakening the vine. However, this type of damage would require a very high population of phylloxera. Most grapevines form nodosities, however, there are a few exceptions. *Vitis rotundifolia* as a species appears to have complete resistance to this type of damage and does not form nodosities. Many selections of *V. cinerea* and several selections of *V. berlandieri* also show strong resistance to this type of feeding. When looking at rootstocks, O39-16, and the German rootstock Börner have very strong resistance to this feeding type. The remainder of the common rootstocks allow this feeding type to occur.

Image 2 Phylloxera Nodosities. A variety of phylloxera caused nodosities including: A. a hooked gall with little swelling; B. a swollen gall with no hooking; C. a gall with exaggerated hooking with no swelling; D. a hooked and swollen gall.

Leaf galls are common across phylloxera's native range in the eastern US. With foliar feeding the phylloxera infest young leaves causing the leaf to produce wart-like galls that surround the phylloxera (Image 3). Erineum mite can produce a similar gall that can be misidentified as a phylloxera gall. The easiest way to tell the difference in galls is that phylloxera galls are closed on the underside of the gall, while Erineum mite galls are open on the underside of the gall. A large number of foliar phylloxera galls cause the leaves to deform their shape. This deformation diminishes the leaves' photosynthetic ability, and with a large enough infestation can reduce the photosynthetic capacity of the entire canopy. Much like nodosities, if the population is allowed to get big enough it can affect the vigor of the plant but will not kill it. This type of feeding is found universally on American *Vitis* species (*V. riparia, V. rupestris, V. berlandieri,* etc.), except for *V. rotundifolia* which again appears to have species wide resistance. Leaf galls can occur on *V. vinifera* , but the phylloxera seem to dislike it as a foliar host. During an outbreak at a germplasm repository outside of Davis, foliar galls were observed on pure *V. vinifera* varieties. However, these galls only formed when heavily infested shoots from regular hosts were found directly above the infested leaves. Young leaves directly up the shoot from infested *V. vinifera* leaves also showed no infestation, which is commonly how foliar phylloxera infestations progress. As most rootstocks are hybrids of *V. riparia, V. rupestris,* and *V. berlandieri* they allow leaf feeding to readily occur. O39-16 does appear to be the only common rootstock to have resistance to this feeding type.

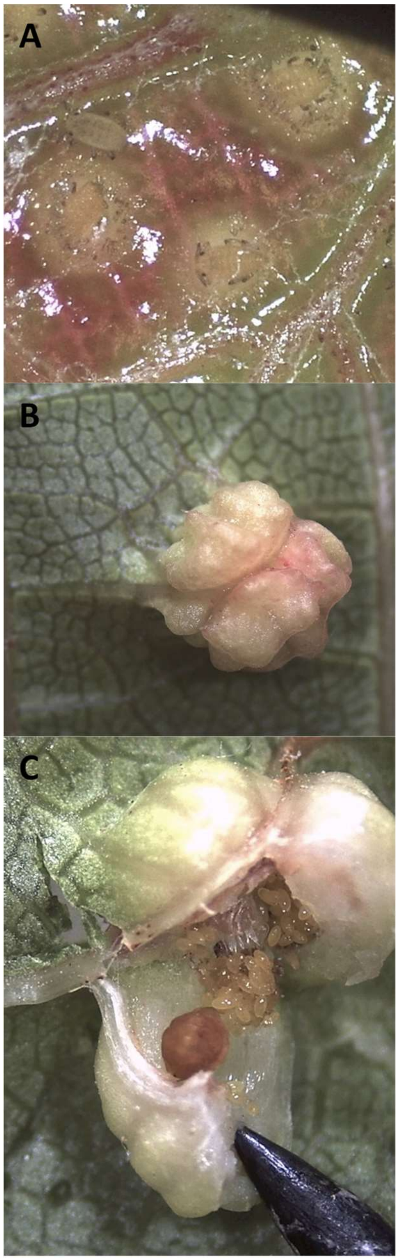


Image 3 Phylloxera Foliar Galls. A series of phylloxera foliar galls going from: A. young crawlers establishing feeding sites on a young leaf; B. a mature phylloxera gall; C. an opened phylloxera gall exposing the feeding adult and her clutch of eggs.

Tuberosity feeding is the most destructive feeding type. In tuberosity feeding the phylloxera infest mature lignified roots. The infestation site swells and cracks (Image 4) allowing for secondary soil fungi to enter the mature root system. These fungi are normally not able to penetrate the lignified root systems, and once inside can cause the roots to start rotting. The infestation site eventually dies off, but not before large numbers of phylloxera eggs have been produced to infect more of the mature root system. As tuberosities can form on lignified roots, it effects all portions of the root system, eventually leading to the collapse of the entire root system and vine death. *V. vinifera,* as well as all Chinese *Vitis* species tested, are affected by this type of feeding.

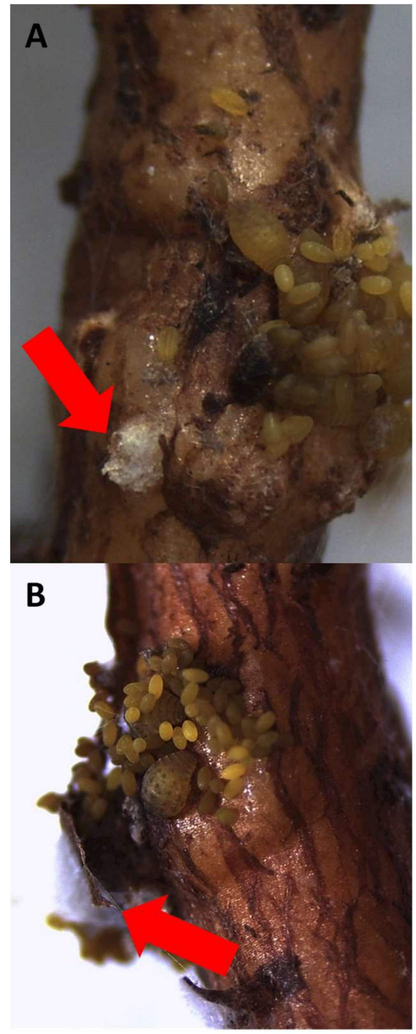
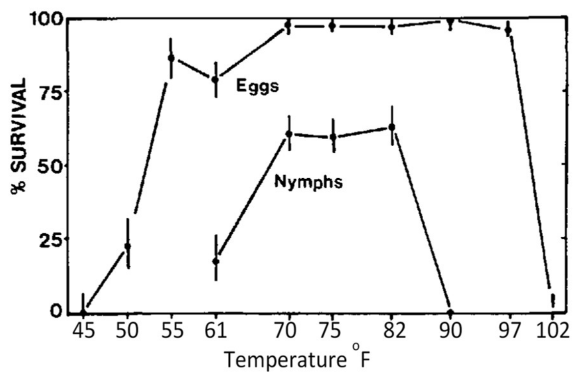


Image 4 Phylloxera Tuberosities. Tuberosities formed on the roots of: A. Chardonnay, and B. Colombard. Red arrows point to callus tissue formation on area were lignified tissue has cracked. These sites are where secondary soil fungi can gain access to root system leading to root death.

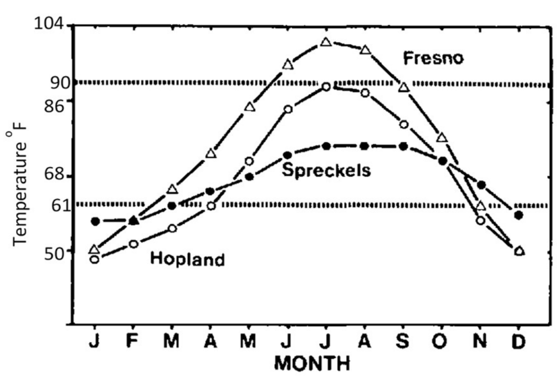
All American *Vitis* species have resistance to this type of feeding. This is why *V. vinifera* scions are grafted onto rootstocks that are, or are bred from, American *Vitis* species. In most cases hybrids of *V. vinifera* and American *Vitis* species, such as the rootstock AXR#1, turn out to also be susceptible to tuberosity feeding. The notable exception to this is hybrids between *V. vinifera* and *V. rotundifolia*, which seem to segregate 1:1 for susceptibility to tuberosity formation. The rootstock O39-16 owes it breeding to this cross and after many decades of use has no signs of succumbing to phylloxera feeding. While the failed rootstock O43-43 was also from the same cross and was susceptible to tuberosity formation.

Table 1 Phylloxera Survival vs Temperature. The survival rate of different stages of phylloxera are plotted against a range of temperature.



*Data from Granett and Timper 1987.

Table 2 Vineyard Soil Temperature. The average monthly soil temperature was collected at 15 cm (5.9 inch) in Spreckels (Monterey county) and Hopland (Mendocino county), and at 20 cm (7.9 inch) for Fresno county. Dashed lines indicate the upper and lower temperature limits of crawler survival.



*Data from Granett and Timper 1987.

Since *V. vinifera* is susceptible to tuberosity formation, and there are many acres of own rooted grapevine in the SJV, how do they survive? The SJV has a couple natural defenses against phylloxera. The first of these is soil type. For a reason that is still unknown, phylloxera have problems infesting roots in sandy soil. As many soil types within the SJV are sandy, this does give a natural defense to vineyards on sandy soil. Another defense in the SJV is high soil temperature. Phylloxera eggs, and especially crawlers, have a limited range of temperatures in which they can survive (Table 1). The work done by Grannet and Timper (1987) has shown that when crawlers get above 90° F, or below 61° F, their survival drops below the level required to maintain population size. When temperatures are outside of this range phylloxera populations will diminish as the life cycle will be broken.

The work of Grannet and Timper (1987) continued by tracking soil temperature in vineyards within different portions of California. They found that: vineyards in Spreckels (Monterey county) saw 9 continuous months with temperatures permitting phylloxera population growth. And vineyards in Hopland (Mendocino county) saw 7 continuous months with temperatures permitting phylloxera population growth. While Fresno county only had temperatures within the correct range for phylloxera population growth for 3 months in the spring and 3 months in the fall. This would mean that in Fresno county phylloxera have 3 months in the spring that allow population growth before it becomes too hot. The summer heat would then prevent the population from increasing, and possibly reduce it. The cooler fall would then allow population growth again for another 3 months. However, the winter would come and reduce the population.

This gives Fresno, and the rest of the SJV an advantage when controlling phylloxera. The natural temperature extremes in both the summer and winter prevent phylloxera populations from exploding like they can in many other portions of California. It is not a death blow to phylloxera. The temperature readings used in the study were taken at almost 8 inches in depth (for Fresno). Soils deeper down will be exposed to less temperature extremes. Grape roots can penetrate much deeper than 8 inches, and the phylloxera will follow. These deeper depths would give phylloxera a refuge to hide in during the hotter and colder portion of the year. Canopy management practices that lead to nearly full ground shading (overhead raisin trellising) would also decrease soil temperature, although the exact effects of this cooling are unknown.

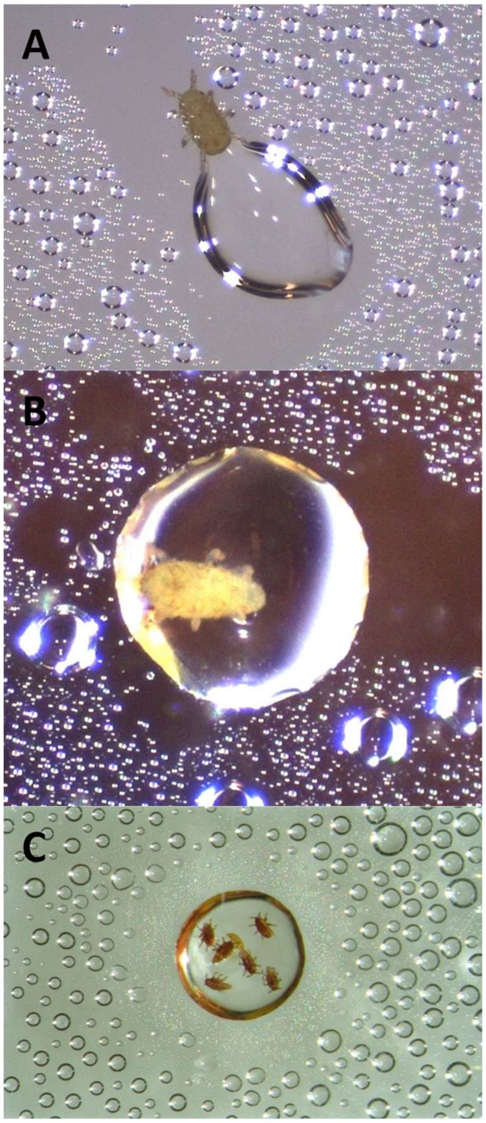


Image 5 Phylloxera and Water. A. Phylloxera getting stuck to water drop; B. phylloxera getting surrounded by water drop C. phylloxera drowning in mass within a water drop.

Common practices also help control phylloxera populations within the SJV. The first of these was extremely popular but has faded with time: flood irrigation. During the phylloxera invasion of France in the late 1800's it was found that flooding a vineyard with 40 cm (15.75 inches) of water for 40 days was effective at reducing phylloxera populations. This is partially due to an interesting combination of biology and physics. For small organisms, the surface tension of water can be stronger than the organisms itself. Due to this many insects evolved a layer on their exoskeleton that repels water. As can be seen in image 5, phylloxera skipped this advantage. Water droplets stick to phylloxera with such strength that as the water droplet grows it easily surround and eventually drowns the phylloxera.

General insecticides are another common practice that helps control phylloxera in the SJV. The UC IPM page lists several insecticides that can help with phylloxera control (http://ipm.ucanr.edu/PMG/r302300811.html). Many of these insecticides are used commonly in grape production to deal with other insect issues. A vineyard in Solano county I was monitoring for phylloxera had a major problem with local sharpshooters and was close to a northern CA hotspot for glassy-winged sharpshooters. As such they would spray to control the sharpshooters, but as a byproduct would control the phylloxera population as well. Systemic insecticides used to control other vineyard pests, such as mealybugs, could also have the same effect.

Overall, the SJV has many natural and cultural practices that limit the extent to which phylloxera will affect local vineyards. While these features do limit their possible effects, it does not eliminate them. Especially as vineyards age the effects that phylloxera have will increase with the declining health of the vineyard. It is a pest that is advantageous to understand and be able to identify.

References:

Granett J. and Timper P. 1987. Demography of grape phylloxera (*Daktulosphaira vitifoliae*) (Homoptera: Phylloxeridae). Journal of Economic Entomology 80: 327–329.

UC CE San Joaquin Valley Trees and Vines

San Joaquin Valley Tree and Vine Website

Enjoying Reading this newsletter? You can find this newsletter, and much more information on both vine and tree on our new website: San Joaquin Valley Trees and Vines. You will be able to find old and new articles written on vineyard and orchard management, integrated pest management, nutrient management, and information on irrigation. We also list all our meetings for easy perusal. Visit https://sjvtandv.com for more information.

Vineyard Early Season Management

George Zhuang, UCCE Fresno County

Early season vineyard management is critical for several reasons. The grapevine microclimate directly effects fungal disease severity during the early season. Fungal disease outbreaks can have a large effect on yield. This is due to yield losses as fungal infection makes fruit unmarketability. Fungal infections can also affect fruit quality by lowering Brix and color in red varieties. Proper early season vineyard management can thus help to reduce these effects and save you money on late season disease management.   Early season vineyard practices can also affect the follow year's success. Bud fruitfulness next season is affected by early season light exposure this season.

The winter of 2020 was relatively dry based on historical average. The accumulated precipitation from 10/01/2019 to 04/19/2020 in Fresno was 8.29" (CIMIS Station #80 at Fresno State) compared to the historical average of 10.67" during the same period. However, spring of 2020 has followed the similar pattern as the spring of 2019 with abundant precipitation during the early canopy growth stage. So far, we have received 4.44" of rain in 2020 from the beginning of March to the end of April compared to the 4.41" of rain in 2019 from the beginning of March to the end of May. Therefore, we might end up with more precipitation in spring of 2020 compared to 2019. Wet spring favors grapevine fungal disease and requires deliberated vineyard management to offset any potential risks.

The most important steps during the early season vineyard managements include:

1. Irrigation
2. Nutrition
3. Pest/disease
4. Canopy management
5. Crop management

The objectives of early season vineyard management are simple and straightforward: to sustain yield with desired fruit quality at harvest with low disease/pest pressure. Irrigation, grapevine nutrition, pest/disease pressure, canopy management and crop level all play in the formula to decide the timing and severity of vineyard practices at the early growing stage.

Water Management

I have covered the basic concepts of water management at previous Vit Tips (https://ucanr.edu/sites/viticulture-fresno/newsletters/Vit_Tips_Previously_newsletter_VineLines58357.pdf). Here, I will focus on early season irrigation scheduling, and two keys are: 1) when to irrigate, 2) how much to irrigate.

When to irrigate:

1. Visual Assessment of Canopy
2. Soil Moisture Assessment
3. Plant Water Stress Assessment

Visual assessment of canopy (1) can be used to gauge the level of water stress. Assessment of items such as: shoot tips, tendrils, internode length, and even budbreak can infer the water stress of the vines. However, visual assessment needs experience and might not be accurate enough for real-time management.

Soil moisture (2) can be judged through different ways, including feel and appearance, soil matric potential (tensiometer), soil gravimetric measurement, soil volumetric water content. Most growers choose soil appearance or soil matric potential to schedule their first irrigation.

Plant water stress (3) can also be assessed by measuring leaf or stem water potential. If the midday leaf water potential is greater than -10 bars it indicates that the vine is water stressed. At this point the grower needs to start their first irrigation.

How much to irrigate:

After growers decide to start the irrigation, growers can follow the recommendation previously outlined in the Raisin Production Manual (Table 1). Crop evapotranspiration (ET_c) can also be calculated from reference evapotranspiration (ET_o) and crop coefficient (K_c). ET_o can be obtained from nearby CIMIS stations and K_c can be calculated using the percentage of midday canopy shading.

Table 1. Vine water use (drip irrigation schedule) for a large canopy vineyard or one using a trellis with a crossarm* (reproduced from the Raisin Production Manual, UC ANR Publication 3393)

Gallons per acre per day$	Month					
Date	April	May	June	July	August	September
1-7	700	2,050	3,550	4,700	4,900	4,100
8-14	1,000	2,400	3,900	4,900	4,800	3,800
15-21	1,300	2,700	4,250	5,050	4,550	3,500
22-30	1,650	3,100	4,500	5,000	4,400	3,200

*Vineyard canopy covers 75% or more of the land surface during summer months. When used to schedule drip irrigations, amounts must be increased according to the efficiency of the drip system.

$Divide values by number of vines per acre to determine gallons per vine per day. Divide values by 27,154 to calculate inches per day.

Nutrient Management

Early season nutrient management should include N, Zn, and B. In addition, K and Mg may also need to be managed at this time. Growers need to consider irrigation amount and the amount of nitrate (NO_3) in their water source. Vine tissue testing is a great way to take a snapshot of vine general nutrient status and can be beneficial to guide the nutrient application program. Typically, bloom tissue test, either from petioles or leaf blades, has the greatest value to tell the early picture of vine nutrient status. Growers can have enough time to adjust the fertilizer program to compensate any negative effects from nutrient deficiency or toxicity.

General vine nutrient threshold of bloom petiole can be found at Table 2. Growers should be careful of vine N critical value since Table 2 N threshold were established on own rooted Thompson Seedless vines. Many factors can affect N critical value, e.g., variety, rootstock, weather, disease/pest pressure and more. Therefore, growers should gauge the vine N status using visual assessment of general vine

Table 2. Guide for grape petiole tissue analysis at bloom* (reproduced from the Raisin Production Manual, UC ANR Publication 3393)

Nutrient	Unit	Deficient (below)	Adequate	Excessive (above)	Toxic (above)
NO_3-N	ppm	350	>500	2,000	8,000
P	%	0.10	0.15		
K	%	1.0	1.5		
Mg	%	0.20	0.30		
Zn	ppm	15	26		
B	ppm	25	30		80
Na	%				0.5
Cl	%			0.5-1.0	1.5

*Critical values are guidelines to help identify potential fertilizer needs. Growers experience and vineyard general health will need to determine a vineyard's nutritional requirements. The critical values are generally acceptable for all varieties apart from NO_3-N, and NO_3-N values are based solely on data from Thompson Seedless on own roots.

health, historical records, yield, disease/pest conditions, and laboratory results. Recently, remote sensing has been explored in Dr. Fidelibus' and Dr. Pourreza's labs in UC Davis to assess vine N status covering large acres using non-destructive measures. Some early results are encouraging showing low cost field images can provide more information covering large areas through the whole growing season.

The general rule of N application is based on the crop removal. For every ton of fresh grape removes approximately 3 lbs of N. Therefore, growers need to adjust the amount of N to apply based on the yield per acre. With an average of 10 tons per acre of vineyard, the amounts of N recommended are approximately 30 lbs. per acre. However, growers need to consider the amount of N from irrigation water and add the amount of N into the calculation. For instance, with 10 lbs. of N per acre foot of water, and a typical vineyard requiring 2 acre feet of irrigation per year, this field would have already received 20 lbs. of N by just irrigating the vines. However, keeping the general rule in mind, growers need to adjust the amount of N based on: soil type, rootstock, irrigation type, vine vigor, and pest/disease pressure.

With the consideration of N amount, timing of N is also critical to achieve the maximum N application efficiency. Two timings of N application have been recommended: early season and post-harvest. Specifically, early season refers to one month after bud break and right after fruit set. The benefit of early season N application is that canopy is growing rapidly at this stage and N uptake efficiency is close to maximum. Post-harvest can be an alternative timing to apply N, however, photosynthetically functional canopy is required to achieve the N application efficiency. Therefore, post-harvest N applications are most appropriate for early to mid-season varieties.

Canopy Management

Pest and disease management are key targets during the early growing stages. Irrigation and nutrient management can indirectly affect the pest/disease pressure through changing the canopy size/density and microclimate. Shoot thinning and leafing are commonly applied to open the canopy. This increase cluster spray coverage and light exposure. It will also improve the air circulation within the canopy, which helps to reduce the relative humidity. The goal of this work is reduce pest/disease pressure while improve fruit quality.

Shoot thinning can be applied by hand or machine at shoot length of approximately 8"-10". Leafing can be applied by hand or machine around fruit set on one side or both sides of the canopy based on the regional climate and row orientation. Recent studies have confirmed that pre-bloom or bloom leafing has minimal effect on yield with greater or similar benefit on berry quality as comparison of fruit set leafing (Cook, et al. 2015).

Disease and pest pressure are another reason why early season canopy management is critical. Wet spring condition favors Phomopsis and Botrytis, and the effectiveness of fungicides will depend largely on the timing and coverage. Typically, growers can adjust the timing of fungicide application based on local weather forecast or UC PM index. Canopy management (shoot thinning, leafing, and cane trimming) can help to open the canopy to improve the spray coverage. It will also increase light exposure inside the canopy and improve the air circulation to lower the relative humidity.

In conclusion, canopy managemnet should be integrated with water and nutrient management as the part of early season vineyard pratice with the consideration of pest/disease management, growing condition, e.g., climate, soil condition and irrigation water availiability and quality, and production goal in order to achieve the maximum production efficiency with low disease and pest pressure.

Reference:

Cook, M., Zhang, Yi., Nelson, C., Gambetta, G., Kennedy, J., and Kurtural, K. 2015. Anthocyanin Composition of Merlot is Ameliorated by Light Microclimate and Irrigation in Central California. American Journal of Enology and Viticulture. 66: 266-278.

Upcoming Meeting

As you know, the State of California has issued a shelter-in-place order to reduce the spread of COVID-19. Due to the current Covid19 outbreak UCCE has postponed all in person meeting until the current situation has passed. We are still here to answer your questions and address needs during this unprecedented situation. Please contact us with any viticultural issues or concerns you are having. You can also get in contact with any of your other local UCCE staff by contacting them through our website.

Fresno County

George Zhuang, Viticulture Advisor Fresno County: gzhuang@ucanr.edu, 559-241-7515.

Website for other Fresno UCCE Advisors and Staff: http://cefresno.ucanr.edu/Contact_Us/

Madera, Merced & Mariposa Counties

Karl Lund, UCCE Viticulture Advisor Madera, Merced & Mariposa Counties: ktlund@ucanr.edu, 559-675-7879 ext. 7205

Website for other Madera UCCE Advisors and Staff: http://cemadera.ucanr.edu/contact_337/

Website for other Merced UCCE Advisors and Staff: http://cemerced.ucanr.edu/about/contact/

Website for other Mariposa UCCE Advisors and Staff: http://cemariposa.ucanr.edu/Staff/

Tulare and Kings Counties:

Gabriel Torres, UCCE Viticulture Advisor Tulare & Kings Counties: gabtorres@ucanr.edu, 559-684-3316

Website for other Tulare UCCE Advisors and Staff: http://cetulare.ucanr.edu/Contact_Us/

Website for other Kings UCCE Advisors and Staff: http://cekings.ucanr.edu/Contacts/