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Spur Pruning and Minimal Pruning on Raisin Grape

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Facing low prices for raisin grapes in the San Joaquin Valley, growers are being forced to make some very difficult decisions. Traditional cane pruning has a higher labor cost than other pruning methods. To save costs, I have witnessed Thompson vineyards being pruned in two different cost saving methods. The first is when the vineyard undergoes spur pruning (Image 1). I have also witnessed growers going in the exact opposite direction and using minimal pruning techniques on a few Thompson vineyards (Image 2). Continued low raisin prices might prompt growers to skip production this season with 2-node spur pruning to hope for a better price and a large crop for the following season. Minimal pruning does not only reduce the pruning cost, but also has the potential to increase the yield although ripening can be delayed for a high rain risk. While these decisions were motivated by costs saving needs, growers who have chosen one of these routes need to pay attention to the general health of their grapevines, as well as being attentive to crop management to sustain production for the following years.

Spur Pruning

To obtain a meaningful yield, growers cane prune traditional raisin varieties, e.g., Thompson Seedless, Fiesta and Selma Pete. This is because these varietals have low fruitfulness on basal buds, while buds farther up the cane have more clusters (Cathline et al. 2020). Cane pruning is also necessary for raisin mechanical harvest, e.g., continuous tray and DOV raisin. Spur pruning by hand does reduce labor cost by 35% in comparison to cane pruning (University of California Sample Cost for Raisin and Wine Grape in 2016). Pruning to a 2-bud spur will eliminate crop yields in the current season. No crop will mean less fertilizer need in the coming season, as harvest is the main loss of nutrients out of the vineyard. No crop could also allow for a longer spray interval, in comparison to a normal production year.

Image 1. Spur pruned Thompson Seedless vines at beginning of this year near Fresno

Growers still need to monitor the vines through the entire season, even if there is little to no expected crop. Healthy, photosynthetically active canopy are needed to produce strong canes and store carbohydrates in the permanent vine structures, such as trunk and roots to sustain the following year's canopy growth. Early season carbohydrate supply also directly impacts the yield through bud inflorescence primordia formation. Therefore, mildew disease management

is still necessary even for spur pruned raisin vines, although a longer spray interval might be enough to control the foliar mildew. Growers should also watch the water and nutrient status of the vines with the goal of producing strong vines and meaningful crop for the next year.

Due to little or no crop resulted from spur pruning, healthy vines tend to be more fruitful the following year. Growers who decide to go with spur pruning this year may need to adjust pruning severity, water, and fertilizer next year to avoid over-cropping and delayed maturation.

Summary:

1. Maintain a healthy canopy even with no expected yield to sustain the following season's crop.
2. Manage vines starting this dormant season for a potentially big crop next year with pruning, water, and fertilizer.

Minimal Pruning

Minimal pruning entails hedging the dormant canes close to the vineyard floor. Minimal pruning has been studied in Australia on wine and Sultana grapes. These studies confirmed that

Image 2. (A) Minimal pruned Thompson Seedless vines at budbreak this year near Kerman. (B) Minimal pruned Thompson Seedless vines at bloom this year with a larger number of clusters near Kerman.

minimal pruning increased the number of clusters, but reduced cluster size and berry size compared to spur or cane pruning. This overall led to improved color of wine grape, but delayed maturation. In addition, mechanical crop thinning was applied on minimally pruned vines to reduce crop load. Thinning advanced maturity, and further improved organic acids and color (Clingeleffer 2009).

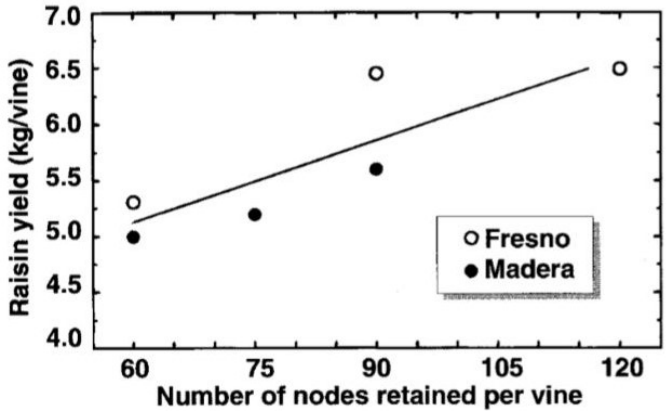

Figure 1. Correlation between pruning level and raisin yields and data were averaged from three years between Fresno and Madera. From Christensen et al. (1994).

A pruning severity study led by Christensen et al. (1994) produced similar results; more nodes retained after pruning led to higher yield. Specifically, for each additional 15-node cane raisin yield increased by 0.36 lbs/vine for Thompson Seedless (Figure 1). However, more nodes retained also lead to lower Brix at drying and poorer raisin quality (Figure 2). Specifically, an additional 15-node cane decreased soluble solids by 0.23 Brix and 0.36 Brix and lowered the B&B better by 1.5% and 2.6% at Fresno and Madera, respectively.

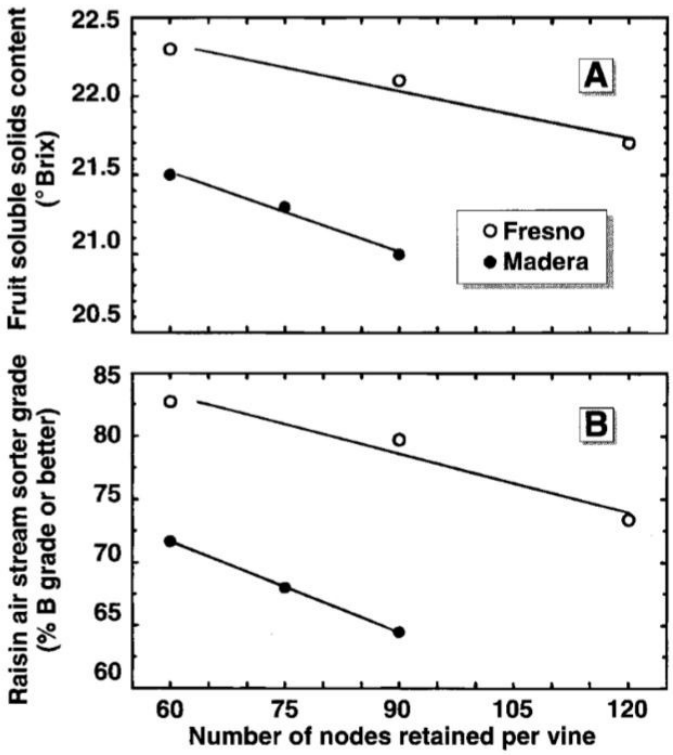

Figure 2. Correlation between pruning level and harvest berry soluble solids (A) and correlation between pruning level and harvest raisin quality (B). Data were averaged from three years at Fresno and Madera. From Christensen et al. (1994).

More recently, a cane length study (Cathline et al. 2020) confirmed the similar results for Thompson Seedless when long canes were retained. However, long canes or more nodes/vine did not increase the raisin yield for new varietals, e.g., DOVine, Selma Pete and Fiesta. Long canes or more nodes/vine did delay the ripening and had the risk to lower the raisin quality across all the varieties, especially the clusters at the apical nodes.

Therefore, minimal pruning or retaining more nodes after pruning has the potential to increase crop for Thompson Seedless, though maturity is likely to be delayed. As for raisin growers, since heavy crops are associated with slow ripening; that also means a higher risk of rain during drying. Minimal pruned vines also tend to have an earlier and larger canopy than normal cane pruned

vines, thus require more water input as well as nutrients. High disease pressure and inadequate spray coverage are also possible due to a large and dense canopy.

Management measures to consider with minimal pruned vines:

1. Supply adequate water.
2. Watch vine for nutrient deficiencies and fertilizer.
3. Improve spray coverage or short spray interval.
4. Foliar K or ethephon spray after veraison.
5. Apply K and ethyl oleate with the spray-on-tray (SOT) treatment.

The first two measures aim to support the large canopy and yield. The third aims at dealing with higher mildew pressure in a denser canopy. The last two target at advancing the raisin drying to facilitate either DOV raisins or traditional tray dry raisins to avoid rain risk. K_2CO_3 is the most widely used form of K for the drying emulsions, and the foliar spray might contain lower rate of K_2CO_3 and ethyl oleate, like 2%, while a higher rate might be needed for SOT raisins. More information about raisin drying emulsions can be found at Raisin Production Manual 2000. UC ANR Publication #3393.

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Bunch Rot

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Botrytis cinerea, also known as gray mold, is a common disease found in all grape growing areas worldwide. Gray mold is the causal pathogen in bunch rot; however, other fungi such as *Aspergillus, Alternaria, Rhizopus* as well as other saprophytic species can also be involved. Advanced infections lead to large portions or entire clusters starting to rot (Image 1). Vinegar flies are attracted to the rotting berries bringing bacteria, specifically acetic acid producing bacteria that progress bunch rot into sour rot.

Image 1. Advanced bunch rot.

Table grape, wine grape and raisin grape production are all affected by bunch rot. Berry infections above 3% can result in significant quality reduction of wine. In raisin production the disease also causes quality reduction at a 5% threshold, which can lead to postharvest mold problem. Table grapes have a zero-tolerance policy for bunch rot. As a single infected table grape berry in postharvest storage can result in an infection that compromises all the fruit in a box leading to the entire box being rejected. This is because Botrytis can continue to spread and infect berries in temperatures as low as 32 F°.

Botrytis infects both actively growing and decaying tissue. For this reason, it can be observed affecting different parts of the plant. This includes the leaves, flowers, canes, buds, and fruits. Cane and leaf infections, also known as botrytis shoot blight, is unusual in the San Joaquin Valley except during rainy springs as we had in 2019.

Image 2. Decaying flower parts in a cluster at berry set. The decaying tissues is a preferred substrate for Botrytis to initiate growth on.

Conditions leading to bunch rot may start at bloom (Image 2). Botrytis takes advantage of the dying flower parts, including calyptras and stigmas to initiate infection. After berry set, the pathogen will continue infecting new berries. This spread will continue if

temperatures are below 86 F°. Above 86 F° the pathogen becomes quiescent, and new infections are not observed. At veraison, the increasing sugar content of the berries, the reduction of peel resistance and cooler temperatures under a bigger canopy, again produce good conditions for the pathogen to resume infection.

After veraison infected berries from green varietals become brown-colored, while infected berries on red cultivars, quickly develop a dark red color. As the fungi grows within infected berries it increases internal pressure. Once the internal pressure exceeds the peel's resistance, peel cracking can occur, releasing juices from the berries (Image 3). These cracks, along with powdery milder scars (Image 4), berry damage from insects and birds, or mechanical damage all serve as new colonization sites for more Botrytis infections. Released juice speed up the process giving the invading fungi an easily available source of nutrients. These sites also allow for infections of other secondary pathogens involved in bunch rot. Vinegar flies, as well as other insects, are attracted to the damaged and rotting berries. The vinegar flies carry more pathogens to the infection sites as well as spread them within and between clusters (Image 5). When temperatures stay below 86F° for extended portions of the day, a gray fluffy mycelium is produced on the surface of affected berries.

Image 3. Berries spliting and bleeding at veraison (left) and at maturing (rigth). These cracks provide easy entry for all pathogens involved in bunch and sour rot.

Image 4. Powdery mildew scars on table grape. Note the compactness of the cluster. Tight clusters are more prone to develop bunch rots.

After harvest, leftover clusters, canes, and other tissues that were colonized by Botrytis may serve as over wintering sites. On these tissues, the pathogen overwinters as sclerotia or chlamydospores. After budbreak, spores can be produced from the chlamydospores under the correct conditions. These conditions include free water drop, such as rain drops or dew drops, temperatures between 58° and 82°F, and a preference for relative humidity exceeding 92% for more than 2 hours. These spores can then start infecting green growing tissues (Wilcox et al. 2017).

Image 5. Vinegar flies and other insects are attracted to rotten berries (A and B). They feed and reproduce there (C) and then move to berries with fresh damage (D) transmitting the pathogens involved in the complex.

Management of bunch rot requires an integrated pest management approach, working first on preventive measures and then on curatives. Before planting, row direction, trellis system selection, and cultivar susceptibility (Table 1) are important decisions to consider. Any action taken to improve air flow will be beneficial. Airflow reduces humidity and allows water droplets to dry faster, which are both important steps to preventing initial infection and managing bunch rot.

In established vineyards it is important to practice good hygiene in order to reduce the inoculum that pass from one season to another. For this, it is important to remove all unpicked

VERY SUSCEPTIBLE	SUSCEPTIBLE	MODERATELY RESISTANT	HIGHLY RESISTANT
Carignane	Barbera	Autumn Royal	Cabernet Sauvignon
Chardonnay	Calmeria	Colombard	Merlot
Chenin blanc	Flame Seedless	Crimson Seedless	Muscat of Alexandria
Melon	Grenache	Emperor	Rubired Ruby Cabernet
Petite Sirah	Pinot noir	Semillon	
Ruby Seedless	Sauvignon blanc	Sylvaner	
White Riesling	Redglobe	Thompson Seedless	
Zinfandel	Ribier		

Table 1 Cultivar susceptibility to bunch rot adapted from Bettiga and Gluber (2013)

clusters and incorporate them into the soil prior to budbreak. Canopy management techniques such as shoot, and cluster positioning are beneficial for disease management. The objective here is to increase air flow, improve superficial water drying and reduce spore germination. In addition, these canopy management practices can improve fungicide spray efficacy.

Irrigation also plays a role in the disease cycle. Over-irrigation can result in continually growing shoots. This extra growth will reduce temperature under the canopy and will lead to an increase of humidity, providing better conditions for fungal growth. Excessive vegetative growth can lead to tighter clusters increasing internal humidity. In addition dense canopies reduce spray coverage efficiency, which can lead to reducing fungicide efficacy.

Biological fungicides, including *Trichoderma, Aurobasidium, Ulocladiumand* and *Bacillus*, have some efficacy against Botrytis, especially when they are applied in a preventive manner. Synthetic fungicides dicarboxamides (FRAC 2), anilinopyrmidines (FRAC 9), hydroxyanilides (FRAC 17), strobilurines (FRAC 11) and SDHI (FRAC 7) fungicides, can be used in conventional agriculture. However, selection of systemic fungicides needs to be done carefully since the pathogen can generate resistance towards fungicides easily. The use of fungicides to control Botrytis is advised in at least 4 critical stages: 1) mid-bloom; 2) before cluster closure, 3) at veraison; and 4) 2-4 weeks after veraison. On table grapes, another spray before harvesting is recommended to help maintain post-harvest quality.

In the Eastern United States, the control of Drosophila Spotted Wing flies (fruit flies) has been identified as part of the strategy to manage bunch rot. UCANR and the USDA are investigating if Drosophila control is beneficial for the San Joaquin Valley.

Key points

What can trigger Bunch rot?

- Clusters in contact with wire or trellis system
- Poor cluster thinning (tight clusters)
- Botrytis infection
- Powdery mildew scars
- Overwatering
- Bird damage
- Poor pruning
- Mechanical damage

How can Bunch rot be treated?

Bunch rot is a complex of fungi, bacteria, yeast, and insects. There is not a "silver bullet" product that can reduce the disease has started. All treatments must be preventive with an integrated pest management approach.

When does bunch rot normally starts?

Bunch rot pathogens normally use entries of scars left by Botrytis or powdery mildew. Infection takes place normally after veraison.

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Pierce's Disease in the San Joaquin Valley

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Pierce's disease is caused by the bacterium *Xylella fastidiosa*. These bacteria live within xylem, the vascular tissue through which water travels in a plant. As the bacteria population grows it stimulates the plant to produce tyloses, cellular outgrowths that plug xylem vessels. The bacteria and tyloses cause vessel plugging which restricts water movement in the plant, thus causing many of the disease symptoms. These blockages will eventually lead to the vine's death. It is estimated that Pierce's disease costs the California grape industry $56.1 million a year in lost productivity (Tumber et al. 2014). To minimize losses, it is important to understand the biology of the disease, including the bacteria's host range, how the bacteria moves from plant to plant, and how to identify infected plants will help growers prevent losses and control the disease.

The bacterium *X. fastidiosa* has a large known plant host range. The European Food Safety Authority maintains a database of known hosts for *X. fastidiosa*; (an updated list approved in April of 2020 can be found at https://doi.org/10.2903/j.efsa.2020.6114). Other local crop plants such as almond, citrus, olive, peach, plum, and alfalfa can all host the bacteria. None cropping trees such elm, maple, oak, sycamore, and mulberry can also serve as host to the bacteria. Ornamental plants such as oleander, Spanish broom, and periwinkle, as well as weeds such as ragweed and wild mustard can all host to the bacteria. Overall, at least 350 host plants have been identified from over 75 plant families as hosts for *X. fastidiosa*. From a control standpoint once *X. fastidiosa* has been introduced to a geographic area it will be virtually impossible to eliminate from that location with such a wide variety of possible hosts.

X. fastidiosa does have another level of complexity. To date four distinct subspecies of *X. fastidiosa* have been identified. *X. fastidiosa* ssp. *fastidiosa* is the subspecies that causes Pierce's disease in grapevine, while *X. fastidiosa* ssp. *multiplex* is the subspecies that causes almond leaf scorch (Rapicavoli et al. 2018). In theory this would reduce the number of potential hosts for the Pierce's disease causing form in the environment. Unfortunately, while *X. fastidiosa* ssp. *fastidiosa* is unable to cause almond leaf scorch, it is still able to survive in almond trees albeit at reduced concentrations. With the reverse being true for *X. fastidiosa* ssp. *multiplex* (Almeida and Purcell 2003). While this does mean that almond trees with almond leaf scorch would be unable to act as a source for Pierce's disease in grapevine. It also means that almond trees would be able to host *X. fastidiosa* ssp. *fastidiosa* with no outward symptoms.

Bacteria within the xylem tissue of one plant may be spread to another plant through the feeding activities of certain xylem-feeding insects. In vineyards two groups of insects have been identified as possible vectors: sharpshooters and spittlebugs. Spittlebugs have been shown to vector *X. fastidiosa* in controlled settings, but their importance as a Pierce's disease vector in

vineyards is unclear. Sharpshooters on the other hand, are known to be effective vectors of Pierce's disease in vineyards.

There are several different sharpshooters that in California vector *X. fastidiosa*. The most important of these in the coastal portions of California is the blue-green sharpshooter. This sharpshooter is not adapted to the hotter climate of the San Joaquin Valley (SJV). In the SJV, we have 3 other sharpshooters: the green sharpshooter (*Draeculacephala minerva*), the red-headed sharpshooter (*Xyphon fulgida*), and the glassy-winged sharpshooter (*Homalodisca vitripennis*). Image 1 shows all three sharpshooters, as well as contains a size comparison of the three sharpshooters in the lower corner of each image.

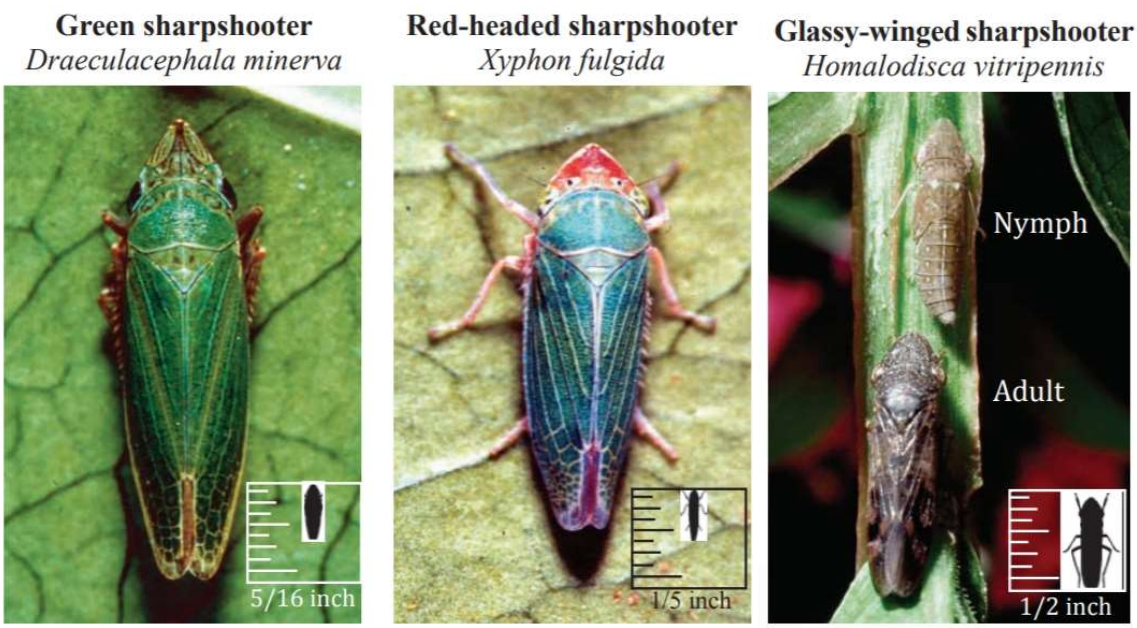

Image 1. From left to right the green, red-headed and glassy-winger sharpshooters. Size comparison measurements are in the bottom left of each individual picture. Photos by Jack K. Clark © Regents of the University of California

The green sharpshooter and the red-headed sharpshooter are both small and prefer to feed on grasses. The red-headed sharpshooter is specifically drawn to and reproduces on Bermudagrass. Both the green and the red-headed sharpshooters can be found in irrigated pastures and along waterways such as stream, creeks, canals, and ditches. Neither of these sharpshooters prefers to feed on grapevines, however they may do so under certain conditions and thus transmit Pierce's disease. However, since neither of these sharpshooters prefer to feed on grapevines, they tend not to spread deeply into vineyards, so when these vectors transmit *Xylella*, it is usually only to grapevines along the edges of a vineyard, whereas vines in the middle, or the sides away from the green or red-headed sharpshooters' preferred habitat, are not affected.

The glassy-winged sharpshooter is twice the size of either of the other two sharpshooters. Their large size makes them more dangerous as a vector for Pierce's disease because they can travel further than smaller sharpshooters and feed more effectively on a wider variety of plants, including woody plants such as grapes. To date over 350 plants have been identified as hosts of glassy-winged sharp shooter: https://www.cdfa.ca.gov/pdcp/Documents/HostListCommon.pdf . Many of the hosts for glassy-winged sharpshooters are also hosts for *X. fastidiosa*. One of the key hosts for both glassy-winged sharpshooters and *X. fastidiosa* in the SJV, and for local control of Pierce's disease is citrus. The large feeding range of the glass-winged sharpshooter also means that it can spread *X. fastidiosa* throughout the vineyard, instead of just to the edges.

The glassy-winged sharpshooter is not a native California insect, only arriving in California in the late 1980's (first recorded in 1989). As this non-native pest is such a dangerous vector the CDFA tracks their distribution. A portion of the 2020 map covering the San Joaquin Valley and southern California can be seen in Image 2. Most of Kern county, parts of Tulare and Fresno Counties, and a very small sliver of Madera county just over the San Joaquin River from the city of Fresno near highway 41 all host to naturalized populations of glassy-winged sharpshooters.

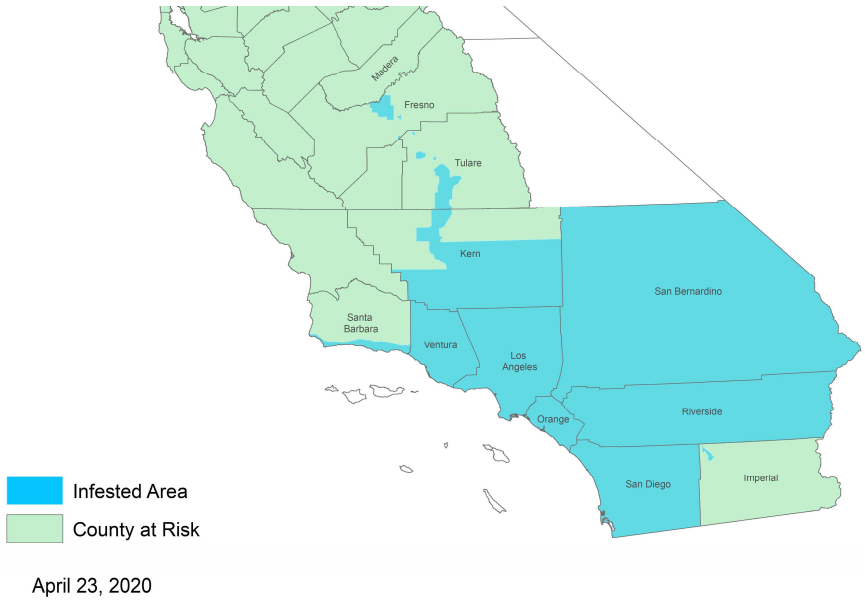

Image 2. April of 2020 California Department for Food and Agriculture map of glassy-winged sharpshooter distribution within central and southern California. Full map available at: https://www.cdfa.ca.gov/pdcp/Maps/GWSS_Distribution.jpg

Identification of glassy-winged sharpshooters within, and near these areas is important for controlling both their spread, as well as the spread of Pierce's disease. Features on its body are helpful to identify him. From the top the insect has a deep brown color with creamy white dots on the head and thorax (Image 3A). These colors and dots continue onto the abdomen, however here they are covered with transparent wings (the source of their glassy name). Highlighting the glassy wings are red lines and patches which can be seen from both the top and side (Image 3B). The other main identifying mark is the flat white marking along the side of the abdomen. When sitting on a stem this white mark stands out under and through the wings

of this sharpshooter. Younger nymph glassy-winger sharpshooters (Image 3C) have yet to develop their namesake wings. Their bodies are a lighter grayish brown with very small white dots. For this stage, the standout feature is their red eyes. The red is the same color that will soon highlight the parent's wings. Later stage nymphs (Image 3D) have started to transition to the adult body color, and the red color in the eye is mostly lost. However, the red color has transitioned onto the wing pads in a pattern that has started to develop the adult wing's patterning.

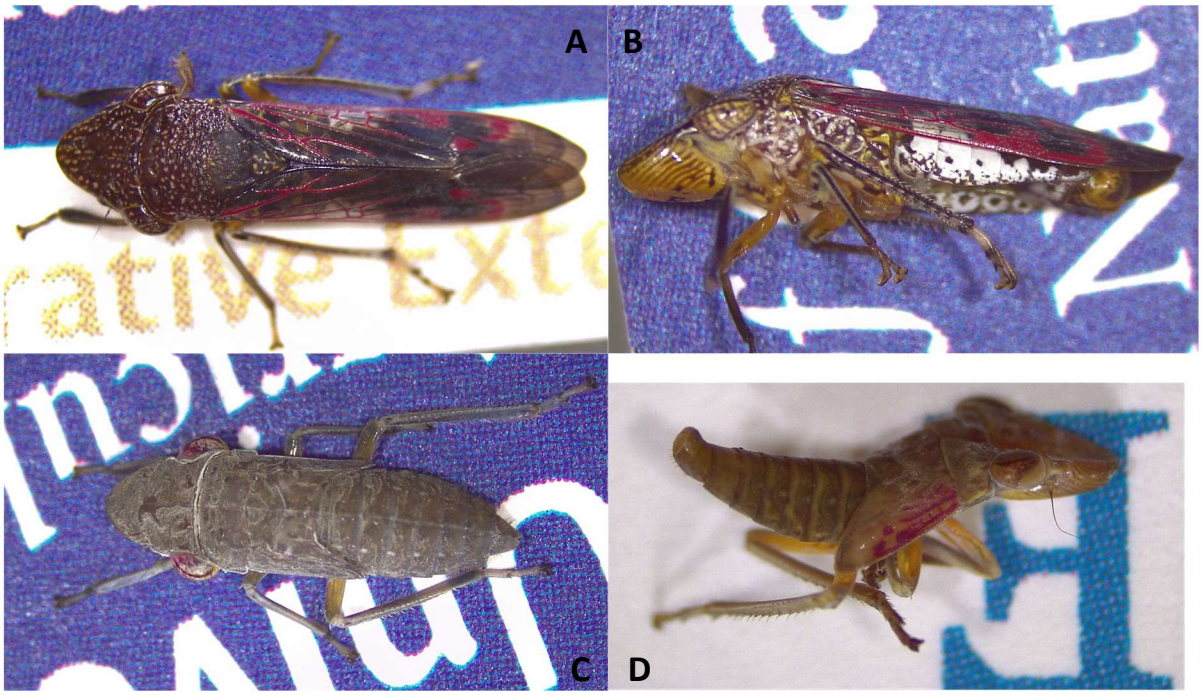

Image 3. Images of Glassy-Winged Sharpshooter. All images were taken with insect on top of a UC ANR business card for sizing purposes. A: Top view of adult Glassy-Winged Sharpshooter. B: Side view of adult Glassy-Winged Sharpshooter. C: Top view of young nymph Glassy-Winged Sharpshooter. D: side view of late stage nymph Glassy-Winged Sharpshooter.

Monitoring for glassy-winged sharpshooters can be done using yellow sticky cards. It is recommended to use cards that are at least 5.5" x 9" in size. One card should be placed for every 10 acres and checked weekly for recent activity. Monitoring should be done from budbreak through November. If a glassy-winged sharpshooter is found, and you are outside of a known population center, please contact your local agriculture commissioner's office or cooperative extension office. Green and red-headed sharpshooters are not attracted to yellow sticky cards, so to monitor their populations you will need to use a sweep net. Sweep lush green grasses near and within your vineyard in April and May to assess population size. For both green and red-headed sharpshooters finding 2 adults in 50 sweeps warrants a response. Unfortunately, as both of these sharpshooters are only incidentally on grapevines, treating the grapevines won't help the situation. The preferred habitat (lush grassy areas) will need to be addressed. For glassy-winged sharpshooters a single find warrants a response. A list of

treatment options for glassy-winged sharpshooters can be found on the UC IPM webpage (http://ipm.ucanr.edu/PMG/r302301711.html).

Image 4. Pierce's disease leaf symptoms. Leaves margins turn yellow (or red in red varieties) then burn back from the margins to center in patches.

Image 5. Pierce's disease symptom on petiole. As disease progresses leaf blade will fall off leaving petiole still attached to shoot. Often the petiole will die and blacken from the tip down giving the appearance of a used matchstick. Photo by Jack K Clark ©Regents of the University of California

Early identification of infected vines is the final step in preventing a larger problem from Pierce's disease. Infected vines can be a source of the disease for vectors to spread to neighboring vines. They are also a strong indicator that the bacteria and a vector are present in your location. The leaves of infected vines will turn yellow (for green varieties) or red (for red varieties) along the margins. This discoloration will then work inwards from the margin with the discoloration quickly turning to brown/dried dead tissue. This often happen unevenly or in sections (Image 4). Affected leaves eventually fall off but will sometimes leave the petiole still attached to the shoot (Image 5). Shoot tissue also shows an uneven maturation process leaving green islands within lignified brown tissue (Image 6). Not all these symptoms will be found on every infected vine. If you suspect a vine is infected with Pierce's disease you can contact your counties viticulture advisor for corroboration. However, ultimately a diagnostic analysis is required to confirm the presence of *X. fastidiosa* in the suspected vine. Table 1 lists

Image 6. Pierce's disease symptom on shoots. Patchy bark maturation on current year's shoots leaving green islands.

laboratories within California that offer Pierce's disease testing.

Pierce's Disease Testing Laboratories (Checked June 2020)			
Lab Name	City	Phone	Website
Agri-Analysis Associates	Davis, CA	800-506-9852	http://www.agri-analysis.com/
AL&L Crop Solutions	Vacaville, CA	530-387-3270	https://allcropsolutions.com/
CSP Labs	Pleasant Grove, CA	916-655-1581	https://csplabs.com/
Eurofins BioDiagnostics	Gilroy, CA	408-846-9964	https://www.eurofinsus.com/biodiagnostics/
FPS, University of California, Davis	Davis, CA	530-752-3590	https://fps.ucdavis.edu/index.cfm
Table 1 California Laboratories that offer Pierce's disease testing			

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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.

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Potassium Nutrition in Vineyards

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With summer season upon us, an understanding of the seasonal uptake of potassium (K) is essential to time fertilizer applications. Potassium is required by grapevines in large amounts and is essential for vine and fruit growth. In the spring from budbreak to bloom there is a high demand for K as new growth develops at a high rate. The most critical need for K comes later in the year during berry development and ripening. It is during this time that berries become the strongest sink for available K especially between veraison and harvest. This may be due to the berry's high demand for K during rapid cell expansion (Bussakorn, et al., 2003).

Potassium plays a key role in cell expansion and has a major role in many plant metabolic processes. Movement of K into and out of guard cells regulates the opening and closing of stomata. As such inadequate K affects stomatal regulation and can lead to excess water loss from leaves. Potassium is a key factor in the plants ability to transport and translocate assimilates which helps to promote root growth and fruit size. Potassium also plays a role in the osmotic potential regulation, which is one of the important mechanisms in the control of plant water relations and turgor maintenance. Since K can affect both the roots ability to uptake water and the leaves ability to stop water loss, deficiencies can contribute to water stress and leaf desiccation. This may be apparent as a "scorch" of the tissue. The affected leaves acquire a scorched appearance, with leaf necrosis and reddening (on red varieties) developing from the leaf margins towards the center of the leaf.

As an essential nutrient it is recommended to use a trifold approach to assessing potassium status in the vineyard. Looking at K concentrations with soil analysis, plant tissue analysis, and visual assessment of foliage for symptoms of deficiency. Soil analysis is done pre-plant, and then every 2 to 3 years thereafter. Plant tissue analysis should be done at least every other year to monitor vine nutrition, or as needed to diagnose potential nutrient deficiency symptoms. Visual assessment is ongoing. Soil testing, however, has limitations in accurately predicting the need for additional potassium fertilizer since there are so many factors that affect uptake and utilization including soil type, texture and depth, amount of soil compaction, root pest damage, varietal, rootstock, irrigation practice and crop size. In fact, the actual K available for plant uptake represents a very small fraction of the total K in soils. This is why soil K levels have generally not ben reliable criteria for indicating the actual K status of grapevines. Petiole analysis has been the main tool for assessing K status and the need for K applications to vines. Petioles are usually collected at bloom from leaves opposite clusters on the shoot. Vines are generally sufficient at 1.5% to 2.0%, and deficiency may occur at 1.0% or less. While petiole analysis is not completely reliable tool for making K management decisions, it is the most consistent guideline currently available.

Deficiency symptoms can appear in early spring in cool wet years, but mild deficiencies may be seen just before harvest. Visual symptoms tend to show when the grapevines are heavily cropped and maintenance applications of K have not been made in the vineyard. Deficiency is often observed in areas with sandy soils with low native K fertility, or where topsoil was removed for leveling. Compacted soils, poorly drained soils, water stress and vines with weak root systems due to presence of soil pests may also contribute to K deficiency due to poor uptake. By mid-summer symptoms of K deficiency will exhibit chlorosis of the leaf margin and between the main veins and marginal burning and curling of the leaves will develop as symptoms progress (Image 1). When deficiency is severe shoot growth is significantly reduced and vines may defoliate prematurely, especially if the crop is large.

Image 1 Potassium deficiency in grapevines. A: Potassium deficiency in late summer only on leaves that receive direct sun. Image from Compendium of Grape Diseases 1988. B: Interveinal yellowing and necrosis of the edges which often curl upwards. Image from L. Peter Christensen ©Regents of the University of California.

Fertilization programs should focus on replacing potassium loses to harvest, as well as to correct for any deficiencies found through monitoring. Wine and table grape harvests remove approximately 5 pounds of K per ton of fresh fruit. For raisins grapes this will translate into approximately 17 pounds of K removed from the vineyard per ton of dried raisins (Christensen and Peacock 2000).

In general foliar fertilization has been an economic and practical method to provide mineral nutrients, particularly micronutrients, however foliar nutrient programs of macronutrients have not been effective and economical on grapevines due to phytotoxicity tolerances, leaf barriers and limited mobility of certain elements (Christensen 2004). On the other hand, fertigation with drip irrigation both micro and macronutrients has been an effective way to manage grapevine nutrition.

A variety of potassium products can be used in dry or liquid forms. In general, different forms of K fertilizer do not offer an advantage from each other, except to consider the use of potassium chloride, which can cause salt injury or potassium–magnesium sulfate in which magnesium can interfere with potassium uptake.

Potassium fertilization should be applied during early spring (a few weeks after budbreak) up to veraison and is most effective when applied under drip irrigation. In the San Joaquin Valley,

many soils have high K fixing capacity and can tie up to 50% or more of added K fertilizer. This K is not lost, but rather stored between layers of clay and slowly released in soil solution as exchangeable K. However, most will not be available fast enough during times of high demand, especially following veraison. Therefore, it is more practical to apply little amounts of K on weekly basis than a large amount all at once. An effective strategy for K maintenance in the San Joaquin Valley is weekly applications over the course of 10 to 15 weeks at a rate of 10 to 15 kg/ha up to veraison. Potassium fertigation is discontinued at veraison as the maturing fruit becomes a strong sink for K (Peacock 2004).

The method of application and formulation of K will be determined by how fast the response is needed, how long it has been since any K was applied, and whether the aim is to fix a deficiency or for maintenance. Generally, there is no hard or fast rule on K application, amount, or timing. Keep in mind that the interaction of available nutrients, soil type, crop load, irrigation management, rootstock, varietal make difficult to establish a general rule that fulfills a wide range of potassium needs in the vineyard.

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IPM Extension available in Spanish

Dr. Gabriel Torres (UCCE Viticulture advisor for Tulare and Kings counties), in collaboration with Dr. Carmen Gispert (UCCE San Bernardino, Riverside, San Diego), Dr. Monica Cooper (UCCE Napa), and Mark Battany (UCCE San Luis Obispo) were awarded grant funding by the American Vineyard Foundation to do Integrated pest management (IPM) extension in Spanish in February. Dr Torres and his collaborators are planning to develop a series of videos and online presentations for Spanish speaker growers, fieldworkers, PCAs and other people interested parties.

The primary scope is IPM, including the management of the most relevant pest such as powdery mildew, botrytis, mealybugs, ants, and spiders. New topics would be considered and proposed into a new grant based on the feedback that the team receive from the audience.

If you would like to have more information about this project, you can contact Dr. Torres at gabtorres@ucanr.edu or 559-684-3316

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Upcoming Meeting

As you know, the State of California is still dealing with the spread of COVID-19. Due to the current Covid19 outbreak UCCE has postponed all large 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.

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