Field Notes
San Joaquin County
November 2023

University of California
Agriculture and Natural Resources

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Tree & Vine Fall Weed Management

The 2023 post-harvest season is upon us, and it's time to prep for your fall/winter weed control activities. The long-range forecast is calling for another wet winter, and November is the ideal time to plan your early winter weed control program, to check that your spray equipment is functioning properly and calibrated, and to clean your orchard floor of nuts and debris.

Weed Control Options

There are a variety of herbicides available today for our tree and vine production systems. No one herbicide will control all the weeds present, but choices exist to achieve excellent control for almost every weed combination. It takes patience and persistence, however, to win the weed war. Before programs are decided, the following things should be discussed with your pest control advisor (PCA): tree age, root stock, soil composition (sand, clay, gravel), irrigation design and practices, water source and quality, cultural practices used, a list of weed species present, whether the weeds are annual, biennial, or perennial weeds, your spray nozzle design, spray volume required, and if there are sensitive crops nearby. Discussing these early will provide the basis for your PCA to make the best recommendations possible while allowing your applicator to minimize the risk of crop injury or drift issues.

Early Weed Control Advantages

The advantage of implementing an early pre-emergent herbicide program "before leaf fall occurs" is to get a jump start on winter germinating weeds at a time when they are just emerging and susceptible. Applying a pre-emergent ahead of a rain, or by activating with sprinklers, it will control millions of weed seeds and provide a clean tree row for 4-6 months into spring. Applying a pre-emergent ahead of leaf drop also eliminates an additional operation of sweeping or blowing leaves after leaf drop has occurred. Weed control is enhanced and herbicide efficacy is extended when the herbicide is already in place before leaves cover the soil. A leaf barrier after an application inhibits weed germination and improves herbicide efficacy. As more orchards and vineyards turn to drip irrigation, relying on rain events to set herbicides becomes critical. A weed management program applying soil active herbicides early in the fall (November/December) and repeated in spring while rain events are still forthcoming (March/April) will provide good weed control into summer. Orchards with sprinkler irrigation have more flexibility in timing their applications and selecting herbicides.

Pre-emergent herbicide use is also a recognized strategy to manage herbicide-resistant weeds that have become established. We hear complaints every year that post-emergent herbicides are failing to control the same weeds they used to and that higher application rates are needed to achieve the same level of control. Some of our more frequently used herbicides are developing weed resistance in the field. They include glyphosate, paraquat, sethoxydim, clethodim, rimsulfuron, and other related acetolactate synthase (ALS) inhibiting herbicides.

Herbicide resistant weeds continue to spread across the state in different cropping systems, with the greatest occurrence in perennial orchards and vineyards. Problematic weeds include annual ryegrass, junglerice, goose grass, hairy fleabane, palmer's amaranth, and horseweed or marestail, with several other annual weeds close behind in developing resistance. There are several approaches to control these resistant weed species, but the best option by far is starting with a pre-emergent herbicide program early and attacking weed seeds at the point of germination.

New Herbicides Expected in 2023-2024

We are always anxious to share information from our various weed and herbicide research trials, but we never know for certain when a new herbicide will be registered for use in California. Two new herbicides are expected to be available this coming season: florpyrauxifen-benzyl and a combination product with indaziflam and rimsulfuron.

Hulk (florpyrauxifen-benzyl) is a post-emergent synthetic auxin mode of action HRAC group 4 herbicide from Corteva Agriscience. It is a foliar uptake and systemic herbicide that translocates through the phloem and xylem accumulating in

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meristematic tissue. It exhibits herbicidal symptoms of twisting and epinasty, typical of phenoxy herbicides. It targets many broadleaf weeds, typical of phenoxy herbicides, but with greater efficacy on certain weed species (Fig. 1). Symptoms develop rapidly when plants are actively growing, but whole plant death may take several weeks to a month, depending on the growth stage and environmental conditions. Currently, labeled crops include pome, stone, citrus and tree nuts. Grapes are being explored and may be added to the label in 2025. Tank mix partners are needed for emerged grasses, which may include the use of glufosinate, glyphosate, clethodim and some ALS herbicides with post-grass activity. Generally, one should avoid using contact herbicides that readily burn leaf tissue, like paraquat, for example, since they may inhibit foliar absorption and systemic movement needed to control the weed. Check the label for specific recommendations.

Centrus (indaziflam + rimsulfuron) is a pre-emergent herbicide from Helena Agri Company packaged with two active ingredients and modes of action herbicides in HRAC groups 29 and 2. Centrus will provide long-term pre-emergence control over a broader spectrum of weeds and grasses (Fig. 2). It is labeled for tree fruit, nuts, and vines for residual weed control targeting winter and summer annual weeds common in orchards and vineyards, including annual ryegrass, filarees, fleabane-horseweed, malva, shepherd's purse, willow weed, knotweed, and many more. In all cases, it will be necessary to add a post-emergent herbicide for emerged weeds. By combining two active ingredients with different modes of action, it broadens weed control across more species while slowing herbicide resistance to either active ingredient. We need to be mindful of mixing different modes of action herbicides and not using the same herbicides repeatedly. By mixing different mode of action herbicides we strive to keep our products viable for years to come.

Mick Canevari, Advisor Emeritus
Brent Holtz, Orchard Systems Advisor and County Director

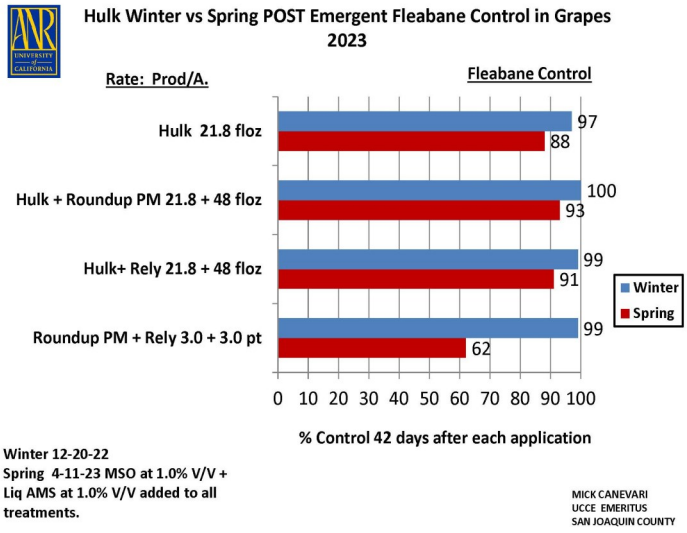

Figure 1. Winter vs spring fleabane control Hulk herbicide.

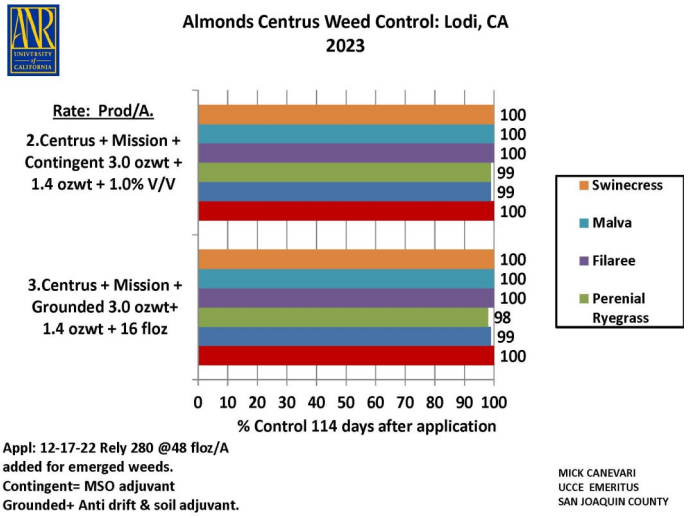

Figure 2. Centrus + Mission pre-emergent control of winter annual weeds.

Planting Tomatoes Following Walnut Orchard Recycling

With many walnut orchards being removed, some of that ground may be rotated into tomatoes in the coming years. Patricia Lazicki is a new UC farm advisor for Yolo, Solano and Sacramento counties and recently wrote a great newsletter article informed by her discussions with a walnut and tomato grower in her area. See her article below. Most of that discussion was around scenarios where the woody biomass was being removed from the site. On the other hand, if the walnut biomass is left on-site and is returned to the soil, then there are a few additional considerations I want to discuss.

Nutrient Tie-up with Biomass Incorporation

The woody biomass of an orchard has a high carbon to nitrogen (C:N) ratio. When the C:N ratio of any soil amendment is high, then the nitrogen tends to get used by microbes and incorporated into their cells. Eventually that nitrogen will get released to the soil from the microbial biomass turning over, but in the short-term, we say that the nitrogen is immobilized or "tied up" because it is not available to the crops immediately following woody biomass incorporation.

UC Farm Advisors Brent Holtz and Michelle Leinfelder-Miles have experience with whole orchard recycling (WOR) of walnuts prior to row crops being planted, and from their experience we can suggest:

- Make sure residues are spread evenly throughout the field (i.e., you don't want residues concentrated where the piles were). After spreading, incorporate grindings/chips as well as possible by deep disking or tilling.
- Increase nitrogen fertilization rates. I'd suggest testing the soil for available nitrate after the tomato field is established and before in-season nitrogen applications begin. The first year after WOR, an extra 100 pounds N or more might be warranted. We know that tomatoes take up around 250 to 325 lbs N per

season, but 50 to 75 lbs of that might be supplied by decomposition of the previous year's tomato resides, which obviously are not present in this post -walnut scenario. In the second year after WOR, extra N might not be warranted, but testing for available nitrate will provide reassurance that N isn't still immobilized.

- Infiltration will be greatly increased by the chips and may also be more variable, being higher at the spots where trees once stood. This could make it challenging to furrow irrigate tomatoes after orchard removal. Drip should mitigate this challenge to some extent.

Allelopathic Chemicals Produced by Walnut Trees

It is my impression that the risk of allelopathic chemicals carrying over in the soil after walnuts is exaggerated, based on what I have heard from grower experience of tomatoes following walnuts and based on the quick degradation of these chemicals in the soil after tree removal. The most common report is that tomatoes don't do well in the spots where the wood chip piles sat after orchard removal. However, that phenomenon is most likely due to nutrient immobilization (see above), not allelopathy. It is true that walnuts do produce juglones, which are known to be toxic to certain plants, including tomatoes. Tomatoes grown close to black walnut (within the root zone) are reported to develop "walnut wilt" primarily when tomato roots contact walnut roots. Black walnut produces more juglone than English walnut. The good news is that these juglones are water soluble and have a half-life in the soil of just weeks. The bad news is that they can persist in the intact bark of walnut roots for years. If feasible, chip or grind large roots that might be brought up by ripping, which will hasten decomposition and reduce the chance of tomatoes roots intercepting intact walnut roots.

Brenna Aegerter, Vegetable Crops Advisor

Tomato Following Walnut: Considerations & Tips

There are some concerns about growing tomatoes on old walnut ground, but very little formal research exists in this area. To support grower decision-making in the absence of this information, I reached out to processors and growers for their thoughts on how to make the transition successfully.

Processors' Concerns

Old walnut ground presents some special challenges for tomato harvest. I spoke with representatives from several canneries to get their thoughts on what to be aware of, and tips for avoiding expensive problems.

Talk about some of the issues with harvesting and processing tomatoes that have come out of walnut. Woody material can both slow down the harvest and end up in the load. Canneries have zero tolerance for woody materials, as they can damage processing equipment, plug sieves, and cause plant shut-down for cleaning. Nuts in the load will also cause it to be rejected, as potential allergens. Roots are especially an issue, since a field may look clean but have many roots below the surface that will be brought up by the harvester. They also may not be recognized by the dirt sorters. If detected as MOT at the PTAB grading station, large wood chunks mean a big deduction for the grower. Wood or nuts not showing up in the PTAB sample but detected while the load is being dumped can lead to the load not being processed. As well as being a financial hit for the grower ($138/ton*26 ton load=$3588 if reconditioning isn't an option), rejected loads can also mean more scrutiny in the future.

How does walnut differ from almond or other crops that leave woody residue? Sunflower, corn, and tomatoes can also leave woody residues in the field. Orchard debris breaks down more slowly. It may also be less likely to float, making it harder for the processor to sort it out from a load. Walnut orchards are more challenging than almonds as roots can be larger (a 40-year-old orchard can have roots that are 12 feet long and 8 inches in diameter). Large pieces are especially dangerous as they're the most liable to break equipment. They also take more labor to remove and persist longer in the soil.

Any tips for growers to avoid costly penalties? Consider growing another crop before putting in tomatoes; consult with the processor. Use due diligence in root removal. The more labor put in on the front end, the cleaner the loads will be. If tomato is the first crop after a walnut orchard, consider hiring extra sorters on the harvester to help prevent woody material from entering the load.

Grower Experience

Bullseye Farms is a large Yolo County operation which has experience successfully transitioning fields from walnut to tomato. Their take is that it's expensive and laborious to clean the ground well, but they haven't had problems with the harvest. Higher yields (likely due to low disease pressure) will make it profitable over time. I also spoke with other growers who are preparing to put tomatoes into old walnut ground but haven't yet done so.

What do you do to remove woody materials from the fields? Push the trees over, grind them up, and haul the biomass off. After this, run a ripper through to 2.5 feet and have hand crews pick up the roots, repeat until the field is clean. It's a significant cost; about $850/acre in labor, on top of the cost of the ripping, grinding and hauling ($1,400-$1,500/acre). The older the orchard is, the more laborious it will be to remove the roots.

What are some issues to watch for when transitioning ground from walnut to tomato? Pre-emergent herbicides used in orchards can have plant-back restriction periods of up to 18-20 months; it's important to check the dates and products used. Nutrient tie-up hasn't been a problem when the field was well cleaned and biomass was removed.

How have you seen this transition be most successful? Just put in the labor to really get the roots out, and be cautious about incorporating materials.

Take-home points

- Tomatoes have been successfully grown directly following walnut.
- There is risk, and it's important to put in the work after orchard removal to avoid problems at harvest.
- If planning to follow walnut with tomatoes, it could be a good idea to discuss with the processor how you plan to clean the field.
- Waiting for a year or two before putting in tomatoes will reduce the associated risks.

Patricia Lazicki, Vegetable Crops Advisor, Yolo, Solano and Sacramento counties

2023 Delta Rice Recap

Rice production in the Sacramento-San Joaquin Delta region has been steadily increasing in recent years (Table 1). While Delta acreage is only a fraction of that in the Sacramento Valley, Delta yields are consistent with statewide averages. I estimate that in 2023, the Delta had around 10,000 acres of rice. In this seasonal recap, I'll overview UCCE research in Delta rice, as well as provide some observations about the 2023 season.

Table 1. Rice acreage and yield.

California Rice Production						
	2022	2021	2020	2019	2018	2017
SJC* Acreage	8930	7070	4990	4360	3620	3060
Proportion of statewide acreage in the Delta	N/A	2%	1%	0.9%	0.7%	0.7%
Average SJC* Yield (cwt/ac)	101	95	88	81	86	82
Average Statewide Yield (cwt/ac)	N/A	91	87	85	97	84

*Rice acreage and yield according to the San Joaquin County (SJC) Agricultural Commissioner's Crop Reports. Rice acreage in SJC is primarily in the Delta region. Delta acreage in other counties is not included in these statistics. At the time of publishing, 2022 CDFA statewide data were not yet available (N/A).

Herbicide Trial

Over the last several years, we have conducted trials to evaluate the efficacy of a new herbicide product, Loyant (florpyrauxifen-benzyl; Corteva Agriscience), on grasses and sedges in the Delta drill-seeded system. Loyant is now registered and was available for the 2023 season. Over the last two years, I have been working with Deniz Inci (UC Davis graduate student) and Kassim Al-Khatib (UC Extension Specialist) to evaluate Loyant for efficacy on cattails. In the Delta's drill-seeded system, cattails may emerge ahead of the rice crop and outcompete the rice. In both years, we found that the label rate of Loyant had efficacy on cattails that were less than three feet tall (Fig. 1). When treated by that size, we were later able to pull up dessicated plants, including the rhizomes. Growers will need to be cautious of drift issues, however, because pistachio and grape are highly-susceptible to drift damage by Loyant, with almond, walnut, and peach being only minorly damaged, if at all.

Figure 1. The herbicide, Loyant, was trialed on cattails in the Delta in 2022 and 2023. We observed good control when cattails were less than 3 feet tall.

Armyworm Monitoring

I have been monitoring armyworm populations in the Delta since 2016, in collaboration with my UCCE colleague, Luis Espino. Monitoring involves scouting for damage and deployment of pheromone bucket traps that catch the moths. We can use trap counts and Growing Degree Day modelling (i.e. a temperature measure of time) to determine whether and when to treat fields. In 2023, we were thinking we might get away with minimal pressure because the population stayed low through early July. Then, the population spiked in mid-July, later than we had ever observed (Fig. 2). We surmise this was due to the cool, wet spring and later planting season. This year, Methoxyfenozide (Intrepid 2F) was available for use under full registration.

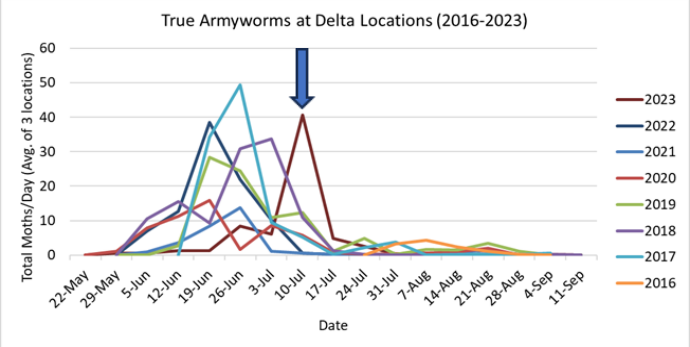

Figure 2. Delta true armyworm trap counts, 2016-2023. In 2023, the population was late to peak, likely due to the cool, wet spring and late planting season.

Disease Observations

We have identified diseases like stem rot, aggregate sheath spot, and rice blast on some Delta farms. It is important to scout for these diseases at late-tillering and early-heading because treatment timing is critical for management. Fungicide treatments are most effective

when applied between late-boot and early-heading. Rice blast may be exacerbated by too much nitrogen, and stem rot and aggregate sheath spot by low potassium (K). K can be limiting in some Delta soils, especially where the straw is baled. There is a loss of approximately 28 lb K/ac for every ton of straw removed. Consider leaf tissue sampling for K between tillering and panicle initiation. The Y-leaf should have a K concentration of at least 1.5%. At heading, the flag leaf should have a K concentration of at least 1.2%. On-farm consultations are a service provided by UCCE. Please reach out if I can help identify pests and provide management guidelines.

Weedy Rice

We should continue to keep weedy rice on our radars because we have observed it in the Delta. In-season management includes rogueing or spot spraying before viable seed is produced. The organic herbicide Suppress is registered for spot spraying. Post-harvest management should include straw chopping, but not incorporation, and winter flooding. This will keep seed on the soil surface, where it can potentially deteriorate over the winter.

Variety Trial

UCCE collaborates with the California Rice Experiment Station to evaluate commercial varieties and advanced breeding lines. The San Joaquin County Delta location was one of ten locations in the 2023 statewide trial. The Delta is a test site for very-early maturing varieties because it has cooler growing conditions than other rice growing regions of the state. Variety trial results will be made available in the February 2024 newsletter.

Cover Cropping

With funding from the CDFA Healthy Soils Program and CA Rice Research Board, I am collaborating with Sara Rosenburg (UC Davis graduate student) and Whitney Brim-DeForest (UCCE Rice Advisor) to evaluate winter cover crops. We are interested to learn whether cover cropping improves soil carbon and nitrogen dynamics in the rice system. Since rice may be grown over multiple seasons without rotation, cover crops may provide an opportunity to introduce plant diversity, including nitrogen-fixing legumes. Trials will occur from 2022-2025, and the Delta site is one of three (also in Butte and Colusa counties). The 2022-2023 winter season presented several challenges for cover cropping. At the Delta location, seasonal rainfall exceeded 25 inches, and in the ten days after planting, the site received nearly 3.5 inches of rain. In addition to saturated soils, bird predation was severe. This fall, our aim is to plant earlier, if conditions allow.

Thank you to all the growers who collaborated with us on these projects. I wish everyone a good end to the year and a great 2024.

Michelle Leinfelder-Miles, Delta and Agronomic Crops Farm Advisor

Protecting California's Vineyards From Summer Bunch Rot in a Wet Year

Weather Woes: A Wet 2023

This year's growing season brought added challenges and opportunities with its wet and cool spring weather that delayed budbreak and bloom in many regions around the state and promoted vine vigor. Additional precipitation created the potential for increased canopy density that traps humidity and stifles air movement, an ideal environment for fungi to thrive. The excess moisture not only heightened potential disease pressure but also made canopy management more critical. Weather this year kept powdery mildew pressure high from the end of May until mid-July in many areas (Fig. 1). Moreover, dense canopies decrease the penetration and distribution uniformity of fungicide sprays, diminishing their efficacy in combating fungal diseases. This situation underscored the need for reevaluating, and possibly, intensifying disease management strategies to mitigate the looming threat.

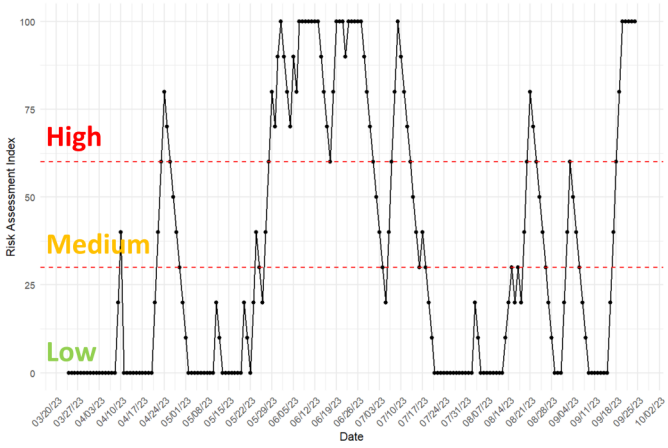

Figure 1. Powdery mildew risk index plotted over the 2023 growing season, from a weather station in the Lodi region of San Joaquin County, from data provided by https://ipm.ucanr.edu/weather/grape-powdery-mildew-risk-assessment-index/.

Summer Bunch Rot

Symptoms of summer bunch rot (SBR) first show up as a light brownish discoloration in affected berries within a cluster in both white and black skin cultivars of grapes. This discoloration may appear similar to sunburn, but there are some key differences (Fig. 2 on page 6). While overexposure of the fruit to sunlight during periods of high heat can cause oxidative damage at any point in its development, SBR only develops in fruit that have accumulated 8 °Brix or more, with the greatest susceptibility to infection occurring after veraison or berry softening. Location of damaged berries in the cluster is also an informative difference. With sunburn, the damage occurs only on one side of the cluster on the side of the canopy that is exposed to the hot afternoon sun. With SBR, any berry that is wounded or damaged may become infected (Fig. 3 on page 6) if wet/humid canopy conditions, which are conducive for the pathogens, occur late in the season. Summer bunch rot may initiate outside

of view, inside of the cluster, with tight cluster varieties prone to skin splitting such as Pinot Noir, Riesling, and Zinfandel to name a few.

Once infection begins it may spread from berry to berry. The culprits behind SBR are a medley of microorganisms including, but not limited to, *Botrytis cinerea*, several *Aspergillus* and *Alternaria* species, and more, any of which can cause the disease (Fig. 4). In time, as the pathogen develops, the spores produced are helpful in identifying the exact culprit. In cool climates, such as coastal sites in which foggy conditions are common, *Botrytis* is the main cause of bunch rot. In hotter climates less favorable to *Botrytis*, the other pathogens in the summer bunch rot complex compete with each other for the sugary resources of the compromised fruit.

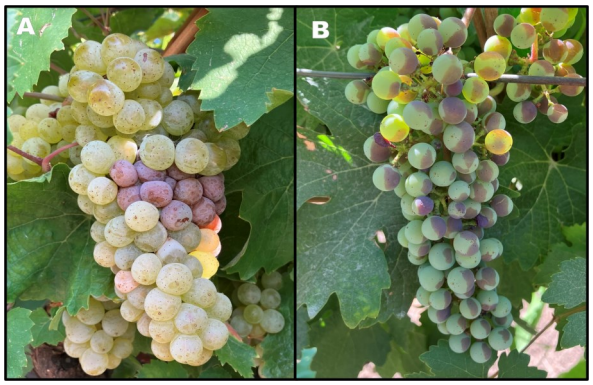

Figure 2. Oxidative damage to berries caused by A) summer bunch rot and B) sunburn. While the reddish-brown color may look similar, the causes of the damage are very different. While low levels of sunburn on fruit is reversable, once rot has invaded a berry this damage cannot be undone.

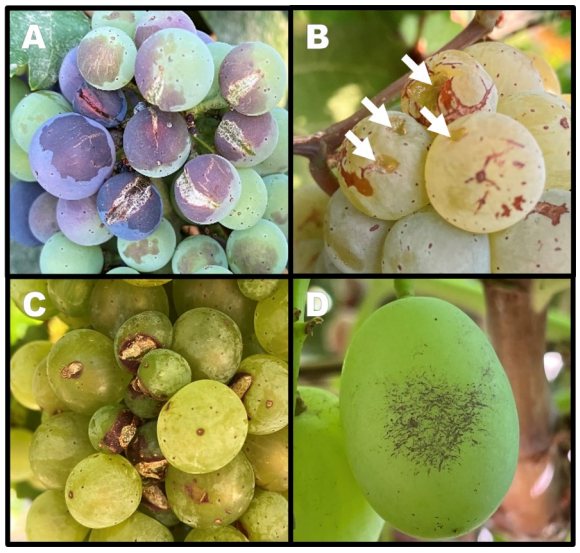

Figure 3. Summer bunch rot will start from wounded berries when wet and humid conditions provide the proper environment for fungal pathogens to invade. Infection is opportunistic, exploiting any type of injury such as A) sunburn, B) bird damage highlighted with arrows, C) mechanical damage, or D) powdery mildew scars.

Sour Rot

In addition to fungal pathogens, yeasts, acetic acid bacteria, and fruit flies (*Drosophila*), are also attracted to injured fruit, which work together to cause sour rot. Fruit flies are attracted to rotting berries and lay their eggs inside of them, spreading yeasts and bacteria which cling to the bodies of the flies as they travel across clusters. Inside of the infected fruit, yeasts digest sugars and produce alcohol while bacteria convert that alcohol into acetic acid, the main component of vinegar, releasing a strong characteristic smell. This is the main difference between sour rot and summer bunch rot. As the larvae of the fruit fly grow and develop inside the berry, they crawl around chewing up the inside of the fruit, liquefying the pulp, and allowing the leakage of berry juice (Figure 5).

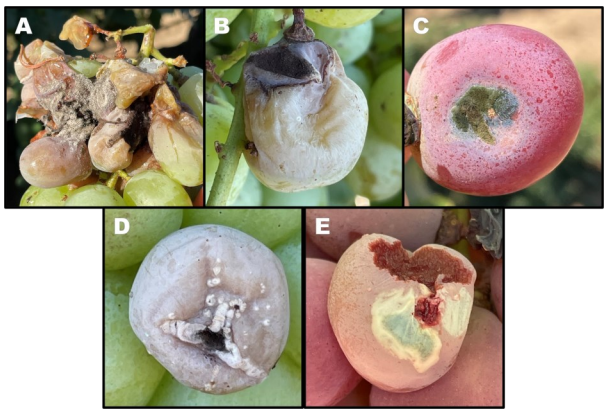

Figure 4. Berry symptoms of summer bunch rot/sour rot on berries caused by different pathogens. A) *Botrytis* bearing greyish spores, B) *Aspergillus*, C) *Cladosporium*, D) yeast and E) *Penicillium*.

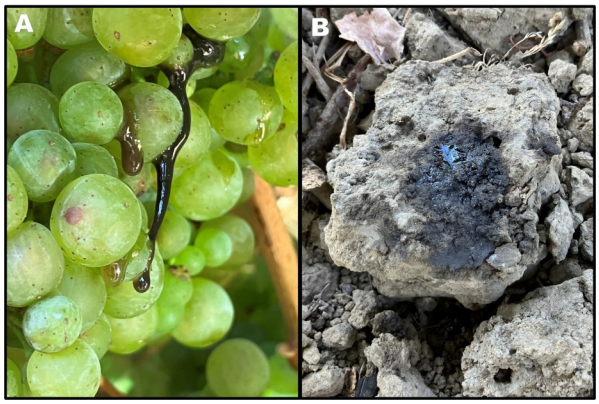

Figure 5. In areas of the vineyard where summer bunch/sour rot abounds, berries often leak juice containing the pathogen which will allow infections to travel to neighboring berries or clusters. A) The color of the discharge can vary from clear to black depending on the presence of bacteria or fungal spores in the leakage. B) By looking on the soil surface under the vine row you can often identify areas where leaking from rot is occurring, shown as dark colored stains directly below the rotting cluster.

Aspergillus Vine Canker (AVC): A Stealthy Adversary

Of the several pathogens that can cause SBR, *Aspergillus* is unique in that it can also infect and colonize woody tissues under the right conditions. After gaining access to considerable carbohydrate resources in ripe fruit, in areas where clusters are rotting directly against shoots, *Aspergillus* may grow into the adjacent tissues colonizing right through intact bark, causing cankers. This is very different from most Grapevine Trunk Diseases that primarily invade through dormant pruning wounds during the winter months when weather is wet and spore levels are high.

AVC symptoms distinctively manifest through premature senescent leaves in affected vines during the fall, contrasting with the still green leaves of healthy neighboring vines. A single vine can harbor multiple cankers located on various parts, such as the trunk, cordon, and spurs. The key sign of AVC is the black sporulation visible at the surface and underneath the bark of affected vines, unlike other trunk disease pathogens that form embedded fruiting bodies in the wood.

Salvaging the Crop when SBR Strikes

In vineyards where fruit is hand harvested, the answer is simple; fruit affected by SBR can be avoided as to not taint the crop destined for the winery. Mechanically harvested vineyards, however, must have rotted fruit cut out before the harvester rolls through to prevent it from compromising the quality of the lot. This practice presents an additional cost to growers but is necessary under the circumstance to save the harvest. But what should you do with unsold fruit infected with SBR? Is it worth it to spend the extra money to drop clusters in hopes of reducing disease pressure in the next season? From a plant pathologist's perspective, the decayed clusters, whether left on the vine or fallen to the ground, are unlikely to significantly impact fungal disease pressure in the subsequent year, as long as standard vineyard maintenance practices, including dormant pruning and floor disking of inter-rows, are employed. The incorporation of infected fruit into the soil allows for its decomposition, reducing the spore loads for the following season. Fruit can be left on the vine until the dormant pruning, when it is removed with shoots and worked into the soil.

The intertwined challenges of Summer Bunch Rot, Aspergillus Vine Canker, and rotten or unsold fruit depict the multifaceted adversities faced by wine grape growers. Yet, with a blend of informed management practices and a community dedicated to advancing viticulture, the horizon holds promise for the lush and productive vineyards of California.

Justin Tanner, Viticulture Advisor
Marcelo I. Bustamante and Akif Eskalen, UC Davis Plant Pathology

Compost Application to Alfalfa

The term ‘soil health’ has become a common term in agricultural research and management. While most of us are familiar with testing soil for chemical properties, like nutrients, salinity, and pH, soil health also considers soil physical characteristics – like compaction, aggregation, and water infiltration – and biological characteristics – like soil respiration, active carbon, and nitrogen mineralization.

These properties influence the soil’s ability to function, and enhancing these properties can improve soil functioning to grow crops and produce ecosystem services. We often relate soil health to management practices like crop rotation, cover cropping, reducing tillage, and adding compost because these have been shown to increase soil functioning in agricultural landscapes. They are also some of the practices that are financially incentivized by the CA Department of Food and Agriculture Healthy Soils Program.

With a Healthy Soils Program grant, we have been evaluating the use of green waste compost on established alfalfa. Compost is decomposed organic matter from plants or animals. Plant-derived composts – like green waste compost – have a high carbon-to-nitrogen ratio (C:N), which is the relative amount of carbon and nitrogen in the material. Animal-derived composts have a low C:N. The C:N ratio is important because it affects microbial metabolic functioning and plant-available nitrogen.

There is a regulatory framework for diverting green waste from landfills to make compost. In 2014, AB 1826 was passed in California, which requires businesses to recycle organic wastes and jurisdictions to set up organic waste recycling programs to divert green waste from landfills. In 2016, AB 1383 established organic waste reduction targets (75% reduction by 2025, compared to 2014). The bill also required jurisdictions to do education and outreach. Green waste diversion is expected to reduce greenhouse gas emissions by 4 million metric tons per year and increase food recovery by 20 percent. Agricultural land could serve to receive green waste compost recovered by this regulatory framework.

Our project objectives were to learn whether green waste compost improves soil nutrient status or other soil health characteristics, whether it improves alfalfa yield or quality, or if its application affects greenhouse gas emissions from the system. Alfalfa was chosen for this study because it has a large footprint on the state’s agricultural landscape and because it has a high phosphorus (P) and potassium (K) nutrient need which compost could help supply. Also, as a ‘high-traffic’ crop, alfalfa soils can have poor physical traits (e.g. compaction, water infiltration), which could potentially be ameliorated with compost.

The study was conducted on commercial farms in Yolo and San Joaquin (SJ) counties. The Yolo site had a mineral soil with high clay content (approximately 50 percent clay), and the SJ soil was a mucky clay with high organic matter (approximately 8 percent). We are comparing two green waste compost rates (3 and 6 tons per acre) to the untreated control. Compost applications were annually (2020-2022) surface-applied in the fall/ winter ahead of rain.

Our preliminary results indicate no statistically significant differences in total carbon and nitrogen among treatments (Fig. 1). There is a trend, however, for compost to increase carbon at the Yolo site, which is inherently low in organic matter. An interesting observation about the SJ site, where the soil is inherently low in K, is that the compost increased soil K (statistically significant, Fig. 2). The compost analysis showed that the product was roughly 1 percent K. Therefore, the 3-ton compost rate should have added approximately 50 lb of K per acre, and the 6-ton rate approximately 100 lb of K per acre. Based on the amount of change in soil K and the

compost analysis, the compost was likely what contributed to the increase in soil K. This appears to be translating into higher tissue K (Fig. 2), and in turn, higher yields (though neither tissue K nor yield are statistically higher than the control, Fig. 3).

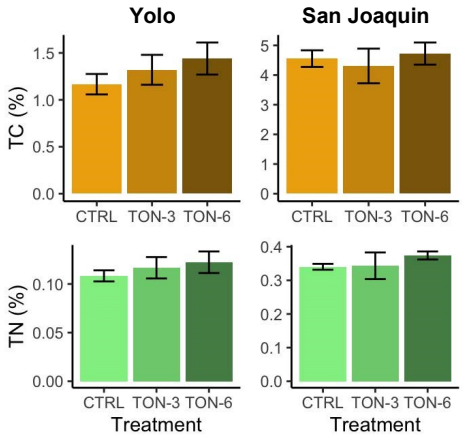

Figure 1. There were no statistically significant increases in soil carbon (C) or nitrogen, but there was an observed trend for C to increase at the Yolo site, which has inherently low soil organic matter.

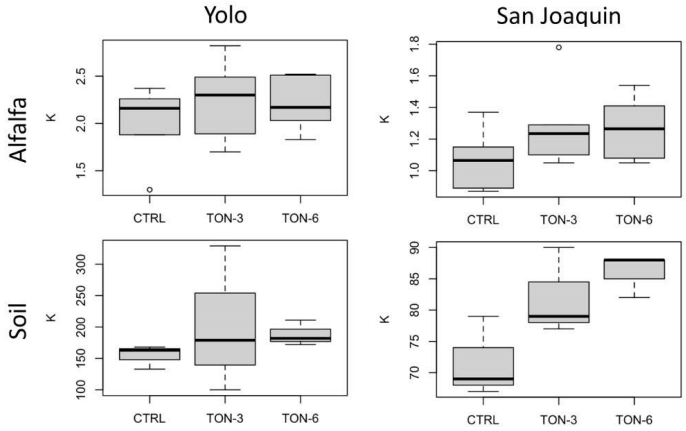

Figure 2. Compost increased soil potassium (K) at the SJ site, where soil K is inherently low. There was a trend for alfalfa tissue K to increase at the SJ site, which was likely the due to the higher soil K.

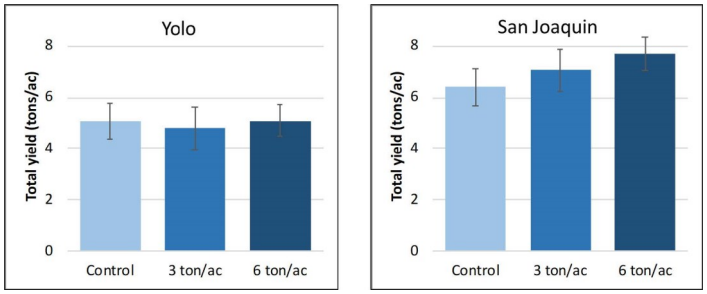

Figure 3. Compost amendment did not statistically improve alfalfa yield, but there was a trend for yield to increase at the SJ site, which we attribute to improved K availability.

Greenhouse gas emissions have not differed among treatments (Fig. 4), indicating that the carbon that is added by the compost is not being respired from the system. There are higher CO_2 emissions at the SJ compared to the Yolo site, which we attribute to the inherently higher carbon of the SJ soil. Additionally, we have observed that the soil acts as a methane sink. This is noteworthy because methane is a more potent greenhouse gas than CO_2.

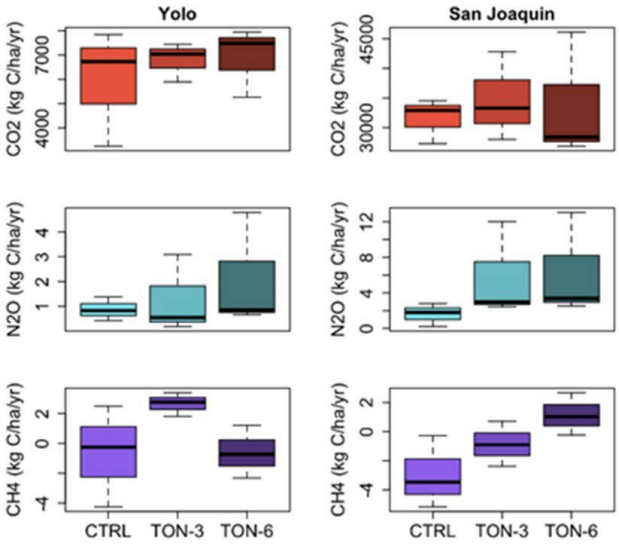

Figure 4. Greenhouse gas emissions did not significantly increase with compost amendment.

Based on our experiences working on this project, we have the following guidance for growers interested in applying green waste compost. While green waste compost is a relatively cheap input, transport cost can be high. In 2021, we estimated that material plus hauling cost was approximately $27/ton and spreading was an additional $10/ton. The highest demand for compost is in the fall. To ensure availability, growers should aim to purchase compost in the spring or summer and store it on-site until fall. Ordering the compost in spring or summer also tends to result in a higher quality product delivered (i.e. less trashy). Timing compost application can be a challenge (i.e. after all harvests but before soil gets too wet), so having the compost already on-site may help in getting it applied more readily. We still have more data to analyze for this project, so more information will be forthcoming. We want to thank the growers in Yolo and San Joaquin counties for collaborating with us on this project.

Michelle Leinfelder-Miles, Delta and Agronomic Crops Farm Advisor
Radomir Schmidt, UC Davis Center for the Environment

Virtual Fencing Becoming a Reality

Wireless dog collars have been around for quite a while. Many of us probably know someone who uses them. But what about using the technology for other critters and in bigger pastures than the yard? The same basic technology is being used to keep cows, sheep, and goats in their “yards.” Virtual Fencing (VF) has been used for a few years and is slowly making its way to the United States and California.

The VF technology is very similar across companies and is user-friendly even for those of us who are not tech savvy (including myself!). The GPS locations are loaded into the collar. Then, if an animal gets close to the invisible line, they hear an audible cue letting them know they are approaching the boundary. If they keep moving forward and cross the “fence line,” they receive a small shock, just like the dogs do. If they keep moving forward, they do not keep getting shocked. Anyone who has

worked around animals knows what would happen in that case: they would not turn around and come back. They would instead run off to get away from the shock. Each company handles this slightly differently, but the animal is given a chance to correct course and get back into the pasture. Most products continue with audible cues and the occasional shock to get them to turn around. The collars also have a failsafe, where after a certain time period, they no longer shock the animal.

Most of the collars have an interface with your phone, so you can be in a meeting in Sparks, pull up your pasture and see where your animals are. A rancher I know in Humboldt did just that at the California Cattlemen's Convention last year as she was telling us about the technology and how it was working on their ranch. She could also change the pasture shape from her phone. Imagine being able to move your animals without even having to be at the ranch.

Since I am not a techie, I am more interested in the use of the collars and not the nuts and bolts of how they work. Australia, one of the early adopters of the collars, has a law on their books that states only dogs can have these types of collars for animal welfare reasons. Researchers had to investigate the animal welfare concerns to have them approved. They collected blood to examine cortisol levels and found no difference between cows with the collar versus the controls; VF was no different from electric fencing. Researchers used the VF to bring pasture based dairy cows in to be milked twice a day and found the cost of the collar was cost effective for moving animals and did not impact milk production.

We know the collars work and do not create undue stress on the animals, so how can we use them in California? I think the options are huge and could open a lot of grazing ground for ranchers (e.g. creating sub-pastures to increase stocking rate on invasive grasses like Medusahead; accessing steeper slopes where traditional fencing is not as feasible). Not only could VF be used to help manage your ranch, it could be used for targeted grazing where there are no fences, like when a fire goes through an area and fences are lost, especially interior fences. They could also be used on public lands to avoid sensitive areas or on public lands where grazing was removed but there are resource concerns that grazing could address. Those are just some ideas. The VF companies are working to be approved in the United States, but we do have one start up in California. There is currently only one company that has collars for small ruminants.

The collars have plusses and minuses of course, but the technology is changing rapidly. I'm sure in a couple of years they will have made leaps and bounds forward to provide a collar that will work anywhere and be cost effective. This is one future item the Jetsons never had! If you are interested in learning more, you can search "virtual fence" and either cattle, sheep, or goats depending on which livestock you have.

Be on the lookout for more information in the future. My colleagues to the east have a small grant to use VF in different settings that are just getting underway. NRCS is considering having VF be an option for EQUIP funding in the future. The advances we see in technology just make me remember a song from the late 80's, "The future's so bright, I gotta wear shades."

Theresa Becchetti, Livestock and Natural Resource Advisor, Stanislaus and San Joaquin counties

UC ANR Announcements and Calendar of Events

Climate-Smart Practices for Fruit and Nut Production Workshop
Wednesday, November 29, 2023
8:30am – 5:00pm
International Agri-Center, 4500 South Laspina Street, Tulare, CA 93274
Registration: https://na.eventscloud.com/climatesmart2023
For more information, email anrprogramsupport@ucanr.edu.

SJC and Delta Field Crops Meeting
Friday, January 12, 2024
8:00am – 12:00pm
SJC Cabral Agricultural Center
Save the date! More information to come on the Delta Crops blog: https://ucanr.edu/blogs/sjcfieldcrops/.
Contact: Michelle Leinfelder-Miles, mmleinfeldermiles@ucanr.edu.

Grape Day
Tuesday, February 6, 2024
7:30am – 1:00pm
Hutchins Street Square, 125 Hutchins Street, Lodi, CA
Contact: Justin Tanner, jdtanner@ucanr.edu.

Northern San Joaquin Valley Processing Tomato Production Meeting
Wednesday, February 7, 2024
8:00am – 11:00am
Modesto Centre Plaza/DoubleTree Hotel, 1000 L St., Modesto, CA, 95354
in conjunction with the California Tomato Growers Association Annual Meeting
For info on educational portion, contact Brenna Aegerter, bjaegerter@ucanr.edu.
For info on CTGA luncheon meeting and exhibition: (916) 925-0225 or info@ctga.org.

Rangeland Summit
Friday, February 23, 2024
8:00am – 5:00pm
SJC Cabral Agricultural Center
Contact: Theresa Becchetti, tabecchetti@ucanr.edu

Principles of Fruit and Nut Tree Growth, Cropping, and Management
March 11-15, 2024
UC Davis
Registration is open: https://fruitsandnuts.ucdavis.edu/events/2024-principles-fruit-nut-tree-growth-cropping-and-management
For more information, email fruitsandnuts@ucdavis.edu.

CLIMATE-SMART PRACTICES FOR FRUIT & NUT PRODUCTION WORKSHOP

Date: Wednesday, November 29th, 2023
Location: International Agri-Center
4500 South Laspina Street- Tulare, CA 93274
With: UC Davis, UC Merced, Land IQ, UC ANR
Registration: $30
(Includes participation fee, coffee breaks, lunch meal, workshop materials, and access to workshop presentations)
Online Registration Link:
https://na.eventscloud.com/climatesmart2023
CEU Credits available

WORKSHOP AGENDA

8:30 - 9:00 am:	On-site Registration
9:00 - 9:15 am:	Welcome to participants. Overview on the Climate-Smart Projects (D. Zaccaria, UC Davis and T. Pathak, UC Merced)
9:15-9:30am:	Financial Incentives for Resource Efficiency, Conservation, and Climate Risk Mitigation (S. Weeks, CDFA-OEFI)

Session 1 - Issues and Challenges in Fruit and Nut Production under Changing Climate: *Moderator: D. Zaccaria*

9:30 - 10:00 am:	Climate Change Trends and Potential Impacts on Agricultural Production (T. Pathak, UC Merced)
10:00- 10:30 am:	Major Challenges for Fruit and Nut Production (C. M. Culumber, UCCE Fresno County)
10:30 - 11:00 am:	Effect of Climate Change and Variability on agricultural pests and potential risk management (Dr. Jhalendra Rijal, UCCE and Statewide IPM Program)
11:00 -11:15 am	**COFFEE BREAK**

Session 2 - Tools and Resources for Climate-Smart Agriculture: Moderator: T. Pathak

11:15 - 12:00 pm:	The CDFA Climate-Smart Web Repository (S. Tillman, Land IQ)
12:00- 12:30 pm:	Climate Change, Changing Electricity Grid, and their Impact on California's Irrigated Agriculture (A. Aghajanzadeh, Klimate Consulting).
12:30 - 1:15 pm	**LUNCH BREAK**
1:15 - 1:45 pm:	CalAgroClimate Decision Support Tools for Managing Risks in Agriculture (T. Pathak, UC Merced)

Session 3 - Case Studies on Regional Adaptation Practices: *Moderator: C. M. Culumber*

1:45 - 2:15 pm:	Water-related effects of Winter Cover Cropping in Nut Orchards (D. Zaccaria, UC Davis).
2:15- 2:45 pm:	Physiological effects of Winter Cover Cropping in Grapevine (R. Yu, CSU - Fresno)
2:45 - 3:00 pm:	**COFFEE BREAK**
3:00 - 3:30 pm:	Mitigation of Heat and Drought Risks in Grape Production (K. Kurtural, Kurtural Consulting)
3:30- 4:00 pm:	Use of weather information for addressing frost, heat, and spray drift risks (M. Battany, UCCE San Luis Obispo and Santa Barbara Counties)
4:00 - 4:30 pm:	Whole orchard recycling can sequester carbon, reduce nitrogen leaching, and improve soil fertility while reducing air pollution (B. Holtz UCCE San Joaquin County)
4:30 - 5:00 pm:	QUESTIONS & ANSWERS and WORKSHOP EVALUATIONS
5:00 pm:	**WORKSHOP ADJOURN**

For questions, please contact:
Maria Alvarez and PJ Kelly - UC ANR Program Support Unit.
Email: anrprogramsupport@ucanr.edu; Phone: (530) 750-1361.

2024 Principles of Fruit and Nut Tree Growth, Cropping, & Management

March 11th to March 15th, 2024

Foundation Plant Sciences | UC Davis Teaching Orchards

Learn the fundamentals of fruit and nut tree biology through lecture, labs, and field demonstrations taught by leaders in pomology at the University of California.

Registration is open now until February 29th, 2024

An optional four-day field trip will be held in the Sacramento and San Joaquin Valleys during the following week (March 18th to 21st, 2024) for an additional fee.

For course content questions, please contact the Fruit & Nut Research & Information Center staff at **fruitsandnuts@ucdavis.edu**

UC CE

University of California
Agriculture and Natural Resources

Cooperative Extension
San Joaquin County

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Notes from the Field

November 2023

The University of California working in cooperation with San Joaquin County and the USDA.