Sacramento Valley Walnut News

Spring, 2023

University of California
Agriculture and Natural Resources | Cooperative Extension

In This Issue

Submitted by:

Luke Milliron
UCCE Farm Advisor
Butte, Glenn, and Tehama Counties

New Orchard Advisor Introduction

My name is Clarissa Reyes, and I am the new Orchard Systems Advisor for Sutter, Yuba, Butte & Placer Counties. My primary crops are walnut, peach, and kiwifruit, and I'm based out of the UC Cooperative Extension (UCCE) office in Yuba City. I have been working as a research assistant in almond, walnut, and prune in the North Sacramento Valley for the past two years, so while some of you may have seen me around, I am looking forward to meeting and serving folks in this new role!

While working in the Sacramento Valley with UCCE Orchard Advisors Janine Hasey, Franz Niederholzer, and Luke Milliron, I have supported several projects, including rootstock and variety trials, whole orchard recycling, and irrigation management experiments. Prior to that, I earned my MS in Horticulture and Agronomy from UC Davis. There I researched soil-plant-water relations in grapevine, where I focused on learning how plants transport water and respond to drought in order to improve rootstock development. I've also done work combining on-the-ground measurements like stem water potential and soil moisture with remote sensing to develop grower support tools.

I am delighted to work in this beautiful region, close to where I was born and raised in Sacramento, and to join a growing team of UCCE orchard advisors. I understand that growers have been experiencing some especially tough times lately, and I hope to work with you all to develop practical ways to adapt to these challenges.

I can be reached by email at clareyes@ucanr.edu, by phone at (530) 822-7515, or by visiting the office at 142A Garden Highway, Yuba City, CA 95991.

Walnut Management Considerations- Budbreak through Early Summer

Jaime Ott, UCCE Orchard Advisor, Tehama, Shasta, Glenn, and Butte Counties
Clarissa Reyes, UCCE Orchard Advisor, Sutter, Yuba, Butte, and Placer Counties

As we enter another year of high input costs and low prices, we've tried to whittle our considerations to the highest priority issues and tasks that will give an adequate return on your investment of time and products, rather than enumerating best practices to create a beautiful, pristine orchard.

April

- With the rain this year, many orchards are contending with flooding. This can lead to waterlogging and infection by *Phytophthora* species. Take photos to document any flooding in your orchard. Check out the Flood Damage articles available at SacValleyOrchards for more information.
- Keep an eye on the weather to prepare for a potential spring freeze. If a freeze is in the forecast, ensure that your orchard soil is moist and that any groundcover is mowed to below 2". This allows sunlight to heat the orchard floor during the day, warming the orchard at night. Running sprinklers during the frost can also provide some protection.

- Scout for limbs killed by Bot canker, which are easy to identify between budbreak and full leaf expansion. Wait to prune out this dead wood until there is no longer rain in the forecast.

- If last year's leaf analysis indicated zinc deficiency, apply foliar zinc when shoots are 6-10 inches long, when zinc can easily be absorbed by the leaf surface. This will ensure the maximum benefit from your investment. Blends with additional micronutrients will likely not show a return for the additional cost. Zinc is critical for carbohydrate production that leads to nut fill and stress responses that can avoid other quality issues. It's worthwhile to correct a deficiency, but for orchards that are not deficient, a spray is probably not worth the investment this year.

- If you're going to invest in applying water and nutrients this year, make sure it will get where it is needed through irrigation system maintenance. Check your irrigation system and address maintenance issues now, before they cause tree stress and reduced yields, and before expensive nutrients get concentrated in some zones and shorted in others. Check for broken or clogged emitters, splice new line into sections with temporary repairs from last season, and replace/refill filter media if needed. Contact your county's Resource Conservation District Mobile Irrigation Lab for a free assessment of your irrigation system.

May

- Time first and subsequent irrigations to when trees reach mild stress levels. If using a pressure chamber, wait to begin irrigating until stem water potential is 2-3 bars drier than the baseline. If relying on ET information, allow ET totals to accumulate to 3 to 5 inches greater than rainfall received after leafout and monitor soil moisture by feel with a soil auger. The soil moisture should at least show significant drying into the first and second foot of soil in the rootzone to trigger the first irrigation. Ongoing research has found that irrigation can be delayed until June in some years, saving water and pumping costs without affecting nut yield, size, or quality. This can also improve root development and water uptake later in the season. Refer to the irrigation article in this newsletter for more information.

- May is the time for an initial nitrogen application. Given the high cost of nitrogen, this is an important year to consult last year's leaf nitrogen results before investing in additional fertilizer. Research in the 1980s indicates that trees have a large buffer of nitrogen than can help supply a large portion of the nitrogen budget to muddle through these high cost, low price times. See the article in this newsletter for more information.

- Consider adapting your IPM program to find some cost savings, emphasizing control of direct pests that will lower your grade quality (i.e. codling moth, husk fly, NOW, mold) rather than indirect pests like scale. Monitoring for pests is less expensive than treating for pests you don't have. See the article in this newsletter about prioritizing sprays for more information.

- Walnut blight remains a concern through May, given the delayed timings of this year. Consider using the Xanthocast model to decide if you can skip a spray. The first blight spray should be when 30-40% of the buds reach the "prayer" stage, and follow-up sprays should be applied every 7 to 10 days as long as rainfall continues. If you are going to skip any walnut blight sprays the later ones are the ones to skip – research has shown that the first two sprays at the start of the season are the most critical and each spray after has reduced impact. For each spray, follow a rotation using the four registered materials available for walnut blight management. Check with your PCA if including recently registered Dodine in place of Manzate may save costs this year. Make sure that your sprayer is calibrated and that you spray every row—if something isn't covered, it isn't protected.

- Survey weeds to assess the efficacy of your fall and winter weed control treatments. Use the UC Weed ID Tool for identification, and the Herbicide Chart for weed control information.

June

- Monitor stem water potential or soil moisture to avoid overwatering. Once the trees require irrigation, use drought irrigation strategies to avoid overapplication and unintentional water loss through deep percolation. Avoid long irrigation sets that lead to standing water and increased risk of *Phytophthora* infection.

- Hang walnut husk fly traps by June 1st. Yellow sticky traps charged with an ammonium carbonate lure work best. Check traps 2-3 times per week and treat based on detection of eggs in trapped females, overall trap catch numbers, or the first flies caught depending on the spray material used, husk fly population, and previous damage.

- Continue monitoring codling moth traps to determine subsequent biofixes. Use trap catches, dropped nut evaluation, canopy counts, and orchard history to determine the need to treat the second flight.
- Spider mite treatment might not be worth the investment in all circumstances this year, but if forgoing treatment leads to severe defoliation, sunburnt nuts, and decreased quality ratings, it may still pencil out. If necessary, monitor for spider mites and their predators weekly through August because treatment decisions should be based on thresholds of numbers of mites and their predators. Consider just treating hot spots to avoid severe defoliation while still being cost conscious.

Healthy Orchards with A Careful Approach to Irrigation in 2023

Luke Milliron, UCCE Orchards Advisor Butte, Glenn, and Tehama
Curt Pierce, UCCE Irrigation Advisor Glenn, Colusa, Tehama, and Shasta
Bruce Lampinen, UCCE Walnut Specialist, UC Davis
Allan Fulton, UCCE Irrigation and Water Resources Advisor Emeritus

All walnut growers want a healthy orchard. Can this still be achieved when crop prices are at rock bottom, and expenses are at an all-time high? A careful approach to irrigation in 2023 is one way to both save money and help ensure you have a healthy and productive orchard.

One of our favorite anecdotes comes from an Israeli irrigation researcher who once noted at a conference: "Growers don't irrigate when the tree is stressed; they irrigate when *they* are stressed." We saw the effects of this during the 2022 drought season when multiple walnut orchards we visited showed poor growth and yellowing leaves, a symptom of prolonged over-watering (Figure 1).

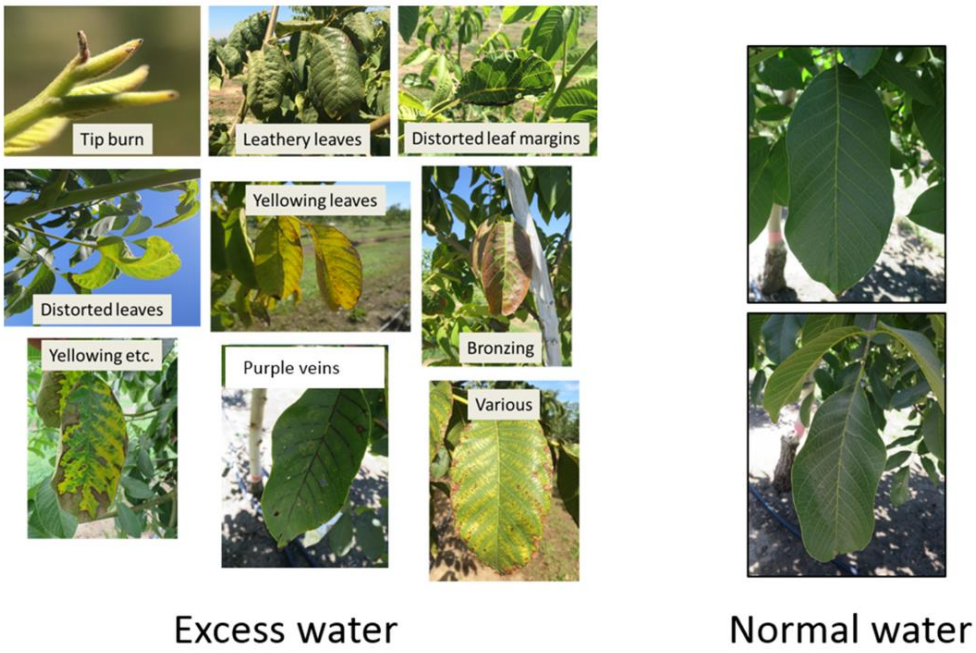

Figure 1. Leaf symptoms of overwatered walnut trees: Various symptoms were observed on trees intentionally over-irrigated throughout the season. Leaf samples listed as normal water were taken at a similar time of the season on trees that were not over-irrigated (photos by Bruce Lampinen).

Currently, the pressure chamber is the only way to consistently irrigate a walnut orchard at an appropriate time for the trees, instead of when we (or the soil, the weather, and our neighbor) are stressed. Butte County growers who have recently adopted the pressure chamber have noted that they saved on PG&E and have healthier looking orchards by not over-irrigating during heat spells, all without reducing yield.

The UC's best practice to save money and help ensure a healthy orchard and good nut quality is to use the pressure chamber and irrigate when trees are between 2 and 3 bars drier than the fully watered baseline season-long. If you start the 2023 season by waiting for the trees to reach this threshold (i.e., the trees are letting you know they are mildly water stressed) and apply subsequent irrigations at this threshold, you will save on water, PG&E bills, and make your trees LESS water-stressed come fall (likely because you didn't suppress root growth in the spring by overwatering).

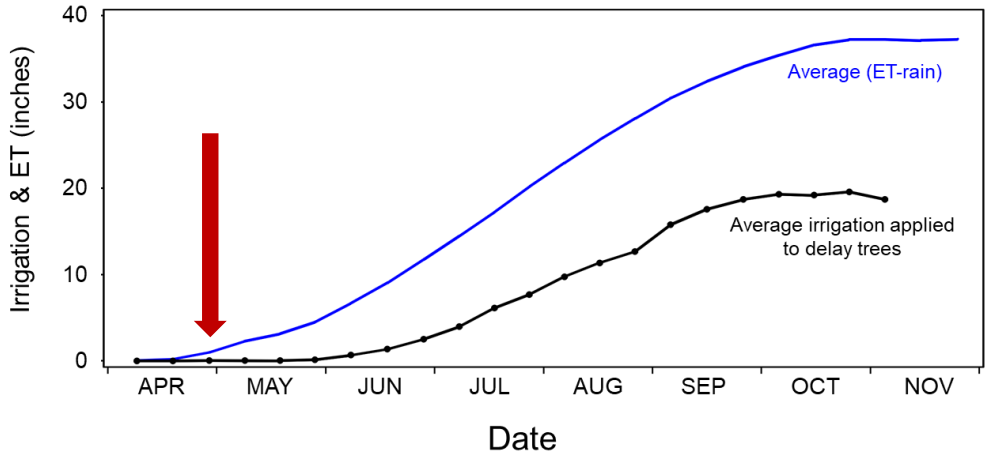

Figure 2. Summary of average orchard water requirement (ET-rain) and applied irrigation for all delayed irrigation tests to date (2014 – 2020). Averaged over all sites and years thus far, the delay period has been almost two months (indicated by arrow) compared to the start of ET. The total water applied to the delay trees has only been about 50% of the orchard ET need (ET-rain).

Barriers to adopting this practice:
Historical thinking. This new research has challenged the conventional wisdom that we must irrigate to keep up with ET to have healthy and high-yielding walnut orchards (Figure 2), as well as the now-outdated advice that it is best to maintain a "connection" between soil water layers at different depths in the soil profile.

Peer-pressure. You may feel more compelled to water if you observe more "stressed" neighbors start irrigating much earlier than the trees need. We have found that in past wet years, it is unpredictable as to when you will need to start irrigating. Although there will likely be adequate soil moisture, roots can be damaged from excessively wet conditions, and the trees may need water sooner than expected. Having pressure chamber data in a year like this is more important than ever. Even in the past two drought years, trees we monitored in the Sacramento Valley didn't reach 2-3 bars drier than baseline until mid-May.

You don't own a pressure chamber. These devices cost north of $1,500, which can be a non-starter when folks are already operating in the red. Thankfully, many farm advisors have pressure chambers they can use during a visit to your orchard. You may also have a neighbor with a chamber, or you can look into getting a used pressure chamber through a second-hand source, local or online. You may be able to add pressure chamber monitoring to your PCA's services for about $40/acre. Finally, in 2023 as an additional resource to growers without a pressure chamber, we will be posting on sacvalleyorchards.com and in the emailed ET reports, the progress of select Sacramento Valley walnut orchards with pressure chamber monitoring as they dry down to the 2-3 bar irrigation threshold.

The economics in actual orchards:
Example #1: A 100-acre walnut orchard irrigated with Nelson R10 mini-sprinklers. The orchard has been divided into three 33 +/- acre irrigation sets. The orchard is close to the Sacramento River so static groundwater level was 20 feet and pumping draw down was 30 feet. In this example once the pressure chamber was adopted, season-long irrigations declined from 26 to 13. **This represented a 50 percent reduction in electricity demand and a total savings of $8,895 or $89 per acre.**

Example #2: 200 acres of walnuts are irrigated with Nelson R10 mini sprinklers. The orchard is divided into four 50-acre irrigation sets. The orchard is located on westside Sacramento Valley terrace soils further from river or tributary influences. Static water table was 170 feet and pumping drawdown was about 230 feet. In this example once the pressure chamber was

adopted, season-long irrigations declined from 29 to 23. **This translated to a total cost savings for electricity of $13,320 or about $67 per acre.**

When this article is available on sacvalleyorchards.com, it will link to the full details of examples 1 and 2. These specific, concrete examples show how it is possible to save substantial electricity costs while sustaining healthy, productive orchards. In summary, it is realistic for irrigation scheduling with a pressure chamber to reduce power bills on the order of $50 to $100 per acre in the first season**. If used across 50 or more acres, it is quite possible to pay for a pressure chamber in the first season and achieve substantial power costs from that season forward.** Costs for subsequent years of using the pressure chamber to schedule irrigations should be limited to labor to acquire and evaluate the field data and maintenance of the pressure chamber which experience suggests should be on the order of $12 to $20 per acre depending on how intensely it is utilized. When using the pressure chamber, it is important to use it correctly and not exceed the management thresholds which could otherwise impact yield and quality unfavorably.

Bottom Line: To save money while helping ensure you have a healthy, and productive orchard this year – simply wait to irrigate until your trees are mildly stressed.

Thinking About Skipping or Shorting Nitrogen This Year?

Kat Jarvis-Shean, Orchard Systems Advisor UCCE Sacramento-Solano-Yolo

In a lean year like this with high fertilizer prices, you may be thinking about cashing in on some stored nitrogen in your walnut trees. We know that trees have much more nutrient storage capacity than annual crops, but how much of this can be relied upon to meet nitrogen demand, and when might it not be appropriate? A series of trials in the late 1980s can help inform this decision-making process. At three different sites, UC researchers had two sets of trees – both had previously received the grower's normal nitrogen application, but then they stopped applying any nitrogen to one set while continuing to apply adequate nitrogen to the other set. They watched July leaf nitrogen levels and yield to see when those two metrics would respond to the lack of applied nitrogen. At one site with 8th leaf Serrs, leaf nitrogen and yield dropped significantly the year after nitrogen was withheld. At another site with 10th leaf Hartleys and a third site with other mature Hartleys, it took three years for leaf nitrogen to drop significantly and four years for yield to drop. In the Serr block, yields rebounded to be indistinguishable the year after nitrogen was restored. In the Hartley orchards, it took two years for yield to rebound to the levels of continuously fertilized trees.

What can we learn from all this? Sensitivity to a lack of nitrogen will vary from orchard to orchard. The Serr site was a sandy loam, while the Hartley sites were a loamy sand and a silt loam, meaning the Hartley sites probably had more nitrogen buffering in their soils. Given that it's hard to know how much soil volume trees at a specific site may be mining for nitrogen, leaf nitrogen content is a much more reliable way to guide decisions. How much nitrogen you can cut back will depend on your leaf nitrogen content in previous years, and how much free nitrogen you may already be applying if you're irrigating with groundwater. Leaf nitrogen in the range of 2.5-2.7% is considered sufficient. Shooting from the hip a bit, I'd say if last year's leaf levels were above 2.9%, you may be able to get by applying roughly half the crop's nitrogen demand this year in large, mature trees without driving your trees into the insufficient range. This would especially be true if you're already meeting a large portion (likely 25% or more) of your nitrogen demand with nitrates in your groundwater. Remember that for every 1 ppm of nitrate in your water, there's 0.6 lb of nitrogen in an acre-foot of applied water. If your report shows a different form, 1 ppm nitrate-nitrogen, that changes to 2.7 lb for every acre-foot. The closer last year's leaf nitrogen was to 2.7% and/or the less nitrate in your groundwater, the more caution I would urge in decreasing nitrogen applications.

The way to get the most benefit from a lower rate of nitrogen would be to use the same number of applications but with a lower rate each time. This is relatively easy with a fertigation system. However, if you're broadcasting, you might be tempted to decrease the cost of application, not just the cost of your inputs, by applying your nitrogen in fewer doses. Strongly consider the cost of one round of broadcasting in person hours and fuel (likely $5-10/acre depending on your operation), versus the loss in use efficiency when concentrating your application (ballpark ~30% efficiency with one dose,

40-50% with two doses, 60-70% with 3-4 doses). If you save $5/acre by applying nitrogen with one less dose, but lose 20-30% of that nitrogen below the rootzone because of lower uptake efficiency, are you coming out ahead? Every orchard's

economics will be different. If you do feel the need to limit application to fewer doses, be very careful with the duration of the irrigation sets that follow those fewer doses, running shorter sets to help keep that nitrogen in the rootzone, and available to the tree, for as long as possible. Given all the stored moisture in our rootzones this spring, recent research indicates you shouldn't need to apply much irrigation before June. Just enough to move nitrogen into the soil profile.

All of the above is pertinent to mature trees. Younger trees are more sensitive to reduced nitrogen application because they have less biomass in which nitrogen from previous years may be stored. Forcing deficiency on young trees impacts growth of future nut-bearing branches, delaying future yield potential. Older trees will have more tissue in which nitrogen may have been stored from previous years, so will be more resilient to decreased nitrogen applications, making them better candidates for decreased nitrogen application during cost-cutting times.

Whatever approach you use to decrease nitrogen input cost, the one thing I wouldn't skimp on would be leaf sampling. Both Hartley sites saw a decrease in leaf N the year before decreased yield. If you farm multiple blocks, at minimum, continue to collect samples from a few blocks that represent similar ages, yields, management and growing conditions.

Prioritizing Sprays When You Can't Afford Them All

Sudan Gyawaly, UCCE Area IPM Advisor Butte, Colusa, Yuba-Sutter, Glenn, and Tehama
Jhalendra Rijal, UCCE Area IPM Advisor Stanislaus, San Joaquin, and Merced

Integrated Pest Management (IPM) is a decision-making strategy that uses cost/benefit analysis to guide growers and farm managers in making pest control decisions. A well-developed IPM program weighs the cost of a pest control practice against the expected return from using that practice and results in pesticides or control measures only being applied when the pest population reaches a density that will cause economic damage. This economic injury level (EIL) is the "break-even point" between the cost of the pest management and the value of the crop. As the crop value decreases, the EIL must increase. For example, consider an orchard yielding 4,000lb/per acre with 4% codling moth damage if untreated. If it costs $100/acre to control the moth damage, at a walnut price of $1/lb, using insecticide sprays would translate to a net return of $60 per acre (4000lbs x $1/lb x 0.04% damage - $100 of insecticide = $ 60 net return). However, if the price of walnuts is $0.50/lb and everything else remains the same, controlling the moth damage will translate to a loss of $20/acre (4000lbs x $0.5/lb x 0.04% damage - $100 of insecticide = -$20). In this case, the grower must increase their tolerance for damage, reducing the number and cost of economically justifiable sprays. This example illustrates how IPM decisions may change with changing circumstances, balancing the damage tolerance or EIL against the cost of pest management. However, it should also be noted that increased damage in a lot will likely decrease the price paid for that lot, so the economic impact goes beyond lost yield if quality is affected.

Most growers follow IPM practices in normal years, but in the current walnut price situation, management decisions that made sense in past years should be carefully reconsidered. To prioritize necessary pesticide sprays, it is helpful to consider the pest damage history of the orchard and the nature of the damage caused by the pest. Pests can cause direct yield loss by damaging nuts or indirect loss by impacting nut quality, or next year's production by interfering with tree growth. In walnuts, major direct pests are codling moth (CM), navel orangeworm (NOW), and walnut husk fly (WHF). Indirect pests include spider mites, aphids, and scale insects, as they feed on non-harvestable parts of the plant.

Treatment decisions for codling moth are based on in-season trap counts, nut damage assessment, and the orchard damage history. For first-generation CM treatment, if the previous year's damage was relatively low (<3%) and the moth counts in the traps during the season are light, it is reasonable to wait until the second peak (1B) or even the second flight. In addition, with low walnut prices, the damage tolerance level should increase to over 3%. One should also note that a high percent nut infestation (generally >2%) by direct pests, including codling moths, navel orangeworm and walnut husk fly, may result in higher loss of crop value due to penalties for failing to meet the required grade quality standard. In the last two years, codling moth pressure has been moderate to low in most orchards in the Sacramento Valley. For that population level and the low crop price, one treatment, most likely the second flight, may be enough. To guide management decisions for second and third generations of codling moth, use trap counts and nut damage assessments.

The IPM practices for managing NOW include mating disruption, orchard sanitation, and a potential one-time insecticide application at husk split, if monitoring suggests it is required. An isolated walnut orchard with excellent yearly sanitation

practice is less prone to NOW damage. Practices such as winter sanitation and proper blight, sunburn, and codling moth management, followed by a timely harvest to avoid late-season NOW infestation should also help reduce the risk of NOW damage even without insecticide applications.

Walnut husk fly (WHF) is another important pest that impacts profit. Walnut husk fly is not an issue in every orchard; when they are a problem, they are likely to concentrate in a particular area within the orchard. If you dealt with higher husk fly pressure last year, they might warrant a timely insecticide application with bait. One cost-cutting measure for this pest is applying the insecticide to cover only the orchard areas or blocks that have a history of high walnut husk fly damage. Suppose only 10% of the orchard area historically (adjacent to the water source/river, etc.) has husk fly issue. In that case, making 1-2 applications during the peak fly season for that area saves 90% of the product cost and a significant amount on application cost. Also, consider the EIL concept and utilize traps counts and in-season nut damage information to make management decisions.

Spider mites, aphids, and scale insects cause indirect damage to walnuts by infesting leaves and foliage and have higher EIL for treatments. Spider mites are usually less of a problem in well-irrigated dust-free orchards. Mite predators can control the mite population for most, if not the entire, season, so it is important to monitor mites and their predators diligently. Most miticides which are non-disruptive to the natural enemies are relatively expensive, so taking advantage of the "free" biocontrol is beneficial. If the orchard has heavy mite pressure especially earlier in the season and has no to minimal predator presence, in that case miticide application maybe necessary to avoid severe defoliation that can impact the nut yield and quality. Aphid populations are generally kept below damaging levels by natural predators and are only a serious problem occasionally. However, outbreaks of walnut aphids may occur if broad-spectrum insecticides are applied early for other pests, such as codling moths. Relying on biocontrol and skipping treatment for the first flight of codling moth can help.

Scale insects, especially walnut scale, are common in the orchard; however, insecticide application to control scale insects can wait if you are not dealing with very high Botryosphaeria issues. Also, scale biocontrol agents are very active in most orchards; careful monitoring of dormant spurs should give you confidence that biocontrol is at work.

In summary, determining the priority for pesticide sprays for insect pests is challenging. Growers and farm managers need to consider several factors, such as the potential loss of crop value, possible multi-year impacts, and the overall goal and resiliency of the orchard to tolerate the loss. Experiences have shown that the best approach is integrated pest management (IPM), which involves balancing the pest populations and management costs to make informed business decisions.

Strategies for orchard weed management hard economic situations

Brad Hanson, UC Cooperative Extension Specialist, UC Davis

I recently participated in a UCCE meeting focused on orchard management decision making when times are hard. This was in the context of the current low walnut prices facing producers in the state, but given the cyclic nature of agriculture could easily apply to other perennial crops as the ups and downs of agricultural commodities respond to domestic and international markets.

When thinking about where weed control costs can be cut and gaming out the consequences of reduced weed management interventions, I think it's useful to step back and remember why we're controlling weeds in the orchard in the first place.

Generally, in tree crops like walnuts, we control weeds to:

1) reduce competition for resources, particularly water and nutrients,
2) reduce weed interference with crop management operations and practices, especially irrigation,
3) reduce plants and debris that can interfere with nut sweeping and harvest operations,
4) be good farmers and stewards of the land and the orchard

In considering "lean" weed control programs, I tend to first think about weed competition in making decision about where to cut back. In a young orchard, say the first 3-5 years after planting, competition from weeds could be really problematic and might set the growth of the trees back in such a way that there are long-term impacts. I probably wouldn't cut back too much in those young orchards because of that risk. On the other hand, weed competition is probably not so bad in a well-

established orchard; sure, weeds will reduce water and fertilizer use efficiency to a degree but probably won't directly hurt the crop too much or cause long-term impacts on tree health.

Next, I think about weeds most likely to interfere with my irrigation system; tall weeds that block sprinkler patterns or interfere with water flow in some way and need to be managed somehow. In this case the weed problem is indirect, but still a problem if it results in poor irrigation and fertilizer distribution. I'd focus here on making sure irrigation uniformity remains reasonable in spite of the orchard being a bit weedier than normal.

Wherever possible, consider the weed's life cycle and try to time any weed management practices to reduce seed set because those seeds will be the source of weeds for years into the future. Mowing or tillage operations can be timed to be implemented before mature seeds are formed. Likewise, if you've got significant problems with perennial weeds like Johnsongrass, bermudagrass, or nutsedges, you might focus resources to reduce their spread and proliferation.

So, if we're going to cut back somewhere on weed control practices, what are some thoughts and approaches?

First of all, weed identification, which is always an important part of good weed management programs, is even more important if you're deciding which weeds have to be controlled and which ones you might be able to live with. Not all weeds are equally problematic. I'd focus here on the perennial weeds, the new invaders, the hard-seeded species with long soil life, and the weeds that will result in large debris that will persist to harvest.

Second, stretch your retreatment intervals. This basically is reducing weed management intensity by mowing and spraying less frequently (and getting used to a few more weeds) to save a few trips though the orchard. I'd time any operation to reduce weed seed set but tolerate a little bit of age-appropriate competition. Consider here the year-round cost; if you skip a mowing but then have to spray and mow twice to clean up before harvest you might not actually save much at all.

In the reduce intensity category, I'd also suggest reducing the width of the tree row spray strips. Blocking a nozzle or two on the inside of the spray boom could reduce the treated area by 1/3 to ½; I'd consider the width of your mower and spray the minimal strip but still be able to mow in a single pass. This also has implications in less-lean times when we are thinking about general herbicide-reduction goals in the orchard. I think that doing a very good job on half the amount of area is a better strategy than doing a mediocre job on the whole area because the tree row is where competition will be most problematic and where weeds will interfere most with irrigation delivery. Also, in the reduced intensity category, think about your tank-mix programs and if every component is really needed; I'd argue that a second (or third or fourth) product added to the tank-mix to increase control from 95 to 99% may be one that could be left out in difficult times. I'm occasionally asked about generic herbicides vs the main branded products because several of our important herbicide active ingredients are off-patent and distributed under many product names. Usually, when I've done head-to-head testing, I've found little, if any, performance differences. My caution here is to make sure that you're really making an apples-to-apples comparison with regard to formulation concentration and surfactant packages. Of course, there are programs and packaging deals to be had in making your overall orchard management pesticide decisions so be sure to talk to your PCA and retailer about overall costs.

I summarized my thoughts on navigating lean weed management decision making as:

- Don't skimp on weed control in the young trees because of long-term impacts from competition.
- Really think about the weeds you have in orchard and their real impact on the orchard and operations.
- Reduce the intensely managed area by narrowing spray strips.
- Reduce treatment intensity and stretch retreatment intervals.

Reducing weed control in orchards during difficult economic times is possible but comes with some tradeoffs. Give up a little in the short term and let it get a little ugly in terms of weediness but reduce the long-term impacts to the degree possible. Focus on maintaining the young orchards, reducing interference with irrigation and harvest, and try to time the weed control practices to minimize weed seed set. Integrated weed management approaches are still key, even when we are forced to move the goal posts due to (hopefully!) short-term economic realities.

Tree and Vine Crop Herbicide Chart – Updated (2023)

Please also find attached the updated tree and vine crop herbicide chart organized by Brad Hanson, UCCE Weed Science Specialist. Remember that rotating and/or mixing herbicides with different modes of action (MOAs) is critical to good weed management, particularly with herbicide-resistant populations. Notes: R = registered, N = Not registered, NB = registered only for Non-Bearing. Always check the current specific herbicide label before use because labels change and there are occasionally differences among products with the same active ingredient.

WALNUT: BACTERICIDE AND FUNGICIDE EFFICACY – CONVENTIONAL

Pesticide	Resistance risk (FRAC#)[1]	Walnut blight[2]	Anthrac - nose	Botryo-sphaeria blight***	Kernel mold***
Bactericides					
Copper + mancozeb (Manzate, Dithane)	low (M1 + M3)	5	5	3(2)	0
Kasumin + copper	low (24 + M1)	5	0	0	0
Kasumin + mancozeb	low (24 + M3)	5	0	0	0
Syllit + copper	high (U12 + M3)	4	ND	0	0
Syllit + Kasumin	high (U12 + 24)	4	ND	0	0
Bordeaux[2]	low (M1)	4	0	0	0
Fixed coppers[2,3]	medium (M1)	4	0	0	0
Zinc sulfate + copper + hydrated lime (Zinc Bordeaux)	low (M1)	4	0	ND	0
Kasumin	high (24)	4	0	0	0
Copper + mancozeb + surfactant[4]	low (M1 + M3)	2	ND	ND	0
Fungicides					
Luna Experience	medium (3/7)	0	5	5	ND
Luna Experience + Regalia	medium (3/7 + (BM 01, P 05)	3	5	5	ND
Merivon	medium (7/11)	0	5	5	3
Pristine	medium (7/11)	0	5	5	ND
Quash	high (3)	0	5	5	ND
Quilt Xcel	medium (3/11)	0	5	5	ND
Luna Sensation	medium (7/11)	0	5	5	ND
Quadris Top	medium (3/11)	0	5	4	ND
Ph-D	medium (19)	0	5	4	ND
K-Phite[3]	low (P07, 33)	2	ND	5	ND
Fontelis	high (7)	0	ND	4	ND
Cevya	high (3)	0	ND	4	ND
Teb, Tebuconzole, Toledo	high (3)	0	ND	4	3
Miravis Duo	medium (3/7)	0	ND	4	ND
Viathon	medium (3/P07, 33)	ND	ND	4	ND
Rhyme	high (3)	0	5	ND	3
Abound	high (11)	0	ND	ND	ND
Luna Privilege	high (7)	0	ND	ND	ND

WALNUT: BACTERICIDE EFFICACY – BIOCONTROLS AND NATURAL PRODUCTS

Organic treatments	Resistance risk (FRAC#)[1]	Walnut blight[2]
Bordeaux[2] (organic with approved copper)	low (M1)	4
Fixed coppers[2,3] (organic with approved copper)	medium (M1)	4
Zinc sulfate + copper + hydrated lime (Zinc Bordeaux) (organic with approved copper)	low (M1)	4
Actinovate	low (BM 02)	3
Regalia	low (BM 01, P 05)	3
Regalia + Copper (organic with approved copper)	low (BM 01, P 05 + M1)	3
Blossom Protect	low (BM 02)	2/3
Serenade (organic)	low (BM 02)	2

Rating: 5 = excellent and consistent, 4 = good and reliable, 3 = moderate and variable, 2 = limited and/or erratic, 1 = minimal and often ineffective, 0 = ineffective, NL = not on label, and ND = no data.

* **Registration pending in California**

**** Not registered, label withdrawn or inactive in California**

***** Research is ongoing to determine the most efficacious materials and the optimum timing of treatments for management of Botryosphaeria blight and kernel mold of walnut. Fungicides rated for kernel mold may have to be mixed (e.g., Merivon -FC 7/11 and Teb-FC 3) and rotated to another fungicide (e.g., Rhyme - FC-3). This mixture rotation is 4 (good and reliable).**

[1] Code numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Fungicides with a different Code number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode-of-actions (MOA) with high resistance risk before rotating to a fungicide with a different MOA (Code number); for other fungicides, make no more than two consecutive applications before rotating to fungicide with a different MOA (Code number).

[2] Copper resistance occurs within sub-populations of *Xanthomonas arboricola* pv. *juglandis*.

[3] Phytotoxicity may occur. For fixed coppers, injury can be reduced by the addition of lime or agricultural oils to the tank mixture.

[4] A single application with a surfactant is not recommended because of build up of populations on buds that may increase disease in subsequent years.

WALNUT: TREATMENT TIMING

Note: Timings listed are effective, but not all may be required for disease control. Timings used will depend upon orchard history of disease and weather conditions each year.

Disease	Catkin emerg-ence	Terminal bud break	7–10 day inter vals	Apr.	May	June	July	Aug. (3-wk before hull split)	Sept. (20–30% hull split)	Oct.	Nov. (1st wk)
Anthracnose[1]	0	0	0	2[4]	3	2	0	0	0	0	0
Botryosphaeria blight	0	0	0	1	2	3	3	2	0	1	1
Kernel mold[2]	0	0	0	0	0	0	0	2	2	0	0
Walnut blight [3,4,5]	2[5]	3	3	3	2	1	0	0	0	0	0

Rating: 3 = most effective, 2 = moderately effective, 1 = least effective, and 0 = ineffective

[1] Make the first application when the size of the expanding leaves is about half of its final size. This first application stage is critical.

[2] Timing for kernel mold is based on a mixture rotation of Merivon (FC 7/11) and Teb (FC 3) followed by Rhyme (FC-3) at the timings indicated. This mixture rotation is '+++' based on the ratings in the efficacy table above.

[3] A temperature-leaf wetness model (e.g., XanthoCast) is available for determining optimum timing of bactericide applications.

[4] Late spring rains are less conducive to disease, provided bloom is not delayed by low chilling.

[5] Male and female flowers are susceptible beginning with their emergence, depending on wetness and temperatures conducive to disease development.

Herbicide Registration on California Tree and Vine Crops - *(reviewed January 2023 - UC Weed Science)*

	Herbicide-Common Name *(example trade name)*	Site of Action Group[1]	Almond	Pecan	Pistachio	Walnut	Apple	Pear	Apricot	Cherry	Nectarine	Peach	Plum / Prune	Avocado	Citrus	Date	Fig	Grape	Kiwi	Olive	Pomegranate
			----- tree nut -------				- pome -		---------stone fruit ---------												
Preemergence	**dichlobenil** *(Casoron)*	L / 20	N	N	N	N	**R**	**R**	N	**R**	N	N	N	N	N	N	N	**R**	N	N	N
	diuron *(Karmex,Diurex)*	C2 / 7	N	**R**	N	**R**	**R**	**R**	N	N	N	**R**	N	N	**R**	N	N	**R**	N	**R**	N
	EPTC *(Eptam)*	N / 8	**R**	N	N	**R**	N	N	N	N	N	N	N	N	**R**	N	N	N	N	N	N
	flazasulfuron *(Mission)*	B / 2	**R**	N	**R**	**R**	N	N	N	N	N	N	N	N	**R**	N	N	**R**	N	N	N
	flumioxazin *(Chateau)*	E / 14	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	NB	NB	N	NB	**R**	N	**R**	**R**
	indaziflam *(Alion)*	L / 29	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	N	N	**R**	N	**R**	N
	isoxaben *(Trellis)*	L / 21	**R**	**R**	**R**	**R**	NB	NB	NB	NB	NB	NB	NB	NB	NB	N	NB	**R**	NB	NB	NB
	mesotrione *(Broadworks)*	F2/27	**R**	**R**	**R**	**R**	N	N	N	N	**R**	N	**R**	N	**R**	N	N	N	N	N	N
	napropamide *(Devrinol)*	K3 / 15	**R**	N	N	N	N	N	N	N	N	N	N	N	N	N	N	**R**	**R**	N	N
	norflurazon *(Solicam)*	F1 / 12	**R**	**R**	N	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	N	**R**	N	N	N
	orthosulfamuron *(Craze)*	B / 2	**R**	**R**	**R**	**R**	N	N	NB	NB	NB	NB	NB	N	N	N	N	N	N	N	N
	oryzalin *(Surflan)*	K1 / 3	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	**R**	**R**	**R**	**R**
	oxyfluorfen *(Goal, GoalTender)*	E / 14	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	NB	**R**	**R**	**R**	**R**	**R**	**R**
	pendimethalin *(Prowl H2O)*	K1 / 3	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	N	NB	**R**	**R**	**R**	**R**
	penoxsulam (*Pindar GT*)	B / 2, E/14	**R**	**R**	**R**	**R**	N	N	N	**R**	**R**	**R**	**R**	N	N	N	N	N	N	**R**	**R**
	pronamide *(Kerb)*	K1 / 3	N	N	N	N	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	N	N	N	**R**	N	N	N
	rimsulfuron (*Matrix*)	B / 2	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	N	N	**R**	N	N	N
	sulfentrazone *(Zeus)*	E / 14	N	N	**R**	**R**	N	N	N	N	N	N	N	N	**R**	N	N	**R**	N	N	N
	simazine *(Princep,Caliber 90)*	C1 / 5	**R**	**R**	N	**R**	**R**	**R**	N	**R**[2]	**R**	**R**	N	**R**	**R**	N	N	**R**	N	**R**	N
	trifluralin *(Treflan)*	K1 / 3	**R**	**R**	N	**R**	N	N	**R**	N	**R**	**R**	**R**	N	**R**	N	N	**R**	N	N	N
Postemergence	**carfentrazone** *(Shark EW)*	E / 14	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**
	clethodim *(SelectMax)*	A / 1	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	N	N	NB	N	NB	N
	2,4-D *(Embed Extra, Orchard Master)*	O / 4	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	N	N	N	**R**	N	N	N
	diquat (*Diquat*)	D / 22	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB
	fluazifop-p-butyl *(Fusilade)*	A / 1	NB	**R**	NB	NB	NB	NB	**R**	**R**	**R**	**R**	**R**	NB	**R**	NB	NB	**R**	N	NB	NB
	glyphosate *(Roundup)*	G / 9	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**
	glufosinate *(Rely 280)*	H / 10	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	N	N	**R**	N	**R**	N
	halosulfuron *(Sandea)*	B / 2	N	**R**	**R**	**R**	**R**	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	paraquat *(Gramoxone)*	D / 22	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	**R**	**R**	**R**	**R**
	pelargonic acid (*Scythe*)	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N
	pyraflufen (*Venue*)	E / 14	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	N	**R**	**R**	**R**	**R**	**R**	**R**
	saflufenacil (*Treevix*)	E / 14	**R**	N	**R**	**R**	**R**	**R**	N	N	N	N	N	N	**R**	N	**R**	N	N	**R**	**R**
	sethoxydim *(Poast)*	A / 1	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	NB	NB	**R**	NB	NB	**R**	N	NB	NB
Organic	**ammonium nanoate** (*Axxe*)	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N
	ammoniated fatty acids (*Final-San-O*)	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**
	caprilic/Capric acid (*Suppress*)	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	N	**R**	**R**	N	**R**
	d-limonene *(AvengerAG)*	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	N	N	**R**	N	N	N
	eugenol *(Weed Slayer CA)*	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**

Notes: R = Registered, N = Not registered, NB = nonbearing. This chart is intended as a general guide only. Always consult a current label before using any herbicide as labels change frequently and often contain special restrictions regarding use of a company's product.