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Sacramento Valley Walnut News

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In This Issue

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Walnut Winter Management Considerations

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Janine Hasey, UCCE Tree Crops Advisor Emerita, Sutter/ Yuba/ Colusa Counties

Time for a hard look: If you haven't already taken the time this winter – follow Franz Niederholzer's advice and ponder the economics and tough realities of your orchard operation before launching into the 2023 growing season.

Clean operation: We understand that economics do not allow for shaking/hand poling, blowing berms, and then flail mowing mummies prior to next season. Therefore, we remind you that any sanitation effort is better than none. Sanitation is the best insurance program against NOW; you must decide what level of this "insurance" you want to buy to help protect your 2023 crop.

2023 Codling Moth Mating Disruption: If you use mating disruption for codling moth – stay the course. Codling moth mating disruption is a proven effective strategy for reducing populations and damage, with return on investment maximized over multiple years of use. Good codling moth management can also mitigate NOW infestation. If you are already a codling moth mating disruption user, get mating disruptants ordered in advance and hung before typical spring biofix in your orchards. Remember that you will need to use monitoring approaches that evaluate female activity as well as male activity in mating disruption orchards. BE KIND to your neighbors and let them know if you are using mating disruption, as traps in nearby orchards can be impacted.

Scale Pests: Delayed-dormant is one of the effective pesticide application timings for managing scale pests. If an insect growth regulator insecticide was used for scale within the last two years, monitoring may indicate that a spray is not needed this year.

Pre-Season Airblast Sprayer Calibration
If you're paying to put on sprays this year, make sure they are hitting the target tissue. Well before you're scrambling to get out your first blight spray this spring; you should spend time on the maintenance and calibration of your airblast sprayers. A properly calibrated sprayer is needed for good pest and disease control. The need for excellent coverage is especially true for walnut blight, where – if it's not covered, it's not protected! Check your sprayer for worn or broken parts (nozzles, strainers, pressure gauge(s), etc.). Calibrate the sprayer by measuring ground speed and spray flow. The general rule is at least 2/3rd of the spray volume (gallons per minute) through the top half of open nozzles.

Tree Replanting Considerations in a Lean Price Year
Considering replanting missing tree spots in the orchard this winter? Make sure you're evaluating what the chances are that the replant will survive and follow all the best replanting practices. In addition, if much more than half of the replant spot is shaded at midday, a replant is unlikely to succeed.

Irrigation System Maintenance: With lean prices, and the cost of both surface water and pumping rising, it is essential to make informed irrigation decisions. First, well before you need to think about the irrigation season, it's good to perform the system maintenance that underpins any improved irrigation management. If you farm in Tehama, Butte, Glenn, or Shasta Counties free system evaluations are available from the Tehama Resource Conservation District Mobile Irrigation Lab.

For more information contact Kevin Greer at (530) 727 – 1297 or kevin@tehamacountyrcd.org. For Yolo County, contact Conor Higgins, higgins@yolorcd.org. For Solano County, contact Kevin Young-Lai, kevin.young-lai@solanorcd.org. For Sutter-Yuba-Colusa, contact Karandave Kang, karandavek@gmail.com.

Don't fly blind with your Irrigation Management: Growers and consultants who already use the pressure chamber indicate the cost to integrate it into their management ranges from about $10 to $20 per acre annually. Careful pressure chamber use can benefit walnut orchard health, as well as achieve water and energy savings. Even in the 2022 drought year, we saw orchards with overwatering symptoms. You can save money by irrigating when the trees are stressed, instead of when you are stressed! If you are interested in the pressure chamber, you can ask your local farm advisor to come out and do a spot check on your trees ahead of an irrigation.

Looking for Cost Savings Season-Long: For 2023, there are other cultural and pest management options to improving your profit margin. We have articles that focus on labor and cost cutting considerations appropriate to each season, while discussing which operations you should not scrimp on.

Vegetation for Infiltration

Curt Pierce, UCCE Irrigation and Water Resources Advisor for Glenn, Tehama, Colusa, and Shasta Counties

Note: The following article ran in the most recent edition of our almond newsletter and was written prior to the recent severe rain events. We include it here because all the recent rain only further highlighted the importance of the topic. Additional images have been included.

Facing a fourth consecutive year of drought conditions across California, groundwater levels dropping throughout much of the Central Valley, and SIGMA policies coming into effect, more and more California growers are looking to incorporate some form of agriculturally managed recharge (AG-MAR) into their water management plans. During the off-season for orchards, AG-MAR looks to divert runoff from winter storms into groundwater basins where the water can be "banked" for future use.

Since the primary factor governing the suitability of an orchard to AG-MAR is soil type, an online tool called the Soil Agricultural Groundwater Banking Index (SAGBI) was developed by the California Soil Resource Lab at UC Davis. Using data including topography, percolation rates, and the root-zone residence time of applied water, the interface allows users to see suitability ratings for soils at most locations throughout the state. The website features tabs where users can quickly toggle between unmodified ground conditions and a theoretical model that accounts for the typically improved conditions that result from deep tillage, having occurred, such as ripping prior to orchard establishment. Growers with operations in areas rated "moderately good" to "very poor" can still benefit from using vegetation to help increase infiltration but need to take extra care to monitor soil moisture to avoid "wet feet" in their orchards, as the root-zone residence time of any water in the profile will be longer than in areas with higher SAGBI ratings.

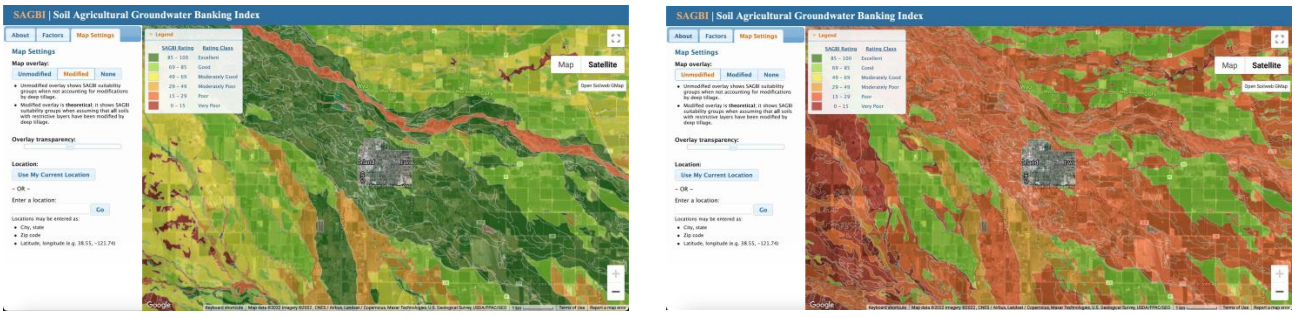

Figure 1. Maps displaying data from the SAGBI website on soil suitability around the Orland, CA area. The map on the right displays theoretical data assuming significant improvement of AG-MAR suitability due to deep tillage.

Once the soil suitability is determined, vegetation can be established, or maintained in recharge areas. The presence of vegetation, whether resident vegetation or a cover crop will help "slow the flow" of water over the surface and increase infiltration into the soil profile. Grasses are relatively deep-rooted and withstand water flows well, but any cover crop or resident vegetation will aid the capture and infiltration of stormwater (Figure 2). Grasses may also help suppress the growth and spread of undesirable weed species.

Legumes, such as clover, provide extra nitrogen to the soil, in addition to slowing water flows. They have a lower carbon-to-nitrogen ratio than grasses, providing a quicker decomposition if they are mowed or incorporated into the soil during the growing season. They're a good choice for orchard middles, where grasses are likely better suited to channels, borders, and basins.

Figure 2. Adjacent orchard rows compared with and without vegetation. Photos taken by the author in Butte County, CA, Jan 11, 2023

Brassicas (mustard, radish, and peas) can be useful in situations where a quick stand is needed but they become "woody" and are more challenging to reincorporate into the soil if left to grow to maturity. They are deep-rooted and very good for water infiltration, while being excellent forage for pollinators when in flower.

Of course, you may have many ever-changing priorities often conflicting with one another. Managing vegetation for infiltration is no different. Vegetation on orchard floors (two inches or taller) during the winter months shades the soil and makes passive frost protection less effective since soil is not warmed by the sun during the day.

For more information, please visit sacvalleyorchards.com for the recent article "Management Practices for Improved Water Capture". Additional resources include the Cover Crop Best Management Practices guide, a joint project by the Almond Board of California, UC Davis, and UC Agriculture and Natural Resources (UC ANR) and the UC ANR publication **Cover Crops for Walnut Orchards.**

2022 Walnut Crop Loss and Poor Nut Quality – What happened?

Janine Hasey, UCCE Tree Crops Advisor Emerita, Sutter/ Yuba/ Colusa Counties
Dr. Themis Michailides, UC Davis Plant Pathologist at the Kearney Ag Research and Extension Center
Luke Milliron, UCCE Orchards Advisor Butte/ Glenn/ Tehama Counties

There are those years we like to leave behind, and 2022 will be at the top of the list for the walnut industry. We are still reeling from the 2022 harvest season with the large crop losses, extremely poor nut quality, and plunging prices. Using several sources of data, the focus of this article is on the most likely environmental conditions that led to 2022 crop damage and subsequent yield losses and poor nut quality. We will be emphasizing the crop loss and poor nut quality associated with the early September heat wave.

Weather events and records

There were three main weather-related events that contributed to 2022 crop loss - spring frost, excessive heat, especially in the late summer/early fall period, followed by rainfall mid-September shortly after the record heat. None are easy to assess in terms of quantifying crop loss in an orchard, but frost damage is easily observable (Photo 1). Nut damage sustained by

the excessive heat is more complex, and it is very difficult to assess the potential related crop losses and total effect on reducing nut quality value, especially related to kernel color. The September rainfall likely contributed to the high mold incidence in 2022.

Tables 1-3 show the most significant weather events that likely contributed to crop loss and/or very poor nut quality.

Table 1. Spring frost damage - minimum air temperature (°F):

Date 2022	**Durham CIMIS weather station-** Butte Co.	**Verona CIMIS weather station-** Sutter Co.
4/12	29.2	30.3

Table 2. Excessive heat - maximum air temperature (°F) at three representative locations:

Date 2022	**Durham CIMIS weather station**	**[1]Verona CIMIS weather station**	**[2]Sutter Co. AG Building station**
9/1	102.2	**109.2***	104.7
9/2	101.9	105.1	105.1
9/3	96.7	101.7	100.7
9/4	101.7	**106.2***	103.4
9/5	**109.1***	**114.1****	**110.3**
9/6	**111.0****	**116.7****	**112.7**
9/7	**102.8***	**109.6***	**106.3**
9/8	**107.0***	**112.4***	**108.9**
9/9	99.3	102.7	102.1

[1]Days >100 °F: June – 6 days, July – 7 days, August – 9 days
[2]Yuba City, CA
*Moderately out of range
**Far out of normal range

Photo 1. Damage on flowers and leaves from April 12, 2022 frost. Photo taken April 21 by J. Hasey.

Table 3. September rainfall (inches)

Date 2022	Durham CIMIS weather station	Verona CIMIS weather station
9/18	**0.13**	**0.10**
9/19	**0.21**	**0.51**
9/20	0.02	**0.01**
9/21	0.02	0.00
9/22	0.02	0.00
9/23	0.01	0.00
9/24	0.01	0.00
9/25	0.01	0.00
Total	**0.46**	**0.62**

Grower surveys of weather-related crop damage

In October, Sacramento Valley UCCE Advisors were in conversation with our local agricultural commissioner's questioning if damage to quality was bad enough after the heat wave (Table 2) to declare an emergency. At that point, we had heard of problems with kernel color in the early varieties (not so unusual), and Chandler harvest was just underway. However, as Chandler harvest progressed, there were increasing reports of blackened Chandler nuts (black hulls, split and unsplit, stuck on the nutshell - see below). High nut losses were noted in the field, at the huller, and at the handler along with increasing mold incidence. Subsequently, some agricultural commissioners such as Lisa Herbert, Sutter County Agricultural Commissioner, sent grower surveys to assess weather related damage to the walnut crop. Several growers responded to her survey. Of these, almost half reported crop loss from the spring frost and all reported loss from excessive heat, citing sunburn damage, mold, loss of edible yield, and poor color grades. Still, the crop loss percentage reported in Sutter County did not rise to the 30 percent needed for a disaster declaration due to excessive heat.

Photo 2. Black nuts with the hulls dried on the shell.
(Photo by T. Michailides)

Blackened hulls on walnuts

As the 2022 harvest progressed, many growers were reporting black nuts on their trees (Photo 2) and on the ground. Walnut hulls can turn black as nuts mature for several reasons including from diseases, insects, and physiological stresses. Plant pathologist Themis Michailides (UC Davis) examined many samples of black hulls on walnuts last fall finding the Chandler variety most affected. These nuts with the hulls dried on the shell (Photo 3) typically had black kernels that sometimes were shriveled (Photos 4 & 5).

Photo 3. Top - nuts with mostly shriveled hulls before hull split; bottom - mostly shriveled hulls after hull split.
(Photo by T. Michailides)

Photo 4. Kernels of nuts with black hulls were typically black and sometimes shriveled as in bottom nut.
(Photo by T. Michailides)

Photo 5. Kernels of nuts with black hulls showing various degrees of shriveling.
(Photo by T. Michailides)

Themis looked at temperature records and found there was a heat spike that preceded the hull damage. The very high daytime temperatures far out of the normal range that occurred in early September (Table 2), possibly coincided with the very early hull split stage for the Chandler variety. He believes that excessive heat likely caused a deterioration of the hull tissue, followed by secondary fungal (hull rot) invasion, and then mold. The high mold incidence was likely worsened by the rainfall following the heat wave (Table 3). This hull rot that essentially stopped the hull split process is the likely cause of black hulls at harvest, dark kernels, and subsequent high field, huller, and processor rejection levels. There is also a consensus that the excessive high early September heat caused a myriad of nut quality issues in early varieties like Tulare, causing darker kernels. The high heat occurred when the oil in the kernel was most susceptible to damage. Darker kernels have a shorter shelf life.

Statewide perspective - processor observations

Several walnut processors have commented that the percent of extra-light and light nuts was much lower than normal in most varieties in the 2022 crop. According to Eric Heidman of Diamond Foods, heat was a statewide issue, but the Sacramento Valley overall had hotter temperatures during the September heat wave than the San Joaquin Valley. The most severe mold was where the temperatures were hottest, specifically the southern Sacramento Valley. Their observation is corroborated with higher temperature spikes at the Verona CIMIS weather station in south Sutter County compared to the more northern Durham CIMIS weather station (Table 2). Diamond found about twice as much mold in nuts from the Sacramento Valley (~10%) versus the San Joaquin Valley (~4-5%) where no rainfall occurred in September. The mold was mainly found on kernels that were light amber or darker. Overall, edible yield was reduced 2 to 4 percentage points in most varieties, including Chandler. In addition to the nut losses many growers saw in the field and at the huller, Diamond estimates they will likely remove an additional 10-15% of the 2022 crop from the pool due to additional off grade, mold, and exceptionally dark color.

Summary

Many growers have the ability to mitigate damage from an April freeze event. Indeed, many growers with the system capability irrigated in the days before and/or actively during the freeze event and evaded damage. However, the heat and rain in September 2022 that are implicated as the cause of high crop losses and poor nut quality were out of grower control. As a grower, focus on what you can control. The California walnut industry must deliver quality. With the current economics of the walnut industry, take a hard look at considering removing those orchard blocks with older varieties that, even in a good year, often don't have the highest quality. Check out the article Time for a Hard Look - Walnuts at the Sac Valley Orchard Source website. The crop loss and poor nut quality discussed in this article was associated with extreme events. To learn more about maximizing walnut quality under normal circumstances check out the article Maximizing walnut quality to improve value in a low-price year at the Sac Valley Orchard Source website.

Winter Chill, Dormancy and Walnut Management

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

Walnuts are one of the highest chill requirement tree crops in California. Multiple recent winters have fallen short of the chill needed for a tight, economical walnut bloom. Scientists expect such winters to be more frequent in the future. Though lower chill varieties are in development, the industry needs tools to support varieties that are currently in the ground for the next 20-40 years. Many products have been shown to compensate for inadequate chill in other crops and other countries but need to be tested in California conditions. With funding from the California Walnut Board, a team including myself and UC Davis's Maciej Zwieniecki and Giulia Marino have begun testing dormancy breaking treatments to help California's walnut growers sustain economic production in lower chill winters. Though 2022-2023 is shaping up to be an adequate chill winter for walnuts, it's good to understand what tools may be in the toolbox in case of future needs.

Why trees need chill and what goes wrong if they don't get it

When walnuts meeting their chilling requirement, trees buds will break dormancy evenly throughout the canopy. Symptoms of inadequate winter chill have been seen in orchards in multiple recent springs (e.g. 2014, 2015, 2020), including delayed budbreak, scattered or prolonged budbreak and buds on southern sides of branches never opening. Prolonged bloom in many cases resulted in a wider variety in nut size, more small nuts and multiple shakes. Prolonged bloom could also result in the need for more sprays for blight control or husk split pests.

Minimum winter temperatures are critical to winter chill accumulation. California's statewide winter minimum temperatures have been increasing since 1970. This warming has coincided with a trend towards delayed budbreak in California walnuts since the mid-1990s, indicating that lower winter chill accumulation is already impacting orchard phenology. By the 2060s, Central Valley winter minimum temperatures are projected to average 3 °F above the minimums of the 1990s. In other words, in the next 20-40 years, Central Valley walnut orchards will get 14-20% less winter chill than in the 1950s when many of our grandparents were farming.

Anecdotal experience suggests the chilling requirement for 'Chandler' is around 60-65 chill portions as quantified by the Dynamic Model. Given decreased chill projections it is likely that currently planted 'Chandler' orchards will not meet their chilling requirement in at least one out of ten years in most of the Central Valley in the coming decades. While breeders are working to develop new cultivars with lower chilling requirements that retain the other desirable traits that growers and buyers want, the industry needs tools for orchards that are currently in the ground or will go in while waiting for new varieties to be developed. Numerous dormancy-breaking products are documented as capable of partially compensating for inadequate chill. However, these products have not been systematically compared in California growing conditions on walnuts to test how much chill compensation is possible, and ideal rates and timings.

What we've been studying to supplement winter chill

The trouble with studying dormancy breaking treatments is oftentimes trees will respond differently to these treatments depending on whether they have gotten enough winter chill or not. So, we could not just spray a bunch of products on trees after any old winter, see what the outcome was, and assume that outcome would be consistent across lots of winter conditions in the future. Instead, we set up an experiment that forced trees to experience warmer winters, by building clear-sided open-top chambers around fifth leaf Chandler trees and pumping in hot air to increase temperatures during the winter. These trees were coupled with unheated trees that got sufficient winter chill, then both sets of trees received the same dormancy breaking treatment sprays. Tented trees were heated from early November through February. The goal was to limit winter chill accumulation to 50 Chill Portions, approximately 30% less than the historical average chill accumulation, but within the range of what can be expected of warm winters in the southern San Joaquin Valley in the next few decades. In the winter of 2020-2021, sensors in each tree told us ambient chill trees experienced 59-65 chill portions, whereas heated trees experienced 46-56 chill portions. In 2021-2022, there were 65-70 chill portions in ambient trees and 56-60 chill portions in heated trees.

Once we had heated the trees all winter, four scaffolds were selected in each tree for treatment. Treatments were applied approximately 30 days before the date of average historic budbreak, at rates and with adjuvants according to recommendations of the companies that provided them. Chemicals were applied using a backpack sprayer from a pruning tower just up to the point of dripping (equivalent to 150 gallons per acre). Scaffolds that were not being treated were wrapped in plastic drop clothes to avoid drift.

In 2021, we tested hydrogen cyanamide, often marketed as Dormex®, at 4%, a blend of nitrogen compounds marketed as Erger® at 6%, and an analogue of the plant hormone cytokinin, marketed as Mocksi® at 15 parts per million. In 2022, we tested Dormex® at 2%, Mocksi® at 20 parts per million, and calcium ammonium nitrate (CAN-17) at 20%. Each year there was also a water-treated control scaffold on each tree. At the time of this writing, none of these products are currently labeled for use as dormancy breakers in walnuts in California. Erger and CAN-17 are labeled as fertilizers. Dormex is awaiting California DPR approval which is expected soon, so check an up-to-date label. On each scaffold, shoots were flagged to track bud break progression and monitored every two to three days from late March through May. These recordings were used to calculate the timing of 50% budbreak, the duration of budbreak and the percent of buds that opened on a scaffold.

In 2021, among the terminal and lateral buds on trees that received sufficient chill, 50% timing was significantly earlier on scaffolds treated with Dormex, but not significantly different among scaffolds treated with Erger, Mocksi or the water control. Dormex advanced terminal and lateral budbreak timing relative to the water control by an average of 7 days and 8 days, respectively, in the sufficiently chilled trees. However, on scaffolds on trees that did not receive sufficient winter chill, Erger also significantly advanced budbreak timing relative to the water treated control. In the insufficiently chilled trees, Dormex advanced terminal and lateral budbreak timing relative to the water control by an average of 16 days and 13 days, respectively. In the same trees, Erger advanced terminal and lateral budbreak timing relative to the water control by an average of 5 days and 6 days, respectively. In other words, 4% Dormex changed budbreak timing whether trees got enough chill or not, but 6% Erger only changed budbreak timing if the trees hadn't gotten enough chill, and then only about half as much as 4% Dormex (Figure 1).

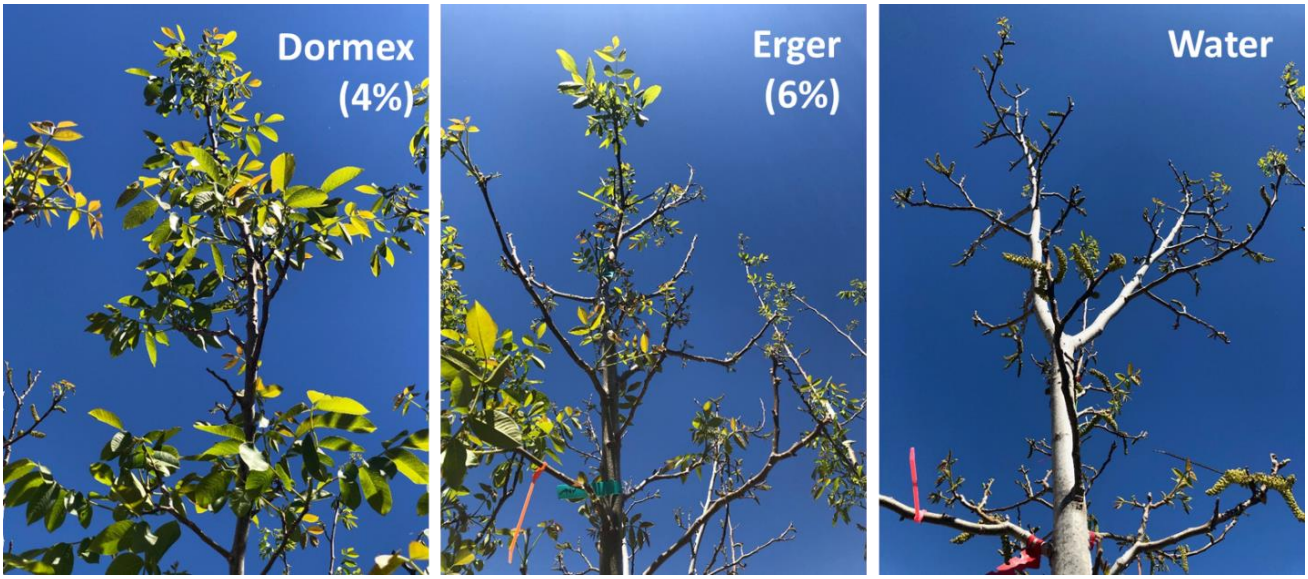

Figure 1. Budbreak on heated tree scaffolds in Spring 2021.

In 2022, we saw no responses in sufficient chill trees to any of the treatments. However, on insufficiently chilled trees across both terminal and lateral buds, response to 2% Dormex and CAN-17 were not significantly different from each other, but both were significantly earlier than the water control, whereas Mocksi was not different from water. Terminal vegetative buds opened 19 and 17 days earlier with the Dormex and CAN-17 treatment than with water, respectively. Lateral vegetative buds opened 19 and 18 days earlier with Dormex and CAN-17 treatments, respectively.

When trees lack sufficient chill, both Dormex at 2% and CAN-17 at 20% moved budbreak timing to similar timing as that documented in the water-treated scaffolds of the sufficiently chilled trees. Dormex at 4% moved timing even earlier than the sufficiently chilled water control, whereas Erger moved the timing but only about halfway between timing with water on heated trees and timing with water on unheated trees. In other words, at least in terms of budbreak timing, it appears Dormex at 2% and 4% and CAN-17 at 20% could prompt the heated scaffolds to behave like they had received enough chill, whereas Erger at 6% only partially compensates for lack of winter chill.

The questions of whether these products can change budbreak duration, which could impact number of blight sprays, harvest shakes, etc., and whether they can impact number of buds that break in the face of low winter chill accumulation, has been harder to answer with this first round of experiments based on design and cost limitations. We have launched additional experiments in a greenhouse and grower fields to better answer these questions. But so far, we at least know three products that have some impact on low chill response behavior in walnuts – Dormex, CAN-17 and Erger.

Is action needed this winter?

This winter, the Sacramento Valley is on track to accumulate as much chill, if not maybe even a little more, than the last two winters, which have gotten more than sufficient chill for walnuts. Looking at a sampling of eight CIMIS weather stations using the UC Fruit & Nut Center chill calculator tool, on average the Sacramento Valley has accumulated 47 chill portions to date (written January 9th), about what had been accumulated by this time last year, and 6 chill portions more than this time of year in 2021 (Table 1). Both last winter and the winter before had accumulated more than enough chill by the end of February for walnut budbreak to progress normally. So, it's *not* looking like this is a year that walnut growers will need to use dormancy breaking treatments. That's lucky given how much everyone is trying to cut down on inputs given walnut prices. Nonetheless, it's good to be aware for future winters that there are options in the toolbox (or almost approved by DPR to be added). We'll continue this project with funding from the California Department of Food and Agriculture to improve understanding of ideal rates and timings, and the physiological response to these treatments inside the trees. Stay tuned!

New Orchard Advisor Introduction

Jaime Ott; *UCCE Orchard Systems Advisor; Tehama, Shasta, Glenn, and Butte Counties*

My name is Jaime Ott, and I just joined UC Cooperative Extension as the new Orchard Systems Advisor for Tehama, Shasta, Glenn, and Butte Counties. I am based out of Red Bluff, and my primary crops are walnut, prune, almond, and olive. I am looking forward to meeting each of you in the very near future!

I grew up in El Dorado County and got my undergraduate degree in Biological Sciences from UC Davis. Upon graduating, I moved to Virginia and spent three years snorkeling in the Chesapeake Bay and earning my M.S in Marine Science. After that, I joined the Peace Corps, where I spent two years living in Africa. My post was in Zambia, where I worked with rural farmers to raise tilapia as a source of high-quality protein.

Since returning from Africa in 2014 I have worked with Greg Browne, a USDA researcher housed in the UC Davis Department of Plant Pathology. I worked on a variety of projects: screening walnut and almond rootstocks for resistance to crown rot caused by *Phytophthora*; testing whole orchard recycling in almonds; and testing and optimizing anaerobic soil disinfestation (ASD) as an alternative to preplant fumigation in almonds. In addition to working in Greg's lab, for the last four years I have been pursuing my PhD in Plant Pathology from UC Davis. I am just wrapping that up, and my research has focused on which *Phytophthora* species are affecting almonds and walnuts in California and looking at ways that *Phytophthora* is introduced into orchards.

For the next few months my main focus will be to get out and meet as many of you as I can, learning about what challenges you are facing and where I can develop my research program in order to best support you. I will be at as many "Days" as possible (see you all at the Tehama Walnut Day on March 2nd and the Sac Valley Prune meetings on Feb 22nd and 23rd). I will be getting out and learning about where I can help the most. I would also love to come out to your field and talk over problems, or just come out to get to know you and your trees. Please get in touch at 530-527-3101 or at njott@ucanr.edu.

Walnut Newsletter

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