

WEST COAST NUT

AUGUST 2020 ISSUE

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PISTACHIO HARVEST

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WEST COAST NUT

By the Industry, For the Industry

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SPOTLIGHT: Preparing for Pistachio Harvest

For Brian Watte of Brian Watte Farms in Fresno, season-ending crop management in pistachios boils down to three keys: "Just keep the bugs off and keep the water going and get it dried up immediately before we shake," Watte said.

Starting on page 44



Some Basic Truths About NOW in Almonds

An overview of the four-component system of navel orangeworm management

By **JOEL P. SIEGEL** | USDA ARS Research Entomologist
and **ROBERT VAN STEENWYK** | UCCE Entomology Specialist Emeritus

Delayed harvest can undo the good work of mating disruption and insecticide sprays, and nuts should be picked up in a timely manner as well (photo by Marni Katz.)



Adult navel orangeworm (*Amyelois transitella*) on a Nonpareil almond (photo courtesy Peggy Greb, USDA ARS.)

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SUCCESSFUL CONTROL OF NAVEL ORANGEWORM (NOW) depends on understanding the following truths:

1. The local population is always greater than you think it is.
2. Insecticide coverage is always worse than the applicator thinks it is.
3. Spraying will always take longer than you think that it should.
4. Little mistakes can have big consequences.

Navel orangeworm management is currently based on a four component “system”. Its elements are: 1. Sanitation 2. Mating Disruption 3. Insecticide Sprays and 4. Timely Harvest. Three of these elements have been in place for decades, while mating disruption is a relative newcomer. All of these elements are important, and none can be overlooked.

Sanitation is Key

Sanitation is the cornerstone for NOW control in almonds, and all mummies must be removed from the tree, preferably by January. The threshold is 2 mummies per tree outside of Kern County, and for Kern County the threshold can be as low as 0.2 per tree. It is just as important to destroy the mummies on the ground by February

as it is to get the mummies off the tree, and all almond varieties can serve as a resource and/or harborage for NOW.

If winter sanitation is inadequate, the overwintering mummy nuts can be treated with an insecticide spray in late April to early May. This will coat the hull so that any eggs laid absorb insecticide and die, plus newly emerged larvae crawling on the nut die from contact toxicity. Insecticides will not kill larvae inside the nut. Treating mummies is important because eggs laid by NOW from mid to late April through early May give rise to the adults in late June to early July, which is the beginning of hull split for the Nonpareil cultivar.

Oviposition during early hull split in the outer rows is often missed by the traditional single spray timing, and when there is substantial hull split in the orchard margins, the NOW population can explode. Use the maximum insecticide rate for mummy sprays because the goal of this spray is to eliminate mummies as a resource from May through June; you want the highest concentration of insecticide possible on mummies. This in turn will decrease the number of moths laying eggs in the orchard margins at the end of June. In previously reported research for Nonpareil almonds, one mummy per tree contributed approximately 1% NOW damage. In the same study, mummies on the ground also contributed to damage when not destroyed by mowing. Mummies on the ground can have infestation rates greater than 75%

and adults will emerge from these nuts. Thus, proper sanitation must include both removing mummies from the tree and destroying all mummies on the ground.

Mating Disruption and Insecticides

Currently, there are two interventions available for control of NOW: Mating disruption beginning in late winter and insecticide application at hull split. Mating disruption success depends on excellent sanitation and is not a substitute for sanitation (see related article on mating disruption in this month’s issue of *West Coast Nut*.) Mating disruption and insecticide application are compatible, and NOW damage can be significantly reduced when they are used together.

When introducing mating disruption, it is important to continue your insecticide program for at least the first year in order to reduce the standing population. In high NOW pressure orchards, multiple insecticide applications may be required. When two sprays are needed, the first application should be applied at 1% hull split in the margins of the orchard, followed by a second application 7-14 days later (depending on the insecticide label.) Pest control advisors have reported excellent results when the entire orchard was sprayed, although the pollenizer varieties had not yet split; this is an area of ongoing research.

When spraying, both sides of the tree should be sprayed within a two-

Continued on Page 6



Semios, The future of mating disruption is NOW

“

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”

**Mark Anderson, PCA
Blue Ocean Organics**

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TABLE 1. Possible insecticide rotations that maximize resistance management for NOW in almond (courtesy R. Van Steenwyk and Joel Siegel.)

Mummy Problem/May Spray		Hull Split One		Hull Split Two	
None/None		Altacor (IRAC 28)	PHI 10 d	Altacor1 (IRAC 28)	PHI 10 d
None/None		Altacor (IRAC 28)	PHI 10 d	Intrepid Edge (IRAC 5+18)	PHI 7 D
None/None		Intrepid Edge (IRAC 5+18)	PHI 7 D	Altacor (IRAC 28)	PHI 10 d
None/None		Intrepid Edge (IRAC 5+18)	PHI 7 D	Intrepid Edge2 (IRAC 5+18)	PHI 7 D
None/None		Minecto Pro (IRAC 6+28)	PHI 21 d	Besiege (IRAC 3A+28)	PHI 14 d
None/None		Minecto Pro (IRAC 6+28)	PHI 21 d	Intrepid Edge (IRAC 5+18)	PHI 7 D
None/None		Besiege (IRAC 3A +28)	PHI 14 d	Besiege1 (IRAC 3A+28)	PHI 14 d
YES/Intrepid (IRAC 18)	PHI 7 d	Altacor (IRAC 28)	PHI 10 d	Altacor1 (IRAC 28)	PHI 10 d
YES/Intrepid (IRAC 18)	PHI 7 d	Minecto Pro (IRAC 6+28)	PHI 21 d	Altacor1 (IRAC 28)	PHI 10 d
YES/Intrepid (IRAC 18)	PHI 7 d	Minecto Pro (IRAC 6+28)	PHI 21 d	Intrepid Edge (IRAC 5+18)	PHI 7 D
YES/Intrepid (IRAC 18)	PHI 7 d	Altacor (IRAC 28)	PHI 10 d	Intrepid Edge (IRAC 5+18)	PHI 7 D
YES/Intrepid (IRAC 18)	PHI 7 d	Minecto Pro (IRAC 6+28)	PHI 21 d	Besiege1 (IRAC 3A+28)	PHI 14 d
YES/Minecto Pro (IRAC 6+28)	PHI 21 d	Intrepid Edge (IRAC 5+18)	PHI 7 D	Intrepid Edge2 (IRAC 5+18)	PHI 7 D

1 Second application at 7-10 days after first application-still treating a single generation

2 14 day retreatment interval-still treating a single generation

Continued from Page 4

day period; do not simply spray every other row (one side of the tree only.) Do not exceed 2 mph with airblast sprayers and use a minimum of 150 gpa for almonds to maximize coverage, especially for tall trees. As ground speed exceeds 2 mph, less spray is deposited in the upper canopy; consequently, failure begins at the top of the tree due to a combination of reduced insecticide deposition combined with increased degradation of the insecticide by ultraviolet radiation.

If it takes more than seven days to complete an application, consider spraying by air for the first spray, since most of the split nuts are high in the canopy. Although a good ground application deposits more insecticide in the canopy than a comparable air application, an aerial application can treat an entire orchard in one day and more insecticide is deposited in the upper canopy, where the newly split

nuts are, than in the canopy below 14 feet. Even when two sprays are made to control NOW, there can be delays due to equipment problems, scheduling or unexpected breakdown that interfere with proper spray timing; consequently, application is always a challenge.

Insecticide applications should be applied at 1% hull split. The UC hull split calculator can be used to estimate the timing for 1% hull split (fruit-sandnuts.ucdavis.edu/Weather_Services/almond_hullsplit_prediction/Hull_Split_Calculator), in combination with the data from your indicator trees. The blank almonds usually split 5-7 days before the filled nuts. The hull split model is particularly useful if you use the predicted 1% hull split date to mobilize supplies and equipment ahead of time in order to improve the precision of your timing. Possible insecticide rotations that maximize resistance management are shown in **Table 1** (this

table is not exhaustive). We recommend using the maximum label rate of insecticide.

Timely Harvest

Timely harvest of the crop removes the nuts from NOW oviposition and infestation. Mummy nut removal, the correct timing of insecticide applications and the use of mating disruption can all be undone by delayed harvest. The harvest should be conducted in accordance with the insecticide label, and when 99% to 100% of the nuts can be removed from the trees by shaking. The nuts will dry on the orchard floor but ideally should not remain on the orchard floor for more than 10 days. It is essential to control ants before harvest or extensive ant damage will occur.

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Codling Moth Wreak Havoc on Early Walnut Crop

Large first flight this year may have impacts on walnut yields.

By **CECILIA PARSONS** | Associate Editor

THINK ABOUT WHAT YOU MAY HAVE left on the orchard floor,” former UCCE integrated pest management advisor Emily Symmes said about the extraordinarily large first flight of codling moth experienced by growers this year in many California walnut orchards.

Symmes, who is now a technical field manager with Suterra, said in

June that the large first flight of codling moth (CM) caused high numbers of dropped nuts and even with well-timed sprays, crop damage is already being observed.

If a grower’s grade sheet from the huller is not that bad, he may forget that first flight was so large, Symmes said, but he should keep in mind the loss in yield.

As harvest approaches for the 2020 walnut growing season, evaluating the success of this season’s IPM program is an important first step to planning ahead for 2021. A thorough review of early season losses, damage assessments from in-orchard harvest samples, information provided on grade sheets, and the overall management program (sprays, timing, materials, application



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rates, non-insecticide approaches, etc.) will indicate what modifications may be necessary going forward to achieve desired crop quality measures.

Minimize Early Damage

The first generation of CM causes nutlets to fall from the tree. Evidence of nut loss by CM early in the season includes the frass found at the blossom end. Early season varieties, especially those with shells not well-sealed, are most susceptible to CM infestation. Toward the end of the first generation and with the second and third generation, nuts do not drop, but CM larvae boring into nuts damage the kernels. The CM also opens the door to navel orangeworm (NOW) infestations. A management program that minimizes early- and mid-season CM damage also reduces harvest damage by NOW.

Early maturing walnut varieties are the most likely targets for CM as they present feeding opportunities as the first flight appears in March and April. The flight of the overwintered generation may have two peaks and can last multiple months. These moths lay eggs that signal the beginning of the first generation. The second moth flight results when the larvae of the first generation complete their development. When moth in the second flight lay their eggs, this starts the second generation.

A third generation always occurs in the Central Valley. The fourth generation may or may not be produced based on growing regions. Both of these generations can cause significant damage if populations are not controlled.

With early varieties, CM larvae can chew into poorly sealed nuts. Later season varieties like Chandler can also sustain larval feeding damage. To detect a CM infestation, look for frass at the point of entry into the husk.

Integrated Approach

An integrated pest management strategy for CM should be in place once a new orchard begins producing fruit. While CM can be mobile between orchards, it is not known to have a range of migration similar to other moth pests including NOW. Maintaining low resident populations of CM in indi-

vidual walnut orchards and blocks can help populations remain low from year to year, and is an incentive to begin control early in orchard development.

There is a well-established and validated IPM program for walnuts. Decision tools developed by UC researchers provide very dependable information, Symmes said, allowing growers to predict flights and time insecticide applications. Use of mating disruption

is also recognized as an effective part of a management strategy.

The recommendation from UC research is to begin hanging CM traps in mid-March. The traps with CM pheromone lures should be placed in the tree canopy. Orchards where mating disruption is used, and those near orchards with mating disruption, should also use

Continued on Page 10

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traps baited with a combination of CM pheromone and pear ester plant volatile, as mating disruption will reduce trap counts in pheromone-only traps.

Traps should be checked to determine first flight biofix, the date where moths are consistently caught in traps and sunset temperatures are 62 degrees F or above. After that first flight biofix day is determined, begin tracking degree-day accumulations to schedule spray applications and predict the onset of subsequent flights. Symmes said the degree-day models for CM pair the known developmental requirements – heat units for a specific pest in a specific crop with the actual heat units.

The degree-day calculator for CM is on the UC IPM web site at ipm.ucanr.edu, in Identify and Manage Pests at weather and degree days. Temperatures can be obtained from the nearest CIMIS station. There is a range for each flight prediction and it should be confirmed with trap activity.

“

Determining the need for a spray application is based on orchard history, in-season trap catches, and for the second and third flights, damage evaluation including dropped nuts and canopy counts.

”

Treatment Decisions

Determining the need for a spray application is based on orchard history, in-season trap catches, and for the second and third flights, damage evaluation including dropped nuts and canopy counts.

High crop damage due to CM in recent years is puzzling, according to Symmes, even with well-timed spray applications. Warmer, drier weather may be one factor in the increased CM damage seen. Another factor may be the loss of chlorpyrifos as a critical tool. Use of chlorpyrifos has dramatically decreased in recent years, she said, but it was a reliable tool that could be used

in the case of a severe infestation. With chlorpyrifos applications, coverage of the tree canopy and precise timing to target the egg or early larval stage, while important, was not as critical as it is with more selective pesticides now in use.

There is one walnut growing region of California that does not have high CM pressure. The Lake County region, where about 4,200 acres of walnuts are farmed and the majority are in organic production, has some environmental advantages, according to UCCE Lake County pomology farm advisor Rachel Elkins. Late spring rains and frost events are common and suppress the resident CM populations, she said. In addition, the varieties grown in that region help lessen the susceptibility to CM damage. Finally, Elkins said, pears grown in the area are a preferred host for CM.

When growers did plant the earlier maturing varieties, they did have issues with CM damage, Elkins said. Once those were replaced with later varieties, the CM infestation lessened. An added benefit, she noted, was that without CM pressure in the orchards, their NOW damage disappeared.

Lower insect pressure in Lake County is one of the reasons growers there are able to use organic production practices, Elkins said.

The main insect pest in the area is the walnut husk fly that prefers later blooming and maturing walnut varieties, and can be managed with organic practices.

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Choosing Amendments for Effective Salinity Management

By MAE CULUMBER | UCCE Nut Crop Advisor, Fresno County



PISTACHIO TREES STAND OUT AMONG TREE NUT CROPS AS tolerant of salty growing conditions, but they have their limits, and production may eventually be affected if steps are not taken to relieve stress that happens with salt accumulation. Pistachio orchards have been planted from the Sacramento Valley to Kern County as well as some desert locations. Estimates are that about 25 percent of pistachio acreage is salt-affected. Most of those orchards are in the southwestern San Joaquin Valley (SJV). Many areas have naturally high salt levels, as the soils are derived from sediment from the coastal range that was once below sea level. However, challenges with irrigation water quality and quantity have exacerbated the issue in recent decades.

Depending on the severity, the harmful impacts of salt-affected soils can develop early in orchard establishment, resulting in stunted trees. Initially, trees are subjected to what is called osmotic stress, meaning they are working harder to take up and transpire water because of the increased salt concentration in the soil.

As salt concentrations increase around the roots, there is less solute differential between the root sap and the soil water. This reduces the ability of the root to pull in water by osmosis. As the salt pressure outside of the root continues to increase, it becomes too much for roots to exclude toxic salts and they begin to accumulate in the woody tissue (**Figure 1, see page 13**). Eventually, necrotic burns on the margins

of leaves may result, a characteristic known as specific ion toxicity (**Figure 2, see page 14**). The composition of tree damaging salts varies across different agricultural areas, but problems commonly result when high levels of sodium (Na), chloride (Cl), boron (B), and bicarbonate (HCO_3) are present in the soil and or water alone or in combination with each other (**Figure 1**). Sodium is among the most problematic of these salts because in addition to the problems caused by osmotic stress and ion toxicity, high levels can also degrade soil structure and reduce drainage from the orchard floor, further compounding tree root stress.

Salt affected soils are commonly referred to as 'saline', but it is important to know the distinction between three broad categories of salt-affected soils: saline, saline-sodic and sodic soils. Saline soils have high overall soluble salt concentrations, but usually have higher levels of soluble calcium, which minimizes problems with sodium. These soils generally have good soil physical characteristics and can be managed with sufficient leaching water and careful fertility management, without addition of amendments. Saline-sodic and sodic soils can have varying levels of overall soluble salts, but high levels of Na in either situation. These soils require soil and water amendments to improve soil physical conditions to effectively leach Na out of the soil.

What to Look for from Soil and Water Reports

High salt levels must be decreased below toxic thresholds to maintain tree growth and production. Knowledge of orchard soil and water conditions is critical to ensure salts are managed appropriately. Laboratory reports provide a lot of information and it can be difficult to know how to interpret them to make management decisions. A basic understanding of soil type and cation exchange capacity (CEC), overall soluble salts, pH in soil, and water can help to identify problems and make informed decisions about how to manage them. Electrical conductivity (EC), reported as either deci-Siemens per meter (dS/m) or millimhos per centimeter (mmhos/cm), is a measure of total dissolved salts present in irrigation water or soil water that provides an indication of potential for salt stress on tree growth. Both units have the same value.

Pistachios are salt tolerant, but depending on the salt composition, irrigation water exceeding 4.5 to 7 dS/m EC is probably not sustainable for the long term, especially if salinity challenges are coupled with poor soil drainage. Salts are either

An advertisement for Krause Fabrication. It features three circular inset images showing different pieces of green industrial machinery. The main text is white on a dark green background. The text reads: 'Complete Walnut and Pecan Hulling And Drying Systems', 'KRAUSE FABRICATION' (in a stylized font), '209-754-9636', and '3474 Toyon Circle, Suite 333 Valley Springs, CA 95252'.

positively charged cations or negatively charged anions that have varying levels of impact on overall salinity stress, with more or less effort to manage. Soil chloride (Cl) and sodium (Na) levels >30 milliequivalents per liter (meq/L), and B levels above 3 mg/L are problematic for the long-term health and productivity of pistachios. Cl can be reduced with clean water alone, however

B ions strongly hold (adsorb) to soil particles at higher pH levels, and acid amendments with ample water are necessary to flush excess B out of the rootzone. Na requires continual management to mitigate current or future problems with toxicity and declining soil structural stability and drainage. However, sufficient levels of calcium (Ca) and magnesium (Mg) can counter or reduce the severity of its effects. The sodium absorption ratio (SAR) and exchangeable sodium percentages (ESP) are indices used to compare the concentration of Na with respect to Ca and Mg levels. A general rule of thumb is SAR levels greater than five times the EC of irrigation water indicates an imbalance of Na to Ca and Mg levels, and likely problems with infiltration.

Elevated pH greater than 7.5, bicarbonate (HCO_3) greater than 2 meq/L, and soil lime (CaCO_3) > 1% indicate potential for reduced nutrient availability, as well as soil sealing and reduced infiltration. High HCO_3 levels appear as a white chalky substance on the soil surface and micro irrigation emitters, which alone can be a major source of clogging when not amended properly. When both Na and HCO_3 salts are present, HCO_3 can tie up Ca in the soil and water, which allows Na to become the dominant cation on soil particle surfaces in the formation of saline-sodic or sodic soil conditions. Calcium is a positively charged ion that is attracted to negatively charged soil clay particles, this attraction aggregates soil particles, giving soil structure that resists dispersal and degradation. Unlike Ca, Na ions cause spaces between soil particles to swell, and at elevated levels will eventually disperse soil aggregates. When loose particles clog the pores and cracks that usually allow soil water to infiltrate into the ground, impermeable crusts can develop on the surface. These crusts slow or stop water infiltration and decrease oxygen levels needed by tree feeder roots to absorb nutrients. These saline-sodic or sodic conditions require soil and or water amendments to improve soil structure and leaching for better tree health.

Soil and Water Amendments

The purpose of amendments is to provide a source of Ca to replace the Na and remove it from the rootzone. This can be accomplished with either the direct application of soluble

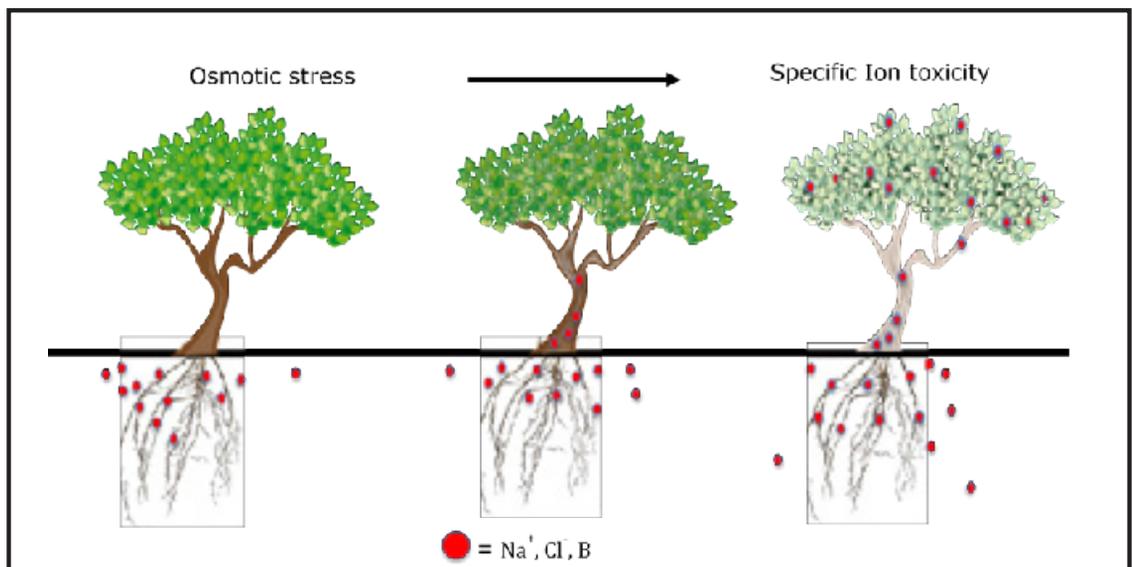


Figure 1. Stress in response to a high salt load starts with osmotic stress, where the ability to pull in water by osmosis declines due to the low solute differential between the root sap and the soil water. This reduces tree transpiration, which limits cell expansion for shoot growth. When the tree can no longer exclude salts, it begins to accumulate in the trunk and leaves. Symptoms of specific ion toxicity include leaf burn and nutritional disorders. (courtesy M. Culumber, UCCE.)

Ca (usually as gypsum) or by use of acidifying products that react with Ca bound by HCO_3 or soil lime (CaCO_3) to make the Ca ion soluble. A combination of both amendments can be beneficial. The sulfate binds with Na to form a compound that is easily leached from the soil, while Ca takes its place

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Continued from Page 13

on the surface of soil particles. A large quantity of Ca is generally needed to displace Na. Yet, because amendments add salts to the soil, too much at once can add to osmotic stress that limits water uptake by trees. Also, any excess applied Ca not displacing Na, has potential to precipitate to form lime or even leach with the irrigation water dependent on soil conditions. The right amendment or combination of amendments largely depends on soil type, pH, the balance of Na with Ca and Mg, and whether there are appreciable amounts of HCO_3 and CaCO_3 in the water and soil.

Calcium amendments are most useful to displace Na where soil pH is less than 7.5, native calcite or lime is less than 1%, and in areas with ultrapure low EC (<0.2) water. The most common Ca supplying product, gypsum, is valued for its moderately slow release of soluble calcium (24%) to continu-

ally improve infiltration and provide a source of plant nutrients. However, solubilities or release rates vary dependent on particle size. Finer particle size products have better solubility and will work more quickly and predictably than coarse material. Fine, solution-grade gypsum injected as a slurry into micro irrigation systems is the most common application form used in-season. Before injecting, managers should evaluate if bicarbonate levels are high (>2 meq/L HCO_3), as injection may cause precipitation of lime and clog irrigation lines. For dormant season applications, growers may consider using coarser sources such as ground wallboard. The larger particle sized material will slowly dissolve with repeated irrigations throughout the season. Not all sources are equal in terms of purity. Ask your retailer for the bulk percentage of soluble calcium in the product. A lower grade with less Ca is generally more economical, but will require heavier application to achieve satisfactory results.

Acidifying amendments are generally most useful in sodic soils with a high pH with soil lime levels greater than 1%. High levels of HCO_3 can also be effectively neutralized by some acids. If soils have less than 1% lime, Ca must be added with the acid to create gypsum in the soil for Na to be leached. However, before these processes can take place, acid-forming amendments (for example sulfur, ammonium polysulfides, and thio-sulfates) require an initial biochemical oxidation of sulfides (S_2) by bacteria, named *Thiobacillus*, to form the sulfuric acid that then breaks down the lime to form free Ca and gypsum. This is important to note because soil temperature and moisture greatly influence microbial activity and the successful conversion of the acid amendment to gypsum. Moist soil with temperatures above 55°F for a period of one to two weeks is needed for the reaction to take place. Optimal soil conditions are around 80°F, therefore a fall application of sulfur will likely provide Na leaching benefits the following growing season rather than during the dormant period when it is commonly applied. Sulfur products, like gypsum, are available in a variety of particle siz-

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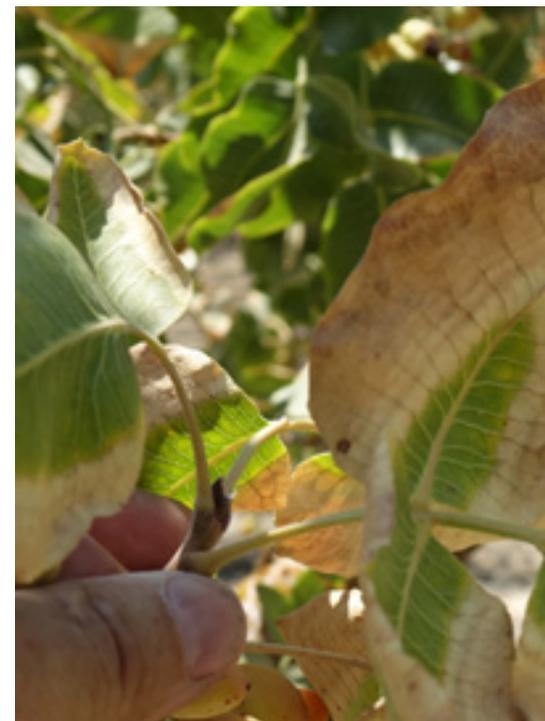


Figure 2. Necrotic leaves are a characteristic of photosynthetic capacity needed to support the Giulia Marino, UCCE.)

es. The finest sized particles provide the fastest response for gypsum formation, while gravel sized particles (popcorn sulfur) can take many years to completely react in the soil.

Sulfuric acid and other sulfate-based liquid acids like urea sulfate make gypsum in the presence of a lime source, independent of the temperature and moisture conditions and do not require microbial oxidation. In addition to the removal of Na, sulfuric acid assists in dissolution of HCO_3^- in highly sodic soil and irrigation water. Sulfurous acid, a safer alternative to sulfuric, is generated with a sulfur burner, which is then injected into irrigation water. Sulfurous acid may provide longer residual acidity that continues to neutralize HCO_3^- and form gypsum.

The use of organic matter including composts, mulches and cover crops are a final consideration in soil amendment goals. Organic matter enhances microbial activity leading to soil aggregation and improved infiltration, and can enhance the effectiveness of other amendments. Kern County Emeritus Soil and Irrigation Advisor, Blake Sanden, found

mixing 1 ton of fine-ground soil sulfur with 4 tons biosolids compost and side banding over the drip hose (a 3" thick by 2 foot wide band) with a low salt source of well water, successfully improved water infiltration in Eastside orchards with severe soil sealing problems. Composts and mulches can also be sources of salt, which can accumulate with salts from irrigation water, therefore laboratory analysis of these materi-

als is recommended before use. Ongoing research is investigating whether additional surfactants, polymers, biostimulants and nutrient amendments reduce soil salinity and improve tree growth and yield in pistachio and almond trials. Cover crops have been shown to improve water infiltration, protect the soil from surface crusting.

Continued on Page 16



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specific ion toxicity. This condition reduces the development of the nut crop (photo courtesy

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Continued from Page 15

and in some instances, significantly reduce soil Na levels. Current research is looking at the benefits and tradeoffs associated with their use in established pistachio blocks.

Rates and Timing

Determining whether to amend irrigation water, the soil, or a combination of both, is dependent on the type and depth of the salt problem. If accumulating salts are limited to the shallow soil surface and not dominated by Na, water amendments applied in frequent small amounts by drip or micro irrigation may be all that is necessary to address the issue. The N fertilizer content of some acid forming amendments may be sufficient and more economical than acid injection to correct the formation of soil sealing lime at the surface. Conversely, if Na loads are high throughout the rootzone, banded or injected acid and/or Ca supplying soil amendments may be needed in addition to other amendments applied to the water. To determine if salt accumulation is mainly at the surface or through the rootzone, soil samples should be taken from zero to three inches, then in one-foot increments, down through the root zone to four or five feet. Poor irrigation water quality with high Na (>15 meq/l Eastside soils, >30 meq/L Westside), on poorly structured soils, will require a focused seasonal to continuous amendment strategy to mitigate current or future problems. Some westside soil types (Panoche, Buttonwillow, Belridge and others) where drainage is not limiting do a better job of handling sodic irrigation water.

If applying amendments through water, determine the rate based on how much Ca (meq/L) or lbs. of material per acre foot of water is needed to raise the water EC so that SAR is no more than five times the EC (**Table 1**). A typical in-season injection rate for fine, evenly graded, 100% gypsum would be between 200-300 pounds per acre, applied monthly in June, July and August. Typical acid injections range between 400-500 lbs. per acre foot of water. Step by step instructions for calculating water applied rates of can be found in the UCANR publication 3375 Agricultural Salinity and Drainage p. 113-115, and

in the UCANR publication 3545 Pistachio Production Manual p. 148-149, or at <https://anrcatalog.ucanr.edu/Items.aspx?hierId=1400>.

If soil reclamation is necessary throughout the rootzone, larger amounts of soil-applied materials can be used in a single application (**Table 2**). Use the SAR, exchangeable sodium percentage (ESP), and CEC from your soil and water report to determine the

Ca requirement and corresponding amendment rate for different materials. Calculation examples can be found in UCANR publication 3375 Agricultural Salinity and Drainage p.116-118. Banding gypsum along drip lines or micro sprinklers is more cost effective than full field broadcasting. Smaller amounts of acid or fine sulfur, shanked into the soil along the drip hose, may increase the efficiency of applied

meq/L Ca	Gypsum (23%Ca, 19%S)	Sulfuric Acid (100% S)	Sulfur (100% S)	Lime sulfur (9% Ca, 24% S)	Nitro sulfur (20% N, 40%S)	Nphuric (10%N 18%S)
1.0	234	133	44	191	109	242
2.0	468	266	87	382	218	484
3.0	702	399	131	573	327	726
4.0	936	532	174	764	436	968
5.0	1170	665	218	955	545	1210
6.0	1404	798	262	1146	654	1452

Table 1. Ca (meq/L) requirement converted to lbs of material per acre-foot/water needed to raise the water EC so that SAR is no more than five times the EC (adapted from UCANR Publication 3375.)

meq/L Ca	Gypsum (100%)	Sulfuric Acid	Sulfur (100% S)	Lime Sulfur (9% Ca, 24% S)
1	1.7	1.0	0.3	1.4
1.5	2.6	1.6	0.5	2.1
2	3.4	2.1	0.7	2.8
2.5	4.2	2.6	0.8	3.5
3	5.2	3.2	1.0	4.2
3.5	6.0	3.7	1.2	4.9
4	6.9	4.2	1.3	5.6

Caution: don't exceed 1500 lbs of sulfuric in a single application as a risk to tree roots
²Lime sulfur provides some Ca benefit, but to get the full equivalency, native soil lime must be present.

Table 2: Ca (meq/L) requirement converted to tons of material per acre-foot/soil needed to reduce the exchangeable sodium percentage. Adapted from UCANR Publication 3375.



Figure 3. Fifteen ton/ac band application of elemental sulfur shanked in with a chisel shank to a depth of 28" prior to planting (photo courtesy Blake Sanden, UCCE.)

amendments. Acid banding on berms in established orchards should not exceed 1,500 pounds per acre to avoid tree damage. These strategies are often easiest and most effective when done just prior to planting (Figure 3, see page 17). If in-season applications are not sufficient to reduce sodic conditions, a dormant season broadcast application

of a coarser, slower dissolving amendment is recommended. If reclaiming a highly sodic site prior to orchard establishment, 3-6 tons of gypsum should be mixed to as deep as the expected rootzone or to at least 12 inches (30 cm) with a final surface application prior to establishment.

Leaching Salts from the Rootzone

Leaching salts from the root zone can be effective in preventing salt build-up in soils. The aim of dormant season salinity management is to replenish soil moisture, improve water penetration and leach enough salt for

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efficient use of irrigation water during the growing season. Prior to leaching, water and soil sampling and analyses should be conducted around early November.

For saline-sodic and sodic soils, make dormant gypsum amendment applications in the fall prior to rain and leaching. Depending on the soil texture and salt load, 6-10 inches of effective rainfall (penetrating past a 2” depth) or fresh-water winter irrigation is needed for efficient leaching after the appropriate amendments have been applied. Leaching calculation and conversions can be found at cekern.ucanr.edu/Irrigation_Management/ANALYTICAL_CONVERSIONS_AND_LEACHING_CALCULATIONS.

If leaching with fresh irrigation water, the first application should fill the soil profile to field capacity. Allow two to four days for drainage, then begin

‘SALT-AFFECTED SOILS ARE COMMONLY REFERRED TO AS ‘SALINE’, BUT IT IS IMPORTANT TO KNOW THE DISTINCTION BETWEEN THREE BROAD CATEGORIES OF SALT-AFFECTED SOILS: SALINE, SALINE-SODIC, AND SODIC SOILS.’

leaching applications. Irrigators should make sure to keep irrigation sets to less than 24 hours to avoid the risk of soil saturation and *Phytophthora*. A good strategy is to begin applying water in January (one inch per event) leaving the soil some ability to absorb any rainfall that occurs before flowering. If no additional rainfall occurs, continue applying one inch every few weeks with the goal of reaching the target 6-10 inches before March. Soil and irriga-

tion water should be sampled again to determine effectiveness of the leaching and provide a reference point for the salt levels at the beginning and end of the growing season.

Managing Salts in Summary

Pistachios are more tolerant than other tree crops, but elevated salt degrades soil structure, decreases water uptake, stunts growth, eventually accumulates salt in tissues and decreases nut crop quality. Knowledge of soil and water conditions is critical to selecting appropriate Ca supplying and acidifying products to mitigate these issues. Calcium supplying amendments are best for use in Na affected soils where lime levels are below 1% and HCO₃ is lower than 2 meq/L. Acidifying amendments are useful in sodic soils with soil lime levels greater than 1%. Elemental sulfur and sulfide containing amendments require warm moist soil conditions for successful microbial oxidation to sulfuric acid, which dissolves soil lime, forms gypsum and removes Na. In general, injected amendments treat shallow sodic surface conditions, and soil applications address rootzone problems. Use caution not to over apply amendments, including composts and mulches that might contain high levels of salt. Apply amendments prior to leaching reclamation efforts during the dormant season. Do not saturate the soil during leaching events. Limit winter irrigation sets to less than 24 hours, then allow soil to drain for two to four days between applications. Finish leaching applications at least two weeks prior to bud break in the spring.

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THE ART OF ETHEPHON

DETERMINE PACKING TISSUE BROWN TO FINESSE WALNUT HARVEST TIMING BASED ON CROP VARIABLES

By **VICKY BOYD** | *Contributing Writer*



SUCCESSFULLY USING THE PLANT

growth regulator (PGR), ethephon, to potentially hasten walnut harvest or improve nut removal and hullability has been described as part art and part science.

To obtain the desired results, growers first need to determine if walnut kernels are mature and receptive to the PGR by accurately sampling the orchard. Then they must factor in other variables, such as variety, tree stress levels, weather conditions, harvest equipment availability and whether the huller/drier they deliver to is ready to receive their nuts, said Bob Beede, University of California Cooperative Extension farm advisor emeritus for Kings County.

Ethephon can be used in two ways, based on a grower's goals. If it is applied when at least 95% of the kernels are mature, it can promote an average of four to five days earlier harvest, depending on the season. This may help the grower harvest more desirable lighter-colored kernels while potentially minimizing navel orangeworm exposure, he said. If done correctly, using ethephon this way could potentially net a grower an average of 5 cents per pound more.

A PGR application made five to seven days after 95% kernel maturity may aid nut removal and reduce the chance of having to shake a second time. Regardless of their choice, Beede said, growers need to begin by assess-

ing nut maturity.

"One of the key elements to using ethephon is to accurately determine the physiological stage of what's known as packing tissue brown, or PTB," said Beede, who has conducted numerous trials with ethephon during his tenure. "It doesn't simply mean talking to your friends or going to the coffee shop and asking people when they're putting on their ethephon because trees in sandy soils often times will mature sooner than trees on heavier ground. Water stress and high nitrogen also affect PTB."

A plant growth regulator, ethephon boosts the release of the plant hormone ethylene, which promotes ripening and senescence.

Sampling for PTB

Walnut kernels reach peak maturity and maximum oil accumulation when the PTB has changed from a bright white to an oak-brown color. At this stage, the kernels are the coveted light blond color. While growers wait for hull split and eventual harvest, the PTB continues to darken as does the kernel.

Kernel maturity typically occurs up to 21 days before an untreated harvest but may occur later in well-irrigated and/or heavily fertilized orchards.

Start sampling about two weeks before PTB is expected to begin, Beede

Continued on Page 22



Collect 100 samples, cut them open and dig out the kernel. The packing tissue should be oak-brown in color. The photo at left is immature and the packing tissue hasn't reached that color yet. At right, the packing tissue is an oak-brown color, so the nut has reached its peak maturity (photos by Bob Beede, UCCE.)



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Accurate sampling to determine nut maturity is an important factor in timing plant growth regulator applications in walnuts (photo by V. Boyd)



The reason for spending so much time accurately determining PTB (packing tissue brown) is because it has been shown by other researchers that applying ethephon before PTB can cause quality problems in terms of oil accumulation and some shrivel of the kernel tips.

—Bob Beede, UCCE



Continued from Page 21

said. Earlier-maturing Chandler varieties, such as Howard, will reach PTB sooner than later varieties, such as Chandlers. Walking diagonally across the entire orchard, randomly collect 100 walnuts—roughly 3/4 of a 5-gallon bucket—from representative trees and from about 10 feet off the ground. Beede uses a reach pruner to collect samples.

Spread the nuts on a sheet of cardboard, slice them in half, dig out the kernel and examine the packing tissue color. Packing tissue with white spots are two to three days away from a uniform oak color, while those with a deep mahogany color or even darker are overly mature. Light oak color means the packing tissue is just approaching PTB but isn't quite there yet.

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Consider an ethephon application when 95% of the nuts in the sample are at PTB. If your results are marginal or if you're unsure whether you've achieved the 95% threshold, Beede recommends waiting a couple more days before making an application.

"The reason for spending so much time accurately determining PTB is because it has been shown by other researchers that applying ethephon before PTB can cause quality problems in terms of oil accumulation and some shrivel of the kernel tips," Beede said.

In fact, applying the PGR a week to 10 days before PTB can actually turn the kernels black, and the hulls will become mushy and difficult to remove.

Based on his research, Beede said walnuts typically approach 80% removal and hullability about 21 days after PTB without treatment. Using ethep-

hon correctly could push up harvest an average of four to five days, he said.

If growers decide to go this route, Beede recommended they notify the huller ahead of time, especially if they're using ethephon on an early variety.

"Be sure the huller is going to be open and ready to accept your nuts," he said. "You want to take advantage of the earlier harvest, and the kernel will be slightly lighter."

Improved Nut Removal

The other approach involves determining 95% PTB but waiting five to seven days to apply ethephon. This will hasten hull split, known scientifically as hull dehiscence, where the hull separates from the nut. In theory, this timing should promote a more uniform hull split and enhance nut removal

during shaking. To make this option pay off, he said growers need to obtain 95% or better nut removal with a single shake.

If you wait much longer to apply ethephon, you're approaching the same harvest date as you would without a treatment. Because actual harvest timing will vary among orchards, variety, irrigation regime and growing region, Beede recommended growers experiment with shaking five, seven and 10 days after treatment.

A benefit of this approach is you're leaving more hulls in the orchard, so you should have to haul fewer loads to the huller/drier. The huller/drier also should see improved hullability and more dryable product.

Mateo Marquez, a pest control adviser with Integral Ag Services in Durham, said most of the growers he

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Continued from Page 23

works with who use ethephon apply it to increase harvest efficiency and recover more nuts during the first shake.

“Especially guys who have custom harvesting, they don’t want to have the harvester coming back a second time,” he said.

Some of Marquez’s growers who have larger acreage use ethephon to help space out harvest and reduce bottlenecks.

“Getting some blocks going earlier can help spread things out,” he said.

This year, Marquez said economics may come into play as growers decide whether to use the PGR. With low walnut prices, some may decide not to apply it as a cost-cutting move.

Year in and year out, Marquez said growers with Howard varieties tend to opt for ethephon. At maturity, the variety has a pellicle that tends to darken quickly after harvest.

“The earlier you can harvest them, the better color you have in the grade, so Howard’s seem to be the most targeted,” he said.

Getting the Most from Ethephon

Ethephon is a gas applied as a liquid formulation, and



When applied five to seven days after PTB (packing tissue brown), ethephon one-shake harvest (photo by V. Boyd.)



When applied at PTB (packing tissue brown), ethephon may hasten harvest

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there’s only a certain amount of time – what Beede called hang time – before the product volatilizes. The goal is to apply it under conditions that will promote the longest hang time, such as spraying at night when humidity is higher or even during fog, he said.

“I don’t even care if it’s slightly drizzling because it is only increasing the hang time of the ethylene on the surface and optimizing the opportunity of absorption into the hull,” Beede said.

Ethephon does not translocate well within the hull, so coverage is the key. For application with an airblast sprayer, Beede recommends 4 to 5 pints of actual material applied in 150-200 gallons per acre. Adjuvants don’t seem to affect efficacy, said Beede, who conducted trials looking at different



promotes a more uniform hull split and typically a



by four to five days (photo by V. Boyd.)

additives.

What does influence efficacy is the amount of ethephon applied, so 5 pints will likely provide improved results compared to 4 pints per acre, he said.

The product also can be applied by air following label recommendations, Beede said. Growers have reported good performance when applied in 20-40 gallons of water per acre, although some have reported premature defoliation of the tops of the trees.

How well varieties respond to ethephon depends on the porosity of the

hull and the thickness of waxes on the hull surface, Beede said, citing research conducted by UC Davis plant physiologist Judy Jernstedt and her post-doctoral researcher, Michael Christianson.

Serr, for example, is not very responsive to ethephon because the hull isn't very porous. Tulare, on the other hand, is very responsive and will literally fall off the tree shortly after treatment. Chandler is moderately responsive.

How well some of the newer varieties, such as Ivanhoe, Solano and Durham, respond is unknown, he said.

"We don't know about any of those newer varieties other than from grower experience," Beede said, expressing his frustration. "All of the new walnut varieties and the potential releases from the breeding program aren't being tested for their preliminary responsiveness to ethephon using a dip test. The reason I was so adamant (about testing)

is because the future goal of the walnut industry should be to eliminate the necessity for a second shake as much as we can. With the second shake, we're harvesting walnuts that are overly mature, thus shortening their storage potential because walnuts are fraught with the problem of constant oxidation, darkened kernels and rancidity."

For more information, download "The Art and Science of Ethephon Use on Walnuts" by Bob Beede at http://cekings.ucanr.edu/newsletters/Nut_Crops39678.pdf.

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PROGRESSIVE CROP CONSULTANT MAGAZINE's popular two-day Crop Consultant Conference this year will be a live virtual event, featuring more than six hours of DPR and CCA continuing education credits, a virtual trade show, live presentations and interactive educational seminars. The Virtual Crop Consultant Conference will be held over two afternoons on Sept. 17 and 18.

The Crop Consultant Conference has become a premier event held in the San Joaquin Valley each September for Pest Control Advisors and Certified Crop Advisors. This year, JCS Marketing, the publisher of PCC Magazine is working with co-host Western Region Certified Crop Adviser and its sponsors to continue the traditional event while acknowledging restrictions on large public gatherings.

"I think the whole industry is learning to be nimble given changes to how we do business during this Coronavirus era and Progressive Crop Consultant is no different," said JCS Marketing Publisher and CEO Jason Scott.

"Obviously agriculture is a relationship-driven business and there is no substitute for live events," Scott continued. "But given our current circumstances, our team is working with our co-host, Western Region Certified Crop Adviser, to make this a dynamic, interactive experience where PCAs and crop consultants can hear the latest about products, strategies and technologies, earn CEUs, and connect with experts, suppliers and each other."

Topics for the interactive seminars include: Managing pests in grapes, citrus and tree nut crops; a special seminar on

hemp production; new tools and technology for applying pesticides; application safety; and fumigation options. In addition, hard to get CCA hours will be hosted by Western Region CCA on topics related to reading and understanding nutrient analysis lab reports; biologicals and biostimulants; and features and benefits of potassium sources.

In addition, Western CCA will present the CCA of the Year Award and announce its scholarship winners.

Registration fees for the two-day event have been reduced to \$65 and include a T-shirt mailed to the participant's address along with other prizes and surprises. Pre-registration is required and can be done at progressivecrop.com/conference.

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Cutting to the Chase in Pistachio Pruning

Research on Alternative Training Systems Shows Promise for Newer Pistachio Varieties

By **MITCH LIES** | *Contributing Writer*

RESearchers are finding that newer training systems for young pistachios may offer benefits over conventionally pruned trees, particularly for newer varieties that may not be as well adapted to conventional systems as Kerman pistachio.

Time will tell if advantages showing

up in the first few years of research into alternative training systems for pistachios bear up over time. But to date, unpruned pistachio trees and those pruned using a modified central-leader training system are performing better than conventionally pruned trees, according to UCCE Integrated Orchard Management



In research trials comparing pistachio tree training systems, conventionally pruned trees, pictured here, have smaller rootstock, fewer side shoots and fewer flower buds than trees pruned using a modified central leader system and unpruned trees (photos courtesy Bruce Lampinen, UCCE.)

Specialist Bruce Lampinen.

In reporting on research that he and co-principle investigator Fresno County Nut Crops Farm Advisor Mae Culumber are conducting in grower orchards, Lampinen said unpruned pistachio trees and those pruned under a modified central-leader training system are yielding better in the early years than conventionally pruned trees. And what may have longer term ramifications, the research is showing that unpruned trees and those pruned on a modified central-leader training system have better branch angles, stronger connections and are less prone to breakage.

“We haven’t seen any breakage in grower orchards trained with the modified central-leader system up to seven years of age,” Lampinen said.

The research could prove valuable as growers consider alternative training systems for newer varieties, said Bob Klein, manager of the California Pistachio Research Board.

“The conventional pruning system was developed for the variety Kerman, and it wasn’t really that great for a variety like Kaleghouchi, where the limbs are more flexible,” Klein said. “And there is a question about how well it works with Lost Hills and Golden Hills.

“At this point, we don’t know how it is going to work out,” Klein added in regard to the research. “It depends on what is going to happen over the next few years. If it provides a way to get trees to bearing with less labor, and maintain the kind of tree growers want, then it will be valuable.”

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Pistachio trees pruned using a modified central leader system, pictured here, are less prone to breakage than trees pruned conventionally.



Unpruned trees in the UCCE research trials, pictured here, yield far better in the early years of development than trees pruned using a modified central leader system and trees pruned conventionally.

In three trials, Lampinen and Culumber are comparing tree responses to three pruning techniques: conventional, where trees are headed at 43 inches at the end of their first dormancy and received in-season tipping; modified central leader, where trees were headed at 62 inches of height at the end of their first dormant season and received no in-season tipping; and unpruned. In the unpruned trees, the researchers “just planted the trees and let them grow,” Lampinen said. The only pruning done on those trees was to remove branches that were so low on the trunk they would interfere with shaking during harvest.

The researchers have three trial sites, two in Kings County, one of which was planted a year later than the other, and a Yolo County site, also planted one year after the first Kings County trial. The first Kings County site was planted to Lost Hills on PG1 rootstock. Site two in Kings County was planted to Golden Hills, also on PG1 rootstock.

Lampinen said differences in the size of rootstock, tree height and numbers of side shoots began appearing after the first year in the first Kings County site.

“After the 2017 season, we had larger rootstocks, taller trees and more side shoots emerging on the unpruned treatments compared to the conventional,” Lampinen said. “We also had more flower buds. We had .17 clusters per tree on the conventional versus 1.45 on the un-headed trees.”

Rootstock size has continued to be smaller throughout the first three years of the trial on the conventionally pruned trees, Lampinen said. “We think that probably has longer-term implications for tree growth,” he said.

Significantly Higher Crop

Early harvest figures showed significant differences. In conventionally pruned trees at the first Kings County site, the team documented that one out of every 40 trees had a crop in 2019, the first year that trees were harvested. On the modified central-leader trees, three out of every 40 trees had a crop. On the unpruned trees, 38 out of 40 trees had a crop.

As for total yields, Lampinen said they were essentially non-existent on the conventionally pruned trees. The modified central-leader trees yielded less than one pound per acre. The

unpruned trees yielded 55 pounds per acre.

“The unpruned trees had a significantly higher crop early on,” Lampinen said. “I don’t know how that will hold up.”

Lampinen also noted that unpruned trees in the second Kings County site tended to be more upright than trees growing under conventional or modified central-leader pruning systems, and shoots developed at lower heights on the unpruned trees and had significantly more buds. “With good water management on these un-headed trees, you can push out a lot of buds,” he said. “We pushed out 40 or more buds on some of these un-headed trees.”

Blank zones appeared in early years on the unpruned trees in the first Kings County site, Lampinen said, but were filling in as the trees matured. “A lot of the gaps are filling in similar to what we see on walnuts,” Lampinen said. “So, the trees are straightening themselves out.”

Lampinen noted that in Australia, where growers have been using the modified central-leader pruning system for the past three or so years, growers call the period where blank spots and irregular branching appear in trees the “gangly teenage years.”

Continued on Page 30

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Continued from Page 29

Lampinen added that Australian growers use the modified central-leader system in large part to avoid breakage damage later in orchard life.

“Trees look irregular in these years and growers don’t like to see that,” he said. “But we found that they seem to be filling in really well by the end of the third leaf. The trees are pretty much

straightening out on their own.”

In the Yolo County trial, which was planted to Golden Hills on nursery grafted UCB1 rootstock, the modified central-leader trees and the unpruned trees again had larger rootstock than the conventionally pruned trees, and the trees were taller. Lampinen noted, however, that the trees were taller “only because they hadn’t been pruned.

“From our experience with wal-

nuts, the trees all reach the same height eventually,” he said, “whether you prune them or not. Pruning just keeps dwarfing them until you stop pruning.”

More Fruiting Positions

As in the Kings County sites, in Yolo County, researchers found the unpruned trees had more early fruiting positions and earlier yield potential than the conventionally pruned trees. And researchers found the trees growing under the modified central-leader and unpruned systems had stronger branch connections than the conventionally pruned trees.

“In the conventionally pruned trees, we see a lot of breakage where the initial heading cut was made and also where the first tipping cut was made,” Lampinen said. “In fact, this is the major place that we see breakage.

“Whenever I see breakage in conventionally pruned pistachio orchards, about 90% or more of that is where that first tipping cut was made,” he said.

The Yolo County trial also had more crop in the interior of the unpruned and modified central-leader trees than in the conventionally pruned trees, Lampinen said.

In measuring light interception, researchers found conventionally pruned trees had the highest light interception in the three trials, while the unpruned trees had the lowest, except in the Yolo site, where light interception in the unpruned and modified central-leader trees were similar.

“We are producing more crop in these treatments with lower light interception,” Lampinen said. “This is exactly what we found in walnuts. We find that we have higher water-use efficiency in years two through six because of the fact the trees are smaller, but they are producing more crop.”

Looking forward, Lampinen said researchers plan to continue data collection on the three original trials and start four new pruning trials comparing both Kerman and Golden Hills on UCB1 seedling and Platinum rootstocks at UC Westside Field Station.

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NEW TECHNOLOGIES PROVIDE INTEGRATED SOLUTIONS FOR NAVAL ORANGEWORM



Christeen Abbott-Hearn and Jeannine Lowrimore of Pacific BioControl evaluate Isomate Mist NOW, Pacific Biocontrol's pheromone mating disruption product (photo courtesy Pacific BioControl.)

By **CECILIA PARSONS** | Associate Editor

ALMOND, WALNUT AND PISTACHIO GROWERS, DEPENDING ON the growing region, list NOW (*Amyelois transitella*) as one of the most destructive insect pests in their orchards. Navel orangeworm feeding on developing nuts not only damages the kernels and lowers their value, it also can allow development of aflatoxin, a mold byproduct that con-

taminates the nuts and limits export opportunities.

Given the high value of tree nut crops in the West, it is not surprising that crop protection technology for insect pests continues to evolve. As navel orangeworm became a major pest, first in almonds and later in pistachio and walnut orchards, crop protection companies understood that pesticide applications alone were not a long-term solution to controlling this pest. Insecticide resistance issues with some chemistries and restrictions on pesticide use have posed control challenges. Development of integrated pest management programs by University of California farm advisors and researchers as well as new products that take different routes to NOW control are helping to reduce reliance on insecticides.

University of California research has proven that sanitation, removal of mummy nuts from the orchard after harvest, is the cornerstone of any NOW control program in tree nuts. Newer technologies are augmenting sanitation, such as mating disruption products and pheromone monitoring systems including lures and traps—all tools developed by crop protection services companies to reduce NOW populations and limit crop damage.

Mating disruption as a pest management practice is now done on more than 400,000 acres of almonds in the San Joaquin Valley, according to Almond Board of California. Pheromone products, tools that disperse pheromones, systems that relay trap counts and environmental conditions leading to hull split, and even trap designs are being developed to expand options on the market. Here is a look at a few of the products currently available and under development.

Pheromone Monitoring and Disruption

Trécé's latest PHEROCON monitoring system includes a lure that attracts both male and female NOW. This rounds out a comprehensive line of lures and multiple trap designs for NOW surveillance. The CIDETRAK line of control tech-

Continued on Page 34

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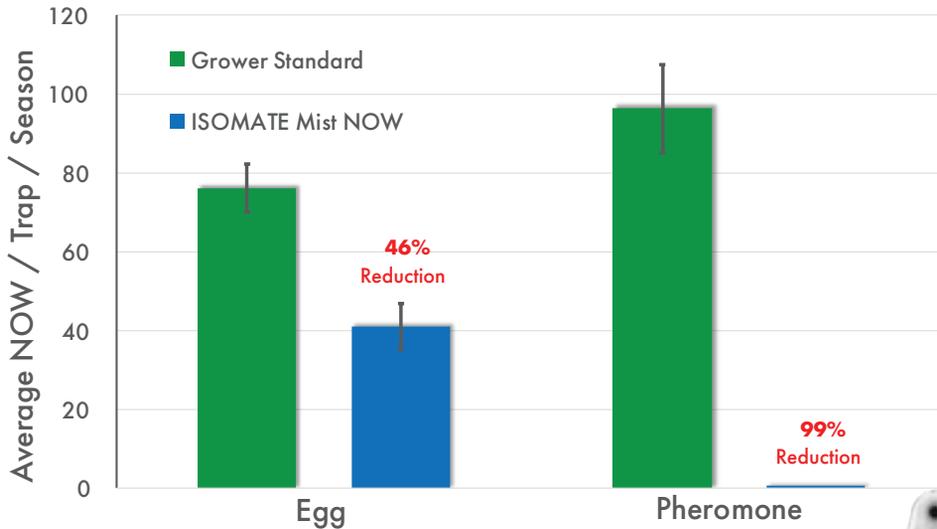
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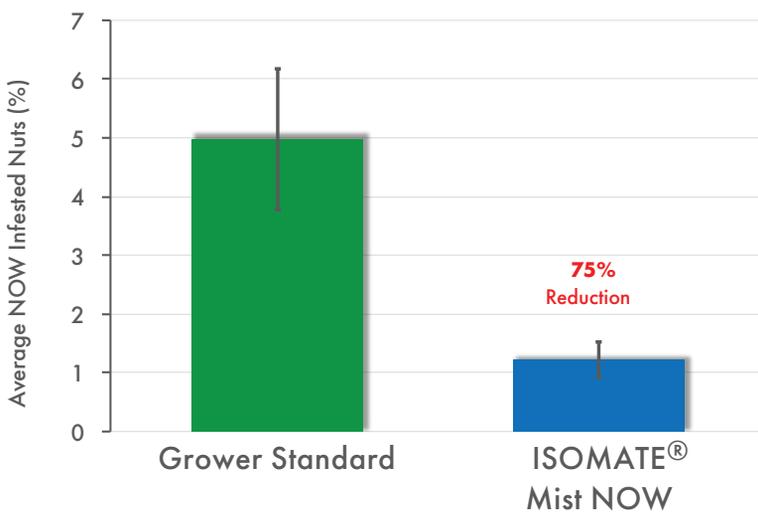
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Replicated 4x - Chico, CA - 2019

Navel Orangeworm
Pheromone Mating Disruption

Simple Deployment!

1 Mist Unit/Acre
Use Rate

225+ Days
Pheromone Release



Continued from Page 32

nology features a solid dispenser pheromone release platform, with constant release 24/7 through the entire season and beyond.

Pacific Biocontrol's Isomate dispensers release over several months a synthetic pheromone that suppresses NOW mating. The pheromone "cloud" saturates the air, making it difficult for male NOW to find a mate.

In 2019, Suterra introduced a sprayable NOW mating disruption option to the market. Flowable pheromone (CheckMate® NOW-F) is applied using traditional pesticide sprayers via ground or aerial applications. It can be tank mixed with a wide variety of agrochemicals or applied alone. When applied alone, lower volumes and higher sprayer speeds relative to conventional insecticides are possible, allowing for more rapid field applications. Flowable pheromone provides flexibility for growers to incorporate mating disrupt-

tion into their existing IPM program, with the added benefit of a familiar application method and minimizing labor costs. Use patterns (number, timing, location of applications) can be customized to specific orchards and blocks based on pest pressure and population dynamics. The flowable microencapsulated formulation is effective for up to 30 days and may be ideal for orchards not suitable for aerosol mating disruptants, such as younger orchards where branches are less able to support the weight of dispensers, or those with irregularly shaped borders.

Semios has a mating disruption system that combines a pheromone dispenser with a monitoring system that records environmental conditions in orchards and sends data that can be accessed via smartphone or computer.

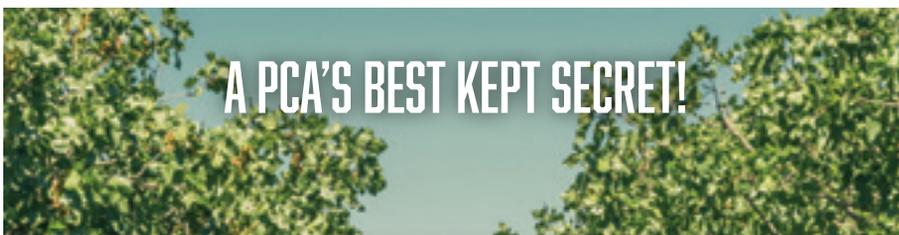
Peterson's NOW traps use "kairomone lures" that emit odors that are attractive to mated female NOW. They contain a mix of ground almond/pistachios wrapped in a mesh bag that is



Semios' NOW Pheromone Dispensers include temperature, humidity, and barometric pressure monitoring every 10 minutes per acre (photo courtesy Semios.)



Isomate Mist NOW is an aerosol emitter that dispenses pheromone when NOW are active and lasts season long (photo courtesy Pacific Biocontrol.)



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Suterra's CheckMate® NOW-F sprayable pheromone can be tank mixed (above) and incorporated into standard IPM spray programs through traditional airblast sprayer application (below.) (Photos courtesy Suterra.)

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The Cidetrak NOW MESO dispenser is designed to give season-long mating disruption with low dispenser rates to cut down on labor for installation (photo courtesy Trécé.)

suspended inside a trap. Baited traps are another tool that allows growers to see NOW pressure levels in orchards.

Tips for Smaller Growers

Brad Higbee, field research and development manager for Trécé, said there are opportunities for smaller growers to adopt NOW monitoring and mating disruption programs, but there can be challenges when neighboring orchards are not managed similarly. Advanced monitoring systems can detect NOW movement into an orchard and targeted sprays can be done. Research has shown that female NOW coming into an orchard are likely already mated. Higbee said they know from past work that immigrating female NOW lay their eggs in trees from four to 600 feet of the orchard border. Monitoring and comparing trap counts on orchard borders with traps at the orchard center can show potential border immigration situations.

Area-wide control programs for NOW are always more effective, Higbee said. Spray timing, mating disruption and sanitation are all more effective NOW controls if done in all neighbor-

ing orchards.

Christeen Abbott-Hearn with Pacific Biocontrol said Isomate Mist NOW is a good option for area-wide use and smaller orchards. Isomate Mist NOW is an aerosol emitter that dispenses pheromone when NOW are active and lasts season-long. The cloud of pheromone moves throughout the orchard with air currents.

“The bigger the continuous cloud of

pheromone, the better,” she said.

Customized placement of the mister units creates optimal pheromone dispersion. Orchards as small as 40 to 60 acres can be successfully disrupted as long as growers take into account the potential for NOW from neighboring nut crops to fly into the orchard. Even then, there are management solutions,

Continued on Page 36

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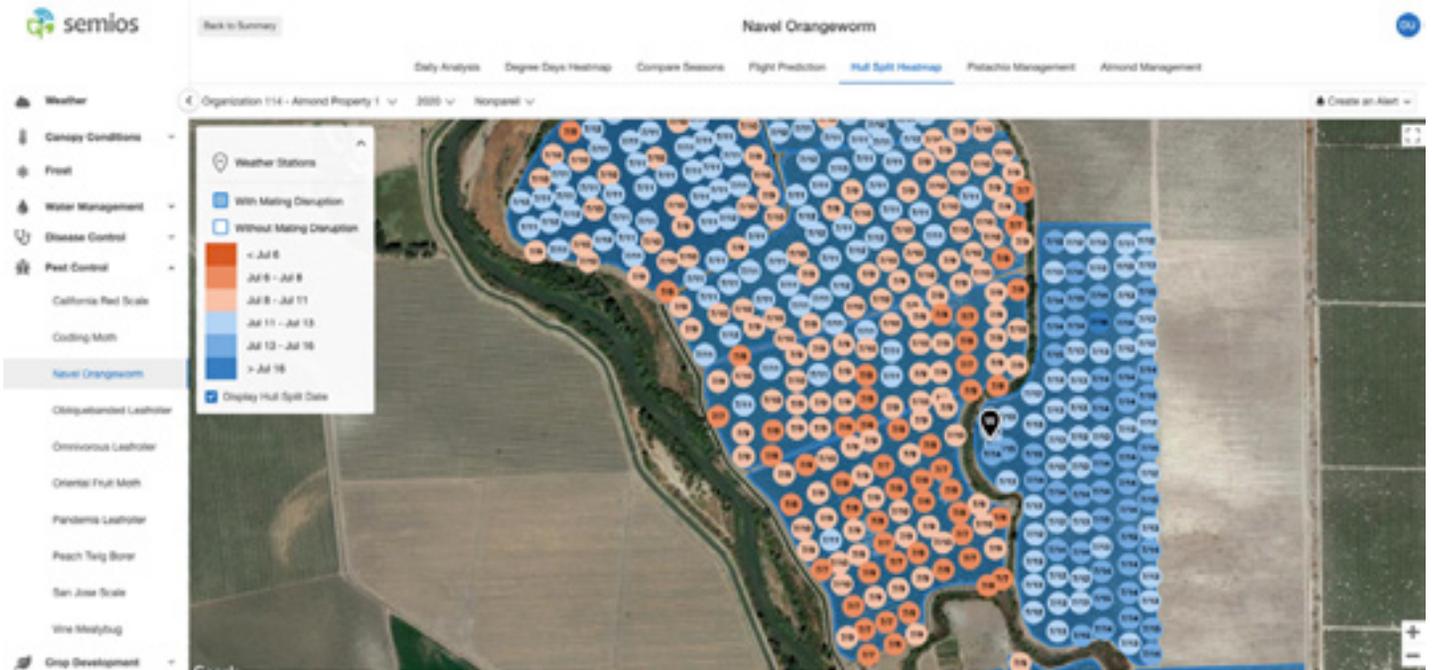
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With Semios' IPM system, growers and PCAs can see how hull split is likely to occur across a block and plan spray timing and logistics in advance (photo courtesy Semios.)

Continued from Page 35

Abbott-Hearn said.

“We always want what is best for the grower and encourage working with each grower to determine the best fit for their particular circumstances. Sometimes, we recommend not using mating disruption but to increase sanitation or to not use mating disruption due to problem neighbors.”

Peterson Traps' kairomone-baited NOW traps are used to catch gravid (mated) female NOW. Justin Nay of Integral Ag said this trap uses a kairomone lure of almond and pistachio mummies to draw in the mated female. Inside the trap, they become stuck to the glue and die with their fertilized egg load. Nay said the lure has a small active space in it is also measuring population density of the orchard, but not the neighboring orchard as the lures only call moths in from one or two rows.

Nay said he has found that matching the number of traps per acre to the expected number of female moths present at first flight results in capturing as much as 75 percent of the first



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flight. If there is a mismatch, and traps are overfilled, a good assessment of expected harvest damage can be made. With that information, an insecticide spray can be done at the right time. Nay said he uses the cumulative number of moths per trap from April 1 to June 15 to determine the threat level.

A grower or PCA still needs to check the hull split timing and flight timing to determine the right time to treat, he said.

Emily Symmes, entomologist and technical field manager with Suterra, said that, although a new option for NOW, Suterra's flowable pheromone technology has been around since the 1990s. It is a proven mating disruption approach that has been effectively used to reduce damage caused by a number of other pest species in various cropping systems. Like any other pest management tactic, whether mating disruption or insecticides or cultural controls, efficacy and economic returns are maximized when implemented as part of an overall IPM program, Symmes said.

Mating disruption does work in smaller orchard blocks, Symmes said, but it becomes more effective in suppressing NOW reproduction and damage when neighbors agree to sanitation protocols and also employ MD in a strategic program. The return on investment also improves with MD coordination over larger areas, and with multi-year use.

Abby Cox, Semios' in-house pest control advisor and entomologist, said the company has introduced NOW Eco—the first organic pheromone based aerosol for MD approved for use in California.

Variable Rate Technology

Centerpiece of Semios' Integrated Pest Management system is its variable rate mating disruption solution. This approach is designed to target pheromone release during peak NOW

activity. The system includes a wireless network of in-canopy sensors for tracking pest development and reporting environmental conditions. The sensors are linked with networked camera traps that enable daily pest counts to be delivered to the grower or farm manager with Semios web and mobile applications.

The Semios IPM system is built on a proprietary variable rate mating disruption platform designed to automatically target pheromone release during peak pest activity for maximum efficacy while sustaining prolonged coverage for late-season generations of NOW.

Semios' wireless network of in-canopy sensors provides growers and PCAs real-time tracking of pest develop-

ment in the orchard by reporting their in-canopy climatic conditions every 10 minutes.

The system is adaptable to any size orchard or block, Cox said, and the platform system saves time by performing the monitoring and data collection tasks.

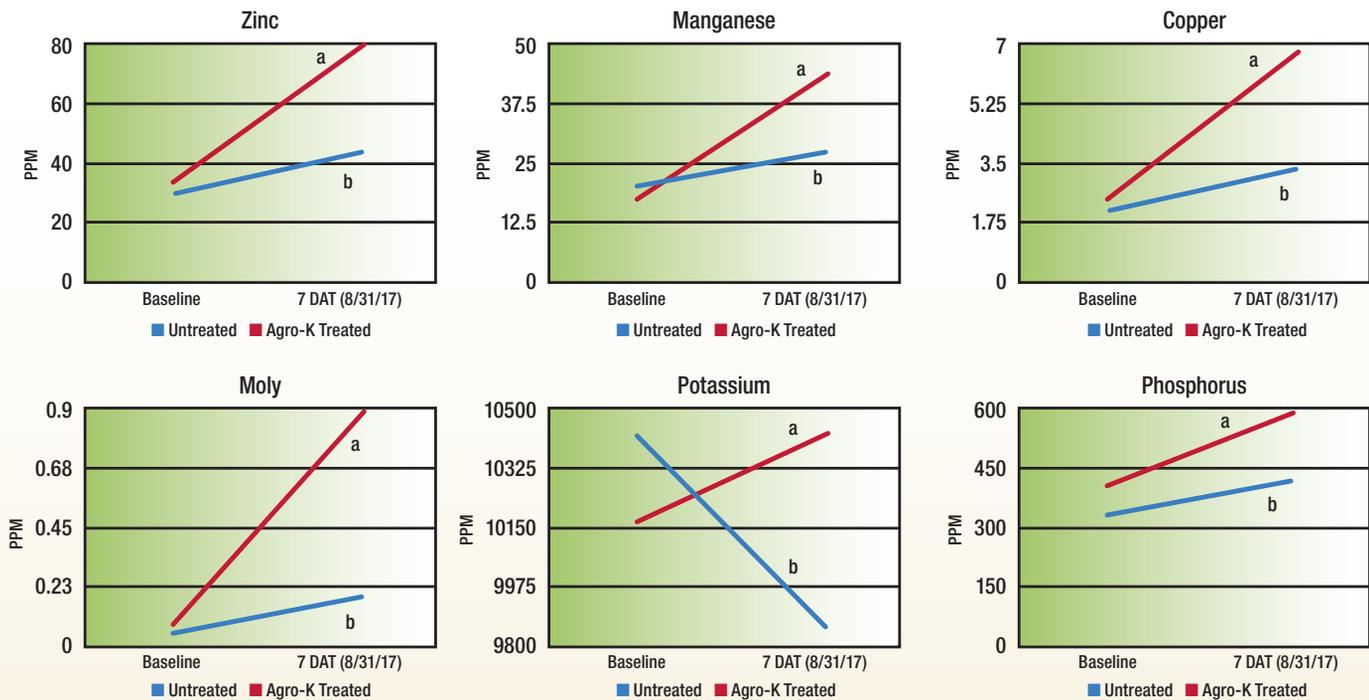
As tree nut acreage continues to grow in California, ensuring crop quality has become a major focus for growers and PCAs. Newer NOW technologies are helping growers deal with NOW challenges by providing additional customized tools for incorporation into NOW IPM programs.

Comments about this article? We want to hear from you. Feel free to email us at article@jcsmarketinginc.com

The advertisement features a green background with a stylized leaf logo for "Dave Wilson Nursery" in yellow and white. Below the logo, the text "Almond trees available now!" is written in a large, bold, yellow font. The bottom half of the ad shows a close-up image of many almonds. At the bottom, a dark green rounded rectangle contains the phone number "1-800-DWN-TREE" and the website "DWN TREES.COM" in yellow text.

Hull Split N.O.W. Applications – A

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Data by Bisabri Ag Research



Hull Split NOW sprays provide a great opportunity to increase this year's nut size, splits and yield and set the stage for higher yields next season. However – many conventional foliar nutrient formulations

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to Hull Split NOW sprays will also increase next year's crop. Even though this year's crop has not yet been harvested, by mid-season the tree is already building next season's crop. Take advantage of the free ride to influence it!

In an August trial a mix of Agro-K nutrients, both micro and macro, were applied to pistachio trees. Utilizing SAP testing methodology over standard tissue testing allowed for analysis of "free nutrients" only; meaning those nutrients currently mobile within the plant's sap and immediately available for plant use. Conventional tissue testing measures what is already bound within the leaf structure and mostly immobile. Measuring sap nutrient levels effectively detects recent nutrient changes. The charts above show statistically significant changes in six different nutrients 7 days after application. Zinc, manganese, copper, molybdenum, potassium and phosphorus levels all increased statistically vs. the control in the week after application.

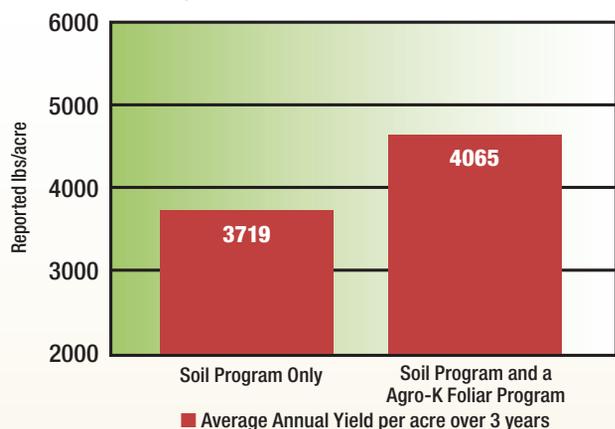
This year, take advantage of your Hull Split NOW application to feed your pistachio trees the key nutrients they need to maximize yield this season and deliver higher yields next year.

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Take advantage of the free ride available with your Hull Split Navel Orange Worm spray to apply nutrient formulations that have been tested and documented to penetrate thick waxy pistachio leaves even during the heat of summer. Applying effective nutrients based on a "Science Driven" approach will help pistachio growers maximize **nut size** and **splits** on this year's crop, increasing per acre returns. In addition, foliar nutrient programs added with Hull Split NOW sprays will also improve yield consistency as well as next year's total yield. Even though this year's crop has not yet been harvested, by mid-season the tree is already building next season's crop.

Applying early-season peak demand nutrients like zinc, phosphorus and boron with your Hull Split NOW spray helps build bud strength and provide critical nutrients that can be stored for next year's developing buds so they are available when the tree breaks dormancy next spring. Agro-K's **System LeafMax** – zinc/manganese phosphite provides eight key nutrient including magnesium, iron and copper in a highly systemic (phloem and xylem mobile) mix for complete chlorophyll development. Along with other materials like **AgroBest 0-20-26** and **Top Set D.L.** Agro-K designs specific nutrient programs tailored to meet the specific needs of your crop.

Our pistachio programs focus on the **5Rs** – Right Nutrient, Right Form, Right Time, Right Mix, Right Place. Building key nutrient levels during Hull Split NOW spray timing works to maximize yield

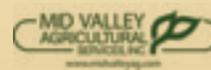
this season while also benefiting next year's crop. Building nutrient levels in the buds this year, leads to more uniform bud break, faster early growth with larger leaves that have more photosynthetic capability and stronger flower buds for increased nut set next season. Ensuring peak nutrient demand timing is met leads to higher nut set and retention. The end result... larger, heavier nuts and increased yield and yield consistency!

Building nutrient levels this year sends trees and buds into winter with more strength and carbohydrate reserves that will be available to the tree next spring at bud break when cool soils limit uptake and nutrient availability. Poor chilling hours have a direct impact on blanks and yield the following year. Chilling hours cannot be controlled but growers can increase carbohydrate levels in the tree by using their Hull Split NOW spray to increase late season photosynthesis leading to increased carbohydrate reserves going into the winter. Incorporate a science driven nutrient program that can penetrate pistachio leaves. Addressing nutrient needs at this time with **System-LeafMax**, **AgroBest 0-20-26** and **Top-Set D.L.** helps minimize blanks and alternate bearing issues. Starting to manage next year's nutrient needs during Hull Split NOW spray timing drives yield increases and yield consistency.

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By RICH KREPS | PCA, CCA, Contributing Writer

SUSTAINABILITY HAS BECOME THE NEW trigger point for consumers in the public’s rapidly expanding politically correct mindset. “I prefer to know the farmers that grew my pistachio/walnut truffle gelato and half-caf, de-caf, almond mocha Frappuccino were sustainable in their efforts.” The ironic thing is, I haven’t met a farmer that has ever said, “Man, I am trying so hard to use up the last remaining piece of fertility this ground can give me before my kids take it over and spend their inheritance...”

We strive every day to make our farms bigger and better than last year, applying the latest and greatest piece of advice we can get to make that happen. Farmers and ranchers are the original “environmentalists” providing food from the same piece of ground, year after year, to keep us from having to hunt and gather again. In those efforts, most of us are exploring new methods of creating healthy and bountiful soils.

The last decade has seen a solid rise in the world of biologically active soil inoculants as we strive to keep our ground as sustainable as possible. Research shows a diverse biological soil population will give rise to bigger yields and better quality. We are realizing the symbiotic relationship bacteria, yeasts, fungi, protozoa, actinomycetes and macro biota have on providing usable sources of nutrition and plant health.

Ask yourself, “Is it really a stretch to think our trees are healthier with better biology in the soil?” Antibiotics came from yeast fermentations in the first place. In a piece as far back as 1998 by Gregory Stephanopoulos and Jens Nielsen in “Metabolic Engineering” Examples of Pathway Manipulations:

Metabolic Engineering in Practice

“Antibiotic production by microorganisms is one of their more interesting features, particularly from a medical and commercial point of view. More

than 10,000 antibiotics and similar bio-active metabolites have been isolated from microbes, with approximately 500 new classes of low-molecular-weight compounds published every year...The primary classes are cephalosporins, penicillins, and tetracyclines, and the majority of these agents are produced by *Streptomyces* (and other actinomycetes) and various *Bacillus* species. Their primary use is in the treatment of human infectious diseases, although a significant number have agricultural and veterinary applications.”

Typical Numbers of Soil Organisms in Healthy Ecosystems			
	Agricultural Soils	Prairie Soils	Forest Soils
Bacteria	100 million to 1 billion.	100 million to 1 billion.	100 million to 1 billion.
Fungi	Several yards. (Dominated by vesicular-arbuscular mycorrhizal (VAM) fungi).	Tens to hundreds of yards. (Dominated by vesicular-arbuscular mycorrhizal (VAM) fungi).	Several hundred yards in deciduous forests. One to forty miles in coniferous forests (dominated by ectomycorrhizal fungi).
Protozoa	Several thousand flagellates and amoebae, one hundred to several hundred ciliates.	Several thousand flagellates and amoebae, one hundred to several hundred ciliates.	Several hundred thousand amoebae, fewer flagellates.
Nematodes	Ten to twenty bacterial-feeders. A few fungal-feeders. Few predatory nematodes.	Tens to several hundred.	Several hundred bacterial- and fungal-feeders. Many predatory nematodes.
Arthropods	Up to one hundred.	Five hundred to two thousand.	Ten to twenty-five thousand. Many more species than in agricultural soils.
Earthworms	Five to thirty. More in soils with high organic matter.	Ten to fifty. Arid or semi-arid areas may have none.	Ten to fifty in deciduous woodlands. Very few in coniferous forests.

This table shows typical organisms in a healthy soil ecosystem (courtesy USDA.)

At my company, we have been using bacillus, actinomycetes, fungal and yeast strains for over 30 years. What used to be called snake oil is now in the mainstream. A new, diverse group of companies use soil inoculants, stimulants and “microbe food” to ensure the good bugs overpower the bad bugs. But here’s the interesting news: the trees beat us to the punch. Root exudates produced by the trees are doing the exact same thing.

Complementing Nature’s Processes

Sugars, complex carbohydrates, starches and acids all play a major role in trees giving up food and creating a healthy environment for the biology that in turn is converting nutrition to usable forms. The secondary effect is that the biology is also creating defenses against pathogens. The question is, “Can we speed that up?” I say yes. Most of my growers spread a good amount of compost on their soil every year. We are simply trying to add organic matter. However, the biology that composted that material in the first place is still there and has a new medium in which to thrive—the soil.

Ground that has had previous cover crops on it now have new friends digesting sequestered nitrogen, breaking down lignin, cellulose and transforming calcareous phosphorus from a rock form into usable nutrients. As they thrive and subsequently die, they can release beneficial compounds for other biology and our roots. Many companies are now propagating their own strains of biology and adding it as liquid amendments to irrigation water, seeds and fertilizers. There are also many companies attempting to populate soils with mycorrhizal strains to increase the size of the root’s “net” or surface area to increase assimilation. *Bacillus thuringiensis* is being shown to help kill nematodes and eat their eggs. Actinomycetes that produce antibiotics can potentially treat some pathogenic issues while other forms of biology may create what is called induced systemic resistance: triggering a plant to create its own defenses against diseases.

Think of it this way. Many healthy adults take probiotics daily to help promote an active and healthy gut. Studies show more is done with the 5 pounds of biology we have in our guts to assimilate nutrition than the organs themselves. The soil does the same thing. It needs biology to make its fertility usable. Just providing the plants food doesn’t mean they have the ability to assimilate it.

Evaluating Products

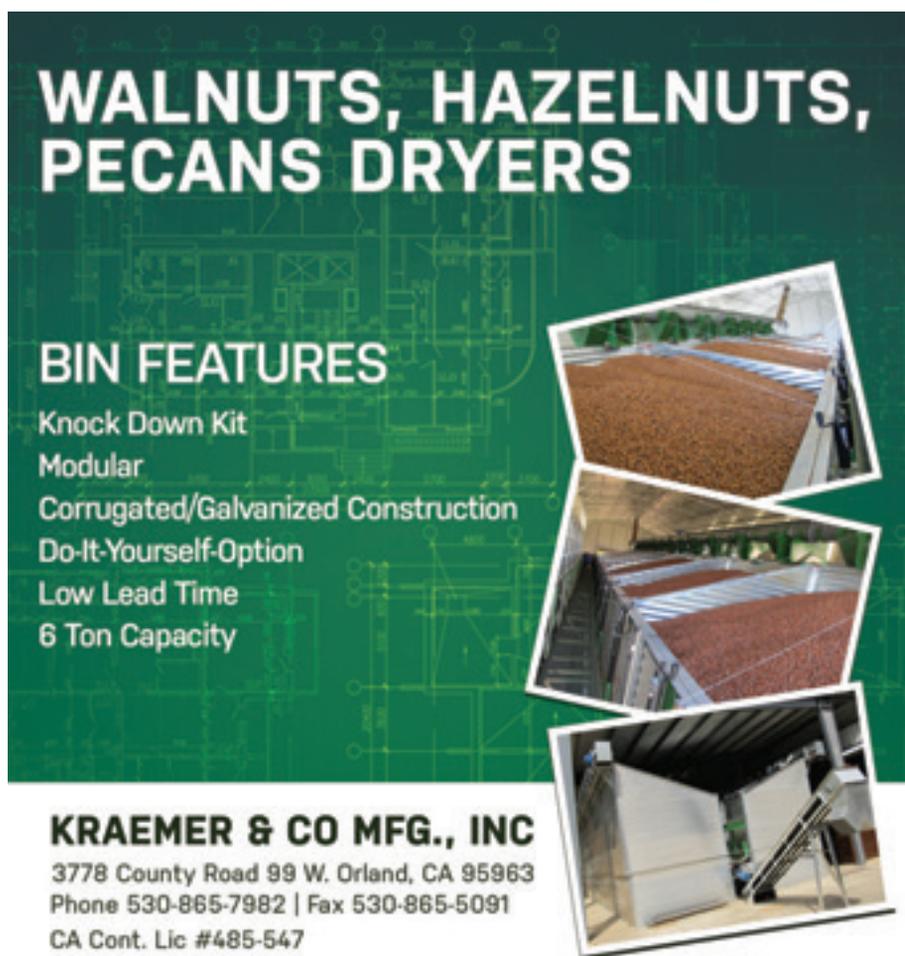
Now comes the blink and uncomfortably long stare I usually get from my growers. This pause is followed by, “What do I do with that information?” I answer this with the resounding, “All of it!... with a few caveats.” Ask questions. Who made it? Can I mix it with fertilizer? Can it store? Will heat destroy it? (A big deal in Calif. and the sunbelt.) Is it native to my soil? And most important-

ly, can we test it once it’s applied?

I tell my growers to apply compost and mulches. I recommend they plant cover crops, monitor the soil moisture, add organic acids, even specific sugars and then test the soil. A solid, active soil biology should produce a larger volume of carbon dioxide when incubated than a less active soil. It’ll even release more usable and stable nitrogen, phosphorus, potassium, calcium, micronutrients, etc.

Your soil isn’t going anywhere. Neither are the roots that are stuck in it. Create as healthy an environment as possible for them by giving them more friends to play with. That’ll sustain higher yields and keep quality to a premium, triggering more happy customers.

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TREE NUT THEFT IS BACK

New crimes mimic sophisticated methods of tree nut thefts four years ago.

By ROGER A. ISOM | *President/CEO, Western Agricultural Processors Association*

'Thieves set up call centers to answer phones as the "trucking company", and the fax/e-mail methods used are often untraceable.'

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THE THEFT OF COMPLETE LOADS OF FINISHED PRODUCT TREE nuts is back. Some four years ago, the tree nut industry suffered more than 40 cases of theft of loads of California tree nuts totaling several million dollars. After more than four years, this past month two loads of finished product almonds were stolen using the same methods.

Sophisticated "Fictitious Pick-Up" Ring

In 2015 and 2016, loads of almonds, walnuts, pistachios and even cashews were stolen in the Central Valley by a

sophisticated crime ring. The method of theft is known as "fictitious pick-up" and is becoming widespread. Cargo theft using fictitious pick-up hit the tree nut industry hard with millions of dollars in losses that year. Unfortunately, it is a low-risk method of theft with a high potential return. And because there is a lag time between when the theft has occurred and when it is determined, it is difficult to investigate and there is a low risk of apprehension. In addition, under laws in California, people that are caught will not spend any time in a state prison, and most likely will be released early because it is a non-violent crime.

The thieves have stolen identities of legitimate trucking companies, shipping companies and/or brokers. All of this information is online at DOT or company websites, even down to driver names on social media like Facebook. The thieves will then incorporate this information on to their own documents and paperwork, and use pre-paid burner phones which have little to no account information and only activated long enough to get the load. These phones are also difficult to trace, and are incorporated right into the shipping documents.

Thieves set up call centers to answer phones as the "trucking company", and the fax/e-mail methods used are often untraceable. The thieves arrange for the pickup posing as a legitimate trucking company and have all of the forged paperwork in order. They take possession of the load, but unfortunately it never arrives at the intended location. By that time, it is already too late.

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Recent Cases and Recommendations

In these two most recent cases, the loads were posted on an internet load board, where a bogus hauler signed up for the loads. In turn, and at the last minute, the bogus hauler subcontracted with a legitimate hauler to pick up the loads. After picking up the loads, the legitimate hauler was subsequently contacted and informed to drop the loads in or around Los Angeles. There they were picked up by the bogus hauler and never seen again.

In response to those thefts, the Western Agricultural Processors Association (WAPA) and the American Pistachio Growers (APG) partnered to hold the Emergency Tree Nut Theft Summit to hear from law enforcement officials, risk management companies and industry representatives on what has happened so far, and what you can do to protect yourself. Out of those meetings came a set of recommendations for handlers to follow. Accordingly, we encourage handlers to use the minimum procedures on **Figure 1**.

These recent thefts serve as an expensive reminder that you must remain diligent on outbound loads and be extremely wary of any changes, especially



Recent incidents of tree nut load theft prompted an Emergency Tree Nut Theft Summit to give handlers strategies for avoiding load theft (photo courtesy WAPA.)

those that occur late in the process. Load tracking can be extremely helpful as well. Law enforcement throughout the state has been notified and is on the lookout for this type of activity. Handlers must be proactive. Assume there will be an attempt on your facility and prepare yourself.

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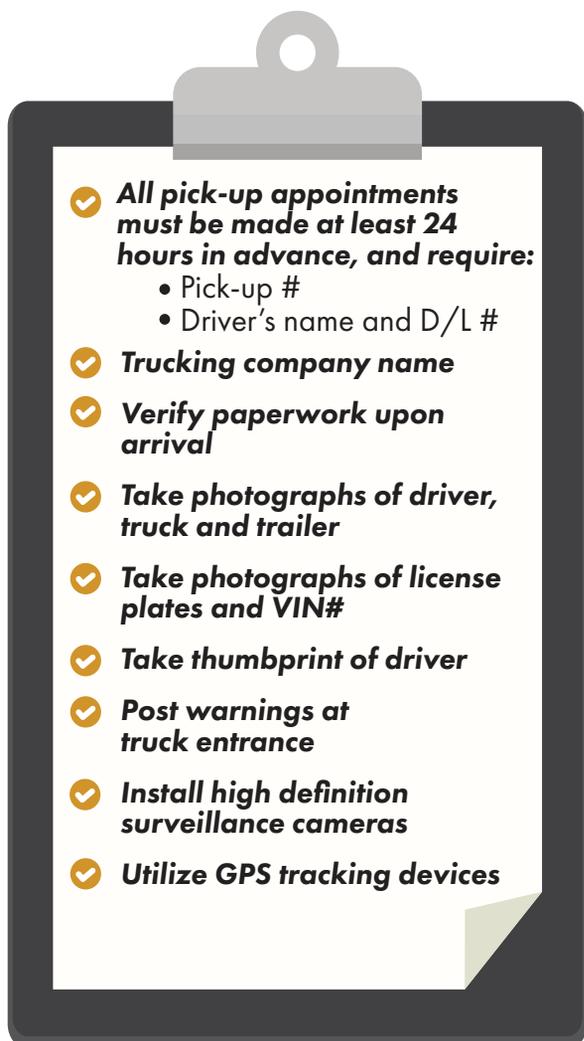


Figure 1: List of minimum procedures for handlers.

PREPARING FOR PISTACHIO HARVEST

With a Billion-Pound Crop Looming, Growers Should Plan Ahead for Harvest Season

By MITCH LIES | Contributing Writer

FOR BRIAN WATTE OF BRIAN WATTE FARMS IN THE SAN JOAQUIN Valley, season-ending crop management in pistachios boils down to three keys: “Just keep the bugs off and keep the water going and get it dried up immediately before we shake,” Watte said.

With their eyes on a billion-pound pistachio crop, California growers, a processor and an extension specialist, recently shared with *West Coast Nut Magazine* some keys to getting the most of this year’s bounty.

Keeping the water running was one constant.

“Unlike in almonds, with pistachios you can put on your water right up until the day you have to stop to get your field



“If you come across a good harvest guy, treat him right, make sure your field is in good shape ... and pay him on time, and you’ll get him back every year.” —Brian Watte, Watte Farms

ready for equipment,” said Rich Kreps, a Madera grower. “So, you can keep that water running, which keeps your profile filled, so you are ready to go with your postharvest nutrition right after you get your nuts off.”

Plan Early for Harvest and Hauling

Getting harvesters to farms in a timely fashion is another key that came up. The best way to do that, according to sources, is to plan ahead and treat them well.

“We have a very good relationship with our harvest guy,” Watte said. “We helped our guy get into the business several years ago, and he takes good care of us because of that. Beyond that, though, generally if you come across a good harvest guy, treat him right, make sure your field is in good shape so he is not out there driving over squirrel holes and all that, where it is hard on his equipment, and pay him on time, and you’ll get him back every year.

“Same thing with truck lines,” Watte continued. “If you don’t jump around and change, if you treat them right, put a little water on your roads once in a while, and you pay them on time, you build relationships. And it is important, especially when you come up on a year like we are now, with a billion-pound crop, and the harvest guys are going to be stretched and the trucks are going to be stretched.

“If you have been with the same crew for several years

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Establishing good relations with a harvester is important in ensuring they will be at your farm when needed, particularly this year, with a billion-pound crop forecast. Here harvesters bring in a crop at Nichols Farm in Hanford, Calif. (photo by L. Ferguson, UCCE.)



Jeff Gibbons, plant manager for Setton Pistachio in Terra Bella, said he believes the industry is well equipped to handle a billion-pound crop (photo courtesy Jeff Gibbons).

and have those good relations, you should get good service,” Watte said. “In most businesses, relationships are important, especially in this nut deal.”

UCCE pomologist Louise Ferguson noted that it is important to start coordinating with harvesters early on. “It is never too early to start working with your contract harvester,” Ferguson said.

Kreps agreed. “Especially if you are a small grower like myself, at 40 acres, you want to line that up early to make sure that when the equipment is coming into your area, your harvest is ready and you’ve got someone lined up so you don’t get pushed on the back burner and lose all the early nuts.

“If you are waiting in line, every day that you are delayed you run the risk of having more insect damage,” Kreps noted.

Late-Season NOW Control

Annually, the biggest crop management issue for pistachio growers in the days leading up to harvest, according to sources, centers around the navel orangeworm (NOW.)

Early Harvest Key to Handling a Billion Pounds

By Mitch Lies

As California pistachio growers, harvesters and processors gear up this month for what could be a record crop, one approaching a billion pounds, questions linger over whether the industry can handle a crop of that size.

“There is a lot of worry this season about getting this billion-pound crop done on a timely basis,” said Brian Watte of Brian Watte Farms in Fresno. “There could be some issues.”

Jeff Gibbons, plant manager for the processor Setton Pistachio in Terra Bella, said, however, he is confident the industry can handle a billion pounds, with a caveat.

“If everybody waits until Sept. 15 to harvest, then there is not enough capacity,” Gibbons said, “but if we start harvesting about the 25th of August and get some of the crop in early, then there is not a problem at all.” Gibbons pointed out that the industry has added capacity in recent years and said it helps that a significant portion of California pistachio acres are now planted to the early maturing varieties Golden Hills and Lost Hills, which is staggering harvest.

Also, he said, double shaking, which many growers are now practicing, is helping ease the burden at processing plants come crunch time.

“There is enough processing capacity for all of the pistachios to get harvested,” Gibbons said. “All the growers will be well taken care of.”

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“Because the infestation is so devastating, from the point of view of aflatoxin contamination and from the point of view of consumer distaste and from the point of view that they are very difficult to sort out, navel orangeworm is the biggest problem in the industry,” Ferguson said.

The availability of NOW insecticides with an array of pre-harvest intervals, including some as short as two days, has made late-season control more conducive to harvest operations, according to growers. Good off-season practices can also help ensure NOW issues are minimal come August.

“Hopefully, if you’ve done everything else starting the previous harvest—you’ve cleaned up with some good winterization and done everything by the book—mostly you don’t have too much navel orangeworm pressure right before harvest,” Watte said. “But with Mother Nature being Mother Nature, occasionally you do.”

Double shaking trees, which has become increasingly common, has helped minimize NOW pressure by helping growers get a head start on winter sanitation programs, according to Jeff Gibbons, plant manager for Setton Pistachio in Terra Bella. He encouraged more growers to use the practice.

“With that second shake, you can export all of the navel orangeworm eggs and larvae out of your orchard, so now your orchard is enhanced for winter sanitation,” Gibbons said. “It really cleans up the orchard and prepares them for a good winter sanitation experience and lower navel orange-worm pressure the following year.”

Double shaking also helps growers achieve maximum yield, according to Gibbons.

“What growers need to know is, don’t wait until 90% of the nuts come off,” Gibbons said. “As soon as 50% of the nuts come off, go out and shake them. Then come back 14 days later and get that second 50%.”

Getting into orchards early for a first shake also exports NOW pressure, Gibbons said, reducing its fourth-flight and helping growers obtain the maximum quality premium for



It is never too early for California pistachio farmers to start coordinating with harvesters (photo by L. Ferguson, UCCE.)

their pistachio crop.

And preplanning for two shakes can help growers avoid a rush to coordinate a second shake.

“What growers sometimes do is they will wait and get off 90% with the first shake and think they’re done,” Gibbons said. “But what they don’t realize is there is still 10% left. And then they’ll think, ‘Son of a gun, there is 10% out there, and it only costs 200 dollars an acre to harvest, so I’ll do a second shake.’ Then they try and find a harvester and all the harvesters are busy. It is just a mess. So, just plan on doing two shakes.”

With prior harvest arrangements, plentiful late-season irrigation, insecticide applications when needed and two shakes, California pistachio growers may indeed be well positioned to reap a billion pounds from this year’s pistachio crop.

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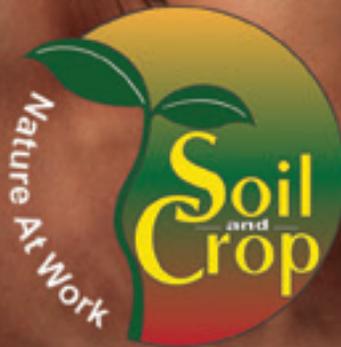
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UCCE ADVISOR PROFILE

HOUSTON WILSON, IPM SPECIALIST



Houston Wilson runs the Wilson Lab at the Kearney Ag Center in Parlier and was newly named to lead the UC's first Organic Agriculture Institute.

By **CRYSTAL NAY** | Contributing Writer

GROWING UP IN AUSTIN, TEXAS, HOUSTON WILSON THOUGHT all of California looked like Los Angeles. After leaving Texas to pursue undergraduate studies at UC Berkeley, he quickly took a much broader view of the state and the world.

"I thought college would be a good opportunity to see a different part of the country," said Wilson. "The University of California is a well-known public institution, and I was

really interested in going to California."

Now a UCCE Orchard/Vineyard IPM Specialist in the Dept. of Entomology, UC Riverside, and based at the UC Kearney Agricultural Research and Extension Center in Parlier, Wilson has become an authority on integrated pest management in nut crops in a part of California that looks nothing like Los Angeles (or Berkeley for that matter!).

Aside from hunting and clearing brush on ranches in his high school days, Wilson's agriculture experience was limited to his academic pursuits studying land use policy and rural development. His major in economic policy and development had him observing the world with a global lens and focusing on issues in Latin America, Asia and Africa, which led him to looking at rural development in particular. This sparked an interest in production agriculture.

"At the time, I was looking at a lot of these policy and market dimensions—how trade, economic and land use policies worked to promote rural and agricultural development, and I ended up getting a lot more interested in the production side of agriculture," said Wilson.

Shortly thereafter, Wilson teamed up with Prof. Miguel Altieri and Dr. Kent Daane at UC Berkeley to work on biological control of vineyard pests. It was through this early experience with applied research and extension that Wilson discovered his love for agricultural entomology and cooperative extension, and ultimately decided to pursue a Ph.D. in agricultural entomology.

"Prior to that, I didn't know anything about opportunities for [working in extension]," said Wilson. "When I finally came upon it, I realized immediately that it was the right blend of what I was looking for in a career. I'm able to do science in an applied atmosphere and collaborate directly with commercial growers to solve real world problems. It's a nice mix of being in the field, being in the lab, interacting with growers and other scientists, plus our findings have implications for both production and policy decisions. It was hitting all the marks. On top of that, it's just really fun to be out there doing it!"

He is now in his 13th year of agricultural research and



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IT'S A DAUNTING CHALLENGE, BUT I'VE ALWAYS BEEN IMPRESSED BY WHAT CALIFORNIA GROWERS ARE ABLE TO DO. THEY'RE SOME OF THE BEST AND MOST INNOVATIVE OUT THERE.—HOUSTON WILSON, UCCE

extension, his 3rd year at the Kearney Ag. Center, and just this summer was chosen to lead the newly created UC Organic Agriculture Institute. In that time, Wilson has noted a strong push towards precision agriculture and the rapid development of technology that bolsters it, such as irrigation sensors, automated insect traps and data management software that help growers record and closely track production data across large areas, and then use that information to make more informed management decisions. He has also noted increased regulations in agriculture, which will continue to put pressure on growers to find innovative ways to address things like water and pesticide use in production.

There's also the constant threat of invasive insects. While California has always had its share of invasive pests, the ever-increasing rate of trade and movement of goods into the state continually poses the threat of introducing new pests into the region. Since his time as an undergraduate student, Wilson has seen programs developed in response to invasions by the vine mealybug, light brown apple moth, European grapevine berry moth, bagrada bug, spotted wing drosophila, Asian citrus psyllid and brown marmorated stink bug – to name a few – and he says spotted lanternfly appears to be on the horizon.

Understanding how to develop, coordinate, and implement an area-wide integrated pest management (IPM)

program is one of the biggest challenges that agricultural entomologists face today. There are a number of insects that IPM experts deal with in orchards, but arguably one of the most important is navel orangeworm (NOW).

“Management of NOW on a block-by-block basis can sometimes seem

futile,” said Wilson. “If a grower is doing all the right things, but a lot of their neighbors are not, then they may ultimately have to deal with a lot of moths migrating into their clean blocks and causing a lot of problems.”

Continued on Page 50

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This is an issue seen in many cropping systems with highly mobile pests with a wide host range, which underscores the need for management on a regional basis.

“Area-wide IPM is a project that’s ultimately going to require some type of cooperative effort that involves growers, processors, extension, and researchers all working in tandem,” said Wilson.

Key to this process is figuring out how to best reconcile what is known about insect ecology and pest management with the economic and agronomic realities that growers face. For instance, while it’s fairly well known that crop sanitation is fundamental to control of navel orangeworm, “We still don’t see everyone sanitizing as effectively as they could,” said Wilson. But, he added, “It isn’t because growers don’t know or aren’t listening; there are just a lot of barriers.”

Labor and equipment costs can be high, or are unavailable at the right time, and for some growers it’s difficult to access the orchard during the winter because of soil conditions. Furthermore, the ability to destroy mummy nuts in some crops, like pistachios, is more difficult.

One of the tasks Wilson willfully accepts as a member of UC Cooperative Extension is taking the ecological knowledge learned through applied research and using that to develop practices that work both economically and agronomically for growers. In the case of sanitation, current methods may not work for all growers, which places more importance on identifying the barriers and creating programs to find alternative ways to get sanitation completed.

“We’re trying to develop strategies for growers that work in the way growers need them to work, and while integrating all the other things they’re doing in their orchards,” said Wilson.

Integration within a grower’s broader operation is key. With an abundance of information covering soil health, weed management, pathogens, irrigation, pruning and more, integration of all these aspects can become information overload. Combined with limited time and budgets, it becomes

a balancing act where growers must prioritize what needs to be done.

“It’s a daunting challenge,” Wilson said, “but I’ve always been impressed by what California growers are able to do. They’re some of the best and most innovative out there.”

From trap crops for stink bugs, mating disruption and sterile insect technique for navel orangeworm, and the development of a new trap and lure system for leaf-footed bugs, the Wilson Lab at the Kearney Ag. Center runs the gamut of applied research, but also includes projects to generate baseline ecological information that helps with the general understanding of an insect’s ecology or biology. The challenges growers encounter are what provide Wilson and his team with a very active slate of ongoing research and extension projects.

In addition to his IPM work, Wilson was also recently named Director of the newly created UC ANR Organic Agriculture Institute, which has been tasked with developing a research and extension program for organic production of tree nuts, tree fruits, raisins and rice in the Central Valley. As the first director of a newly created institute, Wilson will be responsible for building out this program from the ground up. His work in Year 1 includes a needs assessment for organic production in California, development of production costs and market analyses for key commodities, as well as assembling an Advisory Committee that includes growers, researchers and other stakeholders to help guide the program.

“The idea with this Organic Ag. Institute is to provide new information and practices for California growers to help them take advantage of the price premiums that exist for these organic commodities,” Wilson said. “The market for organics has grown exponentially over the past two decades, to the point where we need to dramatically increase production to maintain supplies, and to do so on a scale that is only possible in a place like the Central Valley.”

Overall, Wilson is satisfied with his role in California agriculture. “For me, it’s a privilege to be a part of the University of California and UC Cooperative Extension, and to be able to work with such forward-thinking grower and industry collaborators. Working in California orchards and vineyards means engaging with some of the biggest and most valuable cropping systems in one of the largest agricultural economies in the world.

“Part of the allure of working as an extension specialist is that I not only get to do applied science to address real-world issues, but I get to be out on commercial farms and regularly interact with growers. It’s a blast,” Wilson said. “If you’re going to work in ag, the Central Valley is the place to be.”



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Canker Disease in Almond Orchards

Identification is Key to Controlling the Different Pathogens that Cause this Disease Statewide

By **CECILIA PARSONS** | Associate Editor

KNOWING WHICH PATHOGEN IS LIKELY CAUSING TRUNK AND scaffold cankers in almond trees, or which pathogen is the most prevalent invader in an orchard, is critical for the adoption of the most effective control solutions.

Florent Trouillas, UCCE specialist at the Kearney Agricultural Research and Extension Center in Parlier, said trunk and scaffold canker disease in almond orchards can be found statewide and is the most common call he receives from pest control advisors and farm advisors.

Field diagnosis is often done based on symptom observations, but those can often be misleading. It is common in the Central Valley, he noted, after finding gumming on trees, to blame the infection on *Phytophthora*. *Phytophthora* is a common pathogen that causes gumming, but the symptoms can easily be confused with those of *Botryosphaeria* and *Ceratocystis*, both canker-causing pathogens. Control strategies for



Gumballs on tree limbs are an early symptom of canker disease. Infections become more obvious starting in the 3-4 leaf stage (photo courtesy F. Trouillas, UCCE.)

trunk and scaffold canker diseases can differ, making identification of the problem pathogen important. With that information, a grower or farm manager may adopt specific management practices to control spread of the pathogen.

There are some distinctive symptoms among trunk and scaffold canker diseases, including outer distribution of gumballs, girdling and vascular discoloration. Sampling infected trees in 130 almond orchards in the Central Valley, Trouillas found that *Botryosphaeriaceae* and *Ceratocystis* were the most commonly found canker diseases in almond. *Ceratocystis* canker is associated more with shaker damage, but can also infect branches with fresh pruning wounds.

Trunk and scaffold canker diseases in almond trees can lead to production losses as well as tree losses. In addition to gumming, infected trees can have discolored vascular tissues and wood necrosis. Gumming on the trunk or at the scaffold is an obvious symptom. Scaffold branches can begin to die and in severe cases, the tree will die. Pathogens known to cause trunk and scaffold canker diseases are: *Ceratocystis*, which is associated with shaker damage and bark injuries; *Botryosphaeria* fungi, associated with band canker; and *Phytophthora*, a soilborne pathogen.

Tree Damage Invites Infection

While the pathogens that cause canker may be different, there are some common factors in trunk and scaffold canker diseases. Most have their origin in tree damage at harvest or pruning wounds. The structure of the tree may also predispose it to canker. Poor scaffold selection that causes cracking can be an entry point for pathogens. Trouillas said canker diseases can be found in all ages, but they become more obvious starting in the 3- to 4-leaf stage. *Phytophthora* can cause death in young trees, while in older trees, canker diseases are more of a secondary issue.

UC Davis graduate student Leslie Holland and Trouillas wrote in *Sac Valley Orchards* that most fungal pathogens that cause canker diseases are present throughout the Central Valley. Practices that minimize the conditions that initiate

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disease development in an orchard are important.

Rain events have a strong connection to spread of fungal canker pathogens that invade pruning wounds. Pruning for scaffold selection or removal of branches can leave a tree vulnerable to infection if the wounds are fresh when a rain even occurs. Pruning exposes the vascular and cambial tissues that are normally protected by bark. If the wound has not healed before a rain, an infection can occur.

Field trials conducted by Holland and Trouillas in the Sacramento and San Joaquin valleys showed that canker infections were lowest when pruning cuts were made in January, compared to pruning cuts done in September, October and November. Wound healing does progress faster in warmer temperatures, but studies of almond pruning wounds and cankers caused by Phytophthora showed that the tree substances lignin and suberin, which are associated with wound healing, increase in production in January after declining in November and December.

Fresh pruning wounds in optimum environmental conditions for infection

had the highest rates of infection. As time after pruning increased, wound susceptibility to infection decreased. By eight weeks, infection rates fell to 10%.

Protection Products

Trouillas said trials of products that contained fungicides, biocontrols, paint and wound sealants were conducted to find the best protection when applied to pruning wounds including primary and secondary scaffold selection.

Topsin M (thiophanate-methyl) provided excellent protection of pruning wounds, reducing infection by 82% overall. A biological control product consisting of the fungus (*Trichoderma atroviride* SC1) is being considered for registration as Vintec. It has also shown effectiveness, reducing infection by 80 to 100%. Acrylic paint produced inconsistent results, only reducing infection rates by 45%.

The Topsin M product is being recommended for use as a pruning wound protectant on almond trees. Conventional fungicides may be applied to pruning wounds at label rates with an airblast sprayer to achieve good coverage of wounds.

Topsin M may also be applied to trees with shaker injuries to reduce the risks of infection with Ceratocystis. The injury must first be cleaned by removing the broken bark and avoiding the newly formed cracks that allow entry to insects that can transmit the Ceratocystis pathogen. Cleaning the bark and exposing the cambium also allows for better natural healing. Topsin M may be applied to the cleaned area to reduce the risks of contamination with Ceratocystis.

Remedial surgeries or removal of dead or diseased wood can be labor intensive, but it can reduce the pathogen load in an orchard. Surgery requires making sure to cut several inches into healthy wood to make sure all infected parts are removed. For Ceratocystis cankers, it is recommended to clean around the infected tissue, removing bark and exposing the cambium to promote healing. Diseased or dying wood should be removed as early as infection is detected to avoid further spread into the tree trunk.

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Starrh Farms Has a History of Leadership and Innovation

By JENNY HOLTERMANN | Contributing Writer



Family patriarch Fred Starrh Sr., seated at left, who passed away in 2019, left a legacy of innovation and community to his family, including son Larry Starrh behind him (photo courtesy L. Starrh.)

WHEN THE FORD DEALERSHIP IN Shafter, Calif., closed years back, Larry Starrh joked to his Dad Fred Sr., “Maybe we should buy it and turn it into a coffee shop?” When his dad agreed, the response took Larry by surprise. However, the Starrh family is no stranger to trying new things, being innovative with their resources and giving back to their community.

Now, the old Ford dealership is home to Tin Cup Coffee and the Ford Theatre. The Starrh family partnered with a local coffee company to establish a hometown favorite and a community gathering place. The Ford Theatre is an outlet for the Starrh family to engage in their love of theatre and to lend a place for local children to participate in plays, acting camps and even attend concerts.

The Starrh family provided this community haven after decades of hard work and innovation in farming. “If you don’t see your shadow in your field, you will have problems” was a quote Fred Starrh Sr. lived by. Before his passing in 2019, Fred was often found walking fields and looking for unique ways to make their farm better. Fred fell in love with the romanticism of watching his cotton fields grow and following them through

their life cycle.

“He enjoyed the beginning to end process of turning his crop into something people loved. The boards and industry Fred was involved in allowed him to follow the cotton crop from field, mills, manufacturing plants, garment stores and watch his harvest come to life,” Larry reminisced on the foundation of farming that his Dad built.

Innovation runs deep in the Starrh family. As Starrh & Starrh Farms grew over the years, Fred looked for further ways to innovate and bring his family back to the farm. Larry recalls a time in the late 1970s while he was doing theatre work on the coast, his father called him and asked, “Are you done playing? Do you want to come back to the farm now?” In 1982, Fred expanded the farm and partnered with his two sons Fred Jr and Larry, as well as his son-in-law Jay Kroeker. At their peak, the four partners farmed 8,000 acres of cotton and in the 1980s they started experimenting with 300 acres of almonds.

Grounded in Innovation

“Dad was always an innovator and pushing the envelope. We were looking to try something new and be less depen-

dent on labor,” Larry said. He said his Dad had the foresight to be ahead of the times with farming issues and knew they needed to be innovative and rely less on water and labor.

“Wanting to try something new in the mid 90s, we planted an almond orchard on a 20-by-12-foot spacing. We saw the extra space between the younger orchards and wanted to produce a larger crop and do it sooner,” he said.

There was plenty of opposition to this new way of farming the Starrh family was experimenting with. “Everyone was telling us it was a bad idea; all the diseases that could come with the close plantings, they will stop producing faster if they are too close. But Dad’s idea was if we could get yields up early to help pay off the investment quicker, it might work in the end.”

The tighter spacing orchard was on the west side of Kern County, where the afternoon breeze and low humidity enabled the trees to be less susceptible to disease. The tighter spacing allowed Starrh to utilize mechanical pruning and rely less on labor during an otherwise labor-intensive practice.

“The 5-year-old trees produced a huge crop, and the price of almonds went

up at the same time. All of the sudden, it was profitable to be in the almond business,” Larry stated. They learned a few lessons to adapt further and make changes as needed, like switching to drip irrigation from the microjet system they originally installed.

Altering as they needed and continuing to look to innovation helped Starrh to further progress. “We changed the pattern to a 20-by-18-foot pattern in the next almond planting. It would be a better option for moving forward. To this day, though, that original field is one of our highest-producing orchards to date.”

Larry said it just happened to work out in that area, noting that given different circumstances in a different climate or soil type, it might not have worked out the same way.

As they evolved in farming, Starrh & Starrh Farms found ways to innovate with harvesting as well. “Dad would get so frustrated at harvest with all the sweepers blowing dust and making so many passes around the orchards. We built blowers that would blow two to three windrows into one larger windrow. Then the harvester wouldn’t have to make as many passes.” Larry said this foresight for minimizing passes and looking to harvest efficiencies wasn’t being done much at the time. “Now, the big V-sweepers have come out and made the same process much more efficient.” Larry recalls his Dad always coming up with smart ways to minimize their labor with mechanical innovations. By minimizing water and labor, the Starrh family was able to continue farming on the westside of the valley, where it was generally more expensive than farming closer to town.

As water became more expensive, the Starrh family evolved away from the row crops that built their farming legacy and into diversity of tree crops. In the late 1990’s, the Starrhs planted pistachios in the fields around Shafter.

“It is challenging to farm almonds near town, next to houses that aren’t familiar with agriculture. Pistachios allowed us to minimize our farming impact around town,” Larry said.

Almonds helped the family evolve into the nut industry, where they are able to make economical use of water and their resources, but pistachios have given them diversity and longevity in farming.

Today, the family farms 4,000 acres of almonds and 2,000 acres of pistachios.

Larry said they have to look at each block or parcel of land differently and maximize its profitability. “We planted one block that was separate from the others in Independence almonds. One variety in the field allows us to limit our need for bees, only require one harvest, and for us to not move equipment as much.”

These simple changes help the farm be successful. “Another block that is not near any of our other fields, we planted in pistachios. We put in a water recharge system to take advantage of excess flow water from the district.”

The greatest challenge to the family farm? Larry said, “It is all about water. If we had enough water, we wouldn’t be looking at solar or exploring ways to supplement how to utilize our acreage. Now we are looking at how to minimize our farm footprint and better manage our water supply.”

As land uses change due to lack of water, agriculture land is going to look

much different in the future. The Starrh family is figuring out how to adapt and innovate with the changing regulations and lack of resources.

Larry said water has and will continue to be the limiting factor for their growth. “We’ve been farming on the westside since the 70s and we have understood the water shortage for years. Now that pool of water has more hands grabbing at it. That makes water more expensive. We as growers, have to take advantage of water banking and recharge projects.

“Dad used to say, water was to farm with. If you aren’t going to farm with it, you shouldn’t be using it. But that just isn’t the case anymore,” Larry said. “We have to rethink the look of farming on a broader perspective. The dynamics of farming are hard, and we have a legacy we are trying to provide.”

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HEAT ILLNESS PREVENTION

During the Pandemic

By **AMY WOLFE** | MPPA, CFRE President and CEO Emeritus, AgSafe

AS SUMMER CONTINUES, GROWERS must continue to navigate the ongoing challenges of hot weather, the COVID-19 pandemic and ensuring worker safety. Keeping agricultural employees safe in the heat has long been a high priority for our industry. In 2019, as was the case the previous year, the most frequently issued citation by Cal/OSHA to agricultural operations was failure to comply with the heat illness prevention standard. While we have made great strides at improving our operations to mitigate against this risk, we now face the added complication of balancing the issues posed by the heat and the steps we need to take to minimize the spread of COVID-19. First, though, it's important to review what is required under California's heat illness prevention standard.

Elements of Heat Illness Prevention Standard

Heat Illness Prevention Plan:

A company needs to have a written Heat Illness Prevention Plan with the following elements, and include specific details as to how you will ensure the provisions are met:

- The designated person(s) that have the authority and responsibility for implementing the plan in the field.
- Procedures for providing sufficient water.
- Procedures for providing access to shade.
- High-heat procedures when temperatures reach or exceed 95 degrees F.
- Emergency response procedures including lone workers (ex. irrigators).
- Acclimatization methods and procedures.

When drafting your plan, it is important to consider the size of your crew, the length of the workday and ambient temperatures. The plan needs to be in English and the language understood by the majority of the employees. Lastly, the plan must be located at the worksite and easily accessed by all employees.

Heat Illness Prevention Training:

Employee training needs to be done before an employee begins work, which could result in the risk of heat illness. Training should address the following:

- The environmental and personal risk factors for heat illness, as well as the added burden of heat load on the body caused by exertion, clothing and personal protective equipment.
- The employer's procedures for complying with the requirements including the employer's responsibility to provide water, shade, cool-down rests and access to first aid as well as the employees' right to exercise their rights.
- The importance of frequent consumption of small quantities of water throughout the workday.
- The concept, importance and methods of acclimatization.

The different types of heat illness, the common signs and symptoms of heat illness, and appropriate first aid and emergency responses to the different types of heat illness, and that heat illness may progress quickly from mild symptoms to serious and life-threatening illness.

The importance to employees of

HEAT EXHAUSTION OR HEAT STROKE

HEAT EXHAUSTION	OR	HEAT STROKE
Faint or dizzy		Throbbing headache
Excessive sweating		No sweating
Cool, pale, clammy skin		Body temperature above 103°F
Nausea or vomiting		Red, hot, dry skin
Rapid, weak pulse		Nausea or vomiting
Muscle cramps		Rapid, strong pulse
		May lose consciousness

HEAT EXHAUSTION:

- Get to a cooler, air conditioned place
- Drink water if fully conscious
- Take a cool shower or use cold compresses

HEAT STROKE:

CALL 9-1-1

- Take immediate action to cool the person until help arrives

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Training must include the different types of heat illness, the common signs and symptoms of heat illness, and appropriate first aid and emergency responses to the different types of heat illness, and that heat illness may progress quickly from mild symptoms to serious and life threatening illness (courtesy Sacramento Office of Emergency Services.)

immediately reporting to the employer, directly or through the employee's supervisor, signs or symptoms of heat illness experienced by themselves or their co-workers.

The employer's procedures for responding to signs or symptoms of possible heat illness, including how emergency medical services will be provided should they become necessary.

The employer's procedures for contacting emergency medical services, and when necessary, transporting employees to a point where they can be reached by an emergency medical service provider.

The employer's procedures for ensuring that, in the event of an emergency, clear and precise directions to the work site can and will be provided as needed to emergency responders. These proce-

dures shall include designating a person to be available to ensure that emergency procedures are initiated when appropriate.

Supervisor training needs to be completed prior to supervising employees and include the following topics:

- All the topics covered during employee training.
- The procedures the supervisor is to follow to implement the heat illness prevention plan procedures.
- The protocol a supervisor is to follow when an employee exhibits signs or reports symptoms consistent with possible heat illness, including emergency response procedures.
- How to monitor weather reports and how to respond to hot weather advisories.

Adequate Shade and Water:

Adequate shade means blockage of direct sunlight. One indicator that blockage is sufficient is when objects do not cast a shadow in the area of blocked sunlight.

Shade is not adequate when heat in the area of shade defeats the purpose of shade, which is to allow the body to cool. For example, a car sitting in the sun does not provide acceptable shade to a person inside it, unless the car is running with air conditioning. Shade may be provided by any natural or artificial means that does not expose employees to unsafe or unhealthy conditions and that does not deter or discourage access or use.

Shade needs to be available when the temperature exceeds 80 degrees F. How do you know when temperatures hit 80 degrees? Cal/OSHA urges employers to not rely on your cell phone because it does not reflect the site-specific temperatures. The best practice is to invest in and use daily an outdoor thermometer.

The amount of shade present shall be at least enough to accommodate the number of employees on recovery or rest periods so that they can sit in a normal posture fully in the shade without having to be in physical contact with each other. The shade shall be located as close as practicable to the areas where employees are working. Shade also needs to be available, even



The amount of shade present shall be at least enough to accommodate the number of employees on recovery or rest periods, so that they can sit in a normal posture fully in the shade without having to be in physical contact with each other (photo courtesy AgSafe.)

Continued on Page 58

An advertisement for Cream of the Crop AG Service. The background is a blue-tinted image of a person working in a field. At the top right, it says "PERSONNEL & LAND MANAGEMENT" in yellow. The main text is "Always WORKING FOR YOU!" in large, stylized letters. "Always" is in yellow script, "WORKING" is in large orange block letters with a green outline, and "FOR YOU!" is in large yellow block letters with a green outline. Below this, it says "Cream of the Crop" in a cursive font, with "AG SERVICE" underneath. At the bottom, it says "PROVIDING DEPENDABLE LABOR – SECURING HR & SAFETY COMPLIANCE SINCE '95" in yellow. At the very bottom, there are three small circular icons: a globe for "WEBSITE", a calendar for "SALES FIELD", and a location pin for "VISUAL", followed by the website "COTCAG.COM", the phone number "(661) 588-8675", and another phone number "(559) 625-5152".

Continued from Page 57

when the temperature does not exceed 80 degrees F, upon employee request.

Employees shall have access to potable drinking water. It must be fresh, pure, suitably cool and provided to employees free of charge. The water shall be located as close as practicable to the areas where employees are working. Where drinking water is not plumbed or otherwise continuously supplied, it shall be provided in a sufficient quantity at the beginning of the work shift to provide one quart per employee per hour for drinking for the entire shift. Employers may begin the shift with smaller quantities of water if they have effective procedures for replenishment during the shift as needed to allow employees to drink one quart or more per hour.

Protection From the Heat and COVID-19

Personal protective equipment (PPE) is an integral element in how we help keep our employees safe. As we con-

tinue to work to minimize exposure to COVID-19, PPE is a vital part of our plans. That being said, PPE including face coverings and masks, Tyvek suits and gloves can create heat-related risks that require additional steps. It is essential to employ close-monitoring protocol, including leveraging the buddy system and regularly communicating with all workers, including lone workers, on how they feel. Remind workers of the signs of heat illness and encourage them to speak up should they begin to experience issues or observe co-workers struggling.

In addition, it is important to remind employees of the importance of drinking water frequently throughout the day. These added layers of protection have the potential to increase body temperatures, and in turn, exacerbate heat illness symptoms. Often, individuals do not realize they are in distress until it is too late, as heat illness can develop gradually. By placing an emphasis on continual water consumption, you can help abate the illness from developing in

the first place.

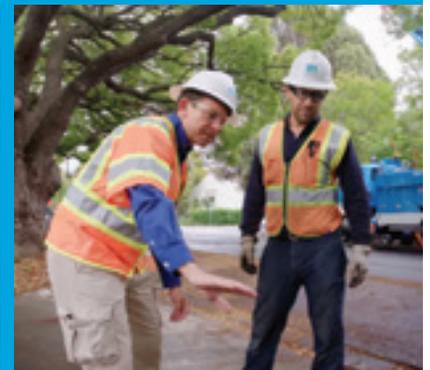
Balancing the need to protect workers from the dangers of the heat and that of COVID-19 requires planning, intentional execution and regular communication. The continued health, safety and well-being of our workforce remains one of our top priorities, and by adhering to the steps outlined, is a goal each agricultural operation can attain.

For more information about worker safety, human resources, labor relations, pesticide safety or food safety issues, please visit www.agsafe.org, call (209) 526-4400 or email safeinfo@agsafe.org. AgSafe is a 501c3 nonprofit providing training, education, outreach and tools in the areas of safety, labor relations, food safety and human resources for the food and farming industries. Since 1991, AgSafe has educated over 85,000 employers, supervisors and workers about these critical issues.

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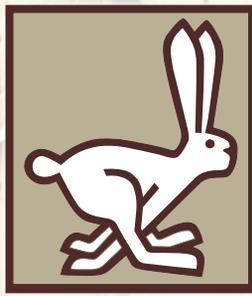
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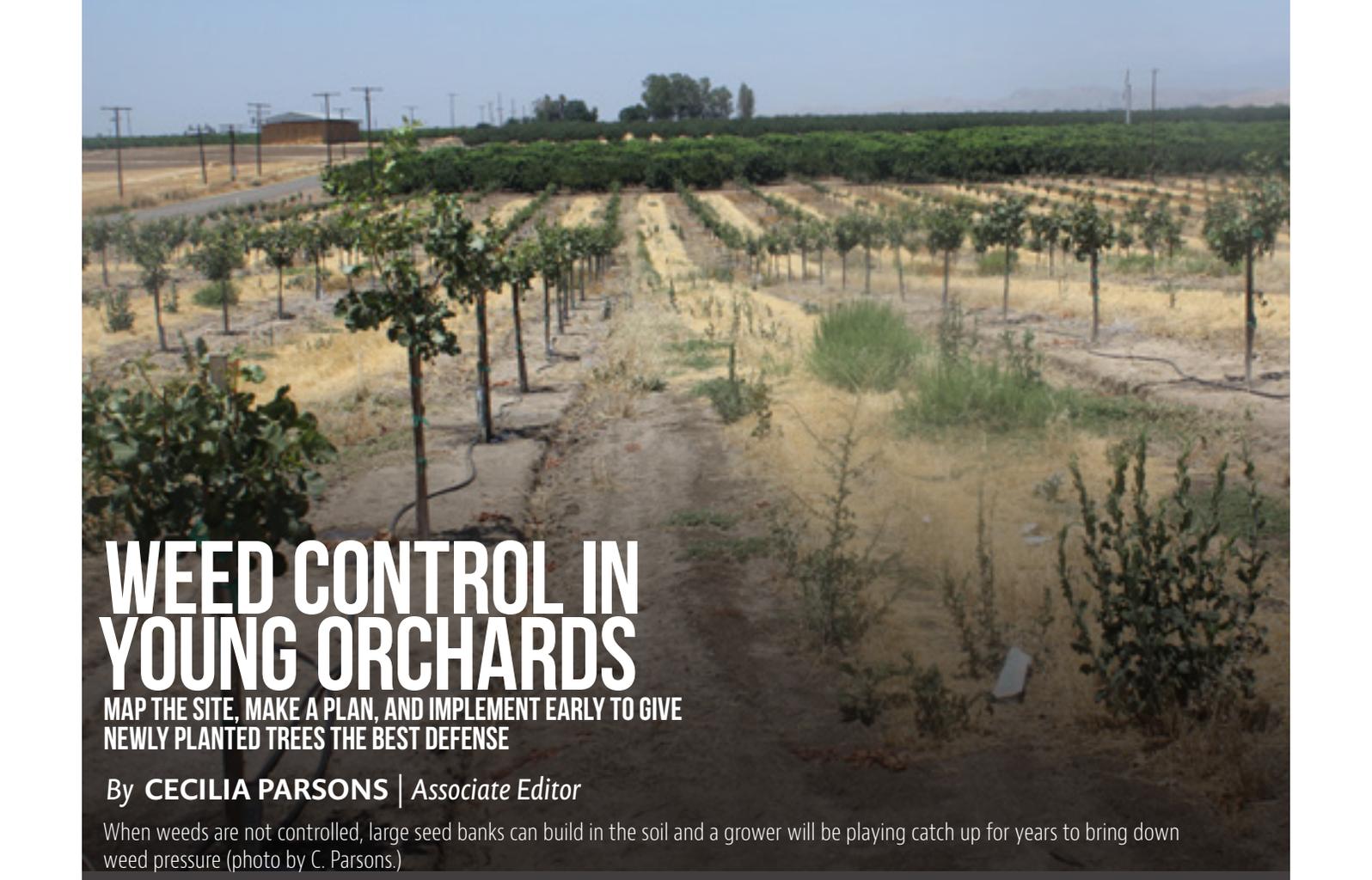


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WEED CONTROL IN YOUNG ORCHARDS

MAP THE SITE, MAKE A PLAN, AND IMPLEMENT EARLY TO GIVE NEWLY PLANTED TREES THE BEST DEFENSE

By **CECILIA PARSONS** | *Associate Editor*

When weeds are not controlled, large seed banks can build in the soil and a grower will be playing catch up for years to bring down weed pressure (photo by C. Parsons.)

PLANNING AND PERSISTENCE WITH weed control is one way to ensure a healthier start for young nut trees. Lack of an effective weed control program early in the life of an orchard robs young trees of water, nutrients and light, affecting their growth and yield potential in the future.

When weeds are not controlled, large seed banks can build in the soil and a grower will be playing catch up for years to bring down weed pressure. Large weeds uncontrolled in a young orchard can affect herbicide spray efficacy and hold leaf litter in place, shielding emerging weeds from herbicide sprays.

Ongoing Management

Brad Hanson, UC Davis weed specialist, said weed management in an orchard is not a one-time practice. New species can move in and resident species can bounce back. Planning a long term and effective weed control program involves being aware of prob-

lem areas, choosing the right control materials, timing applications for when they will be most effective, and evaluating the results.

One of the best weed controls in young orchards is a preemergent herbicide. Although not every orchard herbicide can be used in new plantings, the allowable preemergent materials generally bind to organic matter and soil and have limited leaching. Applied to the soil prior to weed seed germination, they can stop growth of weed shoots and roots and add some residual control. Post-emergent herbicides include contact materials that burn down weeds or systemics that kill weeds over time.

If at all possible, weed control on an orchard site should begin even before planting. This strategy is even more important if there are tough-to-control perennial weeds or high weed pressure in the field. Taking an integrated management approach to weed control calls for mapping the site, planning

weed control strategy, and implementing the plan with well-calibrated spray equipment.

The key to effective and safe weed control with preemergent products, Hanson stressed, is for the herbicide to remain above the shallow roots of the young trees, but into the soil at the depth of the weed seeds. If it sits on top of the soil, it will be less effective. If pushed deep into the soil too much with water, some herbicides can injure new trees with small root systems. Most preemergent products need between .25 and .5 inches of rain or irrigation to be effective and reach the weed seeds.

Cleaning orchard floors of leaf litter, dried weeds and any other litter that prevents soil contact with the herbicide will enhance efficacy.

There is more risk of injury with young trees. If the herbicide application is to be made after planting, Hanson recommended waiting until soil is well settled around the tree before applying

the preemergent herbicide. Cartons are important in keeping post-emergent herbicide off the trunks of the young trees. Leaving the cartons in place until the beginning of the second year will help minimize exposure to herbicides. When applying the material, make sure spray equipment is calibrated, set up and operated correctly to minimize drift into the tree canopies.

The optimum time for application of a preemergent herbicide is prior to seed germination. Hanson said most applications of preemergent herbicides in California tree nut orchards are done in the winter months before weeds germinate and rainfall can move the material in the soil.

Identify Weeds in the Orchard

UCCE Orchard Systems Advisor Katherine Jarvis-Shean's Young Orchard Handbook includes several key steps for weed control in new orchards.

Identification of weed species is an important first step, as selection of a preemergent or post-emergent herbicide hinges on what weeds are growing in the orchard.

With a new orchard site, the previous crops may give an idea of which weed species are likely to be present. In existing orchards or a replant site, the weed history and mapping of problematic areas can help with herbicide selection.

In addition to identification of known weeds, there can be new species invading the orchard. Monitoring weed populations twice a year is recommended. Monitor in the fall, noting summer species that escaped and emerging winter species. Late spring monitoring should be done to find winter weeds that were not controlled. Hanson said some growers take a more formal approach and produce extensive maps that pinpoint heavy weed pressure areas in their orchards.

"Based on field scouting and record keeping, they know that one portion of the orchard has a weed problem while it's still a relatively small problem. If they focus their intensive control efforts on the problem areas, they may be able to save money by using less-intensive

programs in the rest of the orchard," Hanson noted.

Herbicide resistance has become a challenge in weed management. Glyphosate has been valuable for its broad weed control spectrum, but reliance on a single mode of action has led to resistance in several broadleaf and grass species. UCCE orchard systems advisors are recommending herbicide rotations, tank mix combinations, sequential treatments and incorporation of non-chemical strategies to control resistant populations and minimize risk of future cases of resistance.

Get a Clean Start

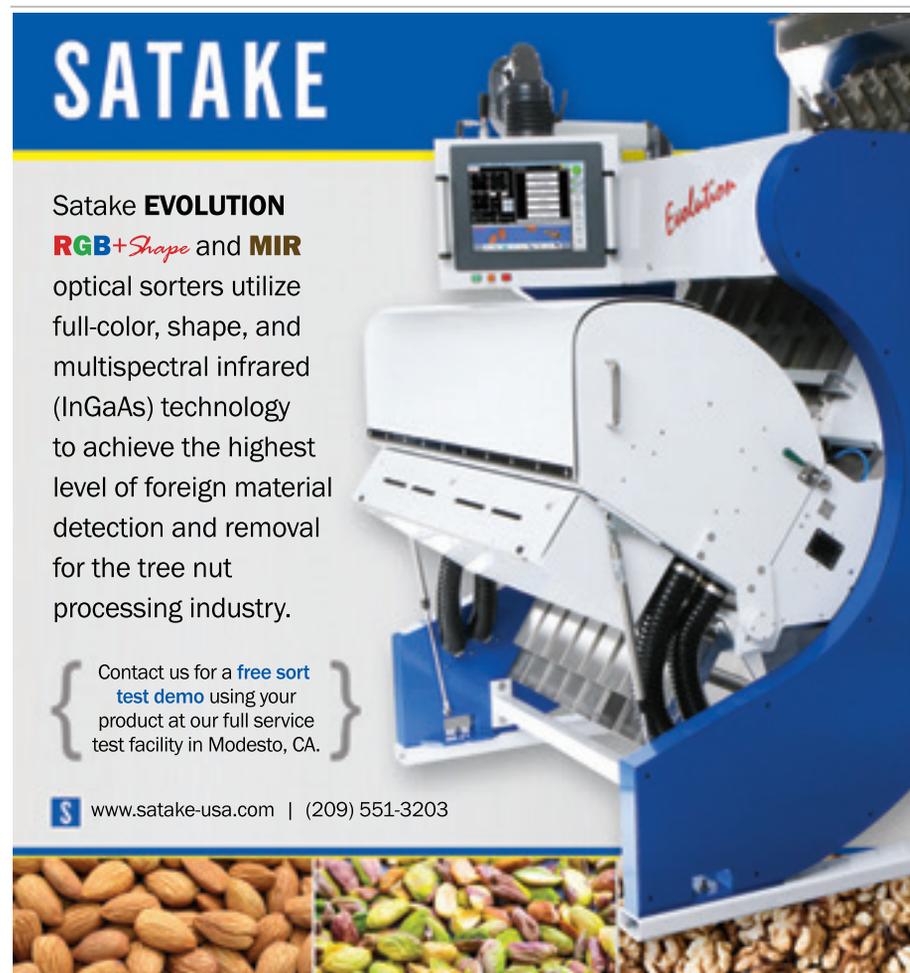
Patterson, Calif. almond grower Daniel Bays shared some of his orchard weed control strategies. The game plan, he said, is to begin with a clean orchard and keep it clean. Although that can involve considerable investment in time and labor, he said it is easier than trying to clean up weed infestations. In developing a new orchard, he said he

would pull up berms early, and when timing is right, apply a preemergent on the clean berms. Post planting, if conditions are right, a preemergent is applied to the soil.

If problem areas in an orchard develop, Bays will come in and spot spray before the weeds mature, but he said care should be taken to avoid drift of the material into the tree canopy. Knowing the weed history of an orchard site is helpful, especially if problem areas can be identified.

Bays said problem weeds in his orchards include bindweed, nutsedge and Johnsongrass. A new weed, threespike goosegrass, has also become common in orchards. If these are not controlled early with a good weed management plan, he said, they will get out of hand quickly and it will take a couple of years to get them under control.

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The advertisement features a large image of a Satake EVOLUTION optical sorter, a white and blue machine with a control panel. Below the main image are two smaller images showing almonds: one is a pile of clean, light-brown almonds, and the other is a pile of almonds with various foreign materials like green and purple pieces mixed in.

4RS OF NITROGEN MANAGEMENT IN WALNUTS

Consider the inputs and outputs of nitrogen when putting together a plan.



THIS ARTICLE IS SPONSORED BY:

By **JULIE R. JOHNSON** | Contributing Writer

"ARE GROWERS APPLYING TOO MUCH nitrogen to their crops?"

This is a question Parry Klassen, director of the East San Joaquin Water Quality Coalition, looks to answer when discussing nitrogen, nitrates, groundwater quality and growing walnuts in a webinar hosted by West Coast Nut in July.

Klassen shared the principles of good nitrogen management, including the 4Rs—right time, right place, right amount and right source. As director of the East Joaquin Water Quality Coalition and executive director of the Coalition for Urban and Rural Environmental Stewardship (CURES), Klassen is right in the middle of the political environment regarding nitrates in groundwater and regulations placed by federal, state and regional government water agencies in California.

"There are many areas of the Central Valley where the groundwater has exceeded the nitrate drinking water standard," he said.

Klassen noted this legacy issue of nitrate in the aquifers is something that can't be changed and restored in the short-term, but is a long-term goal.

"But now, that is our situation, that is what we have to contend with," he said.

Nitrogen Management Complexity

Growers who have been studying nitrogen management over the years have come to realize the complexity of the matter, Klassen explained. Nitrogen is what growers apply to their orchards but nitrate is the molecule that makes its way into the groundwater.

"There are so many inputs of nitrogen in our systems for agriculture, such as fertilizers, many farms in areas have high nitrates in the groundwater, soil nitrates and organic matter, and these are all sources that our trees can use," he said.

"So, when we talk about nitrogen management, it is complex."

Along with the nitrogen "inputs," growers must consider "outputs," such as harvested crop, plant biomass, soil organic matter, gas loss through the atmosphere, and nitrate leaching through rainfall and through irrigation beyond what the crop needs.

"This is where growers need to find a balance, between the inputs and the outputs," Klassen said. "What we want to understand is the effective practices that can help reduce leaching, and at the same time provide the trees with the nitrogen they need."

Klassen said understanding crop coefficients for fertilization in walnuts is an important key and something research is developing.

"Crop coefficients—we are going to hear a lot about the numbers related to this study through the rest of our careers," Klassen said. "What crop coefficient numbers indicate is the amount of nitrogen it takes to efficiently grow a crop with little to no excess of nitrates leaching past the root zone into the groundwater."

The crop coefficient is based on scientific studies using all tree parts to figure out what nitrogen is removed at harvest or at any growth stage of the tree.

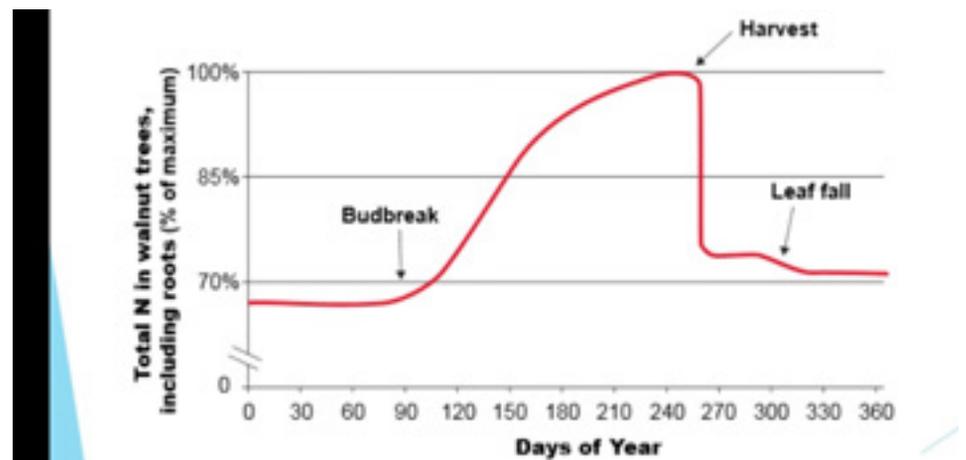
"You can be assured that we, the researchers and organizations involved in this project, are putting a lot of money and effort into refining these nitrogen removed numbers because they are what will be used from the standpoint of determining the efficiency of how we are fertilizing and our performance as growers," Klassen adds.

In the end, what the entire study and project comes down to, said Klassen, is using management practices to reduce leaching potential.

Right Time

Starting with the "Right Time" of the 4 Rs, Klassen said the right time is "when the tree needs to be fertilized, when it needs the nitrogen, when is it hungry if you will, when will it take up the nitrogen."

Crop consumption curves have been very helpful in learning when the right time is for nitrogen application in walnuts.



This diagram illustrates when walnut trees take up the most applied nitrogen to help target "The Right Time" of the 4Rs (courtesy CURES.)



Crop Coefficients are being developed to help growers understand how nitrogen is utilized by walnuts (photo by J. Johnson.)

“What they have found in research is that the tree is really consuming a lot of nitrogen during fruit development early in the summer and clear up to before harvest,” Klassen said. “Studies have shown active root nitrogen uptake is pretty uniform in May, June, July and August, with the ideal to those split applications throughout the growing season.”

For example, 120 pounds of nitrogen/acre for a crop equals 40 pounds/acre/month through the growing season of May through July, and even an applica-

tion in early August if the tree shows the need depending on tissue tests.

“Nitrogen used by a tree in April comes from storage in the tree’s structure from applications made the previous year,” Klassen added. “So applications made in March before trees are moving nitrogen can be a waste of money because if you get rainfall or you have a dry winter and need to irrigate, there is a very good chance you will leach that nitrogen applied in March or April into the groundwater.”

In addition, Klassen explains, trees do not efficiently take up nitrogen post-harvest and late applications can lead to delayed dormancy or risk of leaching.

“The wrong time to apply nitrogen is in the wintertime when virtually none is taken up into the tree or roots,” he added. “And in early spring, very little nitrogen is taken up as most bloom/leaf expansion is coming through nitrogen stored in the tree’s wood.”

Continued on Page 64



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Right Rate

Klassen said a good source for calculating the right amount of nitrogen for application on walnuts can be found online at www.cdffa.ca.gov/go/FREPguide.

With many components taken into consideration, he added, the right rate is about 48 pounds/acre nitrogen per ton of walnuts/acre in-shell, taking into account eight pounds/acre nitrogen per acre lost to leaves/pruning, and 15 pounds/acre nitrogen per acre stored in woody tree parts.

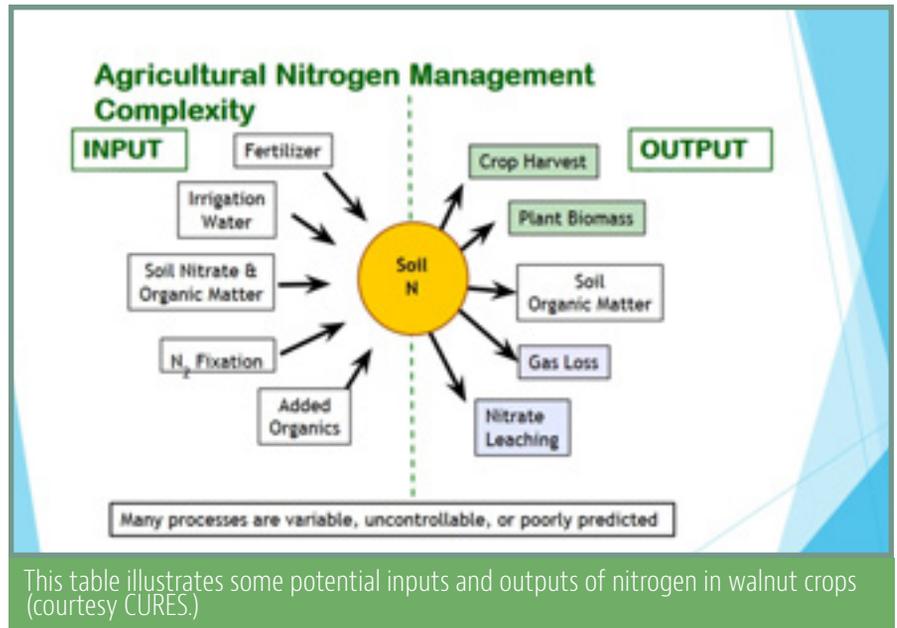
Nitrogen required to grow a crop depends on:

Yield potential (more yield=more nitrogen required.) It is important for growers to know a tree/orchard's history to know its potential.

Nitrogen sources available to root systems.

Efficiency that nitrogen is used by the tree.

"On top of all that, growers need to consider nitrogen available in irrigation

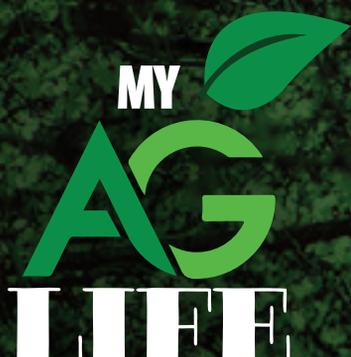


water and organic amendments, such as compost, manure and cover crops," Klassen said.

Leaf concentrations below 2.3% are indicative of nitrogen deficiency.

"Tree responsiveness to added nitrogen declines as leaf concentration

increases between 2.3 and 2.7%. Adding nitrogen to provide leaf concentrations of 2.7% gives little or no yield response and causes nitrogen to accumulate in the soil," Klassen adds.



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Right Source

There are several forms of nitrogen fertilizers, each having different characteristics and behaving differently in the environment, some more mobile and leaching more readily into the groundwater.

“This is something to talk to your fertilizer supplier about, especially with urea and ammonium, as they both can be lost into the groundwater,” Klassen said. “Urea is mobile, but converts quickly to ammonium, which is less mobile, but ammonium quickly converts to nitrate by soil microorganisms in warm, moist soils.”

Urea and ammonium may also be lost through volatilization if surface is applied and not incorporated quickly. Nitrogen fertilization sources should be selected based on best root uptake to minimize excess nitrate movement past the root zone.

“Decisions on what nitrogen source to use is of course not just based on leaching, but also on cost and the ability to apply them in the drip system or broadcast,” Klassen said.

Right Place

“In general, the principle for the best place to apply nitrogen fertilizer is where the roots are, of course, and along the herbicide-cleaned strip,” Klassen said. “For tree-to-tree sprinkler irrigated orchards, many growers broadcast one or more applications, but remember, root systems develop where water is applied, so the best application method is fertigation, water run through sprinklers or micro-sprinklers by injecting fertilizer during last half of the set whether you do a 24-hour set or a 12-hour set. If at all possible, apply during the last half of the set, leaving 15 to 20 minutes at the end to adequately flush out the system of residue that could otherwise be sitting in the system when it is shut off.”

Studies performed over time have shown a dramatic leaching of nitrogen in flood irrigation systems when the fertilizer is applied and then six to eight inches of water are put on.

“Often, the nitrogen is pushed beyond the root systems in the orchard in these types of systems,” Klassen added.

He said a University of California study showed the majority of root growth

is in the top 20 to 22 inches of soil.

“The vast majority of working roots are about between 7 to 18 inches down in the soil, so the principle of putting fertilization in the back half of the irrigation set places that fertilizer in the active roots where it is most efficiently going to be taken up,” Klassen said.

“One other thing I have to dwell on, as we have so many of our orchards in high groundwater nitrate areas, is growers need to be aware of the nitrogen levels in their irrigation water as this can be

a useful source for crop production and the amount can be a pretty significant number. However, it is important to remember the caveat, that number is based on all 30 acre-inches in walnuts, for example, being absorbed by the tree through the year, and we know that is not likely.”

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Franquette: A Classic Walnut in Search of a Home

By **CRYSTAL NAY** | *Contributing Writer*

NESTLED AROUND MOUNT KONOCTI and Cobb Mountain in Lake County, Calif., at an elevation of 1,300 to 2,500 feet, are acres of a walnut variety that once dominated the region. The Franquette walnut made its appearance in Northern California in the late 1800s, and found favor among growers because it had a well-sealed shell, a flavorful and very good quality, light kernel, and as one of the last varieties to flower, it was less susceptible to spring frost.

As more and more Franquettes were planted during the 1920s, 30s and 40s, and more after WWII, Dutch Lauenroth was already well underway in the Franquette walnut business.

“They pretty much planted the whole county; I don’t even know of anything

else when these Franquettes were planted,” said his son Paul Lauenroth, owner of Lauenroth Trucking and Farming in Lake County.

Way back then, as Lauenroth fondly said, his father ran about 200 hand-pickers who picked thousands of sacks a day. Lauenroth himself grew up in the bustling world of Franquette walnuts, where loads went to a large receiving station at the north end of Napa Valley and railcars shipped them out.

“It was a big deal. If you got a ton to the acre, you were doing really well; you can’t really do that anymore. As time went on, it wasn’t profitable to hand-pick, so a lot of orchards went by the wayside.”

These orchards have more than just historical success; they also contain Na-

tive American cultural history and lore. There’s a story— passed to Lauenroth from his father, who received it from his own father— about a Franquette orchard at a higher 4,000-foot elevation. Before the walnuts were planted, the natural clearing they now occupy once served as a space where native tribes built fires for their gods. From what Lauenroth understands, the orchard was planted around 1905, and is still picked today.

“And those walnuts are unbelievably beautiful. They don’t get a lot off of them, but they are beautiful walnuts,” he said.

Many of those orchards that became too expensive to harvest eventually went to the wildly successful Hartley and later Chandler, but remnants of abandoned

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Franquette orchards remain.

Lake County still has active organic Franquette growers, but now they are faced with another problem: finding a buyer for their walnuts.

Walnuts that used to go directly to large processors are now at a loss, with roughly 30 to 45 Franquette growers looking for a buyer for the few hundred acres among them.

Lauenroth makes note of how many abandoned walnut orchards already exist in Lake County. When land went for a few dollars per acre after WWII, people cleared it and planted Franquette, living out a good run for the variety until higher yielding varieties took its place in not only Lake County, but other parts of the state as well.

For the abandoned land that has since been purchased, much of it is being converted to grapes.

Lauenroth currently has Hartley, Chandler, Tulare and Franquette, with Durham on his list for the next section of new plantings. But he has a particular appreciation for Franquette. Even though his Chandler recovers quickly and has a beautiful nut, the taste can't compete against other varieties. He's very proud of the yield on his Tulare trees, and sees the Durham as a rising star. But nothing compares to the flavor of a Franquette.

"Unfortunately, people want quantity over quality. But anyone who has eaten a lot of walnuts will tell you that a Franquette is better tasting than [the others]."

There are a few reasons why the market has narrowed on this once-prized walnut variety. Since Franquettes flower later in the season, the nut set and yield can be low due to their missing other varieties' pollen shed. (Scharsch strain Franquettes, however, are good pollinizers for Hartley and Chandler.) The crack out rate is about 41%, with a smaller sized kernel. And labor and drying can get pricey in a place where some orchards still require handpicking and depend on propane for heat to dry.

While Lauenroth personally won't have any trees that aren't machine-pickable, there are some areas that can't accommodate machines for harvest.

"If you have to pay someone \$10 a sack to pick them, then someone else 15 cents a pound to dry them, and then have to pay somebody else to haul them someplace to sell them, you're better off leaving them on the ground," said Lauenroth. "It's sad."

Franquettes aren't the first variety to end up in the shadows of today's popular varieties. Ashley, Eureka, Serr and others have experienced a similar fate.

"It's primarily tonnage," said Brad Bowen, fieldman/buyer for Mid Valley Nut Company. While taste used to be a determining factor, "Today people want something that looks pretty on a cookie or something they're baking. I look at all varieties, and we have some we prefer over others, and we acknowledge other varieties in other forms. But, for cellophane bags, it always looks better when they're in halves or large pieces and light colored. They just seem to sell better to the consumer. So, I think it's that and tonnage."

These factors alone create an uphill battle for getting this variety to market. Combined with the coronavirus pandemic and its rapid and detrimental effects on the economy at large,

let alone agriculture and food supply chains, Franquettes could easily become a victim of lost markets, if not processing bottlenecks.

"It could be a tough year," said Lauenroth.

Could is the operative word. Lauenroth and his network of growers are taking steps to prevent that from happening.

"Grocery stores aren't closed," said Lauenroth. "Now people are going to go buy walnuts, and they'll buy a 2-pound bag and sit at home and eat them. They won't spoil, and they're good for you."

Lauenroth has his eyes set on the East Coast and the culinary professionals and potential working-from-home, end-consumer snackers that reside there.

Aside from these growers possibly starting their own cooperative and building the infrastructure needed to harvest, process, package and ship, Lauenroth plans to build a buying network at the New York Terminal Market. Famously known as Hunts Point, this terminal market's annual revenue exceeds \$2 billion and is the largest in the world. Ideally, Lauenroth would like to line up with a sales team on the East Coast.

"I think that's where they'll sell," he said. "It's probably impossible this year, since we don't have the time. But if we don't...well, either that or there will be a lot of people going out of the walnut business."

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The Evolution of Orchard Pesticides

Industry Focused on Development of Reduced Risk Pesticides

By SETH HANSEN | PCA/CCA

SOME MEMORIES FROM THE EARLY days of my career as a California licensed PCA stand out among the rest. The first was feeling overwhelmed by the incredible number of crop protection products I needed to learn in the fruit and nut crops for which I was responsible. I doubted whether I could

ever remember all the branded and generic products available. The second was feeling relieved that I would not have to use many of the potent, broad-spectrum chemicals of the past. As growers and PCA veterans recounted their pest management “war-stories”, many highlighted the dangers of those

products that were no longer registered. As a young and idealistic PCA, I was glad to avoid the risks posed by those products, and felt confident in the plethora of integrated pest management (IPM) tools at my disposal.

Over the many seasons since, however, the continued loss of pesticide registrations and increased pest pressures have been alarming. Nut growers and PCAs are recognizing that many pest management programs, especially for certain insect and weed pests, are relying heavily on a few active ingredients (AIs) to achieve control in the field. Along with other IPM practices besides chemical control, growers are in need of new products to control pests and maintain their yield and quality goals. The new generation of crop protection products may look and function much differently from our current ones.

Greater Pressure on Fewer Products

Certain insects, diseases and weeds have become more difficult to control, which is not surprising given the expansion of tree nut production in California. Bearing almond acres, for example, have more than doubled in the last 20 years, according to USDA National Agricultural Statistics Services data (USDA/NASS, 2019). Along with more pistachios, walnuts and other crops, insect pests like navel orange-worm (NOW) have susceptible hosts

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Continued from Page 68

from the southern San Joaquin through the Sacramento Valleys. Nearly contiguous production areas facilitate the movement of these pests, and at some point resistance as well.

The greater pest problems are accompanied by a reliance on a limited number of crop protection products. Regarding NOW sprays, Andre Alves, Strategic Account Manager for Corteva Agriscience, notes that, “Traditionally, pyrethroids were always used, but we know all the problems associated with those. So, there is a lot of pressure to move away from those, but that is putting more pressure on our really effective, selective insecticides.”

The problem we face is that even highly effective, environmentally-friendly products have a finite lifespan. UCCE Specialist Dr. Houston Wilson states, “It’s like any given

chemical class; you have to use it smart, because eventually something is going to happen. There is no chemical that has lasted us forever; they are lost either because of regulation or the insect regulating through resistance, or the cost.”

Even with great IPM practices, there are still times when chemical treatment is necessary. The looming question is whether the industry will have enough treatment options to keep up with evolving pest populations, and satisfy consumer and regulator demands for safety.

Shifting from Conventional to Biological

This is where researchers and manufacturers have been focusing many of their efforts, including major commitments to developing biological products that combine commercial efficacy with environmental safety.

Dr. Surendra K. Dara, UCCE Advisor for Entomology and Biologicals says, “The focus of the pesticide industry is to develop chemistries that are less harmful to the environment, and do their job with minimal impact on non-target organisms and the environment, while ensuring human safety as well.”

Manufacturers have dedicated hundreds of millions of dollars in recent years to partnerships, acquisitions and building out research and development capacity around biological products.

One of the biggest challenges around biological products, which can include a wide

variety of biologically or naturally derived active ingredients, is a lack of confidence that

the products can perform to commercial production standards. Some people may also equate biological products with Certified Organic products, which is not necessarily the case. Dara has observed this from growers and PCAs.

“There is a skepticism about the efficacy of biologicals that everyone is aware of,” Dara said. “At the same time, there is skepticism of conventional pesticides, too. There are several chemical pesticides that give inconsistent results. But they do not question the efficacy, because it is a conventional pesticide. But when it comes to biological pesticides, it may not work. That perception has to change first.”

Building Experience and Confidence

New products on the market may be able to accomplish that perception change. Spear-Lep, for example, is a peptide-based biological insecticide manufactured by the Vestaron Corporation. It is registered for use on labeled tree nuts, and Technical Sales Representative Noel Cornejo shared that trial data suggest comparable activity to conventional products available for NOW control. If manufacturers are able to develop and release cost-effective biologicals with excellent crop safety profiles, new modes of action

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and independently-tested efficacy data, growers and PCAs are likely to try the products. The adoption of spinosyns and even some biofungicides recently has proven the willingness of many growers to change to new tools.

But growers and PCAs also need to understand the unique requirements for handling and applying some biological products, especially those with live organisms. Dara advises, "Knowing the biopesticide and its use strategy are very important knowledge for growers and PCAs, so they can employ them effectively." Heat sensitivity in storage, or tank mix compatibility issues could result in reduced efficacy or failure if correct procedures are not followed. Just like conventional products in use, correct handling, mixing and application procedures are critical to efficacy.

Developing and Leveraging Other IPM Tools

Even the most effective conventional and biological pesticides should not be relied upon alone to manage pest issues.

"Integrated pest management has been around for a long time," says Dara, "and chemical control as a last option has always been emphasized. But even now everybody looks at pest management, and thinks it is about which pesticide they use."

That approach not only increases the risk of developing resistance in pest populations, but it may also prove to be insufficient at keeping crop damage below an economic threshold. Most effective pest management programs require a combination of cultural practices, monitoring, biological control and chemical applications.

As new biological crop protection products are developed and commercialized, there is still a need to develop and adopt new IPM practices to effectively manage pests. Improved weather and pest monitoring can result in better application timing and improved control. Managing water and nutrients may be even more critical than preventative fungicides for certain fungal pathogens. By combining these practices with new, safer modes of action, growers and PCAs will be equipped to ensure the long-term sustainability of tree nuts in California.

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JUST LIKE HUMANS, ALMOND TREES NEED CARBS TO THRIVE

NEW RESEARCH SHEDS LIGHT ON THE IMPORTANT ROLE OF CARBOHYDRATES IN ALMOND PRODUCTION

By **ALMOND BOARD OF CALIFORNIA** | *Contributing Writer*

CARBOHYDRATES ARE THE MAIN SOURCE OF FUEL FOR PEOPLE. They allow our brains to think and our muscles to move. Composed of three key elements – carbon, hydrogen and oxygen – carbohydrates are an integral part of human physiology.

What some may not often consider is that plants need carbohydrates too, including almond trees, which use carbs to build structures like leaves, trunks, stems, seeds, roots and nuts – nearly everything!

The importance of carbohydrates to almond, pistachio and walnut trees is the focus of research conducted by Anna Davidson, Ph.D., and Maciej Zwieniecki, Ph.D., of the

Department of Plant Sciences at the University of California, Davis. Beginning in 2016, data for their so-called “Carbohydrate Observatory” – the process by which these researchers gathered information from growers – was collected from about 550 orchards throughout the Central Valley. Growers, whom Davidson describes as “citizen scientists”, voluntarily sent monthly samples of bark and tree shoots to Davis to be analyzed.

Davidson said this research, funded by a grant from the Almond Board of California (ABC) and other organizations, allowed scientists to see “seasonal trends for multiple years in almonds, which gives us a sort of ‘X-ray’ vision into what’s going on inside the tree.”

Sebastian Saa, associate director of Agricultural Research for the Almond Board, said the new information will help address a “blind spot” in the understanding of almond trees.

“We knew that plants needed to store energy to bloom, set fruit, grow and for many other key phenological purposes,” he said. “Nutrients, irrigation, pruning and soil health all can affect how much energy the trees produce or store. But until now, we never had the ability to quantify the specific amount of energy needed for each of these very critical phenologic steps, and that is the main novelty that this project has brought to our industry so far.”

Importance of Carbs

To understand the critical role carbohydrates play in the production of nuts—and even an orchard’s yield— one first must understand how almond trees create and consume carbs.

Carbohydrates are formed during photosynthesis, when plants convert carbon dioxide from the atmosphere into a biologically usable form (carbs.) Carbohydrates can be either structural or non-structural. According to the UC Davis report “Carbohydrate Dynamics in Almond Trees,” structural carbohydrates like cellulose are used for building the plant, like constructing cell walls. On the other hand, non-structural carbohydrates, or NSCs, support trees in two main forms: sugars (glucose and sucrose) and starch (created when smaller sugar molecules are chained together for easier storage in plants or animals.)

Davidson said that “starch and sugar are constantly being circulated throughout the tree, even during dormancy. The



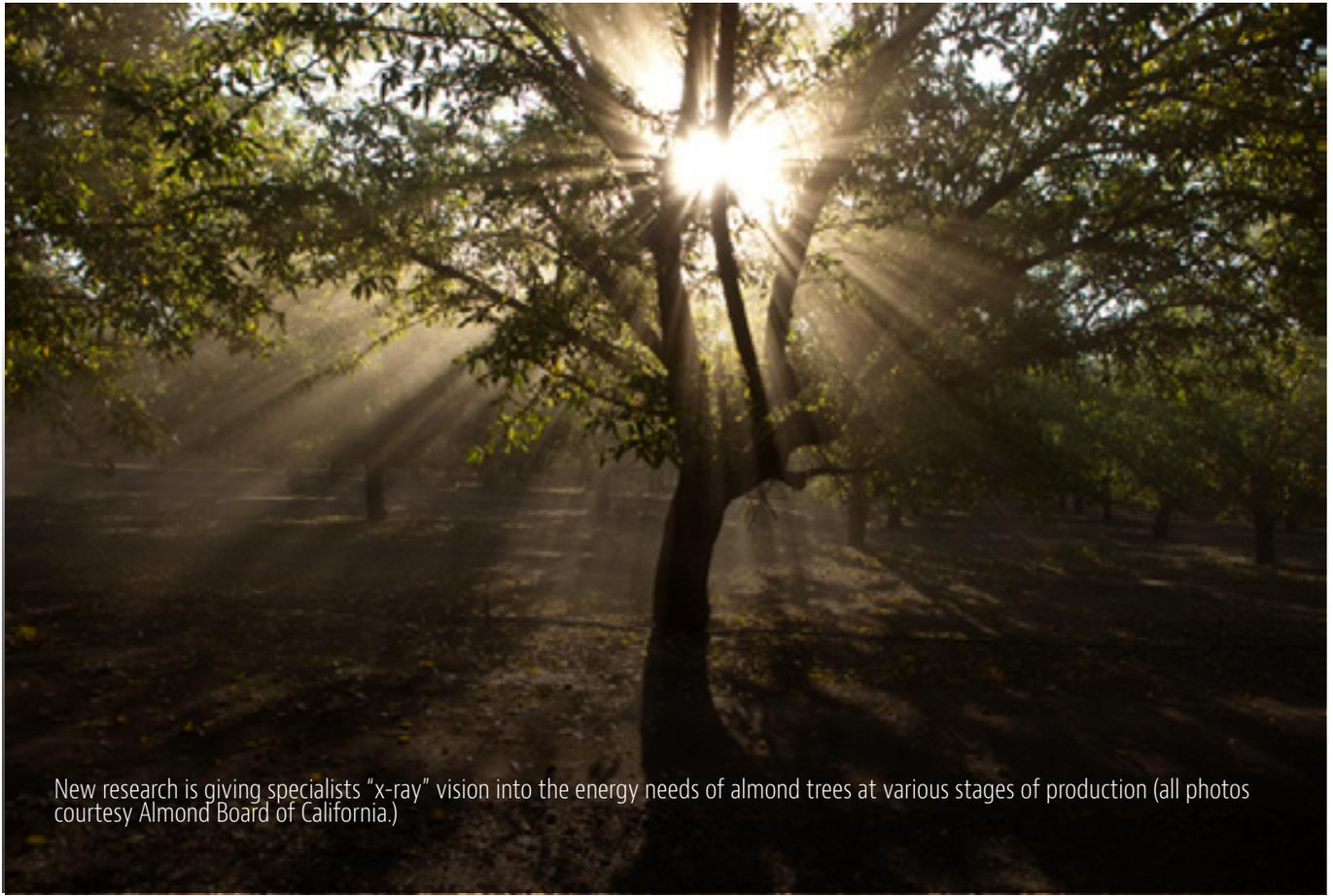
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New research is giving specialists “x-ray” vision into the energy needs of almond trees at various stages of production (all photos courtesy Almond Board of California.)

tree never rests.”

The report shows that almond trees store and use, or “burn,” carbs at various times throughout the year. During bloom, the NSC reserves that allow trees to survive winter dormancy are significantly depleted, as they were largely used for flower development and subsequently leaf out. Post bloom, trees build up their carb reserves to allow for new growth and nut fill. Carb levels then slowly decline throughout the summer until harvest, when levels start to increase toward their peak in late fall, and then the cycle begins again.

Benefits of Tracking Carbs for Orchards

To Davidson, one of the most exciting aspects of this research is the opportunity it presents to better understand the relationship between carb levels and orchard production.

For instance, preliminary results indicate that NSC levels in branches may impact future yields. Researchers have found that high levels of car-

bohydrates in wood and bark prior to dormancy and during bloom are positively correlated with higher yields. However, high yields depend on the reduction of NSCs during the summer – when NSCs should be going toward nut fill – and healthy levels should be low. Subsequently, the following year’s crop depends on the amount of NSC reserves acquired post-harvest.

“It’s important to understand that NSCs recover in the fall post-harvest, and that the amount of NSCs accumulated during that time is the amount a grower will have going into dormancy; then they’ll have slightly less for the following year’s bloom,” Davidson said. “Swings in winter temperatures and/or drought during the dormancy period will cause a need for trees to use those stored NSCs too early in the crop year, leaving less for the bloom season and thus possibly negatively impacting yield.”

Researchers’ next step in learning more about fluctuating carb levels requires focus on how biology and

orchard management affect NSC accumulation.

Davidson said there are also varietal and geographical differences that impact carb levels. Early research shows NSC levels in trees increase the farther south you go in the Central Valley, a discovery attributed to warmer temperatures and a longer growing season.

Tree age also contributes to trees’ ability to store carbs. Not surprisingly, the report finds that older trees tend to accumulate much higher levels of carbohydrates in shoots at the end of the growing season, presumably reflecting their greater carbohydrate-producing leaf biomass and yield.

Despite the many interesting pieces of data analyzed so far, Davidson cautioned it’s still too early to make specific recommendations as to how this information should impact grower practices.

“We haven’t gotten far enough in

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Carbohydrate research has created a connection between citizen scientists (growers) and the scientific community.

our research yet to be able to answer the ‘How does this apply to how I manage my operation?’ question,” she said. “That said, perhaps once we have a more solid understanding of this research about NSC content during the post-harvest recovery period, it may be incorporated into the list of characteristics people pay attention to when choosing the right rootstock and scion.”

Davidson said another important result of the research is the closer connection created between the citizen scientists (growers) and the scientific community. Growers who participated in this study have the ability to compare their data with other orchards up and down the state. That data may be viewed at the website <https://zlab-carb-observatory.herokuapp.com/>.

“I think this research is exciting because we are on track to develop a useful tool that deepens our understanding of seasonal patterns of carbohydrates in relation to climate, geography and management practices while providing another way to assess the health of their trees,” she said. “What’s more, we’ve already given growers the ability to track their NSC levels using our online platform and compare and observe orchards that may have certain nuances about them, thus making them at-home, or citizen, scientists.”

Saa said ABC plans to continue to invest in Davidson’s and Zwieniecki’s work. He said their research is one aspect of a much broader portfolio of research intended to broaden the industry’s understanding of almond production.

“With this research we have learned how to read the tree,” Saa said. “Now, we need to refine management practices. Right now, we know more; the next step is to learn how to apply that knowledge to innovate and develop new management techniques.”

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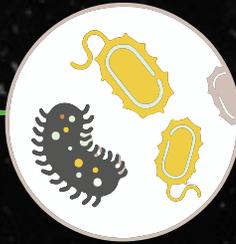
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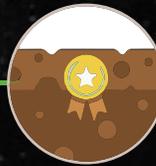
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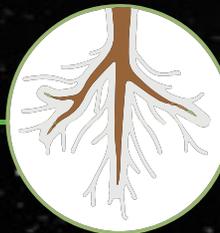


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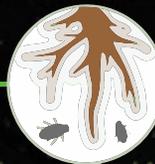
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