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MARCH 2021 ISSUE

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ALMOND BLOOM  
FROM THE BEEKEEPER'S  
PERSPECTIVE

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By the Industry, For the Industry

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### **SPOTLIGHT ARTICLE: Almond Bloom From the Beekeeper's Perspective**

Contributing writer Danita Cahill suits up to give us a bees eye view of the life and travels of almond pollinators. (Photo by D. Cahill.)

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# New Findings on Walnut Kernel Mold

## Research Shows Hull-Split Fungicide Sprays and Cultural Practices Help Fight Walnut Kernel Mold

By **VICKY BOYD** | Contributing Writer

**R**ECENT UC RESEARCH CONFIRMED WORK DONE IN THE MID-1970s that timely sweeping and pickup after shaking helps reduce the incidence of moldy walnut kernels.

But the studies conducted in 2019 and 2020 led by Themis Michailides, a UC Davis professor of plant pathology based at the Kearney Agricultural Research and Extension Center, also identified major causal fungal agents that differ from earlier work by others.

In addition, preliminary results from his research found a fungicide treatment around hull split significantly reduced mold in walnut kernels compared to untreated checks.

“This is some new information for the growers to follow if they have a history of high mold in their orchards,” he said.

This season Michailides plans to repeat field trials designed to fine-tune fungicide spray timing and number of applications.

He presented the results of current research, funded by the California Walnut Board, during *West Coast Nut* magazine’s recent 2021 California Walnut Conference.

### Harvest and Pick Up Quickly

Walnut mold, which the U.S. Grade Standards for in-shell walnuts defines as decay or obvious decomposition of the kernel, is nothing new to the industry. In 1976, Bill Olson, UCCE farm advisor emeritus in Butte County, showed walnuts held on trees past optimum harvest timing or on the ground for 12

days had significantly more mold than those harvested and removed promptly. His work was the basis for current cultural practices of shaking, sweeping and pick-up as soon as possible afterward for delivery to the dryers.

Nevertheless, walnut mold continues to trouble growers, depending on the season and the presence of conducive conditions. In 2018, for example, Northern California farm advisors reported up to 40% mold in walnut orchards. In 2019, it ranged from 10% to 20%. And in 2020, grade sheets showed mold averaged 5% to 6%, with some orchards along the Sacramento River reporting as high as 16% mold.

Jake Samuel, who farms walnuts with his family near Linden, blamed rain and rain delays during the 2018 harvest for mold levels double their average. Mold rejects returned to low levels in 2019, and 2020’s harvest conditions were nearly ideal for timely shaking and pickup, he said.

“We grow predominately Chandlers, and [mold] is not necessarily prevalent in Chandlers, but it can be if there are heavy rains at harvest,” Samuel said.

Together with his brothers, he also runs a custom harvest business, and they are always under pressure to harvest in a timely manner to preserve kernel quality.

“When you’re on time with the nut harvest, on time with hull split and nut drop, you’re less apt to have mold and you’ll harvest a cleaner crop,” he said.

### Contributors to Moldy Kernels

Work by Michailides and his group has shed new light on research conducted in 1979 that found fungal colonization of walnut hulls did not contribute to moldy kernels. Just the opposite is true, he said, citing some of his recent work.

In addition, research he and Mark Doster conducted in 1994-95 found a number of contributors to moldy kernels: damage from navel orangeworm and other insects, sunburned nuts, shriveled husks, nuts with larger openings at the stem, larger-sized nuts and nuts on the ground for 15 or more days after harvest. The latter backed up Olson’s 1976 research.

Samuel said he has noticed similar situations in their orchards. In years with heavy sunburn, insect damage is greater, and the two tend to lead to increased kernel mold.

Michailides’ most recent work also found secondary walnut blight infections that do not penetrate the kernel or result in nut drop can still create an entryway for pests, including



Various mold species isolated from walnuts were plated out for identification. The black mass at the top is *Aspergillus niger*, the white colony on the left is *Fusarium spp.*, and the two charcoal grayish colonies on the bottom are *Alternaria alternata* (all photos by T. Michailides.)



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Half of this walnut kernel shows sunburn and mold.



Kernel mold causing decomposition of the kernel.

*Fusarium* and *Alternaria* mold species. Known as brown apical necrosis, or BAN, these black blighted lesions begin at the apical end of the fruit.

As the fungal colonization progresses, the lesions turn brown and the fungal infection expands under the hull, decaying the hull. Eventually, the infection spreads to the kernel most likely through the stem end opening.

### New Studies, New Insights

Beginning in 2019, Michailides led a wide-ranging project funded by the Walnut Board to identify the causal organisms of walnut mold, determine how and when mold developed and, ultimately, develop management methods.

Initially, he tested samples from various varieties from orchards in Kern County north to Butte County to determine the most prevalent fungal species that caused mold in kernels.

*Alternaria alternata*, *Aspergillus niger* and *Fusarium* species were by far the most prevalent. The findings differed from 1980 research that found *Penicillium* accounted for up to 70% of mold in kernels. Today, it's a minor player.

In orchards with *Botryosphaeria/Phomopsis*, Michailides said they also frequently found those organisms causing mold in kernels.

But does the presence of fungal organisms on the hull correlate to moldy kernels? He sought to answer the questions by conducting a systematic study in two Chandler and one Ivanhoe orchard.

“We found out with only one exception – *Aspergillus niger* that was present in the kernels but not present in hulls possibly due to contamination – in all of the other samples, whatever we get on the hulls, we get on the kernels,” he said. “It is not surprising that the same fungi we isolate from the hulls were also found attacking the kernel causing mold. This

is very important information because since these fungi occur on the hulls, if sprays were effective in reducing hull colonizers, they would then reduce kernel mold. And this is actually the basis of why we went into the management with protective fungicides.”

Based on previous research he led on *Botryosphaeria/Phomopsis*, Michailides said fungicide sprays made in mid-May, mid-June and mid-July – regardless of the chemical – significantly reduced *Botryosphaeria* organisms in the black and brown kernels. But the sprays did nothing to reduce kernel

*Continued on Page 6*



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mold caused by *Alternaria* and *Fusarium*.

### Hull Split Treatments

Subsequent studies where walnuts on trees were inoculated with *Alternaria* and *Fusarium* in August, September and October found only the October timing resulted in significantly more decay.

That led Michailides to examine whether fungicide treatments around hull split might be effective.

In 2019, they looked at five treatments in an Ivanhoe variety orchard in Tulare County: 6.5 fluid ounces Merivon per acre three weeks before hull split, Merivon two weeks before hull split, 7 fluid ounces Rhyme per acre at 20% to 30% hull split, Merivon at three weeks before hull split followed by Rhyme at 20% to 30% hull split and an untreated check.

Rhyme, which contains the active ingredient flutriafol, is a Fungicide Resistance Action Committee Group 3 from

FMC. It carries a two-week pre-harvest interval.

Merivon Xemium brand fungicide is a premix of the active ingredients fluxapyroxad and pyraclostrobin (FRAC Group 7 and 11, respectively) from BASF.

The treatments, except for the one two weeks before hull split, reduced mold 35% to 75% compared to the untreated check. The untreated plots had 45% mold in kernels.

“At least it’s a good indication that these types of sprays before hull split or at early hull split will have an effect in reducing mold in walnuts,” Michailides said.

He repeated the trial in the same orchard in 2020. The treatments were Merivon + tebuconazole at three weeks before hull split, Rhyme at 20% to 30% hull split, Merivon + tebuconazole at three weeks before hull split followed by Rhyme at 20% to 30% hull split and an untreated check.

In the untreated plot, 33% of the kernels had mold. A single spray either three weeks before hull split or at 20% to



Mycelia – a vegetative part of fungus consisting of a mass of branching, thread-like hyphae – attached to a walnut kernel.

30% hull split reduced mold incidence 18% to 24%. Two sprays resulted in a 45% mold reduction.

When they examined the nuts for the presence of mycelia – vegetative part of fungus consisting of a mass of branching, thread-like hyphae – the reductions were even greater. The untreated check had 37% mold. A single spray resulted in a 26% to 36% reduction, whereas two sprays yielded a 71% reduction.

A trial in a Butte County Chandler in 2020 looked at the best timing for applications of Rhyme, which has a short two-week pre-harvest interval. Treatments included three weeks before hull split, one week before hull split, 20% to 30% hull split and two different combination treatments.

None of the fungicidal treatments were significantly different, but all were numerically better than the untreated check. He plans to repeat the trial this season.

“We didn’t find the actual best time to spray, but we know September shows a good trend that reduction of mold will be achieved.”

The results mirror other trials conducted in Chandler and Ivanhoe varieties with different fungicide timings.

“Sprays three weeks before hull split and early hull split reduced walnut mold in both early and late walnut cultivars,” Michailides said.

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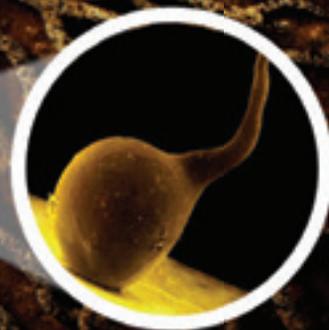
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<sup>2</sup> Velum One applied at 6.5 oz./A, spring 2017, via drip irrigation. Trees planted in January 2017. Increase in green canopy pixels based on an average of two rows of untreated trees compared to an average of two rows of Velum One-treated trees.

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# SMART IRRIGATION TECHNOLOGY CAN HELP WITH WATER MANAGEMENT DECISIONS

By CECILIA PARSONS | Associate Editor

Innovations in irrigation will improve on ground truthing, ET and data collection to improve water management in almonds (photo by C. Parsons.)

**A**LMOND GROWERS DETERMINED TO GET 'MORE CROP PER drop' heard some new takes on smart irrigation technology at the virtual Almond Conference from a panel of researchers and scientists.

"Smart irrigation management will consist of a combi-

nation of hardware and software that will allow almond growers to make precision irrigation decisions," said Sebastian Saa, associate director of Agricultural Research for the Almond Board of California and moderator of the conference session.

Panelists included Ken Shackel, UC Davis; Andrew McElrone, USDA research scientist based at UC Davis; Forrest Melton, NASA Ames and CSU Monterey Bay; and UC Davis researcher Isaya Kisekka.

## Delayed Irrigation

Research done on initiating irrigation in walnuts has application in almond production, Shackel confirmed. Recent field trials in Tehama and Stanislaus counties studied effects on mature almond trees when initial irrigation was delayed on two ET (evapotranspiration) levels.

As previously found in walnuts, the almond trial showed that delaying the first irrigation does result in some tree stress during the delay, but does not result in more stress at harvest. Shackel said that due to differences in location and soils, applying full ET may not prevent substantial water stress in one location, and applying a deficit ET may only cause mild to moderate stress in another location.

"We have all been taught that ET and stress go hand in hand, but it is clear that soils and orchard conditions make a difference. Just because you match ET doesn't mean you won't have tree stress, and falling behind ET doesn't mean there will be a lot of tree stress."

Shackel said more research is needed to try and figure out if a prediction can be made, given soil and orchard conditions, for how ET is going to result in terms of stress.

As was previously found in walnut irrigation research, once the first stem water potential (SWP) threshold is reached, the next is not far behind. Shackel said waiting for a particular SWP trigger may not be as important as just waiting for 'trees to just start drying out.'

## Improving on ET

McElrone's presentation included new information on ET-based irrigation management.

"Ultimately, what we are trying to do is estimate the exact amount of water needed in the system to match water losses," he said.

With ET-based irrigation management, McElrone said the goal is to know how much water to apply, when and where in the orchard.

Looking to improve on the traditional ET-based irrigation management with information from CIMIS weather stations, the new ET models are measuring radiant energy collected by trees and orchard surfaces. The goal of these newer ET measurement collections is to develop inexpensive, site-specific measurements of actual crop water use.



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**“Just because you match ET doesn’t mean you won’t have tree stress, and falling behind ET doesn’t mean there will be a lot of tree stress.”**

– Ken Shackel, UC Davis



Other innovations in measuring crop water use is the GrapeX or Grape Remote Sensing Atmospheric Profile and Evapotranspiration experiment. This is an effort to refine and apply a multi-scale remote sensing ET toolkit for mapping crop water use and stress for improved irrigation management in California. Work is being done to translate this for use in almonds, McElrone said. Methods will include satellite imagery as well as ground truthing with use of sensors. Parsing transpiration from ET is being done with use of drone imaging.

With funding from a CDFA Specialty Crop block grant, the Tree Crop Remote Sensing of ET, or T-Rex, is developing low-cost and accessible irrigation management tools for almonds.

Melton explained OPEN ET and the effort to fill the biggest gap in water management. The challenge, Melton said, is to secure an accurate estimation of national scale near-real-time crop ET with satellite data. With better information on when to irrigate, water will be saved.

OPEN ET is a new web-based platform that will soon be putting NASA data in the hands of farmers, water managers and conservation groups to accelerate improvements and innovations in water management. The platform uses publicly available data and open-source models to provide satellite-based information on ET in areas as small as a quarter of an acre and at daily, monthly and yearly intervals.

OPEN ET primarily uses satellite datasets from the Landsat program, which is a partnership between NASA and the U.S. Geological Survey. Additional data comes from NASA’s Terra and Aqua satellites, the National Oceanic and Atmospheric Administration (NOAA) GOES series of satellites and others.

Because the OPEN ET system uses open-source software and open data sources, it will help water managers establish an agreed upon measure of ET across agricultural areas, said Melton. Different estimates of ET have previously been a source of confusion for water managers, he said, explaining that water users and managers currently have to evaluate a variety of methodologies to measure water use and ET, which often leads to different numbers and debates over accuracy.

### New Irrigation Trials

Kisekka, associate professor in Biological and Agricultural Engineering at UC Davis, outlined irrigation trials looking at water use in young almond orchards, site specific irrigation management by variety and zone irrigation management based on soil type.

Canopy size varies according to tree age, and Kisekka’s study showed crop water use by young trees may also vary, particularly during the summer months. Significantly more water is used by fourth leaf trees than second leaf trees, he said, but there is much less difference in water use between fifth and fourth leaf trees.

Irrigation management strategies for different almond varieties did not show significant differences in tree response, Kisekka said.

A trial at Nickels Soil Lab with different irrigation strategies based on soil types showed stem water potential was not substantially different among varieties.

Kisekka summed up with evaluation of emerging technologies to determine soil and plant water status for data-driven irrigation management in almonds. The trials used large-area cosmic ray soil moisture sensing to collect data across the orchard rather than one site. Automated microtensiometers were used to measure SWP in young trees as an alternative to using a pressure bomb. Kisekka said the sensors provided data similar to a pressure bomb, with less labor involved.

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# Brown Marmorated Stink Bug in Hazelnuts

## Battle Between This Existing Pest and Growers Has Just Begun

By **HAZELNUT MARKETING BOARD** | *Contributing Writer*

**H**AZELNUT GROWERS ARE NO STRANGERS to battling invasive and destructive species. Farmers famously battled back from the brink of disaster after Eastern Filbert Blight came to Oregon and decimated the industry in the 1980s and 1990s. Pests in all shapes and sizes have come to Willamette Valley for decades with a taste for hazelnuts. Contemporary

growers are gearing up for a battle with an insect that made it ways to Oregon in the 2000s and now has a voracious appetite for hazelnuts—brown marmorated stink bug.

Brown marmorated stink bug (BMSB) is part of the Pentatomidae family, a group of insects recognized by their shield-like bodies and five-segmented antennae. Species within this



Brown marmorated stink bug (BMSB) is part of the Pentatomidae family, a group of insects recognized by their shield-like bodies and five-segmented antennae (all photos courtesy Oregon State University)



BMSB has made Oregon's Willamette Valley home.



With their piercing sucking mouthparts, BMSB can penetrate the outer shell of a hazelnut and gorge on the kernel inside.

family also have piercing sucking mouthparts, which enable them to feed on plants and, in turn, cause them to be devastating to farm crops.

BMSB eggs can hatch in four-to-six days and grow through five nymphal stages before reaching adulthood; they can begin feeding on plant tissues as early as the second nymphal phase.

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Prior to adulthood, the bugs cannot fly. However, as fully formed adults, their wings develop, and they become highly mobile.

### High Adaptability

BMSB is native to Asia, and according to Oregon State University researchers, was first found in Portland, Ore. in 2004. The first evidence of BMSB in hazelnuts was noticed in 2014. The bugs have shown tremendous adaptability; they have been found in more than 43 states, in both rural and urban areas. They prefer to overwinter in buildings, which made urban areas an attractive home for the newly introduced pests. However, over time, it has been discovered they can overwinter in layers of tree bark.

Research is still ongoing as to the stink bug's preferred habitats, but they have been found on more than 200 plant species, ranging from urban flower beds to rural farmland and forests. They have shown great affinity for maple trees; this attraction to trees has also contributed to a more pervasive infestation in the woodier northern part of the Willamette Valley and lesser impact, albeit still problematic, on the southern reaches.

Their adaptability also expands to dietary needs. BMSB can survive on an array of plant materials, including leaves and sticks, but they are mostly drawn to proteins, which makes hazelnuts such an attractive target. BMSB will feast on nuts and fruiting bodies of many plants, hazelnut kernels included. With their piercing sucking mouthparts, the insects can penetrate the outer shell of a hazelnut and gorge on the kernel inside. Hazelnuts are also one of the final crops harvested in the Willamette Valley, which means the stink bugs will congregate in the orchard when other foodstuffs are gone; this further prolongs the damage that can be inflicted on hazelnuts.

This is where concern becomes paramount for hazelnut growers—quality. BMSB haven't shown much impact on overall hazelnut yields as they don't cause significant damage to root sys-

tems, leaves, catkins or flowers. However, they can destroy the kernel without growers even knowing. The puncture wounds on the shell can be hard to detect, and the marred kernels will not be revealed until after nuts have been harvested and processed. This is known as "corking damage". If the nuts are damaged, they cannot be sold by the processors, which in turn limits what they can pay back to farmers. As for varietal impact, researchers say there may be some preferences for certain varieties over others, but all production varieties in Oregon should be considered susceptible.

### Samurai Wasps for Biocontrol

Farmers are now racing to find solutions to combat BMSB and protect their livelihood. Oregon State University (OSU) researchers have been the leaders on this front and are continually exploring new avenues for optimum treatment. Perhaps the most promising



BMSB grow through five nymphal stages before reaching adulthood.

and intriguing is a biological control that recently debuted on U.S. soil—samurai wasps. The wasp was a candidate for release but was accidentally introduced. First discovered in Oregon in 2015, the samurai wasps have shown promise in mitigating BMSB. The wasp is a natural enemy endemic to the same regions in East Asia as BMSB.

Samurai wasps are tiny, less than two millimeters in length and are a parasitoid that specializes in hunting stink bug eggs. BMSB lay their eggs on the underside of leaves, typically in bundles of 28. The samurai wasp will hunt down these eggs, pierce them and

*Continued on Page 12*

# WALNUTS, HAZELNUTS, PECANS DRYERS

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# 'Researchers are dedicating more and more time into best practices to combat the pests, but they are here to stay.'



The samurai wasp, a natural enemy endemic to the same regions in East Asia as BMSB, will hunt BMSB eggs, pierce them and inject their own eggs inside. This parasitizes the BMSB, killing them and yielding a new generation of samurai wasps.



It will take diligence, patience and meticulous control measures for farmers to take control of BMSB.

*Continued from Page 11*

inject their own eggs inside the BMSB egg. This parasitizes the BMSB, killing them and yielding a new generation of samurai wasps. The BMSB eggs are white to blue-white, and when they are parasitized, they turn black. Once fully developed, the samurai wasps will chew their way out of the eggs and take flight in the orchard. As this cycle perpetuates,



BMSB has a number of crop hosts across the United States.

more and more samurai wasps permeate the orchard and attack the harmful stink bugs.

Thus far, samurai wasps have proven to be the most effective biological control for hazelnuts. The wasps have not negatively impacted any other species and have been more aggressive in their mitigation of BMSB. Additionally, the wasps can lessen the need for insecticide application.

Samurai wasps are limited due to their ability to only impact the eggs; if the stink bugs can hatch, the wasps are not predatory. Except for some birds, there are no known predators in the Willamette Valley for adult brown marmorated stink bugs. By that stage, chemical applications may be the only option. Growers should be very judicious in any applications and work with professional field agronomists or OSU extension agents before applying.

For Oregon's hazelnut growers and brown marmorated stink bugs, the battle has just begun. Researchers are dedicating more and more time into best practices to combat the pests, but they are here to stay. With such adaptability and the ability to thrive in an array of host environments, BMSB has found a comfortable home in the Willamette Valley. It will take diligence, patience and meticulous control measures for farmers to prevail, yet again.

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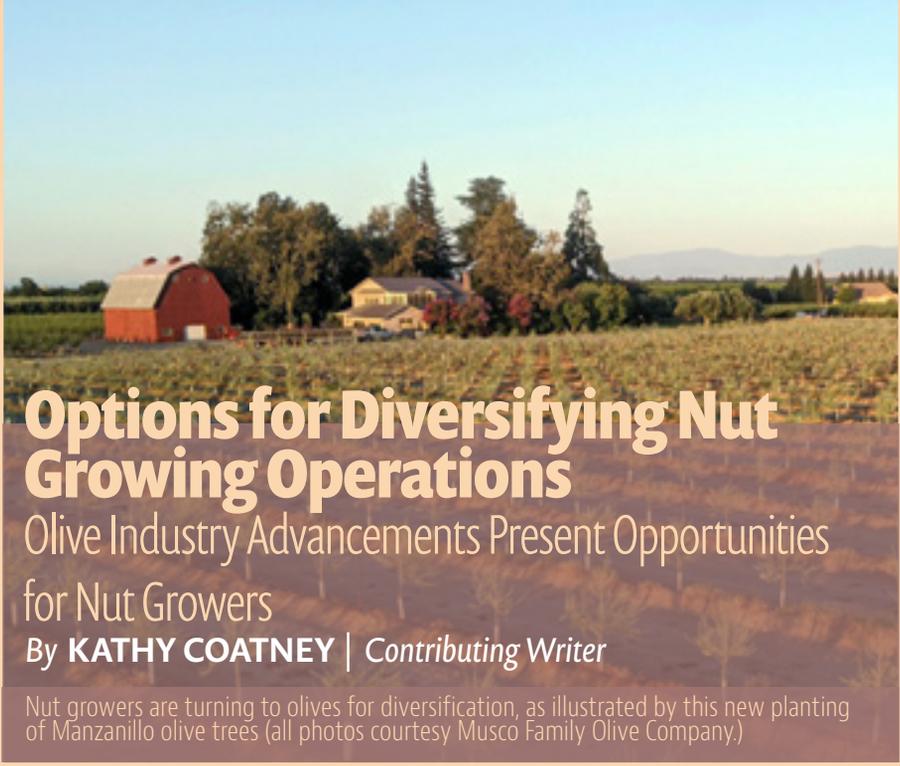
Similarly, Besiege® insecticide provides dual-action protection against the most difficult lepidopteran pests, including NOW. Besiege also delivers excellent efficacy against peach twig borer, codling moth, leaf-footed plant bug and walnut husk fly. Ideal for application at hull split, it offers excellent knockdown and long-lasting residual.

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# Options for Diversifying Nut Growing Operations

## Olive Industry Advancements Present Opportunities

### for Nut Growers

By **KATHY COATNEY** | *Contributing Writer*

Nut growers are turning to olives for diversification, as illustrated by this new planting of Manzanillo olive trees (all photos courtesy Musco Family Olive Company.)

**D**IVERSIFICATION IN AGRICULTURE improves economic stability by reducing financial risk and stabilizing farm income. Many California nut

growers have diversified their operation with different nut crops, but another niche permanent crop to consider is table olives.

Commercial table olive production began in the early 1900s in California, but its Achilles heel has been labor. Everything from pruning to harvesting required hand labor. But that is changing. The 21<sup>st</sup>-century table olive orchard is mechanically pruned and harvested. This is a game changer for the industry, and it offers a unique diversification opportunity to nut growers.

“Diversification is, I think, really important in today’s world,” said Dennis Burreson, vice president for Musco Family Olive Company. “[Table] olives have the advantage that this is new going from hand harvesting to mechanically harvesting. It’s a transition, and transitions present opportunities for new people entering it.”

Mike Silveira, chairman of the Olive Growers Council of California, is a walnut and table olive grower in Glenn County. He sees table olives as a good crop to diversify with his walnut operation.

“I think you need to be diversified. Most of the guys have diversified into the nuts, whether it’s almonds or walnuts, but I think table olives themselves will offer a great opportunity,” Silveira said, adding now that they are mechanically pruned and are using a trunk shaker, this will alleviate the labor pressures.

### Benefits of Olives

Burreson offered several benefits for growing table olives: In general, olives: Use less water; Grow well in a wide range of soils; Have minimal pests and disease; and are Mechanically harvest and pruned.

In addition to these benefits, Musco Family Olive Company is offering free Manzanillo trees to growers interested in planting a minimum of 40 acres configured for mechanical harvest. They are also offering growers long-term contracts.

“Our goal is to make table olives the crop of the future in California,” Burreson said.

Musco’s offer is a great deal, Silveira said. “It’s what’s needed. We do need to mechanize the [table olive] industry.

“I think Musco is totally committed to the California market, and the California growers appreciate that,” Silveira continued, adding there are still

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potential opportunities for mechanizing established trees, too.

### Mechanical Harvest

Burreson has been successfully using mechanical harvest in his orchards for over a decade. “I converted an orchard 11 or 12 years ago that we’ve been mechanically harvesting for 10 or 11 years,” he said.

Table olives use two pieces of harvesting equipment. One side is the shaker and the other is the catch frame.

“The olives are shaken, dropped onto the conveyor belt and up into a bin,” Burreson said, adding it’s very compatible with pistachio and prune harvesters.

This also makes it feasible to hire custom harvesters, since olive harvest is after the prune and pistachio harvest.

“Commercial harvesters, I would say, are going to become a reality,” Burreson said, adding they are currently removing 75% to 85% of the crop with mechanical harvest.

“Along with mechanical harvesting,

mechanical pruning is something that’s being utilized. There’s still, of course, some hand pruning that has to be done, but a lot of it can be mechanically pruned,” Burreson said.

Using a pistachio or prune shaker requires very little retrofit, Silveira said, so it would be a smooth transition for the industry.

The California Olive Committee has done some studies on mechanical pruning and the proper way to prune table olives to get the most advantageous harvest from a trunk shake, Silveira said.

### Pests, Disease, Soil and Water

Compared to almonds, walnuts and pistachios, which have several pests and diseases, table olives have minimal problems. Olive Fruit Fly (OLFF) is the main pest, and there are chemical treatments for controlling it. The main disease is olive knot, which is managed with copper treatments.

Olive knot is more problematic in the northern versus the southern part of the

state.

“In the southern part of the state, olive knot is not really an issue. It tends to be very minor down there. Conversely, in the northern part of the state, it’s more of an issue,” Burreson said, attributing the difference between the two regions to a wetter climate further north.

“We do use minimal plant protection products, and that’s an added advantage,” Silveira said, whereas nut crops today have multiple sprays from insecticides to fungicides.

The California Olive Committee is pursuing additional plant protection products for olive knot, Silveira said.

Burreson said table olives need well-drained soil, but don’t need Class I or II soils to do well.

Silveira agreed. “As long as it’s well drained soil, you’re in pretty good shape. And as long as you feed those olives, feed them with the proper nutrients, you’re going to be fine.”

*Continued on Page 16*

  
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Mechanical shaking of table olives has reduced the once labor-intensive nature of the crop.



Mechanically harvesting table olives is a two-step process.

*Continued from Page 15*

“Table olives are more drought-tolerant...They use less water, which is important in the state,” Burreson said.

### Longevity

Before mechanization, olive trees were in the ground for hundreds of years. Currently, it’s unknown if mechanization will reduce the longevity of the tree, Silveira said, but it wouldn’t be any less than an almond tree. He believes growers will still get the longevity out of them, he added.

“I’ve seen olives that have been abused, and they seem to handle it. If you go back with kid gloves and water them and

take care of them, they seem to come back,” Silveira said, adding he thinks there’s a good chance that table olives will continue to have longevity even with mechanization.

Olives by and large are a durable crop when they have sufficient water and fertilization as well as OLFF treatment, Silveira said.

“We do get into some alternate bearing, but we can cure that either through pruning or olive thinning so they’re pretty consistent,” Silveira said, adding the rate of return compares as good as or better than nut crops.

These new plantings for mechanized table olives would be high-density acreage—200 to 250 trees to the acre or more, and 10 to 15 tons to the acre is feasible for mature trees, Silveira said.

The one downside to table olive production was labor, but converting to mechanization has made that a moot point, Silveira said.

With the tariffs that went in, processors will eventually be able to pick up some of the lost food service market, especially as the industry moves to mechanization, and they will be able to recover that market, Silveira said.

Table olives are a niche market, Silveira said. He estimates the industry needs somewhere in the range of 80,000 to 90,000 tons annually and said that it’s a finite market.

“I think if you’ve got the right soil, you’re looking for some diversification and you want a tree crop that can be mechanized were now we’ve proven that olives can be mechanized, this could be a good alternative,” Silveira said.

Burreson said there has been a lot of interest from growers about Musco’s offer of trees and contracts. For more information, go to [www.milliontrees.com](http://www.milliontrees.com).

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# Almond Growers Consider Multiple Factors in Replanting Decisions

## Lower Prices Push Out Older, Less Productive Orchards

By MITCH LIES | Contributing Writer

Proper pre-plant operations, including ripping and excavating soil, can provide long-term benefits for an almond orchard (photo courtesy R. Duncan.)

**L**OW ALMOND PRICES APPARENTLY ARE not deterring growers from replanting, even in the face of high tree costs, and, in fact may be pushing forward some plans, according to nursery executives.

Noah Tarry, market development specialist for Dave Wilson Nursery, said the Hickman-based operation is busier than ever as growers are embracing opportunities in improved orchard performance and setting aside concerns over replant costs.

“I don’t think I’ve talked to anybody who is really deterred by the cost of the

trees,” Tarry said. “We continue to see orchards being removed at a good clip.”

“Growers are definitely pulling out their orchards,” said Cliff Beumel, president of Agromillora California. “Less productive orchards, old varieties are coming out left and right because the price is down and you no longer can justify them being in the ground. It costs more to farm it.

“You are definitely seeing an uptick in removal of orchards,” Beumel said.

Motivations for pulling out orchards vary, according to Roger Duncan, UCCE farm advisor in Stanislaus County, but often come down to economics. In many cases, low prices can provide an incentive to replant, particularly when orchards are past their prime.

“Growers have to take into consideration the trajectory of their yields,” Duncan said, “but if you are getting over \$3 a pound and an orchard is producing 1,800 pounds per acre, it can still make sense to keep it in. If prices are \$1.50, it probably doesn’t make sense to keep it in.”

A desire to switch varieties or revamp an irrigation system also can spur replacement plans. “There are a

lot of things at play,” Duncan said. “You may want to change rootstocks. You may want to change spacing or your irrigation system. You may want to change varieties; all of those things come into play.”

### Start Process Early

Regardless of why a grower chooses to replant, sources say it is important to start the process well before putting trees in the ground.

“As soon as you get an inkling that you are ready to start replanting, that is the time to call and chat with one of our field reps to get the ball rolling,” Tarry said. “You don’t want to wait until December, for example, to try and order bareroot trees for that same year. We aren’t going to have the sizes. We aren’t going to have the quantity you want.”

Soil and water sampling also should take place early in the process. And when testing soil, Duncan said, it is important to dig deep.

“I always suggest that folks sample down to a 5-foot depth at 12-inch or 18-inch increments,” Duncan said. “And do that in areas that are good and areas where you have some trouble spots.

“If you are only sampling the top foot or so, you really don’t get a good picture of what is happening beneath it. And there could be changes that have occurred through the years. You could have changes in pH, you could have areas where salt is accumulating below the rootzone. So, it is important to sample the deeper profile,” he said.

Soil sampling to a depth of 5 feet also can help determine if there is a need to physically modify the soil, modifications that can be critical to improving drainage, an important factor in the long-term health of an orchard.

“Even though you may be using drip



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Almonds planted on size-controlling rootstock, such as these Shasta variety almonds budded to the Agromillora California rootstock Rootpac 20, can be densely planted, in some cases as closely as 10 feet by 4 feet (photo courtesy Agromillora California.)



Soil modifications to a depth of five feet can be critical in improving drainage in some orchards, an important factor in the long-term health of an orchard (photo courtesy R. Duncan.)

and microsprinkler irrigation, it is very important to have good drainage well beyond the root zone,” Duncan said. “These physical modifications are really key to improving your future orchard performance.”

### Rootstock Selection

A working knowledge of a soil’s composition and the presence or absence of any pests also is a critical factor in choosing rootstock appropriate for a site, Duncan said. “You want to choose root-

stock based on any problems that you have identified at your site. If you have multiple problems, then it becomes more difficult, because then you have to find a rootstock that has a range of tolerance for different soil and biological problems.

“But then there are a lot of orchards that don’t have those problems,” Duncan said. “In that case, you might want to pick a rootstock that is a little more vigorous or a rootstock that has better root anchorage.”

In cases of high soil pH or high salt

or alkali soils, peach almond hybrids like Hansen, Nickels, Brights Hybrid, Titan and Cornerstone have been shown to perform well, along with Viking and Empyrean 1, Duncan said.

In the case of poorly drained soils, Duncan noted that Nemaguard has not performed particularly well. Plum rootstocks, on the other hand, have been shown to be fairly tolerant to heavy soil.

In the case of heavy ring nematode

*Continued on Page 20*

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pressure, growers should look for rootstock that is tolerant of the pest, Duncan said, such as Viking or Guardian, or maybe even Lovell. “And, of course, you would make the decision to fumigate as well.”

“There is always going to be something that you can’t solve with a rootstock,” Beumel said. “But you solve as many problems as you can with your rootstock choice.”

In cases where tree loss to Prunus replant disease (PRD) is a concern, fumigation is an option as well as use of anaerobic soil disinfestation (ASD), and a grower can always choose to fallow an orchard site. USDA-Agricultural Research Service Plant Pathologist Greg Browne said research has shown that in cases where PRD is impactful, its growth suppression can be reduced by roughly 50% for each additional year of fallowing after the removal of an old orchard. When doing so, however, a grower should

weigh what Duncan referred to as the opportunity costs, or the cost of taking land out of production for a year.

### Tree Spacing

When considering tree spacing, Duncan said growers should consider the expected vigor of a site. In general, he said he wouldn’t plant trees farther than 16 feet apart. Trees planted to size-controlling rootstock designed for dense spacing can be spaced as closely as 10 feet apart, according to Beumel, whose company specializes in super-high-density planting.

When removing an orchard, more and more growers are turning to whole orchard recycling, which involves incorporating the old orchard’s woody debris back into the soil, a practice Duncan characterizes as “one of the best ways to really make an impact on the organic matter in your soil.

“You can improve your soil’s organic

matter, and there have been data showing that we can improve the fertility of the soil with this practice,” Duncan said. “The woody debris helps with water-holding capacity and nutrient retention.”

As for whether to go with bareroot trees or potted plants, Duncan said both alternatives are viable. If planting bareroot trees, Duncan advised growers to complete their preplant soil modifications and any fumigation applications as early as possible in the fall with the goal of planting trees in January or February.

“If the field is not ready in time or wet weather prevents timely planting, it may be best to place trees in cold storage until more favorable field conditions exist,” he said.

Potted plants work well if planted in the spring or fall, Duncan said.

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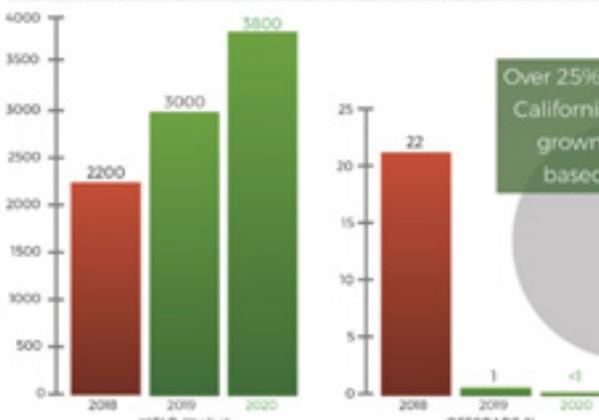
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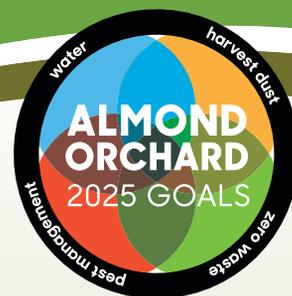
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# GROWER INSIGHTS:

## MALLVINDER KAHAL GENERATIONAL FARMING AND THE EVOLVING STORY OF AGRICULTURE

By **SABRINA HALVORSON** | Contributing Writer



Mallvinder Kahal grew up working on his family's Madera County almond orchard, and he started running Atlas Almonds with his family in January 2020 (photo courtesy M. Kahal.)



**W**ITH THE VAST MAJORITY OF FARMS IN THE U.S. BEING FAMILY owned, the intricacies of generational farming and transitioning the family business are important to the industry. According to the latest statistics from USDA, 96% of farms in the nation are family owned. That means at some point, nearly every farmer in the country will be faced with the role of either passing down the farm or taking on the family business.

Mallvinder Kahal grew up working on his family's Madera County almond orchard, but he says it took him awhile to decide the farm is where he wanted to be. After high school, Kahal attended UCLA, where he started out as a biochemistry major.

"My parents really wanted me to be a doctor and my sisters were in medical school at the time," he said.

During his first two years at the university, he became an emergency medical technician. He says that was when he decided it was not the future he wanted. After a discussion with his brother, he changed his major to environmental science and prepared for a career in agriculture.

"I was basically put at the bottom of the ladder (at the family farm) and told I had to learn everything from the ground up. And so that first six months, which isn't that long of a time, but that first six months was pure machine operating," Kahal explained. "Every year, a little bit more responsibility was added. My dad's philosophy is that at the core of being a farmer is being a jack of all trades, and you need to be able to do anything

you tell someone else to do. I was brought up that way, and even coming back from college I was forced to do stuff that I'd been doing already my whole life."

### Generational Handoff

Kahal said his father prepared him for one day teaching others how to operate the machinery, how to run the farm from the ground up and how to think like someone invested in the farm rather than someone just doing weekend chores.

He has now been back on the farm for about six years and his parents are now retired.

"They still have a say in things," he said, noting that he likes the continued involvement of his parents because of their years of experience. "Don't go too far because of the wisdom. It's a balance."

His experience with picking up the torch of the family farm gave him a new perspective and some advice for others.

"Both parties have to be happy. That's the first and foremost thing. If one side or the other is not happy, something needs to change," he said. "If I was talking to someone who was in my position five or six years ago, I would tell them don't be shy to explore your full potential. Keep busy and ask questions. It's easy for your parents to not always realize things need to be explained.

"As somebody who's in there and trying to take over and be a successor, it's really up to you to ask the questions," he continued. "You have to dig for the information. That's not because the generation before you is trying to hold it back. It's just that when somebody's been doing something for so long, it doesn't cross their mind to explain it."

For both sides of the generational handoff, Kahal recommends patience.

"It's easy to get frustrated. It's family. You're working together. You want to do right by them, and they want to do right by you," he said. "The ideology can be different. Approaches can be different. It's really a balance.

"And then I would say for the parents out there, also be patient because generally when people are trying to learn and come in, there's a lot of emotional investment," he continued. "That can get the better of a person. It's just patience on both sides. Take the time and have respect. I think that's the most important thing to a successful transition. The second is recognizing the value each generation brings."



## Advice for New Growers

For newer farmers, Kahal also recommends trying several aspects of agriculture. He was a fellow in the Almond Board of California's Almond Leadership Program in 2016 and learned to take on side projects while farming.

"Farming is one of those unique things where there's so many ways to be a part of it," he said. "During the last six years, I always had one foot in farming, like taking over the family operation, but I also had another foot in something I could do to diversify or vertically integrate. For example, my first year was just all farming. But I spent my second year training with a honeybee keeper. I had this mindset I could keep my own hives. For my training, I went out with him. I got my bee suits. I learned how to look for the varroa mites and learned how to look for the queens."

He said he did not end up keeping hives, and in his third year in farming, he tried another project.

"I tried to start a butter company called Better Butter. I made almond butter with my sister. That was more of a hobby but it taught me a lot about the whole aspect of sales and the gap between farming and retail," Kahal explained. "And it taught me there's this huge gap. There's this whole middle section. You can't just be a farmer and then jump to retail. It taught me a lot about branding."

For his fourth year, Kahal became a licensed real estate agent. His family had been looking at property and he was interested in learning how to broker real estate deals.

"The whole time I was farming and every time I took on a side endeavor, it really brought on this whole other network and this whole other perspective into my farming," Kahal said, noting the side projects each brought different insights into agriculture as a whole.

His latest endeavor is the one he determined was more than just a side project.

"We decided we want to start up a processing plant. So, I was able to take away that even if those other things weren't connected to this new project, it taught me how to take initiative on something new, how to learn and how to seek out people who are willing to teach you," he said.

The family started running Atlas Almonds in January 2020. "I'm confident that that's our new foot going forward, but I don't think I would have got there if I didn't take the initiative with the Almond Board, if I didn't take the initiative trying to learn something connected to farming but really tangent to it like the beekeeping or getting my real estate license or working on the almond butter product we had.

"I guess what I'm saying is if you always have one foot in the door, trying to think of something you can add in addition to your farming, eventually, something will click," he continued. "It may take three or four tries like it did for me, or you just might find it on the first go-around."

Kahal also recommends that young farmers create a five-year plan to help set a trail to their goals. His five-year plan came to completion in 2020, and he is now considering his options for the next five years.

"I've had a crazy year. In 2019, we were building the plant, which took a full year because it was a new building

and fresh construction. Last year, I got married and COVID happened. It was just chaos and chaos. So, I feel like the year just kind of slipped by me," he said. "On the farming level, we've had a successful transition. We have responsibilities doled out between me and my brother. My parents are still involved to the capacity they want to be and it works for us because it's helpful and they're there when we need them. The farming is just exactly where we wanted to get to when we first thought about transitioning it. So now that we've kind of hit our stride, I think our five-year plan is to keep growing our farming, trying to match the challenges that are coming ahead."

*Sabrina Halvorson is the host of MyAgLife Daily News Report. Listen to the full interview with Mallvinder Kahal in the February 5<sup>th</sup> MyAgLife Daily News Report at [myaglife.com](http://myaglife.com) or on the MyAgLife app.*

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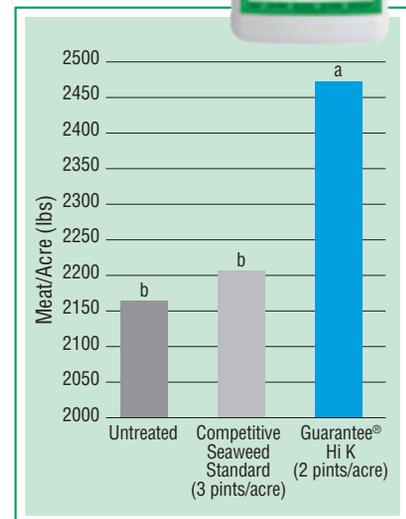
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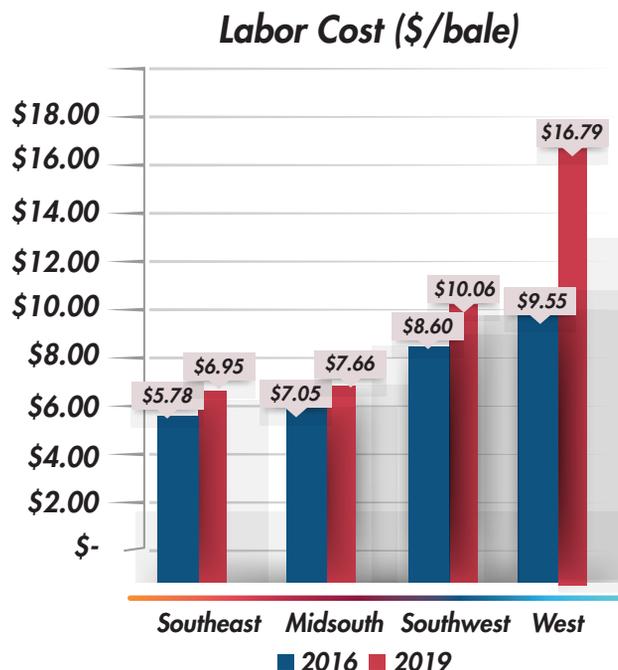
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# California Businesses: How Can We Compete?

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



California was more than \$6.73 higher than the next highest region and more than \$7 higher than the national average for labor costs (all photos courtesy CCGGA.)

**F**OR THOSE DOING BUSINESS IN CALIFORNIA, this is a question that gets asked every time another regulation gets passed or when the minimum wage goes up as it did again on Jan. 1. When it comes to the tree nut industry, the naysayers tell us there is no one to compete with so what's the issue? Well, for one reason, that's not true. The tree nut industry competes with other countries and, in the case of pistachios and pecans, states. Furthermore, consumers will only pay so much. For example, when the price of almonds gets too high, at least one cereal maker cuts back on how many almonds they used. Unfortunately, it's truly getting to a point where businesses can't compete. It's why a walnut processor moved to Sparks, Nev., why an almond processor moved to Texas, and one reason why almonds are being tried in Arizona. There is no longer any doubt about it; the regulatory climate and corresponding economic impact is clearly taking its toll.

Understandably, the cost of ginning cotton is an important concern for cotton producers and cotton ginners. While it isn't specifically for almond hullers or walnut processors, a paper was recently published by USDA-ARS

that demonstrated just how bad the disparity in cotton gin operating costs is between California and other states in the country.

## Cost of Doing Business

Every three years, USDA-ARS conducts a survey of cotton gins across the country to determine cotton ginning costs by region. Data from this survey allows cotton gin management to compare their operation to regional and national data, and provides information about key variable costs as a component of the overall cost of ginning cotton. The survey looks at the costs of repairs, bagging and ties, labor, drying fuel and electricity. These five costs make up the operating cost of a typical cotton gin. The data helps to identify trends of gin operation and document how the adoption of new technologies in cotton harvesting and ginning has impacted ginning cost.

In their most recent survey conducted in 2019, USDA-ARS released the preliminary results. While a cost discrepancy is expected for the West compared to the rest of the cotton belt, the significance of the amount of discrepancy was not. The results clearly

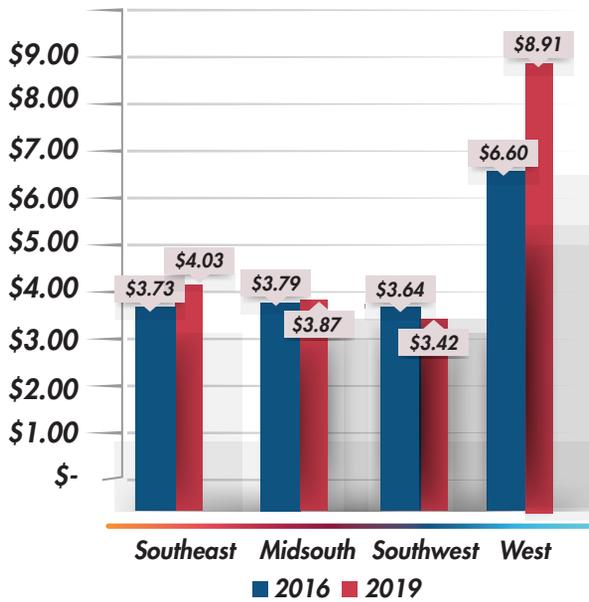
demonstrate the unlevel playing field between California and the rest of the cotton belt. The largest impacts are felt in labor costs as a result of California's high minimum wage; and electricity rates, where California's energy and environmental policies heavily impact rates. Overall, cotton gins in California operating in 2021 have costs more than \$16/bale higher than any other cotton growing state. That is up from a little more than \$12/bale only three years prior from the last comparison in 2016, when the discrepancy was only \$4.55 per bale.

In the charts provided, California makes up 90% of the "West" cost numbers. In looking at labor costs, California was more than \$6.73 higher than the next highest region and more than \$7 higher than the national average. Upon reviewing electricity costs, California was \$4.88 higher than the next highest region and \$4.73 higher than the national average.

## Widening Discrepancy

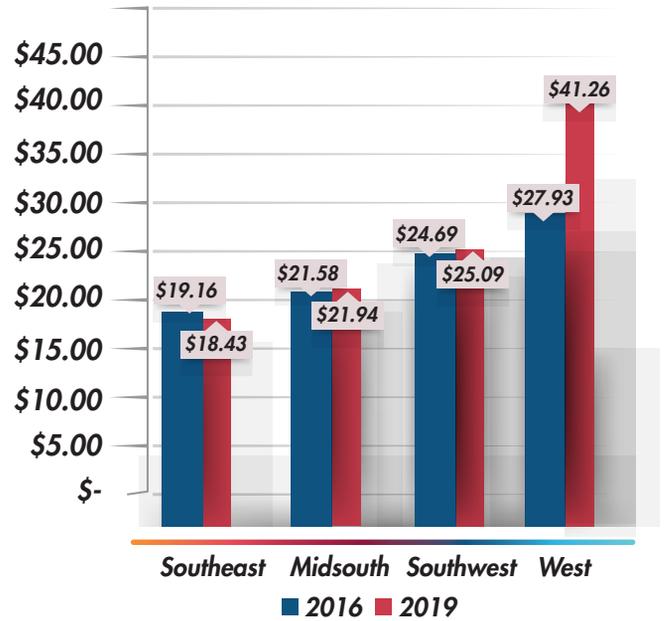
What's really disturbing is the fact that it is getting worse. In comparing the results to the 2016 USDA-ARS report, it is clear the disparity is increas-

### Electricity Cost (\$/bale)



California was \$4.88 higher than the next highest region and \$4.73 higher than the national average for electricity costs.

### Overall Cost (\$/bale)



Overall, the difference in total operating cost between California and the rest of the nation grew from \$4.55 per bale in 2016 to \$16.85 per bale in 2019.

ing. Overall, the difference in total operating cost between California and the rest of the nation grew from \$4.55 per bale in 2016 to \$16.85 per bale in 2019. This is primarily driven by the increase in electricity and labor costs.

While other states are looking at an increase in minimum wage, many states rely upon the national minimum wage as the standard. Until it is increased, the disparity will remain. Furthermore, the climate change regulation and wildfire safety concerns will continue to force electricity rates higher in California, so relief from the disparity in the near future will not be seen. Many hullers and processors continue to automate to the extent possible to reduce labor costs, and many operations have installed solar to offset rising electricity costs.

So, when people wonder why someone might try planting almonds in Arizona, maybe now it makes sense. Their operating costs are much lower and they don't have the regulatory pressures California does. They don't even have a Heat Illness Regulation like California, despite being much hotter for a longer portion of the year!

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2. Valco, T.D., H Ashley, D.S. Findley, J.K. Green, R.A. Isom, and T. L. Price, 2018, The Cost Of Ginning Cotton – 2016 Survey Results, 2018 Proceedings of Beltwide Cotton Conferences, National Cotton Council, Memphis, TN. CDROM.

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Chill, Heat and Choosing Male Pollinizers:

# A Complex Situation

for Pistachio Growers

By CECILIA PARSONS | Associate Editor

Lack of adequate chill hours during the winter dormant period is forecast to occur more frequently in coming years. (photo by C. Parsons.)

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**I**N SPITE OF BEING A HARDY TREE, PISTACHIOS can be picky about bloom time temperatures.

Mood swings aside, pistachio growers may want to consider using supplemental male pollinizers in addition to standard males when planting a new orchard. UCCE Farm Advisor Craig Kallsen, Kern County, made this suggestion in his presentation for the annual Statewide Pistachio Day.

Kallsen also noted that ensuring bloom synchronization does not guarantee adequate pollination and yield potential in years with inadequate chill.

Lack of adequate chill hours during the winter dormant period is forecast to occur more frequently in coming years. Katherine Jarvis-Shean, UCCE farm advisor in Yolo, Solano and Sacramento counties, said in her Pistachio Day presentation that climate models predict winters in the future will be warmer than in the past. Models also predict winter temperatures will

*Continued on Page 28*

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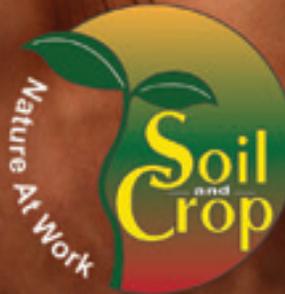
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Continued from Page 26

continue to vary from year to year. Winter-to-winter variability will be two times the expected shift in temperature, Jarvis-Shean said, and there will be some cold winters and winters that would now be considered average.

With more low chill winters predicted, understanding pistachio tree response will be critical to achieving

adequate nut yield.

### Dormant Season Influence

How well pistachio trees leaf out and/or bloom in the spring partially depends on what happens during their dormant period. Dormancy, Kallsen explained, is closely associated with environmental conditions. During dormancy, growth and development is reduced, there is decreased metabolic

activity and carbohydrate resources are conserved.

Plants that go dormant in the winter are generally adapted to cold climates, and going dormant reduces their chances that new growth and flower buds will push when temperatures are freezing. Pistachio trees grown in the San Joaquin Valley have been able to adapt, Kallsen noted, but some rootstocks do not appear to go dormant.

There are two types of dormancy, Kallsen explained. Endodormancy is broken by chill accumulations while ectodormancy is broken by heat accumulations. For leaf out and bloom to occur, the plants endodormancy requirement for an adequate fall/winter cold period first must be met. That means the weather during fall and winter must provide the trees with a certain amount of 'cold' before trees will come out of dormancy.

Kallsen said pistachio trees appear to be 'switched off or on' to enter or exit dormancy through genes and associated proteins. These genes are fully integrated in pathways leading from 'sensing' and 'measuring cold' to resuming growth after the endodormancy period. Gene-encoded proteins exist in plants that measure the length of day and may also be involved in the tree entering and breaking endodormancy.

Once endodormancy or chill requirement is met, the plant is primed to get growth started in the spring, but not until temperatures warm. The time period between when a plant is 'switched on' and to when temperatures are warm enough for growth is ectodormancy.

Kallsen said pistachio trees need a certain amount of heat to push buds and begin flower development. When that level is reached, the tree is no longer in ectodormancy and the growing season begins with initiation of flowering and bloom. The warmer it is, Kallsen noted, the faster these things take place.

### Time for Bloom

Once growth commences, the

Continued on Page 30

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Continued from Page 28

available carbohydrate is critical for bloom, nut set and yield as well as next year's flower bud retention.

Adequate flower development and pollination appear to have a window of success, Kallsen said. Hot temperatures (one study noted over 80 degrees F) during this time can cause reduced flower weight, premature senescence of pollen and ovaries, and poor flower quality. If cool temperatures prevail during bloom, enough heat will be available for slow but normal flower development, but Kallsen said that there will be a threshold where temperatures are too cold for fertile male and female flowers to develop. Flower development must occur within a given time frame, and flowers cannot wait indefinitely for warmer temperatures.

“If you are planting a new orchard with Kerman, Golden Hills or Lost Hills, it might be good to have more than one male.”  
– Craig Kallsen, UCCE

“Trees adapt to a certain time frame, and if this time frame is missed, there won't be much nut production,” Kallsen said.

In the San Joaquin Valley, pistachio

trees that experienced insufficient fall and winter cooling, compounded by fall and winter solar bud warming, will have the following symptoms: Male and female trees not blooming together; North side of tree blooms before south and top of tree resulting in late or prolonged bloom – or no bloom on south side; Abnormal flower development; Flagging of shoots; and Leaves only pushing at ends of branches.

Leaf-out on the Valley floor in the cool and rainy spring of 2020 was slow, Kallsen noted, but it was uniform and there was male and female bloom synchrony.

At higher elevations, tree showed some unusual symptoms, where both sides of trees experienced late leaf-out. Kallsen attributed this to low winter chill and low temperatures during bloom. This should not be confused with winter juvenile tree dieback, he noted, as the branches were not dead and eventually did leaf out.

### Picking Male Pollinizers

In recent years, the pistachio industry has assigned a standard pairing for pollinizing males and female cultivars. Those are Kerman-Peters, Golden Hills-Randy, Lost Hills-Randy and Gumdrop-Tejon. However, Kallsen noted that in the 1970s and 80s, it was common to plant two different male pollinizers in orchards.

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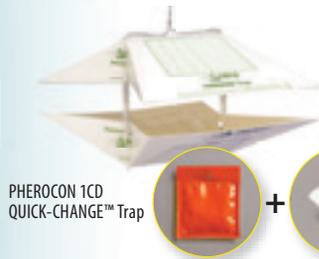
						
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to that practice, he said, in an effort to compensate for erratic bloom.

Average full bloom date for Gumdrop is March 28. For Golden Hills and Lost Hills, it is April 7. Kerman is last at April 12. At a given location, and for similarly aged trees, Gumdrop will be in full bloom about 11 days before Kerman.

“If you are planting a new orchard with Kerman, Golden Hills or Lost Hills, it might be good to have more than one male,” Kallsen said.

For Kerman plantings, Peters would work in good chill years and Randy in low chill. For Golden Hills, Randy would work in moderate chill, but Tejon would help with low chill. Kallsen said that as the trajectory for chill decreases, there is no need for a male pollinizer in high chill years.

However, Kallsen warned that male and female trees blooming at the same time does not necessarily mean that pollination and nut production will happen.

*Comments about this article? We want to hear from you. Feel free to email us at [article@jcsmarketinginc.com](mailto:article@jcsmarketinginc.com)*

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# Nutrition Plans for Pistachio Orchards

## Follow Demand Curves to Make Better Orchard Health Decisions

By RICH KREPS | CCA, SSp., Contributing Writer

**CREATING A PISTACHIO ORCHARD** nutrition plan can be a daunting task and drive you nuts. Every farmer I know wants that silver bullet that will increase those yields with better quality and size. Well, sorry Tonto, Kemosahbee didn't really have silver bullets in the Hollywood prop belt.

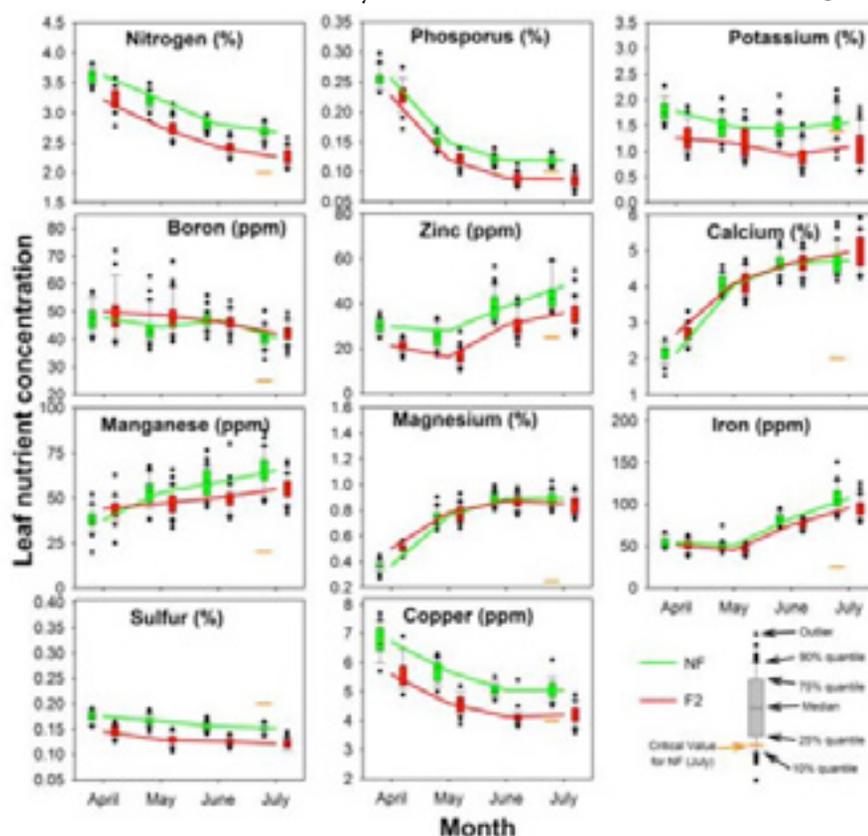
As a Certified Crop Advisor, it is very frustrating for me to meet with a new potential client and hear the words, "What is your normal pistachio nutrient program?" Lee Ann and I only farm 40 acres of pistachios in Madera county on the east side, and in just our little 40-acre block, we have four different soil types with varying CECs of 3.8 (practically river sand) to 11.5 loamy sand. I don't even have a normal program for any 10 acres of my property! However, it becomes a logistical nightmare to separate four different programs in the irrigation sets for 10-acre parcels. Like most farmers, we farm to the deficiencies of the averages of all four soil types. I'm sure it has been very frustrating for the powers that be in academia as well. That question gets echoed very loudly in their ears on a continual basis: "How much do we put out on our fields every year?" We need to use the data at hand to make better decisions for our orchard's health.

### Nutrient Demand Curve

Let's take a look at the nutrient demand curve provided. Notice how high the levels are in the beginning of the season for N and P (see Figure 1). The critical levels of those two nutrients seem to be almost baseline by late

May into June. The experts will tell you our trees don't even take up N until leaf-out and draw from internal stores in the roots early in the season. The window seems pretty small to get the

*Continued on Page 34*



**Figure 1.** This nutrient demand curve illustrates how high the levels are in the beginning of the season for N and P (graphic courtesy UC ANR.)

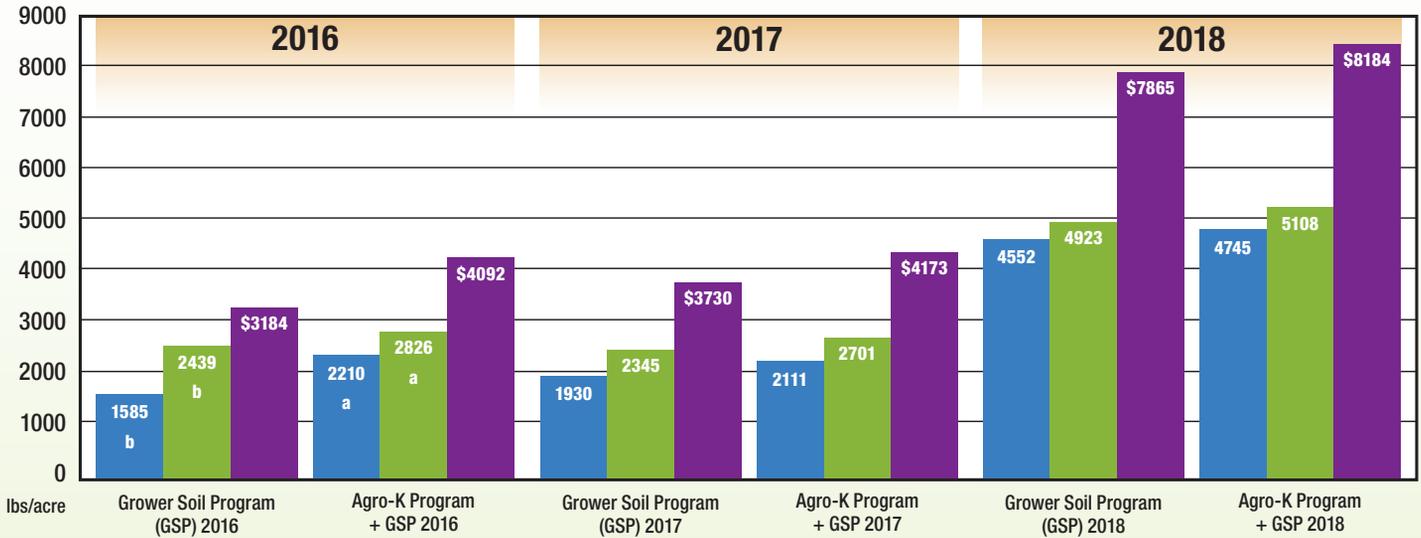


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required N (at current blanket recommendations) into the tree early for optimal yields.

But there is another aspect. Let's look at the nutritional components for the nuts as well to see how they play out (see Figure 2). In one cup of pistachios, we can ingest 26% of our RDA for Calcium, 36% for Potassium and 37% for Magnesium! One cup of pistachios will contribute 50% of the RDA of protein for an average sized human and 104% of the RDA for vitamin B-6. As you know, protein contains a lot of N. Those are power-packed little nuts.

But what does that tell us? The nutrient demand curves are based on tissue analysis, not the nuts themselves. How much goes into the actual nuts? As the season progresses and we move into nut fill, that nutrition goes from the "source to the sink" (the soil, the roots

and the leaves to the nuts). This tells me two important things: 1) If we are deficient in the tissues, we are probably causing ourselves yield reductions, and 2) the derivative of the nutrient is as important as anything in making sure what we put on actually goes in.

According to Jane Higdon's research from the Linus Pauling Institute at Oregon State University, she found, "Vitamin B-6 and its derivative pyridoxal 5-phosphate (PLP) are essential to over 100 enzymes mostly involved in protein metabolism." Cobalt is found in the body and nuts as vitamin B-12. Molybdenum increases nitrogen use efficiency significantly and can aid in creating a healthier microbial soil environment. Phosphorus starts very high in the spring and tapers throughout the season, but it's a big deal in nut nutrition. Most foods high in protein will also

Continued on Page 36

**Scientific name:** Pistacia vera  
**Higher classification:** Pistacia  
**Conservation status:** Near Threatened  
 (Population decreasing) Encyclopedia of Life  
**Rank:** Species

**Nutrition Facts**  
 Pistachio nuts  
 Sources include: USDA

Amount Per	1 cup (123 g)	% Daily Value*	
<b>Calories</b>	691		
<b>Total Fat</b>	56 g	86%	
Saturated fat	7 g	35%	
Polyunsaturated fat	17 g		
Monounsaturated fat	29 g		
Trans fat regulation	0 g		
<b>Cholesterol</b>	0 mg	0%	
<b>Sodium</b>	1 mg	0%	
<b>Potassium</b>	1,261 mg	36%	
<b>Total Carbohydrate</b>	34 g	11%	
Dietary fiber	13 g	52%	
Sugar	9 g		
<b>Protein</b>	25 g	50%	
Vitamin A	10%	Vitamin C	11%
Calcium	12%	Iron	26%
Vitamin D	0%	Vitamin B-6	104%
Cobalamin	0%	Magnesium	37%

\*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

**Figure 2.** One cup of pistachios provides half the daily requirement of protein, which in turn requires ample, well timed nitrogen (graphic courtesy Nutrients Review.).

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'After we've spoon fed our Calcium in smaller shots all spring, keep it rolling through nut fill. Adjust your N applications to coincide with your tissue sample levels.'

## OMC Hedgehog Model 3014 Hedger

### Machine Features

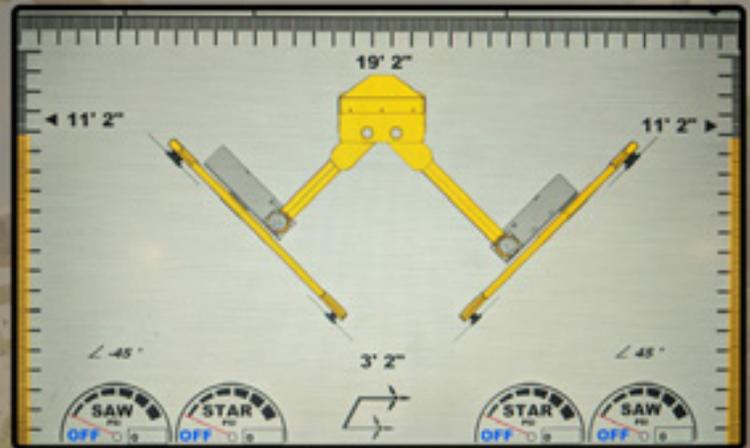
- 4.5L 200 HP Cummins Stage V turbo-diesel engine
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- Hedging dimensions fully adjustable from the cab, no tape measure required!
- Color display (shown below) contains all relevant hedger information, such as:
  - Hedging heights, widths, and angles with visualization
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Easy, precise adjustments from the cab

### Dimensions & Capacities:

- Top Speed: 20 MPH
- Max flat topping height: 22 ft
- Minimum hedging width: 24 inches
- Max hedging width: 12 ft
- Max hedging height (at 24" width): 26 ft
- Max lateral incline angle: 8 degrees
- Fluid Capacities:
  - Fuel: 100 gal
  - Diesel Exhaust Fluid (DEF): 10 gal
  - Hydraulic Oil: 70 gal



carry quite a bit of P themselves. P, of course, is critical in the Krebs Cycle, creating energy, or Adenosine Tri-Phosphate (ATP). Okay, Rich, enough chemistry; what does it mean? The nutrition we put on our trees has to be at the right rate, source and time to get into the tree to create those delectable little nuts that we rely on for human nutrition.

### Apply N and P Early

Back to the nutrient demand curve. We need a significant supply of N and P early. Most N is coming from the roots. P is a continual battle to get to proper levels. A tree can only assimilate orthophosphate into the roots. And look at the slope of the P curve. We need to get it into the tree early. That's tough with insoluble P when it's cold and wet. Add it to the soil and foliars early. We have to use a soluble, plant-ready source to get it into the trees at bloom. As soon as we start seeing a little green on those branches at leaf-out, we can start with the N.

However, remember that those nuts need calcium for cell division and cell wall integrity. I'm a big fan of soluble Calcium with early Nitrate in smaller shots. After we've spoon fed our Calcium in smaller shots all spring, keep it rolling through nut fill. Adjust your N applications to coincide with your tissue sample levels. A pistachio tree is going to need as

**'Taking a more scientific approach to growing our pistachios will keep us from going "nuts" trying to figure it all out at harvest without a plan.'**

much Calcium in a year as N. It's going to need 10% of its N consumption in amounts of Phosphorus and Magnesium. If your season starts low in Magnesium, since that is the central element to chlorophyll, it'd be best to be adequate. We only have a base saturation of 8% Magnesium in our east side soils, so I add an early soil shot to the ground to get things started, then add it to our foliars as the season progresses. Follow the curves, especially on the east side of the valley. I tested yellow leaves at the end of our branches past the nut clusters to prove a theory. I didn't think it was solely an N deficiency, but also a Magnesium deficiency. It certainly was. Our trees need a significant amount of Magnesium early through May. Now notice the copper curve. Add it early to your foliars. Focus more of your Manganese nutrition in April. Add the bulk of your Zinc and Iron nutrition in May to match the summer demand.

The researchers in our industry have put a lot of effort into the science of nutrients. As farmers, we have to find a way to get those nutrients into our trees. Until we have separated the data on the actual nutrient load of pistachios as they develop from exocarp through embryo development to shells splitting, and what each stage consists of, we haven't followed the nutrient demand curves like the one posted. The way we put that information to good use is to be diligent on what was applied, when, how much and what the actual derivative of that nutrient was. If end-of-season levels are coming up and yields are rising, we have made a difference. We can then dial in our individually applied field nutrients and match the trees' needs. Taking a more scientific approach to growing our pistachios will keep us from going "nuts" trying to figure it all out at harvest without a plan. The only future silver bullet we'll have to ask for should have blue mountains when we cheer to our success!

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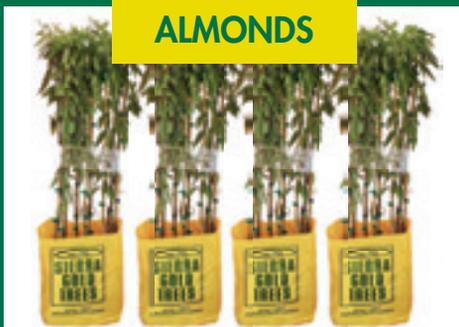
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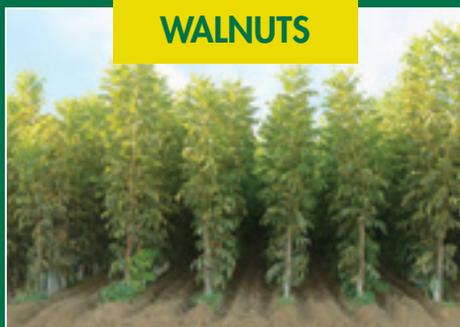
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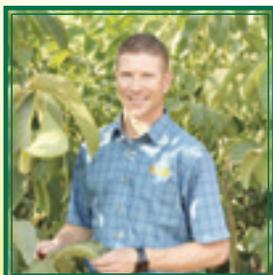
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# PHYTOPHTHORA A MAJOR THREAT TO ALMONDS AND WALNUTS

SPECIES CAN WREAK HAVOC IN ESTABLISHING ORCHARDS IF NOT CONTAINED

By MITCH LIES | Contributing Writer

Good scaffold selection can help minimize Perennial *Phytophthora* Canker issues (all photos courtesy M. Yaghmour.)

**O**F THE MANY PATHOGENS AFFECTING California almond and walnut production, *Phytophthora* species rank high on any list of concerns.

*Phytophthora* species are widespread in orchard soils, difficult to control and can be deadly to trees. They are generally classified as soilborne, but can occur and move in surface water and can be moved up onto above ground tree surfaces as evidenced by a recent resurgence of Perennial *Phytophthora* Canker (PPC). Pathogenic *Phytophthora* can enter a tree through a wound, but wounds are not necessary for infection.

Young trees are particularly susceptible to *Phytophthora* diseases, and their presence can wreak havoc in establishing orchards, according to Jim Adaskaveg, UC Riverside professor and plant pathologist.

“Currently, epidemics are occurring in many newly planted almond and walnut orchards,” Adaskaveg said, “and thousands of trees are being lost.”

The most common diseases associated with *Phytophthora* in walnuts and almonds are crown and root rots. Crown rots advance rapidly and, according to the UC Statewide IPM Program website, infected trees can collapse and die soon after the first warm weather of spring. Trees suffering from root rots, on the other hand, may go years before succumbing to the disease, but typically will experience reduced growth, early senescence and leaf fall and yield poorly throughout their life.

While chemical control options are limited, several cultural practices can minimize an orchard’s exposure to *Phytophthora* diseases, the most crucial being proper water management. Keeping orchard soils well-drained and preventing water from accumulating around the crowns of trees can go a long way toward reducing incidence of *Phytophthora* diseases, Adaskaveg said. But doing so is easier said than done, particularly when establishing an orchard.

“Bare-root and potted trees have small root systems that need water,” Adaskaveg said. “Irrigation emitters are often placed near trunks and cardboard tree trunk-and-crown protectors seem to provide a favorable environment for *Phytophthora* infections.”

While none of the widely available and adapted almond rootstock is highly resistant to *Phytophthora*, some are more susceptible than others. In general, according to the IPM website, plum rootstocks are more resistant than peach or peach-almond hybrids, and Marianna 2624 is the most tolerant. Growers should be aware that peach-almond hybrid rootstocks, which have become popular in much of the San Joaquin Valley, are more susceptible than the old standard, Nemaguard rootstock, said USDA Agricultural Research Service Plant Pathologist Greg Browne.



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In walnuts, Paradox hybrid rootstock (typically *Juglans Hindsii* x *J. regia*) is more tolerant of *Phytophthora* species than Northern California black walnut or English walnut rootstock. But Browne said that only RX1 rootstock, a clonal hybrid of *Juglans microcarpa* x *J. regia*, offers high resistance to *P. cinnamomi* and moderate to high resistance to *P. citricola*.

The IPM site advises walnut growers to plant on berms, avoid soil compaction, limit irrigation run times and avoid standing irrigation water.

For almonds, the website recommends growers employ similar cultural practices and provide adequate drainage to low spots in orchards as well as leaving areas without adequate drainage unplanted. Further, if planting in an area where *Phytophthora* is present, either plant trees on small mounds as shallowly as possible or on broad ridges with the upper roots near the soil level.

### Chemical Control

None of the chemicals labeled for *Phytophthora* diseases provide total control of the pathogen's diseases, according to the site, and fumigating soil pre-plant only temporarily reduces the population of *Phytophthora* in soil. Applications of phosphite fungicides can be quite beneficial, but, in general, fungicides don't have much curative activity on *Phytophthora* diseases, according to Browne, particularly in cases where a tree has extensive cankers or gumming.

Nevertheless, Browne said, in previous almond and walnut orchard trials, phosphite treatments before infection suppressed development of *Phytophthora* cankers. He suggested that phosphite treatments may be beneficial in suppressing further incidence of a well-documented *Phytophthora* problem in almond and walnut orchards.

Ridomil also can be effective when applied in a timely fashion for controlling *Phytophthora* caused by root and crown rots, according to Mohammad Yaghmour, UCCE Farm Advisor for Kern County, and should

be considered when planning multiple sprays. UC research has shown that over reliance on phosphite fungicides in other crops, such as citrus, can lead to resistance and poor performance, said Adaskaveg.

Alternative chemical control options could be available in the near future, given that Adaskaveg is researching fungicides with different modes of action than currently labeled products. He noted that Orondis (oxathiapiprolin), which is currently being reviewed by the state of California, was federally registered on almond in December of last year and most likely will be registered in California in late 2021. Adaskaveg is looking at pre-plant and immediate post-plant chemigation treatments to protect newly planted trees and said the new fungicides "are highly effective at extremely low rates."

He added, however, that pre-plant and immediate post-plant applications won't necessarily protect trees from *Phytophthora* introduced to an orchard from surface water irrigation, which has been shown to be a source of *Phytophthora* infection. "Well water is generally free of the pathogen," Adaskaveg said. "However, surface water can carry inoculum of *Phytophthora* spp., resulting in re-introduction of the pathogen into an orchard even after fungicide use."

Researchers are developing a two-application strategy with root flushes – one in the spring and another in later summer or early fall – as a strategy to contend with this re-introduction. "This is important, particularly in the first few years of establishing an orchard," Adaskaveg said.

### Phytophthora Canker

A concerning de-

*Continued on Page 40*



Perennial *Phytophthora* Canker (PPC), pictured here, is associated with spring rains. Almond trees infected with PPC develop cankers that can grow several feet a year.

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Continued from Page 39

velopment in almonds in recent years is a resurgence of what is known as Perennial *Phytophthora* Canker disease (PPC). PPC, which caused high incidence of tree loss in the late 1990s and early 2000s in Southern San Joaquin County, occurred in several almond orchards in Kern County over the past three years, most notably over the past two years, according to Yaghmour.

According to Browne, who has studied PPC extensively, the disease seems to be associated with late-winter and spring rains, which create conditions ideal for infection to spread into trees from inoculum that has gathered on dust and debris in tree scaffolds.

“Those pockets where the scaffold branches join the tree trunk are really a perfect setup for infection, because you often get growth cracks where the scaffold branches push against each other and split as they grow,” Browne said. “And those scaffold pockets also tend

to collect water and hold it for a while until you get infections of trees from these swimming spores (of *Phytophthora*) that collect there. Once infected, almond itself is a really susceptible tissue.”

Researchers have found that inoculum of *Phytophthora* can reach tree trunks or scaffolds in at least three ways: by moving up from roots and crowns, by flood waters along riparian ecosystems (mainly in Northern California) and through infected dust and debris that are blown from the orchard floor into trees by equipment during harvest. Almond trees infected with PPC develop cankers that can grow several feet a year and that will eventually girdle a portion or all of a tree. Several thousand trees have been lost to the disease in the past two years, according to Adaskaveg. He added that he and Browne are working to develop new management strategies for this type of

*Phytophthora* infection.

In the meantime, phosphite fungicides can provide protection from aerial *Phytophthora*, according to Yaghmour.

“Phosphites will not kill the pathogen,” Yaghmour said, “but it will stop the progression of the disease.” He added that in cases where growers gain control of the disease and then stop using phosphites, there is a possibility the canker will reactivate.

Good scaffold selection also can be key to preventing problems with aerial *Phytophthora*, Yaghmour added. “If you have good scaffold selection, it will not only help with the prevention of *Phytophthora*, but it will help with the prevention of other canker diseases as well.”

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Interesting!

## Federal Marketing Order Works: Studies Show Results for the Industry

By AMERICAN PECAN COUNCIL | Contributing Writer

**I**N 2016, THE AMERICAN PECAN INDUSTRY APPROVED A Federal Marketing Order (FMO). The purpose of the marketing order was to implement five critical areas. These included: Marketing/Promotion; Research; Grades & Standards; Data & Statistics; and Compliance.

The American Pecan Council (APC) does not and cannot do the following: set prices; buy/sell product; or set tariffs.

Unfortunately, there are several in the industry that have a misperception that the APC sets prices or oversees adjusting the price. This is not true. The APC has the ability to increase awareness, assist in educating the consumers about pecans and their health benefits and drive consumption. In short, the APC focuses on “pull marketing” activities, which essentially means we drive consumers to “pull” pecans off the shelf.

### Early Data Supports the Need of an FMO

In a study conducted by the APC in its early months, data proved how vital it was to establish a marketing program for consumers due to the large volume of pecans that were going to hit the market within the next 10 years. Specifically, supply was growing 33% faster than demand under current projections. Additionally, 20% of global demand growth was driven by the Chinese market. In short, if the industry did absolutely nothing for marketing or consumption activities, product would exceed demand by 15% in ten years, and consumption was growing at a negative to stagnant level while other nut categories (almonds, walnut, cashew and pistachio) grew by double digits. The APC had to put pecans on the map and fast.

### Marketing and Data Collection

After approving a strategic plan for the industry, the APC went to work to increase “pull” marketing activities, consumer awareness and consumption as well as focus on fighting for its fair share in the marketplace. Partners helping the industry include Weber Shandwick, Digital Magnet/I-Heart Radio, Learfield, Eat Well Global, Health Researchers, social influencers and Chefs Summit to name a few. In fact, the APC utilizes over 70% of its budget for consumer activities. It needs to be emphasized that these activities are aimed at our target audience and seek to drive consumers to “pull” pecans off the shelf, not

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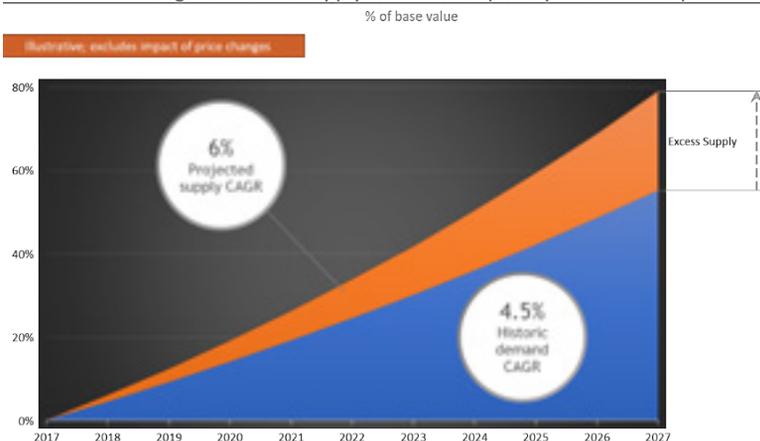
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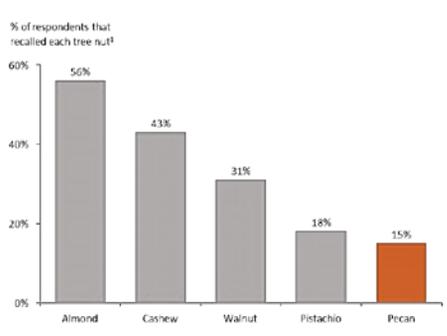
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Growth of global market supply and demand (steady-state forecast)



At current rates, global pecan supply will exceed demand in 15 years (all photos courtesy American Pecan Council.)

**'Top of mind' awareness<sup>1</sup> of pecans in US is low relative to other mainstream tree nuts**



U.S. pecan demand significantly lags other tree nuts today.

for growers and handlers—who are already avid pecan lovers—to pull product off the shelf. While we'd love industry members to be intercepted with our advertisements as they go about their lives, it's not a bad thing that that's not the case. The APC bears the responsibility of being a wise and informed steward of industry funds. We are fully committed to making the highest impact with limited resources, so we rely on data to inform who, when and how we target those who have a greater potential to move the needle. Consumers in top markets did not understand what a pecan was. APC activities have helped consumers understand more about the health benefits of the product and, through recipe development, have showed consumers how to use pecans in snacking, baking and everyday occasions. Until the APC, there were no widespread materials for consumers to understand the versatile pecan.

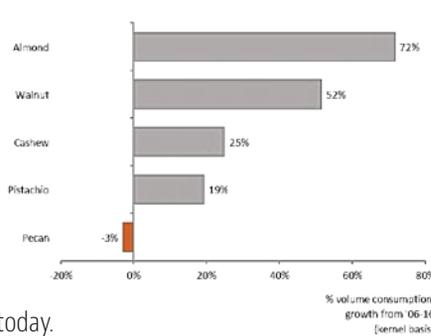
Thanks to advertising via radio, social media, TV and earned media (free advertising), awareness of pecans has shot through the roof. In 2016-2017 when the APC first began, only 12% of consumers knew what a pecan was or bought pecans. Today, that number is over 30% and growing. This is a big success for the industry in getting the word out about pecans.

**Shipments**

As Share of Voice grows, the next measurement to look at is shipments.

**Ten-year US pecan consumption stagnant while other tree nuts have experienced growth**

*International markets account for majority of pecan consumption growth (4-5% annually)*



Despite the China tariffs, hurricanes, floods, fires and a pandemic (all within 18 months), consumption and shipments grew. How? As consumers become more aware of pecans, the demand grows. The result—despite all the challenges the industry faced—was success. Consumers still want pecans! For example, Chinese tariffs had a dramatic impact on the market. Approximately 1/3 of the U.S. crop was exported to China prior to the tariff imposition. However, when the tariff hit, 80 million pounds of nuts had to find a home. Without marketing activities driving consumers to the store to purchase pecans, shipments would have halted, and consumers would have chosen other products that they already knew. The additional nuts not going to China would have placed more product on the market and conditions could have been worse. The APC continued to drive consumer awareness, making sure consumers knew about the availability and versatility of pecans. Additionally, the APC increased its international marketing efforts in Europe and China, driving consumer awareness. The increased shipments domestically and in exports in 2020 from 2019 show the success the industry is having in these challenging times thanks to the marketing activities of the APC.

**Consumption**

Another measurement used to

*Continued on Page 44*

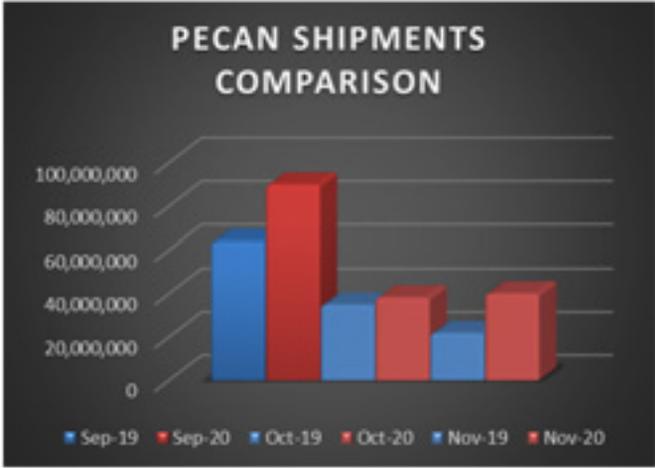
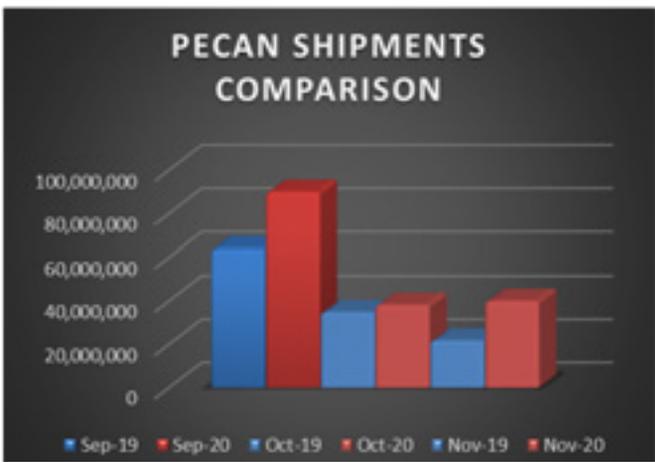
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Shipments and exports for pecans increased from 2019 to 2020 despite current hardships.

*Continued from Page 43*

measure success is consumption. If awareness and shipments are up, then consumption should also be up. The short answer is yes, it is. Thanks to APC efforts in increasing awareness and shipments, consumption grew, despite the tariffs and pandemic. In 2019, consumption was up 33.5%. In 2020, it was up an additional 14.5%, with a pandemic and loss of food service. In fact, with the heavy social media platform presence that APC was using, consumption went up due to mobile pickups and grocery deliveries.

### Rate of Return

The final measurement the industry measures is the Rate of Return on Investment. This is a mandate by USDA for all programs. The study must be conducted by a third party, and all activities and budgets are reviewed and studied to see what type of return, if any, there is for the industry and specifically the grower. In January, the University of Texas A&M completed a review of the FMO and concluded in their executive summary:

"The primary conclusion from the promotion analysis is that, despite its relatively recent launch, the American Pecan Council has effectively enhanced domestic and export

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# LESS DAMAGE MORE ROI

demand for U.S. pecans over 2016/17 through 2019/20 through its generic promotion activities and generated a relatively high rate of return to pecan producers who have paid for the promotion over that period. The principal accomplishment of the APC domestic and export promotion program has been to support the annual average producer price of pecans about 24¢/lb (11%) above the level to which it might have fallen over the period of 2016/17 through 2019/20 if the promotion had not been done. Given APC promotion expenditures (including MAP funds but excluding administrative costs), the benefit-cost ratio for the APC promotion program for 2016/17 through 2019/20 is calculated at 9.9, meaning that the promotion returned \$9.9 in profit to pecan producers for every dollar spent on promotion.

An important implication of the promotion analysis is that the pecan promotion program is vastly underfunded imposing a huge opportunity cost on pecan producers of potentially millions of dollars. For every dollar in additional assessment NOT paid by pecan producers and thus, not spent on pecan promotion, producers lose an average of \$9.9 in additional profit. Of course, increases in checkoff assessment rates and total spending on promotion are usually accompanied by a reduction in the corresponding BCR. But with such a high estimated BCR, producers could profitably afford to increase the assessment rate substantially beyond current levels and still expect to generate a quite reasonable rate of return comparable to the \$2 to \$6 per dollar of promotion earned by the beef, pork, cotton, soybeans, and other of the larger commodity promotion programs."

Once published, the full study can be viewed on the APC's website at [americanpecan.com](http://americanpecan.com).

### Other Activities

It should be noted that there are several other activities that the APC

*Continued on Page 46*



— **Kevin Davies,**  
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Continued from Page 45

continues to work on other than promotion. Specifically, this includes gathering data that is audited and disseminated amongst the industry. This data is audited if not submitted and provides industry with real, non-survey data.

Additionally, the APC has completed its satellite acreage survey. For the first time, the industry has the total acreage of each state and the age of the trees. This will assist the industry in forecasting and establish a database on crop production.

Furthermore, the APC continues to look at developing a Quality Assurance Program (QAP) that will assist the industry in getting sustainability credit and potential dollars for activities that they are already doing. By utilizing this program, the approved grower or handler may utilize a special seal on their packaging letting consumers know that the pecans meet or exceed the requirements of the QAP. This will assist in telling the story of how pecans get to

the market and what type of activities are utilized for growing quality pecans, all while building consumer confidence in the product.

Other activities include: Chef Summits; pecan health research; conversations with health professionals; employing lifestyle and nutrition influencers as pecan advocates; and coordinating the 20+ state, regional and national organizations to share and disseminate information amongst the industry so we save dollars and avoid duplicating efforts.

### The FMO Works

In 2016, the industry voted to establish a federal marketing order that would assist the industry in marketing, promoting, researching, compiling data and statistics, and establishing grades and standards for the betterment of pecans. It took 18 months to establish the FMO (hiring the staff, establishing the office and programs, collecting assessments and compliance with the USDA regula-

**'DESPITE THE CHINA TARIFFS, HURRICANES, FLOODS, FIRES AND A PANDEMIC (ALL WITHIN 18 MONTHS), CONSUMPTION AND SHIPMENTS [FOR PECANS] GREW.'**

tions), but once it was in place and operational, activities progressed. The results have been fantastic. In the past three and a half years:

- Awareness is up
- Shipments are up
- Consumption is up
- Website traffic is up
- Social media engagements are up
- For every \$1 invested into the APC by industry, the returned value equates to \$9.9

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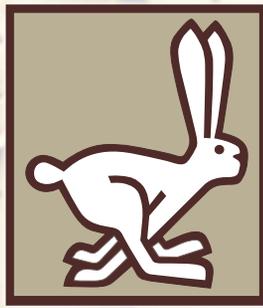
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# ROOT LESION NEMATODE IN WALNUTS: PLANTING THE SEEDS FOR ORCHARD LONGEVITY

By KRISTI SANCHEZ | Ph.D., Nematologist,  
TriCal Diagnostics and TriCal

**W**HEN IT COMES TO MAKING MANAGEMENT DECISIONS FOR any crop field, such as walnut and almond orchards, it should be a standard practice for growers to collect soil samples to determine whether they have the presence of plant pathogens or key plant parasitic nematodes. In California, plant parasitic nematodes can significantly impact crop production. They are destructive pests that cause considerable damage to plant roots, thus disrupting the uptake of water and nutrients which results in reduced crop vigor and yield.

Plant parasitic nematodes are microscopic roundworms that feed on plant tissues. In walnut orchards, root lesion nematode is a key pest that causes substantial damage and is estimated to



Root lesion nematode juvenile, target pest of walnut and almond (all photos by K. Sanchez.)

Walnut field trial showing fumigated trees (left) compared to non-fumigated (right). Importance of fumigation includes larger tree canopy, uniform growth compared to untreated smaller trees with slow growth.

be present in roughly 85% of walnut fields. This nematode can negatively impact growth in young trees by invading and destroying smaller root mass. In mature, older trees with more established root systems, the impact is less significant. Nematodes are defined by their feeding lifestyle; root lesion is classified as a migratory endoparasite.

All stages, both juvenile and adult, enter the roots and feed internally, causing damage to plant cells and leaving behind dark necrotic root lesions. Ring nematode, another key pest of walnut, is classified as migratory ectoparasitic. Juveniles and adults feed on the outside of the roots, causing damage and stunting. The spectrum of damage includes lack of vigor, stunting, general decline in growth and lower yield. Wounds inflicted on roots by plant parasitic nematodes can indirectly lead to additional damage by providing an entry point for secondary plant pathogens, such as bacteria/fungi, to invade and promote root rot.

The nematode density and the damage they cause will continue to increase if sufficient susceptible plants are available and favorable environmental conditions persist. There are other nematodes present in walnut that are known to cause damage, but the most significant destruction is done by root lesion.

## Diagnosing Nematode Symptoms

Diagnosing crop decline due to nematodes can be quite difficult because very few plant parasitic nematodes cause distinctive diagnostic symptoms. Symptoms can differ greatly and often appear nonspecific. A thorough field diagnosis to determine the presence of plant parasitic nematodes should consider these key factors: foliar and root symptoms, field history and laboratory analysis. Above ground symptoms are generally nondescript and often misdiagnosed as nutrient deficiency or drought stress.

As a grower, when examining your orchard, visually observe differences in growth, including stunting, chlorosis, premature



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*Continued from Page 48*

wilting and non-uniform distribution within a field. This will indicate a potential issue, warranting further investigation. You will then want to examine tree roots for symptoms, which is imperative when identifying a nematode problem. Nematode damage on roots is often associated with specific plant parasitic nematode feeding lifestyle. For example, root knot nematode causes galling/swelling knots on roots, whereas root lesion nematode causes lesions/necrosis. The feeding by these nematodes and others causes stunting of the root system and excessive lateral growth.

Another key component in determining nematode diagnosis is examining the field history. This can aid in identifying the presence of plant parasitic nematodes and other pathogen pests. Nematodes present in the field in recent years would have resulted in prior crop decline and are more than likely to be present or will resurface in future seasons.

### Sample Soils

Once all of these key factors are evaluated, the most vital component that growers should implement in their program is collecting soil and root samples for laboratory diagnostic analysis. Sending composite soil samples to a lab will confirm the presence of key plant parasitic nematodes and their relative pressure within the field. Knowing the identity of the plant parasitic nematodes and the relative density estimates is critical in determining the right management decisions and pre-treatment measures, such as crop rotation, fumigation and rootstock.

Nematode soil sampling is vital when preparing to plant or replant an orchard. For predictive sampling, soil should be taken prior to planting or preferably at the end of the previous crop/orchard. It is best to collect both roots and soil as nematodes are soilborne pathogens that feed directly and within the roots. The number of plant parasitic nematodes of specific genera can give some indication about the damage potential. When laboratory analysis indicates presence of nematode pressure of key plant parasitic nematodes such as root lesion, ring, or root knot, specific treatment plans can be



Root lesion nematode diagnostic root symptom: dark lesions on walnut root tissue.

formulated to target these specific genera.

### Treatment and Control

For pre-treatment control, especially with regards to walnut and almond replants, soil fumigation is the standard management tool for growers. The objective is to reduce nematode populations below a threshold to avoid serious crop damage. Even when laboratory tests detect low nematode pressure, the pests are likely to increase in density in the first few years of a new planting. Soil fumigation helps to suppress a broad spectrum of soilborne pests including root rot, prunus replant disorder and plant parasitic nematodes. Mitigating the damage caused by these pests ensures a strong start to the seedlings or dormant propagative material. Fumigation promotes healthy soil for the grower's long-term investment. This pre-plant measure helps flourishing root systems, which enhances trunk, shoot and canopy growth. There are two fumigants that are commonly applied: Telone II (1,3-dichloropropene), the industry standard pre-plant nematicide, and Chloropicrin, the industry standard pre-plant fungicide. These products can be co-applied or stand alone.

TriCal has been providing pre-plant soil fumigation support to growers over 50 years. Field trial research has demonstrated that orchards starting out in fumigated soil experience rapid seedling establishment, increased initial growth, earlier and larger harvest yields and increased orchard longevity. To determine the right fumigation prescription for an orchard, the rate and method are based on the potential crop and pathogen pressure.

Proper soil preparation and applica-



Walnut replant trial in Yolo County examining the performance of fumigant treatments, grower standard Telone II and Telone in combination with Chloropicrin.

tion are necessary for optimal fumigation efficacy. Field preparation should include a deep rip of the field soil and removal of as much old root mass from the prior crop/orchard as possible. This is important because old roots can harbor nematodes such as root lesion and root knot, which can remain dormant for several years after a mature tree has been removed. Heavier textured soils such as clay loam also can produce large clods after tilling, where clods can hold moisture as well as viable nematodes. Clod reduction is important.

At TriCal Diagnostics and TriCal, we help growers with their management decisions by following integrated pest man-

agement practices that include pre-plant measures, fumigation and post-plant treatments. TriCal Diagnostics offers disease and plant problem identification services for growers, field personnel and PCAs while conducting problem-solving in the field as well as specialized lab-based research projects. Our primary goal is providing growers guidance and support for their management decisions and help diagnosing plant/nematode issues.

One of our main foci in TriCal R&D is conducting field trial research. We have initiated field trials throughout the Valley and Northern California, on various key crops to examine the

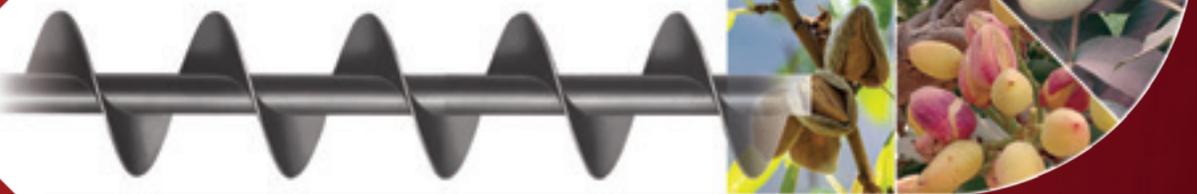
performance of fumigant treatments using Telone II and Chloropicrin. We are actively investigating different application depths, rates of both fumigants in combination or stand alone and IPM nematode management programs (e.g. pre-plant fumigation followed by post-plant contact nematicide). Nematode control within a field requires integration of multiple strategies to provide effective, long-term crop protection.

### Fumigant Research

A multi-year walnut replant demo trial was established in Fall 2018 in Yolo County to evaluate six different one-acre fumigant treatments versus an untreated area within an 84-acre field. The primary objective of the trial was to examine performance of the grower standard (Telone II at max rate of 33.5 GPA with an 18-inch injection depth) compared to other fumigant treatments, which included variations of TriCal's go-to treatment for replant disorder (Telone II with strip

*Continued on Page 52*

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<b>FUMIGANT TREATMENT</b>	<b>SPRING 2019</b>	<b>FALL 2019</b>	<b>SPRING 2020</b>
Untreated	6.77 ±1.55 ab	7.19 ±2.19 b	7.35 ±1.65 c
Grower Std: Broadcast Telone II 33.7 GPA, Non-Tarped	6.40 ±1.71 b	8.83 ±1.95 a	9.26 ±1.52 a
Telone II 33.7 GPA + strip PIC 200lbs/ac, Non-Tarped	6.12 ±1.80 b	7.86 ±1.57 ab	8.79 ±1.50 a
Telone II 33.7 GPA + TIF strip PIC 200lbs/ac, Tarped	5.99 ±0.91 b	7.43 ±1.23 ab	8.34 ±1.12 ab
Telone II 33.7 GPA + strip PIC 200lbs/ac, Broadcast TIF	5.92 ±0.93 b	8.24 ±1.88 ab	9.28 ±1.76 a
Telone II 33.7 GPA + PIC 200lbs @ 18" depth and 150lbs @ 12" depth, Broadcast Tarped with TIF	5.51 ±0.92 b	7.71 ±1.21 ab	8.39 ±1.39 ab
McKenry Recommendation: Telone II 33.7GPA, Buessing shank split depth: 18" and 36", Non-Tarped	8.05 ±1.99 a	8.86 ±1.64 a	9.08 ±1.49 a
<b>P-value</b>	<b>0.000</b>	<b>0.010</b>	<b>0.001</b>

**Table 1.** Walnut Replant Trial: Effect of fumigant treatment on tree growth (measuring circumferences) through 3 seasons Spring 2019-2020. Values are means ±SE (each treatment N=20 trees). Means with the same letter(s) in the same column are not significantly different from each other by HSD Tukey Test (P<0.05), One Way ANOVA. For each season, the P-value was calculated.

*Continued from Page 51*

or broadcast Chloropicrin, tarped and non-tarped treatment variations) and the recommendation from Dr. McKenry (UC emeritus), which relies on Telone II applied by the Buessing shank (split fumigant injection depth at 18 and 36 inches) in suppressing root lesion nematode populations. We conducted thorough evaluations each season by identifying key plant parasitic nematodes and determining relative pressure post-fumigation every fall and spring as well as collecting tree growth metrics. Pre-treatment nematode assays revealed significant pressure from lesion nematode (average populations of 200 to 350 nematodes/250 g soil), where the economic threshold for lesion nematode is often cited as being 1 nematode/250 g soil. Soil fumigation occurred in Fall 2018. Initial post-fumigation nematode evaluation was done in Spring 2019. No plant parasitic nematodes were detected within the fumigant treatments, while significant root lesion nematode density was evident within the untreated area of the field. Through monitoring

and sampling, we documented sustained nematode suppression through 2020. Treatment areas continue to demonstrate a significant reduction in root lesion pressure compared to the untreated control.

Tree circumference over time is a measurable indicator of the benefits of fumigation. In Spring 2020, all fumigant treatments demonstrated significantly greater tree growth compared to the untreated control (One-Way ANOVA, P-value 0.001, **Table 1**). Trees on untreated ground were smaller in size and had less canopy growth than did the trees within the fumigant treatment. On average and over the 2020 year, the fumigant treatments resulted in a 45% to 55% increase in tree growth from initial Spring 2019 measurements compared to untreated control, which only exhibited an 8% increase over the same period. Monitoring the fumigant treatment blocks and commercial field through the seasons has shown the benefits fumigated soil can provide when establishing a young orchard. This is critical to formulate management decisions for orchard longevity. A key takeaway is to highlight the importance of pre-fumigation soil sampling to determine the appropriate pre-treatment pest control prescription for when starting a new orchard. Additionally, soil sampling for nematode post-fumigation and post-planting should be done to monitor the duration of nematode suppression offered by Telone II (with or without Chloropicrin) and to assess the possible future need for integrating post-plant contact nematicides into your agronomic program once the initial (multi-year) benefits of fumigation taper off.

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# California Almond Bloom From the Beekeeper's Perspective

A Bees-Eye View of the Life and Travels of Almond Pollinators

By **DANITA CAHILL** | *Contributing Writer*



**Aaron and Felix Lafond get hives ready to take to California for almond pollination (all photos by D. Cahill.)**

**A**ROUND CHRISTMASTIME, **AARON LAFOND AND HIS SON FELIX** of Southpaw Bees and Manufacturing LLC in Lebanon, Ore. start splitting their honeybee hives. Once split—the top 10 frames removed from the bottom 10 frames—they check the health of the hives and feed the bees.

The long, flat pollen patties that they place on top of the bee frames is a nutritious food source that not only feeds the bees but stimulates them and convinces the queens it's time to start laying vast quantities of eggs. Without the additional food, the

queen wouldn't start laying eggs in earnest for another several weeks. The bees may not have realized it yet, but Lafond's queens and their worker bees are gearing up for the biggest pollination event in the world—the California almond bloom. Honeybees, of course, play a critical role in almond pollination.

## Sending the Hives

Only around 500,000 honeybee hives reside fulltime in California. Since it takes approximately 2 million hives to pollinate

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Aaron Lafond holds a frame of honeybees.



Honeybees feed on a pollen patty.



This hive has been inspected and marked. It has nine vigorous frames of bees.

the 1.2-million acres of almonds in the state, beekeepers and their hives travel far and wide to assist – some from as far away as the east coast.

Before shipping 1,800 of his hives to California, Lafond does a preliminary grading of hive size in his bee yards. The yards are scattered around Oregon’s Mid-Willamette Valley. A vigorous colony contains around 20,000 to 80,000 honeybees. The Lafonds take frames of healthy, active bees out of half-sized nucleus hives and add them to the full-sized hives as needed. Lafond’s contracts with almond growers call for an eight-frame average with a five-frame minimum.

“That’s standard in the industry,” Lafond said.

Lafond splits his hives among five California almond growers outside of the Chico area. The size of those growers’ orchards range in size from 20 acres to nearly 700 acres. The largest grower alone leases 1,000 hives from Lafond. Since Lafond has held the same contracts for years, he doesn’t need to use a broker.

The bees are shipped the 425 miles on an open semi-trailer with netting covering the hives.

“We could probably ship them without netting, but Shasta County requires it,” Lafond said.

Like the bees, once the hives arrive in Butte County, Lafond’s work is just beginning. Lafond, his wife Beth and their three teenage children follow the bees. They haul their travel trailer to stay in, along with the bee equipment needed to unload and care for the bees. Equipment includes a Hummerbee articulated

forklift, which is specially manufactured for beekeepers.

The Lafonds spend two weeks in California getting the bees settled into the various orchards. They’ll return home to Oregon for a couple of weeks, only to turn around and head back to the Sacramento Valley again at the end of February for peak almond bloom.

During the last two days in February, Lafond starts raising his own queens. He genetically chooses larvae from hives with good health and honey-making prowess. Lafond carefully removes a grub-like white larva one at a time with a metal tool that resembles a long, thin crochet hook. He grafts the larva into

*Continued on Page 56*

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small, plastic cell cups and hangs several cups from a frame inside a queen-less hive. Because there is no queen, and because the queen cells are hanging from the frames in a similar way that bees hang their own queen cells, the worker bees feed the larvae royal jelly, which turns them into queens.

Lafond pulls the queen cells out before they hatch. Honeybees only allow one queen to live in each colony and will kill the others. He uses the new queens to start his new nucleus hives, known as nucs. Unlike the standard 20-frame full-size hive (18 frames of bees with two feeder trays), a nuc is half the size – double story with five frames in each story. When there is die-out in hives, Lafond pulls frames of bees – each has around 1,700 adult bees caring for the larvae inside – from the nucs to add strength and numbers to weakened full-size hives.

### Honeybee Health

As far as weakened hives, or hive die-out, Varroa mites, *V. destructor*, are the

biggest issue for beekeepers and are usually to blame. Like honeybees, which are of European descent, the Varroa mites aren't native to the United States. Varroa mites likely came from Australia. The mites are a vector for at least five different incapacitating bee viruses, including varroosis, otherwise known as deformed wing virus.

"They are born without wings or with wings that are messed up," Lafond said.

Varroosis and acute bee paralysis virus (ABPV) are the two biggest issues Lafond has with his bees. ABPV causes the bees to tremble with sprawling legs and wings. Infected bees show symptoms within two to four days and die within a day after that.

Varroa mites can only reproduce in a honeybee colony. They live in the hives and on the bees. The male mites are white. The females, which are the real problem, are reddish-brown and can be easily spotted on honeybees.

"It's like if a human had a volleyball stuck to their head," Lafond said about the size of mites in comparison to the size of bees.

The mites attach themselves between the platelets of bees and feed on their fat, weakening the bees or even killing them. Open wounds caused by the parasitic mites become sites for disease to enter.

It takes 21 days from egg-laying to emergence of an adult worker bee. Once a brood cell is capped, it will hatch in ten days. In the first 11 days, the larvae emit pheromones that signal the worker bees to feed them. When they've had enough to eat, the larvae release different pheromones that tell the workers it's time to cap the brood cells. Mites also understand the pheromone change and react by entering the cells before they are capped. Inside the cells, the mites lay eggs and feed on the bee larvae.

"Mites chew on them and shorten the bee's lives. Then, the mites live in the hive and on the bees," Lafond said. "There's always losses that you have to deal with. 20% to 30% is standard loss. This year, we had 22% loss in the winter and 8% in the fall. Mites are here to stay."

Other issues that have affected Lafond's bees includes theft, vandalism and

Continued on Page 58



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Aaron Lafond holds an old queen cell.

*Continued from Page 56*

wildfires, although on a much smaller scale than mites.

“I believe that the smoke from the fires did suppress brood some,” Lafond’s wife Beth said about the 2020 western wildfires.

As for theft and vandalism, Beth said, “We have had a few hives stolen in California over the years, but not very many. We have had feed jugs stolen in Albany (Oregon) but no hives stolen. We’ve had hives shot up and ran over a few times in the

(Willamette) valley.”

### Spray Carefully

Lafond said the almond growers he works with are careful with sprays around the bees. If they have to spray, they do it at night when the bees are in their hives. He did have die-out once from fungicide sprayed during the day.

“The growers we work with try extremely hard not to spray fungicides near the bees,” Lafond said.

He noted that helicopter spraying could be an issue since it is only done during the day. But the growers he works with don’t utilize aerial spraying.

“It’s one of those give and takes. It’s farming,” said Lafond, adding, “It shouldn’t necessarily be at the expense of bees.”

### Honey Season

Almond blossoms don’t make a whole lot of honey, Lafond said. What almond honey the bees do make tastes slightly bitter to humans. During the first week in April after the almond petals drop, Lafond will ship his bees back to Oregon. He’ll lease out his hives to pollinate Willamette Valley crops such as blueberries, radish, clovers, Chinese cabbage, sun flowers, spinach, coriander, meadowfoam, blackberries and turnips. Turnip honey crystalizes in the hives. Meadowfoam makes sweet honey. But wild blackberries are the main honey crop in Oregon.

“We set the bees in areas with a lot of wild blackberries. They produce two times more honey than any other crop,” Lafond said.

It takes the Lafond family three weeks from mid-July to August to pull all of the special honey boxes, called supers. They get around 85 barrels of honey a year. Beth sells honey and bees wax wholesale. She also bottles wildflower, blackberry and meadowfoam honey and sells it retail at their farm.

After pollination and honey season, Lafond, who has a background in cabinetry, catches up on orders for bee boxes, pallets, tops and bottoms in his wood shop. His family helps him build 500 to 1,000 bee boxes a year for himself and 4,000 to 5,000 for other beekeepers.

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# IMPLEMENTING YOUR NEW SEASON SAFETY RESOLUTIONS

By THERESA KIEHN | President and CEO, AgSafe

**T**HE START OF A NEW SEASON IS ALWAYS full of possibilities and presents an excellent opportunity to reflect on successes as well as areas of improvement. This year, as you begin to develop operational goals, ensure reviewing and updating workplace safety practices and

providing timely employee training is at the top of your list. This practice will help to ensure regulatory requirements are being met, reduce the risk of injuries and illnesses, and ultimately save time and resources. In this article, we will review three trainings you need to provide

employees before the season kicks into full gear.

## COVID-19 Prevention Training

If COVID-19 Prevention Training was not on the top of your list last year, ensure it is your first training topic this season. The COVID-19 Prevention Emergency Temporary Standard went into effect December 1, 2020 and requires employers to establish, implement and maintain an effective COVID-19 Prevention Program. If you currently do not have a COVID-19 Prevention Plan, it is essential you

get one established immediately (Cal/OSHA created plan templates which can be found on the AgSafe website at [agsafe.org](http://agsafe.org).) The Emergency Temporary Standard outlines very specific training topic requirements:

- The employer's COVID-19 policies and procedures to protect employees from COVID-19 hazards.
- Information regarding COVID-19 related benefits to which the employee may be entitled under applicable federal, state or local laws.
- The ways in which COVID-19 is spread.
- Methods of physical distancing and face covering requirements.
- Proper handwashing hygiene.
- The company's indoor practices to reduce the spread of the virus, including engineering controls, use of face masks and proper hand washing.
- Recognizing COVID-19 symptoms and the importance of not coming to work if symptomatic.
- How to obtain a test if an employee is experiencing symptoms.

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- For a detailed list, please visit the Cal/OSHA COVID Resource Website at [dir.ca.gov/dosh/coronavirus/](http://dir.ca.gov/dosh/coronavirus/).

### Fieldworker Pesticide Safety Training

The California Department of Pesticide Regulations (DPR) worker safety regulations specify safe work practices for employees who work in treated fields. As an employer, it is your responsibility to provide required pesticide safety training prior to employees working in a treated field. This training must be performed annually and by a qualified trainer. In order to train fieldworkers, you must meet one of the following qualifications as outlined by DPR:

- A California certified commercial applicator.
- A California certified private applicator.
- A person holding a valid County Biologist License in Pesticide Regulation or Investigation and Environmental Monitoring Issued by the Department of Food and Agriculture.
- A person who has completed a DPR-approved “instructor training” program.
- A California licensed Agricultural Pest Control Adviser.
- A California Registered Professional Forester.
- Other trainer qualifications approved by the DPR Director.

The training must cover the subject areas in a manner that employees can understand orally, from written materials or audio-visually, using non-technical terms. There are 23 different topics required by DPR, ranging from routes of entry to first aid and emergency decontamination procedures. For a complete list of topics and resources, please visit [cdpr.ca.gov](http://cdpr.ca.gov).

### Heat Illness Prevention Training

When reviewing Cal/OSHA’s most frequently cited standards in the agricultural industry, heat illness continues to be one of the most cited regulations. In order to be in compliance with this regulation, it is imperative to establish, implement and maintain a Heat Illness Prevention Plan. Your plan should cover the following elements:

- Access to water and shade.
- Weather monitoring and acclimatization.
- High heat procedures.
- Employee and supervisory training.
- Written procedures including emergency response.

*Continued on Page 62*

“HEAT ILLNESS PREVENTION TRAINING SHOULD BE PERFORMED AT THE BEGINNING OF YOUR SEASON AND MULTIPLE TIMES THROUGHOUT THE YEAR, ESPECIALLY AS TEMPERATURES BEGIN TO RISE IN THE SPRING AND SUMMER MONTHS.”



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The advertisement features a large blue and white Satake Evolution optical sorter machine. Below the machine, there are two rows of images showing sorted almonds: the top row shows uniform, light-colored almonds, and the bottom row shows a mix of almonds with various colors and shapes, including some green and purple ones, representing foreign material detection.

As with the COVID-19 Prevention Plan, if you do not have a written plan developed, it is essential to get one established. Additionally, it is important to note that supervisor and employee training have different topic requirements. The supervisor training should include the following:

- The heat standard requirements.
- The procedures they must follow to implement the requirements.
- Procedures to follow when a worker exhibits or reports symptoms consistent with possible heat illness, including emergency response procedures and first aid.
- How to monitor weather reports and how to respond to hot weather advisories.
- The employee trainings should include the following topics:
- The environmental and personal risk factors for heat illness as well as the added burden of heat load on the body.
- Your company's heat illness prevention procedures.
- Importance of frequent consumption of small quantities of water.
- Different types of heat illness,

common signs and symptoms and appropriate first aid or emergency response.

- Knowledge that heat illness may progress rapidly.
- The concept, importance and methods of acclimatization.
- Importance of immediately reporting signs or symptoms of heat illness to a supervisor.
- Procedures for responding to possible heat illness.
- Procedures to follow when contacting emergency medical service, providing first aid and, if necessary, transporting employees.
- Procedures that ensure clear and precise directions are communicated to emergency services to locate the worksite.

Heat illness prevention training should be performed at the beginning of your season and multiple times throughout the year, especially as temperatures begin to rise in the spring and summer months. Additionally, consider how your Heat Illness Prevention Program aligns with your company's COVID-19 Prevention Program and make adjustments accordingly.

If you should need assistance with providing this training to your workforce, AgSafe will be hosting a series of annual training virtual workshops designed specifically for your workforce this spring. Topics will include general agricultural safety, pesticide safety training for fieldworkers, heat illness prevention, sexual harassment prevention and COVID-19 protection in the workplace.

Please keep in mind that this is



The California Department of Pesticide Regulation created a series of booklets to assist the agricultural industry with compliance assistance. *Fieldworker-Employees Working in Treated Field* provides an overview of training requirements. This resource can be downloaded at [cdpr.ca.gov](http://cdpr.ca.gov).

not a comprehensive list of required trainings, and as an employer you have a responsibility to provide training on topics such as equipment and tools utilized within your operation (i.e. ladders, forklifts, tractors, pruning shears, etc.). If you have questions regarding your safety training program or would like to learn about our upcoming workshops, please feel free to contact AgSafe at 209-526-4400, send an email to [safeinfo@agsafe.org](mailto:safeinfo@agsafe.org) or visit our website at [agsafe.org](http://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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# OPTIMIZING ORCHARD PROFITABILITY IN ALMONDS

By CECILIA PARSONS | Associate Editor



Cutting corners on irrigation and nutrition in young orchards in particular could have long term effects (photo by Marni Katz.)

**C**ALCULATING THE RIGHT MIX AND level of inputs to ensure high almond yields while still maintaining profitability is no easy task. A panel of experts pointed out some pitfalls and potential opportunities for improving orchard profitability while maintaining long term orchard health at the 2020 Almond Industry Conference in December.

Panelists emphasized good irrigation, nutrient and pest management programs as key to long-term orchard health and yield. Moderated by ABC Director of Sustainability and Environmental Affairs Gabriele Ludwig, the panel included CCA and almond grower Bill Brush; Blue Diamond Growers regional manager Mike Griffin; UCCE farm advisor Franz Neiderholzer; and

Scott Severson, a grower and PCA with Mid Valley Ag Services.

## A Long-Term Investment

“This is not a one-year crop or even a five-year crop,” Brush said. “Don’t short your young trees.

Pulling back on older orchards

*Continued on Page 66*

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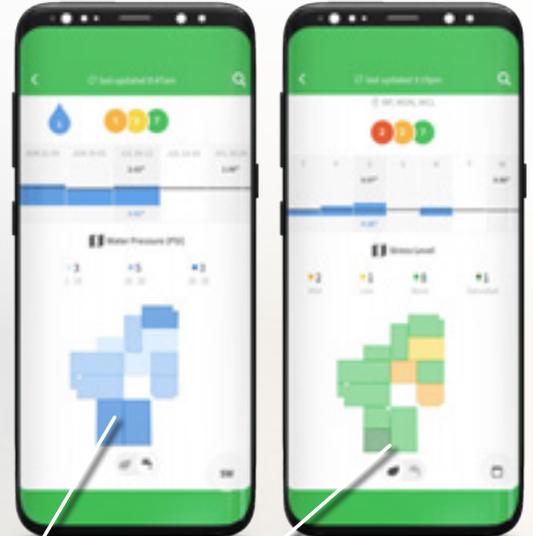
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might be a consideration when returns are low, but growers need to ensure the long-term health of a young orchard to preserve yields and provide a return on investment.

Brush, who advises growers from Red Bluff to southern Kern County, said growers do need to take a close look at their spreadsheets to see production and harvest costs. Water, nutri-

tion, pollination and pest control costs will have to be weighed against pounds produced and the price received.

“You have to look at the benefits of an input; you don’t put them on for the cost, but for their effect,” Brush said.

With a perennial crop such as almonds, Neiderholzer said long-term vision and consistent high net returns are necessary to remain in business.

“You are farming two crops at

once by August, this year’s and next year’s. Stress at harvest will impact flower numbers the following year.”

Speaking from a pest management perspective, Severson said that when choosing chemistries, consider the cost per day of control. There may be a temptation to use a lower priced material, he said, but the more expensive chemistries will have a longer residual effect, lowering the control cost per day.

“It is easy to be attracted to the low cost, but that may not be the most economical,” he said.

Severson said timing of the pesticide application is also critical to achieve the best results on the investment. A pesticide application will be more effective if done at the most vulnerable stage of a pest’s life cycle or when the crop is more vulnerable. With herbicides, applications before weeds mature will be more effective and less weed seed will be produced.

Annual inputs are vital to orchard health and maintaining high yields, but Griffin said growers need to determine if their inputs are effective and efficient.

Water sensor monitors in the soil and tissue analysis are examples of how input effectiveness can be calculated. Griffin also recommended using spreadsheets to show where money is being spent and the return on investment.

### Water is Number One Input

Brush said water is the number one input in growing almonds and the biggest expense for many growers. Getting the water right for each soil type and growing region is important. Cutting water back may seem like a cost savings, but research has shown that yield losses will occur if the trees do not receive the 55 to 60 inches of water they need, whether it be rainfall or applied water. Soils and region are major considerations in water use. There is no buffer capacity with sandy soils, and lesser amounts of water and nutrients can still leach below the root zone. Kern growers know they won’t receive the winter rainfall needed to keep their

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soil profile filled, Brush said, so they plan on irrigation to meet tree needs in dry winters. Growers in the north can usually count on rainfall to supply part of their water needs, but that may not be the case every year.

You may not see the benefits until August, Griffin said, but getting the soil profile filled will help the crop continue to grow through hot summer months. Trees that are well irrigated going into harvest will have fewer mite issues.

In a dry winter, a decision to irrigate needs to be made before roots become active, Severson said.

### Nutrients are Important

A decision to forego an expensive nutrient application, such as potassium, may not affect the current year's crop, Neiderholzer, but growers should think about the potential effect on next year's crop. Proper nutrition at the right time and the right amount will ensure a marketable crop for the next year. Cutting back on nutrition may be an option if soil and tissue analysis indicate levels are adequate. If soil analysis says potassium levels are sufficient, you may be able to get by with half the amount applied and maintain potential for next year.

Brush said there are times when a grower needs to get away from costs and focus on the benefits of a crop input. Squeezing a mature orchard a little can be okay, but you have to invest in the health of young orchards to ensure their long term viability. With a fertility program, if you don't put in the basic requirements, you will pay for years. You can control timing of applications to make the most of the money spent on this input, Brush said.

An important part of a fertility program is to adjust for what was taken out of the orchard at harvest, Griffin said.

*Comments about this article? We want to hear from you. Feel free to email us at [article@jcsmarketinginc.com](mailto:article@jcsmarketinginc.com)*

### Final Thoughts on Orchard Profitability

**Bill Brush:** Soil building is one example. It may be easy to skip on this when prices are low, but when times are good, the investment will pay off over time.

**Mike Griffin:** Make sure what you apply in the orchard gets used by the trees, not lost below the root zone. "Feed the trees, grow wood and spurs to get yield."

**Scott Severson:** Early harvest to protect crop quality is not a cost, but can lower nut reject levels, making a difference in the return per acre. When almond prices are low, that will make a difference.

**Franz Neiderholzer:** Look at inputs as profit maximizers, not cost minimizers. You can't skip and have a marketable crop.



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# BEING A VOICE AND EARS FOR THE WALNUT INDUSTRY

By **MARNI KATZ** | Editor



Joshua Rahm joined the Walnut Board as the Director of Technical and Regulatory Affairs in Fall 2020.

**A**S THE NEW DIRECTOR OF TECHNICAL and regulatory affairs for the California Walnut Board and Commission, Joshua Rahm has a very large, and very full, plate. He works on behalf of California walnut growers and handlers to be sure they are represented when new rules and regulations are being crafted monitors within key markets to provide guidance and adherence to the technical trade barriers ensuring global growth and demand for California Walnuts.

Rahm joined the Walnut Board in Fall 2020, bringing a farming background along with a lifetime of professional agribusiness experiences to his new role.

"I've been part of agriculture my whole life throughout the entire process from crop research and development, to production and supply chain to what it takes to get that product into consumers' hands," Rahm said.

Rahm grew up on a family corn/soybean and hog farm in Iowa and has worked professionally with growers, manufacturers and throughout the global supply chain on technical and regulatory issues of importance to the agricultural community. His national and international experiences in multiple commodities, crop protection and sourcing and procurement, combined with a farming background well suit him for the issues ahead, he said.

"It's an honor to be a new friend and defender of the walnut industry. With the domestic and international landscape continuing to evolve, it's a critical time in the industry," Rahm

said. "Keeping the grower and handler community and other stakeholders well-informed with what is involved to protect, develop and sustainably grow the industry is a key driver to keep me staying ahead of the curve."

## Technical Trade Barriers

Key among those issues, Rahm works on technical trade barriers, grades and standards, pesticide regulation and review issues, food safety and regulatory compliance.

On the crop protection front, he serves as a liaison between walnut growers and handlers, registrants and state and federal agencies on pesticide use and registration issues to ensure key products are available to growers. Through task forces, working groups and other stakeholder groups, Rahm helps monitor compliance with established domestic and export Maximum Residue Limits (MRLs) and also facilitates the reporting for the California Walnut Board Annual Statewide Pesticide survey.

Glyphosate is one recent example in which the California Walnut Board has provided vital input on behalf of walnut growers for the US EPA's evaluation, opinion and consultation for reregistration of this critical weed management tool. As a result of input from several interested stakeholders, glyphosate usage appears to have been secured for the near future while additional weed management tools and mitigation measures are developed. He is also currently working with a group of commodities to

secure a Section 24C special local needs registration for fungicide treatment options in orchards this spring.

Technical trade barriers are another critical part of Rahm's portfolio. Rahm works to provide practical and science-based input on MRLs, fumigation and other potential technical trade barriers and is involved in providing the value-add input for walnut grades and standards, food safety and other post-harvest issues that can impede the flow of California walnuts in key export markets.

In cooperation with national and international groups Rahm responds to international trade issues as they arise. Recently, he led the California Walnut Commission's effort to coordinate a

**"It's an honor to be a new friend and defender of the walnut industry."**

-Joshua Rahm

USDA response to India's proposed draft standards for several commodities, with a focus on shelled walnuts.

"We have USDA standards that are proven and confirmed and provide alignment for inspection. So we continue to encourage science based standards that are practical and achievable," Rahm said.

Rahm also interfaces with the California Walnut Board's production research director, and leads the grade and standards committees to anticipate and address food safety issues, enhance shelf life and improve post-harvest crop health and quality, among other value-added benefits to the industry.

"It's my job to provide strategic direction and work closely with industry collaborators and researchers in a collective team effort to implement best practices," he said. This team works together to get relevant information on stewardship and compliance back to the grower and handler community.

In addition to targeting shelf life and food safety, another research priority Rahm is involved with as part of the Board's Grades & Standards Committee is looking at opportunities for further developing byproduct alternative uses for hulls and shells.

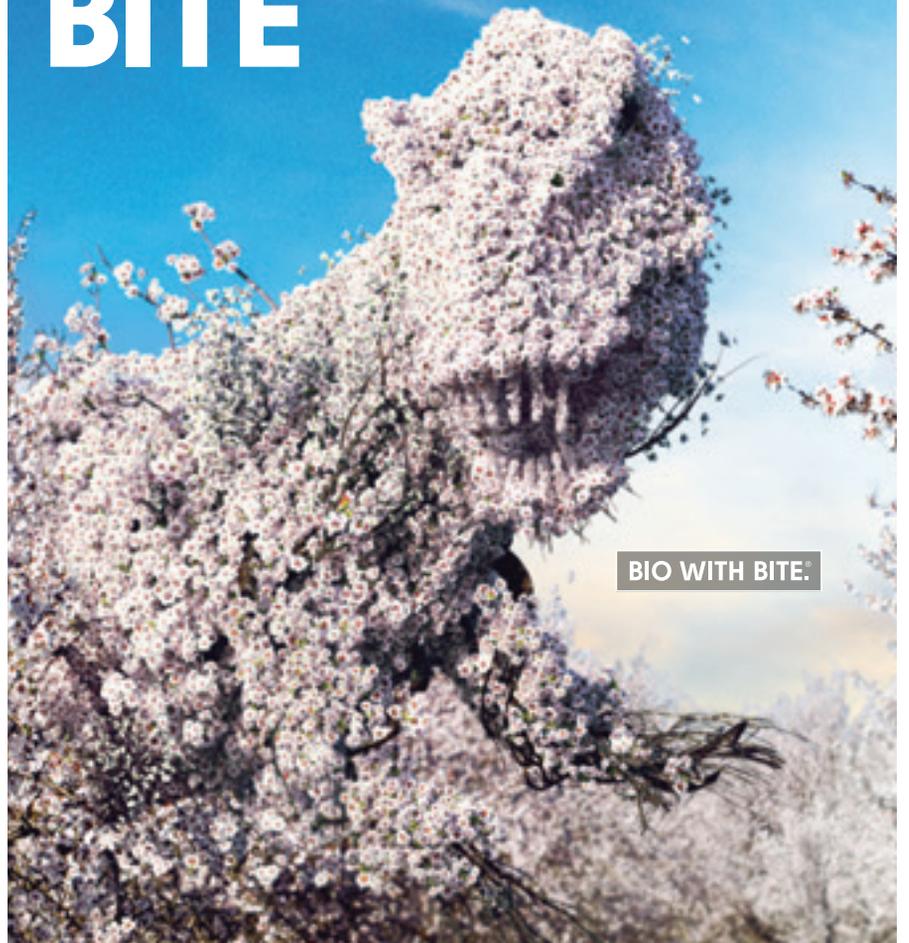
"We're in the process of looking at ways to reduce or minimize waste while being good stewards of the environment," he said. "With record crop volume comes record hulls and shells, we want to help our growers and handlers get added value out of their byproducts and also promote sustainability."

Many of the goals Rahm strives for on behalf of walnut growers are shared in common across other nut and commodity groups, and Rahm works closely with other commodity groups and industry associations to pursue common interests. He is actively involved with the Peanut and Tree Nut Processors Association, Frucom (the European Federation of Trade for dried fruit, nuts and other commodities), and other organizations on behalf of California walnut growers and handlers.

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Winter sanitation is critical to controlling future generations of navel orangeworm in walnuts (photo by C. Parsons.)

# CONTROL CODLING MOTH TO CONTROL NOW IN WALNUTS

## MONITORING, MATING DISRUPTION AND INSECTICIDE SPRAYS WILL KEEP MOTH POPULATIONS DOWN

By **CECILIA PARSONS** | Associate Editor

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**“ IN WALNUT ORCHARDS, NAVEL OR-  
angeworm control starts with  
codling moth control.”**

Houston Wilson, UCCE Specialist (Dept. of Entomology, UC Riverside) at the Kearney Ag Center in Parlier and Director of the newly created UC Organic Agriculture Institute, stressed this point in a recent online Walnut Conference presentation.

Walnuts are generally protected from NOW early in the season when husk integrity is high, since young NOW larvae are unable to chew through this protective covering. In contrast, codling moth larvae can readily bore through walnut husks, and this damage creates an opening for NOW larvae to access new crop walnuts. NOW access to new crop nuts can also be facilitated by blight and sunburn, both of which produce damage to the husk that can provide a point of entry for NOW larvae.

#### **NOW in Walnut Orchards**

Research has shown that mummy

*Continued on Page 72*



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**“You want to use a combination of tools and hit them in as many ways as possible.”**

– Houston Wilson, UCCE

*Continued from Page 70*

nuts on the tree and trash nuts left on the ground in orchards provide overwinter sites for NOW larvae. The larvae begin to pupate in March and emerge in April with peak emergence from late April to mid-May, depending on loca-

tion of the orchard and weather.

NOW are nocturnal, and newly emerged adults exit from pupae at dusk. Female NOW emit a pheromone during the night that allows males to find them. Once the males arrive, the females will mate during the early morning hours and start to deposit eggs the following night. NOW can produce three to four generations per year depending on weather and host quality. Populations develop more rapidly as the season progresses due to warmer weather and the availability of new crop nuts. Although NOW can migrate into an orchard, the size of the first generation emerging from mummy nuts within the orchard in the spring can determine potential for crop damage. Infested mummy nuts left in orchards mean there will be more NOW pressure the following year.

NOW damage in California walnut

orchards was first reported in the 1940s. As almonds and later pistachios became more widely planted, NOW became established as a significant insect pest of these orchard crops. NOW damage in walnuts has increased in the past ten years according to Joe Grant, retired UCCE farm advisor and research director for the California Walnut Board, who said orchards in the southern San Joaquin Valley area of Tulare and Kings counties are experiencing serious NOW damage.

Wilson said NOW pressure is not necessarily higher in walnut orchards adjacent to almonds or pistachios, but researchers suspect there is movement of NOW from those crops into walnuts since they are both harvested earlier than walnuts. The California Walnut Board is currently funding a research project to better understand and predict the timing and extent of NOW movement between orchards, led



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by USDA research entomologist Chuck Burks.

### Controlling NOW in Walnuts

Processor tolerance for NOW damage in tree nuts is very low, and growers typically aim for NOW infestation levels of <2%. Infestations in orchards lower yield and quality and lead to higher costs for sorting and processing. Infested mummy nuts left in orchards mean there will be more NOW pressure the following year.

Wilson stressed that there are multiple approaches to NOW control in walnuts. “You want to use a combination of tools and hit them in as many ways as possible,” he said.

Winter sanitation is the foundation of NOW control. Shaking mummies, gathering them into the row middles and then discing or flailing to destroy them will reduce the initial spring flight as well as remove egg laying sites for subsequent generations.

“Winter is the one time of year when moths are static – use that to your advantage, get those mummy nuts out and destroy that base population,” Wilson said.

Cold, wet weather can cause NOW mortality, Wilson said, but growers should not depend on weather alone to control this pest.

Mummies are lower quality hosts compared to new crop nuts, but NOW will continue to use mummies throughout the season. New crop nuts help drive NOW population later by supplying better nutrition to developing larvae.

Research in pistachios, and more recent data from almonds, show that NOW larvae in mummy nuts on the ground tend to fare worse than those in the tree canopy. Additionally, mummies in ground cover or moist bare ground appear to have higher NOW mortality than mummies on dry, bare ground. While not specifically demonstrated in walnuts, these same factors likely apply to NOW in mummy wal-

*Continued on Page 74*

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Continued from Page 73

nuts as well.

Codling moth can be controlled in walnut orchards using a series of well-established protocols that include monitoring, mating disruption and well-timed insecticide sprays, Wilson affirmed. More details on the codling moth control program in walnuts can be found at the UC IPM website ([ipm.](http://ipm.ucanr.edu/agriculture/walnut/codling-moth/)

[ucanr.edu/agriculture/walnut/codling-moth/](http://ucanr.edu/agriculture/walnut/codling-moth/)).

There are two parasitoids that suppress NOW in tree nut orchards. Both were imported into California, Wilson said, but are not very effective when aiming for the 2% damage level, as their host population (i.e. NOW) will not be sufficient for significant parasitoid populations to develop in an orchard.

There is evidence that birds and

mice could potentially reduce mummy numbers by knocking them to the ground and consuming them, Wilson said, but the reliability of this remains unclear. Research is currently underway by a group at UC Davis to determine how vertebrates can affect NOW populations in walnut orchards.

### Mating Disruption

Mating disruption (MD) is a tool used in many almond and pistachio orchards to reduce NOW. Mating disruption uses a synthetic pheromone, which reduces the ability of male NOW to locate females. Various forms of synthetic pheromone emitters can be used in orchards during the growing season. Research carried out by UCCE farm advisor David Haviland in almonds showed that all MD products are effective in reducing NOW infestations. However, Wilson said, mated females can still fly into your blocks, and for this reason suggests that MD will be more effective when used over large, contiguous orchards areas (i.e. large square blocks >40 acres, ideally >100 acres).

MD products will shut down pheromone traps used to monitor NOW numbers, but the phenyl propionate (PPO) lures will remain attractive as will egg traps. Mating disruption products work best in lower NOW populations, Wilson noted.

“The idea is to get numbers down and keep them down,” Wilson said. The MD products used in Haviland’s trial were used in conjunction with insecticide applications, he noted.

### Monitoring

Various traps are available for monitoring NOW in walnut, although trap catch alone cannot be used to predict damage levels. Clear, economic thresholds have not been established for NOW in walnuts, and as such growers must rely on their relative year-to-year experience to make treatment decisions. Available trap types include pheromone lures (attract males) and oviposition

Continued on Page 76

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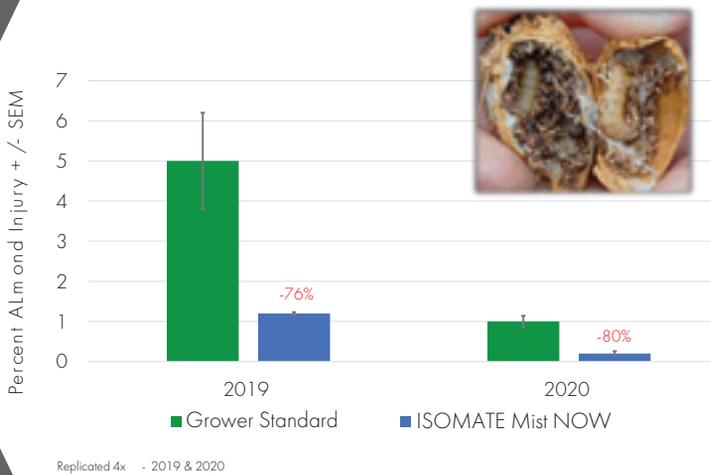
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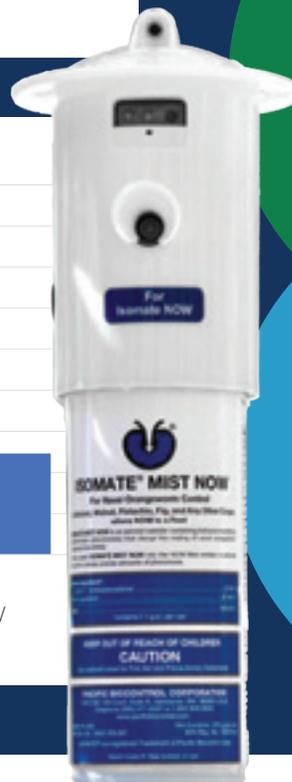
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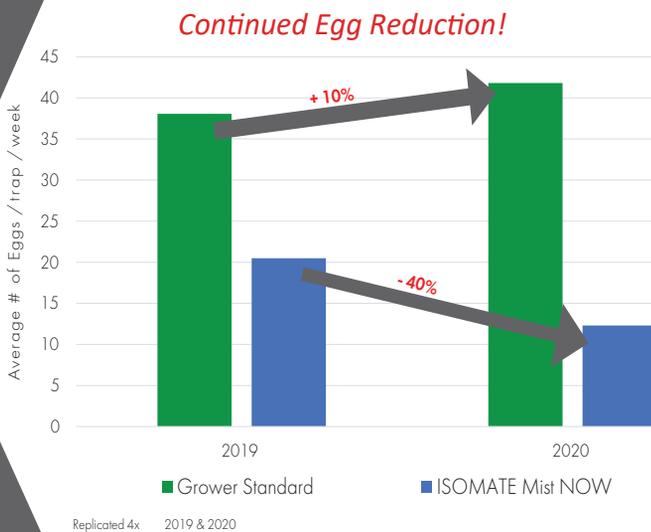
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Continued from Page 74

baits (i.e. Peterson traps, attract mated females). More recently, PPO lures (attract males and females, but remain attractive under mating disruption) have also become available.

Multiple trap types and more traps per acre will provide more detailed information on NOW populations, as will inspecting damaged nuts on the ground and taking harvest samples. Pheromone and oviposition bait traps typically utilize either a wing-trap or delta trap with sticky liner. These traps should be set out in spring at a rate of one trap per ten acres, if possible, or at least two traps per 40-acre block. Traps should be hung mid-canopy with no foliage interference and checked at least once a week. Replace liners every one to two weeks and lures as recommended

by the manufacturer.

### Chemical Controls

Wilson said spray timing for chemical control should be based on trap counts and nut inspections. Monitoring data, especially egg deposition at husk split, is also important. If an application is indicated, timing at husk split is most effective.

Insecticides for NOW control are listed on the UC IPM website. These chemical controls include Intrepid, a larvicide, and Altacor, an ovi-larvacide, along with a few pyrethroids. Note that pyrethroids are broad spectrum and can harm beneficial insects, plus NOW resistance to bifenthrin has been recently documented.

### Timely Harvest

Harvesting walnuts as soon as

possible will reduce their exposure to NOW, Wilson said. Generally speaking, the longer the crop hangs on the tree, the greater probability of NOW damage, especially later in the season when NOW populations are really high. Use of ethephon is an option to speed maturity, but there are cost considerations.

“Growers have multiple tools available to them for NOW, so in many ways it is simply a matter of logistics, planning and execution,” Wilson said.

“Winter sanitation is critical. Whatever you do, develop a management plan, stick to it and use your harvest samples to decide whether or not you need to modify the plan in subsequent years.”

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# UCCE FARM ADVISOR PROFILE

## MOHAMED NOURI LIFETIME IN AGRICULTURE FUELS PASSION FOR PLANT PATHOLOGY

By TAYLOR CHALSTROM | Editorial Assistant Intern



Mohamed Nouri, a UCCE area orchard systems advisor in San Joaquin County, brings many years of plant pathology and research experience to UCCE.

**M**OHAMED NOURI JOINED UCCE IN July 2019 as an area orchard systems advisor for San Joaquin County. Nouri, who received his Master's degree in microbiology and plant pathology from Tunis University

in Tunisia and completed his doctoral research at the Kearney Ag Research Center in Parlier, has been directly involved in agriculture since childhood.

"I became interested in agriculture at a very young age. I'm not only a

farm advisor now; I'm also a farmer," Nouri said. "I grew up growing olives, almonds and pistachios with my father and grandfather. So, it's not only an experience; it was something I was born into."

Nouri noted that tree crop farmers in his home country often suffer tree loss due to fungal or bacterial diseases, and this made him interested in plant pathology.

"I have always tried to learn how to identify biotic or abiotic disorders [in tree crops]," Nouri said. "I've always wanted to be involved in the diagnosis of diseases, and my experiences have made me more excited to

learn about diseases."

### Past and Current Research

Nouri gained an extensive amount of research experience in plant pathology before joining UCCE.

"My Master's degree project was about studying *Verticillium* wilt in olives and almond," Nouri said. "*Verticillium* is classified as one of the most important diseases in olive trees worldwide."

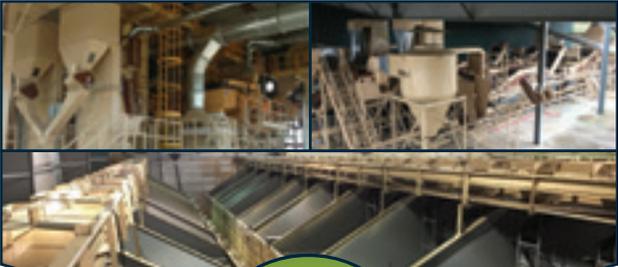
"My research for my Ph.D. in California focused on understanding emerging diseases of fruit and nut crops and delivering innovative and efficient control strategies for those diseases," he continued. "My main project while at Kearney focused on pistachio canker diseases and soilborne diseases as well as emerging diseases of olives. These projects included basic and applied study of disease biology and epidemiology as well."

While Nouri said that his previous work has been published in highly reputed journals for Plant Pathology, he is working on new research at UCCE addressing production and pest management issues in commodities such as walnut, cherry, olive and apple. He also responds to calls from growers with small acreage crops, though these are not part of his current research.

Nouri spoke in detail at the 2021 Virtual California Walnut Conference about his current research investigating *Botryosphaeria/Phomopsis* blight and

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canker diseases of walnut.

“Botryosphaeria and Phomopsis diseases have been observed increasingly in almost all walnut growing regions in California,” Nouri said. “Weather stresses, including heat that causes sunburn, can create damaged areas that serve as entry points for the fungal pathogen to cause more infections.”

An overall survey of the diseases focused on spore activity and dispersal in San Joaquin County walnut orchards. Nouri and a team of researchers found Diaporthaceae fungi (Phomopsis) to be the most prevalent fungal pathogen.

“We found a strong relationship between spore release and precipitation,” Nouri said. “We also detected high aerial dissemination of spores when grinding of infected branches deposited between tree rows.”

Nouri’s research is key to further investigate whether an early spray timing would be effective to reduce the disease incidence, and the results are relevant not only to San Joaquin County but across California, he said.

Additionally, Nouri is participating in a project that is investigating dormancy status in cherry trees.

“Our objective of this project is to improve identification of winter dormancy status of the trees and thus efficacy of dormancy-breaking agent applications [to the tree],” Nouri said.

“I am also very interested in learning more about irrigation and horticultural research, including varieties and

rootstock trials, in collaboration with other farm advisors, UC specialists, USDA scientists and private sector cooperators,” he added.

“There is so much to learn and know when you’re a farm advisor,” Nouri added

### Future Goals

Nouri said that his short-term research goal is to divide his extension activities into two main categories: meet as many growers and stakeholders of the fruit and nut industry as possible to understand the challenges that face them; and extend his research experience and science-based information to his clientele through consulting and diagnostic activities.

“I understand very well what it takes to be a farmer,” Nouri said. “I know about the challenges that farmers can face and the critical importance of agriculture, not only from an economical viewpoint but also from a sociological viewpoint. I am very excited to have chosen this path in agriculture, and it’s a pleasure for me to be out in the field working with growers.”

As a newer farm advisor, Nouri said he will strive to conduct effective research and extension programs that can be adapted to his clientele needs. Overall, Nouri offers many years of

plant pathology and research experience to UCCE, San Joaquin County and California growers.

*Mohamed Nouri is based at the UCCE San Joaquin County Office in Stockton and can be reached at (209) 953-6115 and [mnouri@ucanr.edu](mailto:mnouri@ucanr.edu).*

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Federal support can help expedite water conservation and management improvements, fish passage and recovery, and habitat restoration (all photos courtesy California Farm Water Coalition.)

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**T**HE BIDEN-HARRIS ADMINISTRATION HAS STATED that one of its key goals is to address our country's failing infrastructure. As Californians who have dealt with water issues for decades, we are all keenly aware that infrastructure is much more than roads and bridges; it is also the aging water infrastructure that is necessary to provide fresh water to all Californians, farms, cities, rural communities, and the environment.

Recognizing the opportunity at hand, a group of more than 200 agricultural organizations and urban and rural water districts have reached out not only to the new Administration but to Congressional leadership as well, working to ensure that western water projects are given appropriate consideration for any COVID-19 stimulus package or infrastructure legislation.

Our nation clearly needs a stable domestic food supply that both nourishes Americans and safeguards national security. Food security is an issue everyone should be taking more seriously. We cannot wait until the supermarket shelves are empty to take action to protect our ability to feed ourselves and much of the world.

## A Need for Federal Aid

In order to maintain a healthy, affordable national food supply as well as clean water for our commu-

nities, federal investment is necessary in essential water infrastructure including water conservation, water recycling, watershed management, conveyance, desalination, water transfers, groundwater storage and surface storage.

The effort, led by Western Growers, the California Farm Bureau Federation, Family Farm Alliance and the National Water Resources Association, included a number of specific recommendations.

Top among those recommendations is environmentally and hydrologically sound investments in new water storage—both surface water and groundwater—in order to adapt to a changing hydrology and develop usable and sustainable supplies to meet growing demands for water. Water storage projects should be geared to local circumstances and needs.

In some cases, storage projects will be



New infrastructure may include tools to accurately measure and deliver water to improve on-farm water use efficiency.

*Continued on Page 82*



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Continued from Page 81

above ground; in others, they will be below ground. Additionally, some will have traditional construction using American steel and concrete, while others will be 'green' natural infrastructure projects – all dependent on the wide variety of local needs in place across the West.

Funding for storage will also help address climate change risks.

New funding will be needed to kick-start new water recycling, reuse and desalination projects currently being studied or that are ready for construction.

Programs that fund water conservation and management improvements, fish passage and recovery, and habitat restoration – all in support of water project operations in the Reclamation states of the West that are in need of additional funding to accelerate construction of this “ready-to-go” infrastructure.

Additionally, in order to respond to current and future water shortages,

**"WE CANNOT WAIT UNTIL THE SUPERMARKET SHELVES ARE EMPTY TO TAKE ACTION TO PROTECT OUR ABILITY TO FEED OURSELVES AND MUCH OF THE WORLD!"**

Congress must also encourage federal agencies to implement a more cooperative approach toward achieving multiple goals under existing environmental laws and regulations.

Download the letter at <https://bit.ly/2MyrmzD>.

And the plan laid out by these organizations would accomplish several Administration goals at once:

It boldly addresses aging infrastructure that so desperately requires attention and impacts the lives of all California users from the largest city to the smallest town to the farms our country relies on for a safe, healthy food supply.

It will help our economy recover from the pandemic not only by pumping dollars and jobs into the system, but it will also help ensure delivery of clean water to all Californians, without which the economy cannot move into full gear.

Many of the steps suggested in the letter, such as increased water storage, groundwater recharge and habitat restoration, help us combat climate change.

It offers immediate progress on all fronts.

If the new Administration truly is committed to all of these goals, there is a clear path forward, and the time to begin is now.

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