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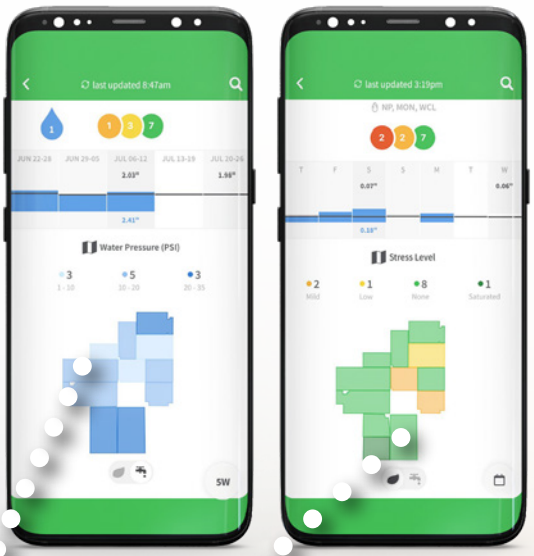

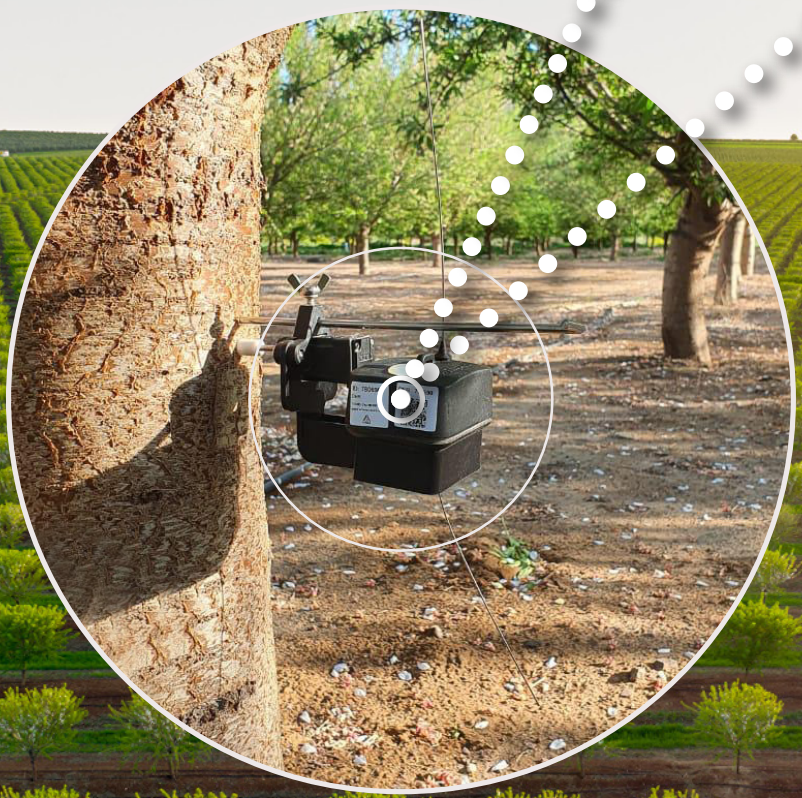

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SPOTLIGHT ARTICLE: Canopy Management in Pistachios

A look at mechanical and hand pruning techniques to create an efficient pistachio canopy and reduce alternate bearing yield.

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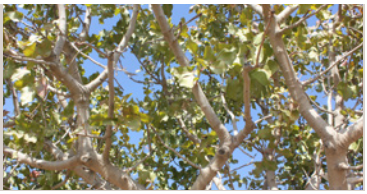

Delaying Irrigation Offers Benefits in Walnuts and Almonds

New almond research shows some of the same efficiencies as earlier walnut trials.

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

Resident vegetation is shown drying out last spring in this UC research plot in Tehama, which is analyzing the effects of delaying the irrigation start in almonds. So far, early research results suggest growers may be able to delay the start without much effect on yield and quality (photo by L. Milliron.)

SIX YEARS OF UC RESEARCH HAS SHOWN THAT WALnut growers may be able to delay starting irrigation by up to two months without significantly affecting yield. And one year of research into delaying irrigation in almonds is showing similarly positive results.

The research could have profound effects on water usage, pumping costs and plant health, according to researchers.

The results in walnuts were surprising, UC Davis Plant Sciences Department Professor Ken Shackel said, in part because of the belief that walnut trees rely on stored soil moisture to avoid defoliation and other negative occurrences at harvest. Researchers, however, found no supporting evidence that preserving a deep soil-moisture profile with early season irrigation helped walnut trees at harvest.

"The concern is if you don't irrigate early and keep a full profile from the get-go, you will get behind and never be able to catch up in both almonds and walnuts," said Luke Milliron, UCCE orchard advisor for Butte, Glenn and Tehama counties. "I can see how growers would have that worry, but so far, we have not seen that bear out in our experiments."

Over the years, growers have used an assortment of tools to determine when to start watering walnut and almond trees, Milliron said, including soil

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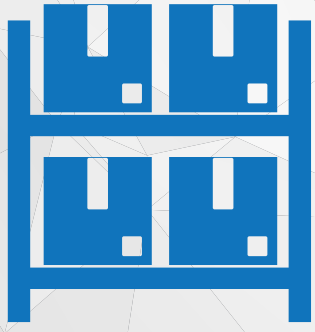

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moisture probes, evapotranspiration measurements or simply waiting for that first dry spell, all inexact sciences that aren't looking at the primary element: the tree itself. The biggest mistake growers make is starting too early, he added.

"My concern is that growers start irrigating too early and that is a risk," Milliron said. "The early season is so important in terms of root growth, and for root growth, you need good aeration. And if you are over-watering early on, you could really be compromising root health for the whole season.

"Roots need oxygen," Milliron added, "and if you are filling up more of those soil pores with water, you could be starving the roots."

Milliron advocates letting the tree determine when to begin irrigating by measuring stem water potential with a pressure chamber. The pressure chamber determines the water stress experienced by trees by gauging the amount of water tension in a leaf, a more direct gauge of a tree's needs than soil moisture or other factors.

Initial Skepticism

Researchers started looking into the effects of delaying irrigation in walnuts in 2014 using funding from the California Walnut Board.

"I don't mind telling you, the people on the Walnut Board's research committee were very skeptical that this would work at all, because they knew that their trees needed water and they had to give them water when they leafed out," Shackel said.

"It was very surprising to everybody what we found," he added. "They thought we were going to hurt those trees, and, if anything, the trees looked better in the delayed trial than they did in the control. It was very counter-intuitive for the growers to think that less is better."

Using stem-water-potential readings, which express water tension through bars on a graph, the researchers started irrigating at five different points, with the most delayed irrigation taking place four bars below the baseline, or nearly two months after growers in the testing area started irrigating, or typically about 30 days after leaf-out.

"We expected that one or two bar triggers might cause mild water stress with minimal effect on the trees, but that the three or four bar triggers would show some detrimental effects," Shackel wrote in a report. However, researchers found that yield was only about 10% below the control plot when delaying the start of irrigation until four bars below the baseline, or nearly two months after the control plot. And, Shackel reported, the trees that weren't watered until the four-bar trigger had a healthier looking canopy.

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"The first year's results were kind of a jaw dropper in terms of 'holy moly,' we waited a month and it didn't do anything," he said.

Researchers also found that trees with an early start of irrigation showed more water stress at harvest than trees given a delayed start. This occurred despite the fact that the trees under a delayed start received about 10 inches less water, about 28 inches over the course of the growing season than trees under an early-start, which received about 38 inches over the course of the season.

"After three or four years, walnut growers decided it worked on really deep, well-drained soil, but now we have to try it on clay soil," Shackel said.

"So, we went down to Patterson three or four years ago, and that is pretty much showing the same thing as the first trial, but with even more clear results. If anything, it looks like you can wait a long time to start irrigating for trees in a clay soil."

Researchers initially proposed the project to the Walnut Board because Bruce Lampinen, UC ANR integrated orchard management specialist, started thinking that maybe overwatering was causing poor root health and triggering several in-season tree health symptoms, including chlorosis and potassium deficiencies and boron excesses. Symptoms included distorted leaf margins, purple veins, yellowing leaves and leaf-tip burn.

"They were just very unusual and interesting leaf symptoms that were all

> **"I think we are going to find there are a lot more efficiencies possible to manage almonds in terms of the yields we get for the same amounts of water."**
> - Ken Shackel, UC Davis

over the board," Shackel said. "I think that led Bruce to thinking, 'maybe this isn't a nutrient availability problem, maybe it is a root physiology problem, where the roots are having trouble taking up the nutrients that the plant needs.'"

Whether the delayed watering solved those issues is hard to say, Shackel said, given that the researchers have had a hard time reproducing those symptoms in their plots. But the idea that early watering may be drowning out a tree's deepest roots has risen to the surface with merit, he said.

"Those deep roots are very important later in the season," he said, "and it looks like it is better to let that bottom soil dry out a little bit to keep the roots healthy, even though it involves a little bit of stress for the tree."

Almonds Responding Similarly

Researchers launched two almond orchard trials in 2020, and thus far are encountering similarly promising results.

"The (almond) trees did what we thought they would do," Shackel said of the first year's results. "They get a little bit of stress before they get their first drink, and that takes a couple of weeks to wear off, just like it did in walnuts. Then, at the end of the season, there was no difference in yields (between the control plot and the plot under delayed irrigation)."

Despite the encouraging initial

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findings, Shackel doubts that almond growers will find the same type of water saving opportunities that are apparent in walnuts.

"My guess is that we won't save as much water as we did with the walnuts," Shackel said. "But I think we are going to find there are a lot more efficiencies possible to manage almonds in terms of the yields we get for the same amounts of water."

"I think there is a lot to learn yet about what the tree is experiencing," Shackel said. "I think we've just seen the tip of the iceberg. I don't think we have a very good idea about how much stress is too much stress at any one time. We have some idea, but, really, the whole field of irrigation has never really been based on plants. It is based on ET (evapotranspiration) or soil, so I think we have to rewrite the book when it comes to irrigation when it is based on plants. And I suspect there are going to be a lot of surprises that we are going to find here in the next ten years."

As for more immediate applications, Milliron said he knows of at least one grower who has started using the pressure chamber to determine when to start irrigating walnuts in the Butte and Glenn county area. The results? "He said the trees are looking healthier and he is saving a lot on his pumping costs," Milliron said.

> **"Roots need oxygen, and if you are filling up more of those soil pores with water, you could be starving the roots."** - Luke Milliron, UCCE

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MULTIPLE CAUSES ARE LIKELY RESPONSIBLE FOR ALMOND MALADY

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

In severe cases, trees affected by delayed leafing produce no viable vegetative buds, only nuts on several branches.

Although the malady is not widespread, young trees seem more susceptible to delayed leaf out than mature ones (all photos by L. Milliron.)

ALTHOUGH DELAYED LEAFING IN ALMONDS HAS BEEN reported sporadically for more than two decades, in 2020 it captured the attention of researchers who say they want to make an effort to better understand the malady.

Marked by vegetative buds that do not push or are slow to push, the problem has raised several yet unproven theories about the cause.

"I can't tell you what's causing it, but I can tell you what isn't causing it in many instances," said Luke Milliron, UCCE orchard systems advisor for Butte, Glenn and Tehama counties.

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[2] 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.

Even in June, some trees affected by delayed leafing had not caught up to their unaffected counterparts.

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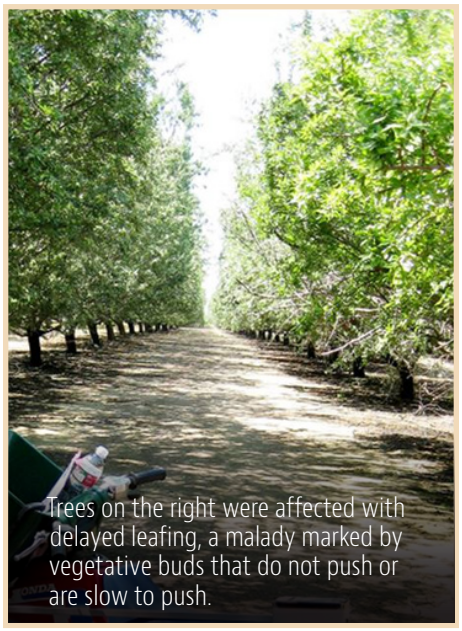
He said he also believed the problem, dubbed leafing failure, is likely due to multiple factors and not just a single one.

Milliron recommended growers have patience and avoid hastily pruning or removing affected trees since they frequently recover later in the season. Instead, they should mark the affected trees so they can follow them throughout the season and subsequent years.

"I think growers do err on the side of action because they see a problem and they want to address it," he said. "But I think that might lead to more problems than solutions. In a couple of cases, the problems have gotten worse. Historically, it can be an issue that really isn't an issue going forward. I really stress to be cautious and not err on the side of pulling trees out."

In a couple cases, Monterey trees with severe symptoms in 2018 did not recover in 2019, with the problem becoming more severe in 2020. But in several others, Milliron said, trees that had the problem early in spring 2020 were undistinguishable from non-affected ones later in the season by all but the growers themselves.



Trees on the right were affected with delayed leafing, a malady marked by vegetative buds that do not push or are slow to push.

> "YOUNG TREES JUST MAY NOT GO DORMANT AS EARLY AS OLDER TREES IN THE FALL, ESPECIALLY IF PEOPLE ARE STILL TRYING TO PUSH THEM. THIS MAY DELAY THE ONSET OF CHILL ACCUMULATION."
> - ROGER DUNCAN, UCCE

He also recommended minimizing any stressors – such as bark damage from shakers, insect pests or diseases, or under- or over-irrigation – that the trees may be experiencing. At the same time, he said growers should avoid throwing excessive nutrient treatments or irrigation at the trees to help them recover and advised growers to take a wait-and-see approach.

What is Delayed Leafing?

Delayed leafing symptoms have been periodically noted before 2000. More recently, farm advisors reported the issue in 2000, 2006, 2010, 2017, 2018 and 2020. In each of these years, farm advisors and specialists tried to link the problem back to clues in that year's weather and stressors in the orchard's history.

It is not non-infectious bud failure, or crazy top, which is a genetic disorder found in many varieties with Nonpareil in its parentage, most notably Carmel, Milliron said.

Delayed leafing has been seen predominately in the Monterey variety, ranging from a few trees on an orchard's edge to a couple Northern California orchards that had over half of Monterey pollinizers affected. And not every orchard with Monterey has had the problem, either. Rather, it has been scattered, Milliron said.

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Delayed leafing also has been reported in the Bennett-Hickman variety, although he said he isn't convinced the two issues are related. Bennett is a relatively new variety just starting to see commercial plantings, so it doesn't have the history of many of the older varieties. In addition, Milliron has seen a couple minor cases of the malady in the Butte and Padre varieties.

In minor cases, growers have seen leaf-out delays on just a few branches. In severe cases, there are no viable vegetative buds, only nuts on several branches.

Typically, if you cut into the bark of affected branches or shoots, the vascular tissue is green and alive. As the season progresses, some growers have seen spotty tip dieback.

Theories Abound

The cause or causes remains elusive, although several researchers have their own theories.

Roger Duncan, UCCE farm advisor in Stanislaus County, said he has seen similar symptoms in Monterey in scattered orchards over the years. But during 2020, the malady appeared more widely and was particularly noticeable in many second-leaf orchards with Monterey or Bennett-Hickman.

"The symptoms of uneven budbreak somewhat mimic the effects of low chill," he said. "Young trees just may not go dormant as early as older trees in the fall, especially if people are still trying to push them. This may delay the onset of chill accumulation."

Like others, Duncan said he isn't certain about the cause or causes, but he agrees that lack of chill hours or chill periods may contribute. "Even though the models showed we had sufficient chilling, maybe we still have things to learn about how best to measure chill."

In addition to almonds, growers of walnuts and pistachios also reported issues with delayed leafing during the 2020 spring. "What it means, we don't know," he said. "Even just looking at some of the red-leaf maple trees around town that often require higher chill hours, I saw there were a lot of trees that had uneven bud break that looked similar to what we saw in some almond orchards."

A dry winter with little precipitation also may be a factor, Duncan said. In

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Trees with delayed leafing in March had a noticeably less dense canopy than those that weren't affected.

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2019-2020, for example, the state didn't receive appreciable precipitation until March 2020, with no rain falling in the month of February. And heading into the 2020-21 winter, the state had received only scant rain as of early December.

Katherine Jarvis-Shean, a UCCE orchard systems advisor for Yolo, Solano and Sacramento counties, said she saw a few orchards in her area with the issue in 2020, but it wasn't widespread.

"It wasn't like my phone was blowing up with requests or questions from people," she said. "Until this year, it wasn't something that was hugely on my radar."

One orchard that came to mind had trees that didn't bounce back after delayed leafing and appeared to struggle throughout the season. In a couple other orchards, growers pointed out a few scattered trees that had less growth on them than the others.

What Jarvis-Shean has all but ruled out is a genetic disorder like crazy top. "It's certainly not the same thing that Carmel experiences," she said. "The fact that it's not every year and the fact that it's not in every orchard indicates there's some overlaying climate, weather and some type of management element. We're still trying to figure out which stressors relate to how much of

this is occurring. We're still trying to get our arms around it, and I know it's frustrating for growers."

UC Davis almond breeder Tom Gradziel said he also believes it may be a combination of warm winters and a history of severe tree stress. Those could include severe water stress during the previous harvest, wet conditions the previous season, acute anthracnose history, defoliation from mites and trunk bark cankers.

The Role of Carb Loading

UC Davis Plant Sciences Professor Maciej Zwieniecki has found the Monterey variety seems to store lower amounts of non-structural carbohydrates at the beginning of winter than some other varieties.

Warm fall and winter conditions can increase tree respiration, resulting in exhausted carbohydrate reserves as the tree enters reproduction in late winter. Delayed leafing has occurred after a warm winter in some, but not all, years. Zwieniecki also plans to look at whether low precipitation amounts could be a contributing factor.

To help shed more light on the role of carbohydrates in nut trees, he founded the Carbohydrates Observatory, which enlists citizen scientists. In this case, he asks growers of almonds, pistachios and walnuts to send monthly samples of wood and bark for analysis of starches and sugars. (For more information on the observatory, visit bit.ly/35WCqxm)

"We need more growers to send their samples," Milliron said. "Monterey, Bennett, Independence – on all of these varieties, we don't have a lot of data."

Growers who submit samples can track their tree carbohydrate levels throughout the year and tie them to climate, management or phenological events. Ultimately, Zwieniecki hopes the information can be used to improve spring and fall management as well as improve the industry's understanding of chill periods. He also is working on a large database of information, which can be used to develop an easy-to-use tool to predict yield the following season.

In irrigation trials conducted in the late 1990s and 2000s, UCCE Almond and Walnut Specialist Bruce Lampinen was able to create similar delayed leafing symptoms in Monterey with over-irrigation.

With delayed leafing in 2018 and 2020, Lampinen pointed to wet conditions the previous spring as a possible contributor. Both he and Milliron continue to promote the use of pressure bombs to time the season's first irrigation and avoid over-irrigation in early spring. Monterey trees, in particular, don't like wet feet in the spring. Saturated spring soil conditions also can lead to root death and water stress during the summer.

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Almond Yield Forecasting by Drone

Virtual Orchard Technology Captures Light Interception for Improved Crop Forecasting

By **ALIREZA POURREZA** | *Director*
and **XIN ZHANG** | *Postdoctoral Scholar, Digital Agriculture Lab, UC Davis*

ALMOND YIELD PREDICTION HAS become a priority for almond growers in California because it enables them to correctly estimate and apply seasonal nitrogen demand and prevent violation of the new nitrogen management regulation that does not allow overapplication of nitrogen. Accurate forecasting of almond yield is difficult due to complex affecting factors, such as blossom condition, environmental temperature, soil status, precipitations, irrigation volume, variety and age. One major determinant of almond yield is the amount of sunlight that is intercepted by the canopy.

Light Interception

Solar radiation is used for the photosynthesis process in which carbohydrates are produced from water and carbon dioxide. The visible range in the electromagnetic spectrum (400 to 700 nm) is known as photosynthetically active radiation (PAR), commonly defined as the quantity of photons per unit time per unit area intercepted by the tree canopy.

In practical use, light intercepted by the canopy during the solar noon (also known as the incoming Fractional PAR (fPAR)) is determined by measuring the PAR below and above the tree and presented as a percentage. The size of the tree's shadow on the ground at the solar noon is also an indication of fPAR. Measuring fPAR can provide growers with an accurate estimation of canopy biomass. Previous studies showed that fPAR is the most important factor determining the maximum amount of dry kernel yield (potential yield) that an almond orchard can theoretically produce under an optimum condition (no stress, no extreme weather, no pest/disease and desired bee activities.)

A mobile lightbar platform was previously developed at UC Davis and has been commonly used for measuring fPAR in mid-season and predict potential yield in almonds. It includes an array of light sensors mounted on a horizontal bar and carried by a gator vehicle under the canopies and in every row of an

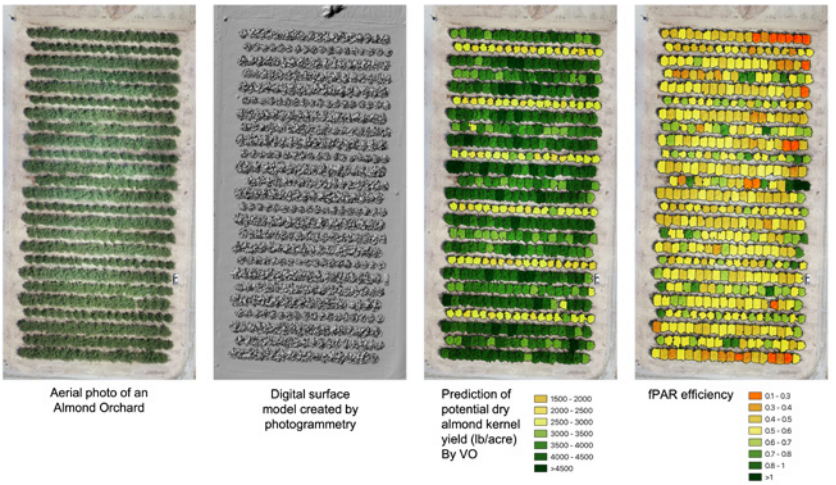
orchard at the solar noon. The analysis of 10 years of lightbar data in California showed that a mature almond tree could produce up to 58 pounds of dried kernel yield per acre for each 1% of fPAR intercepted by the canopy. Although ground measurement of fPAR is useful for predicting potential almond yield, it's not the most efficient approach because it needs to be done only at the solar noon (midday), it's not widely available for large-scale commercial scanning, and it requires technical expertise for data collection and processing.

Virtual Orchard Results

At the digital agriculture lab at UC Davis, we developed a drone imaging technique called Virtual Orchard (VO) to scan and generate 3D models of orchards and accurately estimate fPAR with tree-level precision. We use small and affordable unmanned aerial quadcopters (equipped with RGB cameras) as well as a flight mission planner application (both are commercially available off-the-shelf, and the planner app tool can be used for free) to automatically collect aerial RGB imagery from an orchard at any time of the day, while fPAR measurement by the lightbar platform has to be done only during the solar noon. We process the aerial imagery with a photogrammetry technique to generate a point cloud reconstruction of the orchard (3D model). The VO algorithm then processes the 3D point cloud and estimates fPAR.

Our evaluation confirmed that fPAR estimated by the VO technique strongly correlates to fPAR measured by the lightbar platform (near 1:1 ratio), particularly for Nonpareil, which is California's leading variety. In a research project funded by the Almond Board of California, we monitored temporal canopy changes of 1,440 individual mature almond trees in eight different varieties such as Nonpareil, Monterey, Wood Colony, Butte, Carmel and Lonestar and two ages (6- and 11-year-old trees) from May to August during the 2019 season.

We also measured dry kernel yield per tree and conducted a statistical analysis to determine the accuracy of yield prediction by fPAR at different growth stages. The drone-based method could predict Nonpareil dry kernel yield with a mean error of 227 lbs/acre in May, 199 lbs/acre in June and 195 lbs/acre in July; all were below the standard deviation (or data variations) of the row-level yield data (~500 lbs/acre). The VO method using drone imagery could predict Nonpareil almond yield with significantly higher accuracy than the lightbar platform. Also, VO technology offers more precision at the tree-level, which is not available with the lightbar platform.



The types of maps generated by the VO technology (photos courtesy A. Pourreza.)

Radiation-use efficiency is defined as "the ratio of dry matter produced per unit of radiant energy used in its production." We can calculate radiation-use efficiency for nut crops by the ratio between actual dry kernel yield and potential yield estimated by the lightbar model. Since mapping an orchard by a drone will provide tree-level precision, individual trees'

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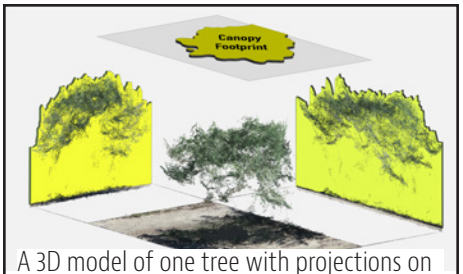
productivity can be determined using the actual yield data. Early forecasting of (potential) yield as a decision support tool enables growers to have a more accurate estimation of the seasonal nitrogen demand and make better decisions for irrigation frequency and rate.

Grower Adoption

Drone technology has grown exponentially in the past few years; today, the drone market offers more affordable prices, better imaging quality, safety/control options and more comfortable use. Many of these inexpensive drones can collect the aerial imagery required by the VO method for early yield forecasting. Tree-to-tree variations can be monitored accurately during the season and used for precise management of nitrogen and water. At the digital agriculture lab, we periodically provide hands-on training on using commercially available drones for collecting aerial data (as well as introducing other accessible processing tools or sensors on aerial imagery) to deliver hands-on experiences and educations to the growers.



A 3D model of one tree with projections on side, front (or back) and Canopy footprint. 3D models for each tree are used to calculate the canopy light interception and then predict potential yield.

A 3D model of the entire orchard made by aerial RGB imaging and photogrammetry techniques.

Training and consulting services for data collection will be provided to growers interested in adopting VO technology. A web application platform (myvirtualorchard.com) was created as a decision support tool to facilitate the data processing and analytics pipeline. Raw aerial RGB imagery collected using any drone (with our instruction) can be uploaded to the cloud, where 3D model generation and analytics are conducted in the server and the output is delivered as Excel/PDF reports or interactive online maps. The results include per-tree information such as PAR, tree size (height, area and volume), estimation of potential yield, prediction of actual yield, fPAR productivity and nitrogen and irrigation rates.

Drone imaging and Virtual Orchard technology for precise orchard management have become more promising and reliable by integrating multi-year and multi-location data collected across the state into the decision support tool. In the digital agriculture lab, we collect and analyze annual aerial and ground truth data from several nut orchards to determine and document canopy growth under various management practices and improve the yield prediction model. Nut growers will benefit by forecasting (potential) yield early in the season when optimum orchard management can still be achieved using the Virtual Orchard decision support tool.

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Adoption of COVID-19 Regulation Places Additional Pressure on Employers in 2021

By **MICHELLE RODRIGUEZ** | *Safety Specialist, Western Agricultural Processors Association*

AFTER MONTHS OF ESTABLISHING GUIDELINES AND ALREADY enforceable requirements for employers to follow in the efforts to minimize the spread of COVID-19, the Cal-OSHA advisory board has decided to adopt a formal COVID-19 regulation that will add to the challenges employers are facing in 2020.

In March, Cal-OSHA and the Centers for Disease Control teamed up to provide a variety of industries with guidance on the measures they can take to prevent the spread of COVID-19. These measures included completion of a risk assessment for each work area to determine and establish controls, employee training, sanitation practices and monitoring of all employees and visitors who enter the facility. Additional precautions are completion of investigations to determine if exposure for COVID-19 positive cases occurred within the workplace and reporting procedures. It has been a learning curve for California employers as they have navigated through application of these kind of controversial guidelines for the first time.

New CalOSHA rules will place additional COVID-19 related burdens on agricultural employers (photo by Catherine Merlo, contributing writer.)

On Nov. 19, 2020, the Cal/OSHA Standards board spent an entire day listening to company and affiliation representatives as well as individual testimony from a substantial number of industries for the pros and cons of the added regulation. The public had only five days to review and comment on the very open-to-interpretation, 25-page document before this meeting. Once the allowed testimony from over 110 participants was heard, a brief board discussion was held on the urgency to adopt the bill due to the current threat to public health with very minimal regard to the discrepancies and lack of attention to detail in the actual interpretation and application to these guidelines for the many industries that will suffer the consequences of this regulation.

New Requirements

Rush and haste to pass this regulation now places additional pressure on employers to determine how they will consider and comply with the additional requirements of the following:

Engineering and Administrative Controls

Indoor operations will be required to modify and increase the ventilation of outdoor air. If it is not possible for work stations to enable social distancing, employers are required to install partitions that will assist with prevention of possible transmission. Employers will continue to be responsible for providing face coverings and requiring employees to wear them. Specific exceptions for situations where it is not possible to wear a face covering are listed.

COVID-19 Exposure Employee/Subcontractor notifications

Employers will be required to notify all affected employees and subcontracted employees that they have been exposed to someone who has tested positive to COVID-19 or has been instructed to quarantine by a medical physician in writing within one business day of having knowledge of the exposure. Employees who have a laboratory confirmed positive result from

a COVID-19 test and anyone who has been exposed to that employee must be removed from the workplace for 14 days after the last date of the exposure. These employees will not be allowed back to the workplace until the 14 days has passed regardless of any test results that indicate the employee is COVID-19 negative.

Housing and Transportation

When housing and transportation is provided by the employer, the employer will be required to transport employees living in the same household and work at the same worksite in the same vehicle. Employees riding in the same vehicle must be separated from each other by at least three feet and required to wear face coverings. Additionally, similar social distancing requirements are listed in housing situations.

Outbreaks and Testing

The requirements describe a COVID-19 outbreak to be defined as three or more confirmed COVID-19 cases within a 14-day period. Employers will be responsible for reporting an outbreak to their local public health department within 48 hours of knowledge of the outbreak and continue to report additional cases thereafter. Information that needs to be provided includes the names of the infected employees and their personal contact information. The company NIACS code must also be provided along with any other requested information. In addition to these reporting practices, employers will be responsible for providing no-cost COVID-19 testing to any employees who may have been exposed during paid working hours and additional testing one week after.

Investigations and Recordkeeping Practices

An internal investigation must be completed by the employer to determine if a work-related exposure led to any positive cases. If it is found that the exposure occurred in the workplace, it must be recorded on the OSHA 300 form as an occupational illness case.

Order Prohibiting Use and Citations

This regulation allows Cal/OSHA to deem COVID-19 related exposures in the workplace as an imminent hazard and therefore use an order prohibiting use that will result in shutting a workplace and its operations down. A serious citation related to COVID-19 exposures can be issued by Cal/OSHA without the usual pre-citation notice provided in the previous 15 days.

2020 COVID-19 Related Citations

One of the many concerns and arguments against AB 685 is that Cal/OSHA has already been issuing citations to address the exposures and issues related to COVID-19 under the Title 8 §3203 Injury and Illness Prevention Program and Title 8 §5199 Aerosol Transmissible Diseases for medical facilities. According to public records, from August to November of 2020, a total of 165 citations that added up to $1.53 million in proposed penalty fines have been administered by Cal-OSHA. Why is our state investing additional time and money into passing regulations that are already enforceable through Title 8?

These and the already-established guidelines for COVID-19 spread prevention are in full effect as of Jan. 1, 2021. Nut processors and other agricultural related employers had very little time to comprehensively review and prepare for full implementation of these requirements, which do not reflect an understanding of the time, monetary and management resources that it takes to implement such guidelines. One question remains: Has Cal/OSHA assessed the impact on the agricultural industry by addressing a public health issue as if it were the result of an occupational hazard?

Western Agricultural Processors Association along with others representatives of the agricultural industry have combined their efforts to issue comments to request for Cal/OSHA to take the time to review the items within COVID-19 regulatory requirements that threaten the very existence of many of these employers along with the employment they provide to millions of California workers and the resources they provide to our state.

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

The Almond Company is one of California's largest almond processors. Its Madera facility is a former distribution center for Gottschalks Department Stores (all photos by C. Merlo.)

Processing lines at The Almond Company's Madera plant have fewer workers to comply with physical distancing requirements.

HOW ONE ALMOND HANDLER HAS KEPT COVID-19 AT BAY

By **CATHERINE MERLO** | *Contributing Writer*

Safety manager Betty Chavez walks through The Almond Company's vast processing plant near Madera, Calif., pointing out what's different since the COVID-19 pandemic brought new restrictions last March.

Every employee, from processing-line worker to forklift driver to floor sweeper, wears a mask. Each keeps six feet away from others to prevent the spread of the virus. Break-area tables offer only two chairs, one at each end, to meet physical distancing requirements. Where there were once three clock-in stations, there are now only two, separated to keep employees from standing too closely together when they punch in or out. Lines leading to the clocking stations also are marked for social distancing. Signs calling for mask-wearing are posted throughout the 420,000-square-foot plant.

While The Almond Company doesn't do temperature checks on employees, it does require them to answer a daily health-check questionnaire before starting their shifts. Employees

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Like this forklift driver, all employees and visitors wear masks at The Almond Company.

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also must wash their hands with soap and water before entering the facility. Further, hand sanitizer is located in break-rooms, near doors, clock-in stations, the front lobby and office hallways. In the front lobby, security director Joseph Reyes monitors video footage on multiple computer screens to see what's going on throughout the plant.

All combined, these measures have succeeded in keeping COVID-19 at bay at The Almond Company, one of California's largest almond handlers. The operation has had no COVID-related deaths among employees. Only two out of the 120 who work at this plant have tested positive for the virus since March.

"And those cases were contracted from family members, not here on the job," says Chavez.

Taking It Seriously

There's a simple explanation for The Almond Company's success in avoiding a COVID-19 outbreak, says Roger Isom, president and CEO of Western Agricultural Processors Association (WAPA).

"They took COVID seriously from the start," Isom says. "Because they did, they haven't missed a beat during the peak of the season."

The Almond Company, part of the vertically integrated Harris Family Enterprises, processes more than 100 million pounds of almonds for distribution domestically and internationally each year. As a food-processing facility, the company has always required employees to adhere to strict food-safety protocols, such as donning hairnets and smocks. But the pandemic took its food-safety policies to new levels.

When new COVID-19 restrictions were called for last spring, Chavez had held her safety role for less than a year. Initially overwhelmed, she turned to a health and safety consultant and to WAPA to help her develop new pandemic protocols. She relied on information provided by Cal/OSHA and

Betty Chavez, The Almond Company's safety manager, had been in her role less than a year when California announced coronavirus pandemic restrictions in March.

the Centers for Disease Control and Prevention. She also gathered 18 of the plant's managers, supervisors and leads for input on the best ways to comply with coronavirus regulations and increase employee awareness.

By April, The Almond Company had developed a seven-page COVID-19 action and preparedness plan. Among other things, it includes holding COVID "tailgates" every other Thursday among the plant's various departments. These meetings allow managers to seek suggestions and concerns from employees. Out of those meetings came the need for more tables and chairs both in and out of the building and staggered break times to accommodate fewer employees per space.

"Safety is my main priority," Chavez says. "We take it very seriously. Our goal is to send all employees back to their families safe and healthy."

In connecting with the plant's workforce, it helps that Chavez also speaks Spanish, since many of the employees don't speak English. Some cannot read or write. Chavez relies on her own background to relate. Born in Mexico and brought to the U.S. as a toddler, Chavez grew up in her family's farm-labor contracting business in the Central Valley near Merced.

Her experience in the fields and bilingual ability help her understand their concerns and boosts communication. Moreover, Chavez uses what she calls "true stories" to underscore the need for COVID-related training and education.

"Early on, there were a lot of processing plants that shut down because of COVID outbreaks," she says. "We talk about how people were out of work. But

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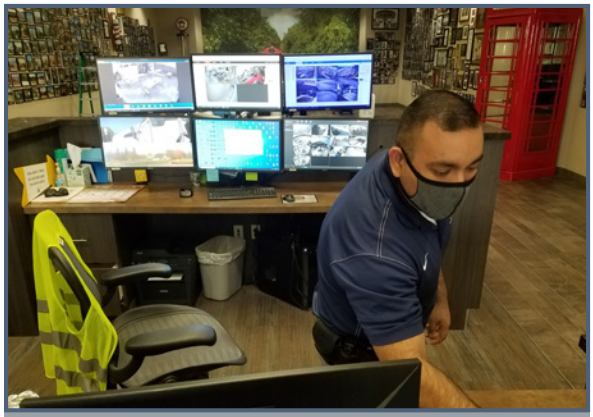

In the front lobby, security director Joseph Reyes monitors video footage on multiple computer screens to see what's going on throughout the plant.

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we've kept our safety and our jobs."

Staying Vigilant

Adapting to the new pandemic normal hasn't been easy. Early on, port closures and supply-chain disruptions slowed company shipments. In-house inventories grew for a while before outbound loads began flowing again. But hardest for Chavez have been "non-believers of COVID."

"They would shake their heads and roll their eyes when we talked about our safety requirements," she says. "But after a few found out that a family member got COVID, they came and apologized to me."

If employees are spotted not following COVID-related measures, supervisors speak to them. If the non-compliance continues, the employee gets a write-up in his or her personnel file.

To curb COVID-19, the company also relies on the Silver Dihydrogen Citrate (SDC) disinfectant. SDC kills bacteria, fungus and virus, but it's non-toxic to humans and animals. A local company sprays SDC two nights a week after employees have left the plant.

Another result of the company's pandemic vigilance? No visits from Cal/OSHA, which enforces California laws and regulations concerning workplace safety and health. The agency also assists employers and workers in implementing and following rules.

"They've been great in helping us," Chavez said.

The Almond Company has paid for all personal protection equipment for its employees. Chavez won't say how much that has

Continued on Page 32

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Chavez in one of the break-rooms at The Almond Company. Only two chairs per table are allowed to keep employees distanced during lunch and breaks.

Continued from Page 30

cost, only that "it's a large amount of money." But the price tag isn't the issue.

"The well-being of our employees doesn't have a number," she says. "The money that's been spent is well worth it."

Her advice to other tree-nut handlers about coping with COVID-19: Educate employees. Learn their names and let them know they're doing a good job. And network with other processors to share policies, protocols and resources that benefit all.

"It's been a hard ride," Chavez says. "Every day there's something new. We have to be on top of things. But, here at The Almond Company, we've done a great job with our safety measures and employee education."

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Ag Industry Opposes New California COVID-19 Emergency Regulations

By **CATHERINE MERLO** | *Contributing Writer*

COVID-19 emergency regulations adopted November 19 by California's Occupational Safety and Health Standards Board have drawn protests from a coalition of agricultural commodity groups, food processors and supporting industries.

"There can be no question that these proposed regulations go far beyond the authority of the Board," noted a November 18 letter signed by 25 ag leaders.

They believe the board's COVID-19 Prevention Regulations are unnecessary, unreasonable or unclear. Existing regulations already adequately address workplace standards for protecting employees from COVID-19 and are strictly enforced, the coalition letter said. In particular, the new regulation regarding housing and transportation holds employers responsible for issues outside of their control.

In addition, some of the proposed rules conflict with existing guidelines. For example, the emergency regulation states that "employers shall ensure that [employee] housing units, kitchens, bathrooms and common areas are effectively cleaned and disinfected at least once a day to prevent the spread of COVID-19." This section directly conflicts with guidance from the Centers for Disease Control and Prevention, Cal/OSHA and others, the coalition letter said.

Further, the proposed regulation includes no sunset date directly tied to the COVID-19 pandemic. The ag coalition said it's clear petitioners are using the emergency regulation "as a springboard to developing permanent regulation dealing with infectious diseases." Without the full vetting of a robust stakeholder process, the letter added, it would be inappropriate to convert the flawed emergency COVID-19 regulation into a permanent one for infectious diseases.

Among those who signed the letter were Elaine Trevino of the Almond Alliance of California and Richard Matoian of American Pistachio Growers.

In its 57-page "Finding of Emergency," the State of California said the proposed emergency action was necessary to combat the spread of COVID-19 in California workers. Yet the ag coalition letter pointed out that the board's own staff evaluation concluded the emergency regulation was unnecessary and recommended it be denied.

The new regulations put the onus of COVID-19 prevention on employers, said Roger Isom of Western Agricultural Processors Association. Moreover, the public was given only a week to study the proposed regulations before the November 19 meeting of the standards board.

That was not enough time to review the "extremely complicated" document, said Isom. "We didn't get due process. They are shoving it down our throats."

More than 100 people testified at the November 19 board hearing to oppose the proposed regulation. But for now, it appears the board will move forward with the order. Legal analysis is underway to look for ways to overturn or revise it. But fighting the regulation, including turning to the California Courts of Appeals, could cost up to $1 million and take too long, Isom said.

"We're still trying to figure it all out, but it will be a real challenge," he added.

Read more about the Occupational Safety and Health Standards Board's Proposed Emergency Regulation at dir.ca.gov/OSHSB/COVID-19-Prevention-Emergency.html.

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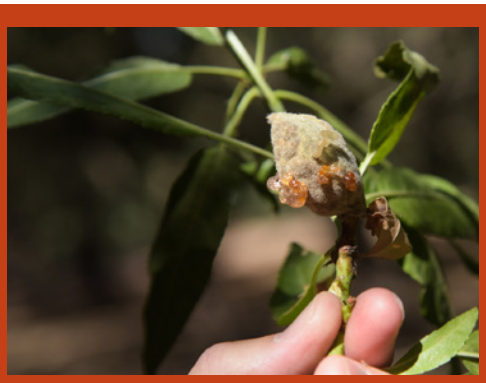
SPRING DISEASES PROVIDE CHALLENGE FOR ALMOND GROWERS

Weather Patterns Can Determine Overall Disease Pressure

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



Profuse gumming on kernels is a symptom of advanced anthracnose infection of almonds. Diseased fruit die and turn into mummies that remain attached to spurs (all photos by F. Trouillas.)

Grayish-black spots on fruit is a symptom of scab infection of almonds. Lesions usually aren't visible until late spring or early summer.

WHEN IT COMES TO MANAGING diseases in almonds, watching the weather can be as important as watching your crop. Especially in the spring, when diseases like brown rot blossom blight, jacket rot, anthracnose and bacterial blast threaten crop health, it is often the weather that determines disease pressure.

"Watching the forecast is critical when it comes to control for all spring diseases," said Florent Trouillas, UCCE Assistant Extension Specialist in plant pathology.

In a typical year, brown rot blossom blight, caused by the fungus *Monilinia laxa*, is the most prominent disease at bloom. It is an outlier of sorts in that it is favored by rainfall but can thrive even in years of low rainfall, according to Jim Adaskaveg, UC Riverside professor and plant pathologist.

"A lot of the new varieties are highly susceptible to brown rot, and it doesn't need much in the way of rain," Adaskaveg said. "It needs some moisture, but spores are windblown, and there is always moisture down in the basal cup of the flower."

Other diseases, however, are very environmentally specific, Adaskaveg said.

Watch the Weather

"With the other diseases, like jacket rot, you have to have the right conditions," he said. "You have to have a really good fruit set, and if it is wet and cool, you can get jacket rot. If you do not have all of those conditions, you will not see jacket rot."

And the same with anthracnose," Adaskaveg continued. "If you are getting two, three inches of rain during fruit development, then most likely you are going to have anthracnose on several of the major varieties like Monterey and Carmel. It is very environmentally specific to high rainfall conditions. And warmer temperatures are more conducive [to anthracnose development] than cooler temperatures."

He added: "If you are getting high rainfall, you should be spraying for anthracnose." If the disease gets a foothold, it can get into the wood of a tree and cause dieback. At that point, growers need to prune it out in the

Continued on Page 36

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offseason, he said.

"If you don't prune it out, it will come back to haunt you year after year," Adaskaveg said.

Cooler than normal conditions at bloom in recent years have led to higher than normal pressure from bacterial blast, a disease that favors frosty temperatures, according to Trouillas, who is based at the Kearney Agricultural Research and Extension Center in Parlier.

In addition to liking cold temperatures, bacterial blast's causal agent, *Pseudomanas syringae*, is very host-specific, Adaskaveg said. "We see it a lot on the newer varieties, the self-pollinating varieties," he said. "We hardly see it on Nonpareil, for example, and some of the older, traditional varieties."

Shot hole is another disease that needs rainfall and/or prolonged periods of wetness to flourish, Adaskaveg said. It hasn't been much of an issue over the past decade or longer, however, in large part because fungicides used to control other diseases have kept it at bay, he said.

"We haven't seen a major epidemic of shot hole in many years," he said.

Once an orchard gets past the early leaf stage and early developing fruit stage, shot hole isn't a threat to current year yields, he added. "At that point, it becomes a cosmetic problem, and it is an indication of what could happen next year with increased inoculum present on the tree, but it rarely causes crop loss once you get into April or May."

Scouting for Disease

When scouting for spring diseases, growers and PCAs should take into account the history of an orchard, and particularly disease pressure the previous year, plant pathologists said.

"If you have a history of disease, then you have to prepare for the season knowing your risk," Trouillas said.

"You have to break it down into what diseases are affecting your orchard and in what location," Adaskaveg said.

Brown spots on fruit is a symptom of advanced jacket rot, also known as green rot, an infection of almonds. The disease can be particularly problematic where nut clusters trap senescing flower parts.

"Your PCA or the grower who has a PCA license and some training can identify these diseases from the previous year. You look for symptoms and see what diseases you have at low levels, and those are the ones I would be concerned with the following year."

Jacket rot symptoms, which include water-soaked brown spots on petals, will show up at the latter part of the bloom period, according to the UC Statewide IPM Program website. Trouillas recommends growers treat orchards at full bloom for jacket rot if conditions are conducive to disease development. Growers should consider continuing treatment until rains cease, especially when there is substantial fruit set and senescent flower parts are caught amongst the developing fruit.

Trees infected with brown rot blossom blight will have flowers that are blighted or rotting. Also, the brown rot pathogen, *Monilinia laxa*, can move beyond the flower into young shoots and twigs and cause a canker.

Flowers can become infected from pink bud to petal fall and are most susceptible when fully open, according to the IPM website.

In most years, one fungicide application at 80% bloom is sufficient to control the disease, Trouillas said. In years of extended bloom accompanied by rainfall, an application at pink bud may be needed, as well.

Cultivars very susceptible to brown rot include Drake, Winters and Wood Colony, Butte, Carmel and NePlus Ultra,

according to the IPM site.

Flowers infected with anthracnose look similar to flowers infected with brown rot, according to the website. To better identify it, look for leaves on infected spurs that have developed marginal necrosis, beginning with water-soaked areas that fade in color. Dead leaves will remain attached to branches. Infected nuts show round, orangish, sunken lesions on the hulls, symptoms that may appear about three weeks after petal fall.

When treating for the disease, Trouillas advised growers to do so at full bloom and to continue treating for up to five weeks after petal fall if conditions are conducive to anthracnose development. High rainfall in May coupled with warm temperatures can also cause anthracnose epidemics.

Shot hole appears as spots on leaves, fruit, twigs and flowers, according to the IPM website. Growers can monitor orchards in the fall and spring for the presence of shot hole by looking for the presence of fruiting structures in shoots and leaves. Fruiting structures appear in the center of leaf lesions as small black spots and can be seen with a hand lens.

Bacterial blast symptoms include burnt-looking flowers, Trouillas said. For treatment, Trouillas recommends growers consider applying the bactericide kasugamycin, or Kasumin, the week prior to a forecast of cold and freezing temperatures at bloom

Finding the Right Fungicide

In general, controlling diseases in almonds is not for the faint of heart. A full 26 diseases are discussed on the IPM website, with treatment timings spanning from the dormant season through June.

"There are many spring diseases," Trouillas said. "The challenge is to have products that have efficacy for a wide diversity of pathogens and to get them on in the proper timing."

When treating for the diseases, Trouillas and Adaskaveg encouraged growers to rotate chemistries and use premixtures when possible.

"I like premixtures, such as a DMI with one of the other groups, like an SDHI or a QoI," Adaskaveg said.

"The QoI fungicides are very good on shot hole as a group," he said. "And all the DMIs and SDHIs are very good on brown rot. So, if you have a mixture of those compounds, you are going to get brown rot and you are going to get shot hole and even anthracnose."

Also, he said, keeping spray numbers down can help slow the buildup of resistance. "In California, we are trying to keep our total sprays at four or five a season," he said.

As for post-bloom sprays, Adaskaveg said he prefers a fungicide with broad spectrum activity. "During the petal-fall period, I would use a broad-spectrum material like chlorothalonil, (tradename Bravo or Echo)," he said. "It is registered with a long PHI (preharvest interval), but it can be used in early spring. It works on anthracnose, it works on shot hole, and it has some botrytis (or jacket rot) activity."

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BACTERIAL BLAST IN ALMOND

PENDING RENEWAL OF KASUMIN BACTERICIDE WILL BE KEY TO DISEASE MITIGATION

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

Bacterial blast infections affect almond varieties depending on their stage of bloom when cold, wet weather hits. The bactericide Kasugamycin acts as a protective layer on emerging green tissues and blossoms and is locally systemic (photo courtesy David Doll, The Almond Doctor.)

IN THE WET AND COLD SPRING OF 2019, the disease bacterial blast blasted almond orchards from Butte to Fresno county, destroying shoots and dormant buds and exposing trees to canker infections. There was no treatment or preventative product allowed for this infection at the time.

By the spring of 2020, a Section 18 emergency registration use in almonds was secured for a bactericide that proved effective against bacterial blast, but warmer and drier conditions limited the opportunities for the bacteria to attack trees. A renewal of the Section 18 registration for UPL's Kasumin has been submitted to DPR and EPA by the Almond Alliance of California. Kasumin is already being used in walnuts for walnut blight control after receiving federal and state registrations in 2018.

Almond growers who previously lost production to bacterial blast and those with vulnerable orchards will be carefully watching weather forecasts this year so they can apply the preventive bactericide if cold and wet weather is forecasted just before or during bloom.

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Disease Conditions and Effects

Almonds are the tree nut most susceptible to bacterial blast as the trees bloom when frost conditions are most likely to occur. Almond shoots exposed to –4 degrees C for two hours have been shown to be more susceptible to blast. Ice-nucleating bacteria and freezing temperatures are major factors in this disease. There is no treatment for this disease after the infection occurs. UC IPM Guidelines report bacterial blast symptoms are shriveled up 'fried' looking blossoms often on twigs that have died back. Additionally, buds can die, and dieback can occur on larger branches as a result of severe infections.

UC Riverside Plant Pathologist Jim Adaskaveg, who has worked on bacterial blast in almonds and assisted the Almond Alliance of California in preparing the Section 18 renewal for Kasumin use in almonds, said outbreaks of bacterial blast are caused by the bacteria *Pseudomonas syringae*. He said the disease was found in 2019 to be most severe in some self-pollinating varieties of almond as well as other cultivars that bloomed during frosty weather conditions. Losses in production in affected trees can reach 30% to 40%, he said.

Bacterial blast infections affect almond varieties depending on their stage of bloom when cold, wet weather hits. In early blooming Independence, Aldridge and Monterey, the disease affects blossoms and leaves which wilt and die. The bacteria, with the right environment and susceptible host, colonize plant tissue damaged by cold weather. Non-bearing trees are also affected, and the subsequent dieback of fruiting wood can delay production. Established orchards can also lose fruiting wood due to the disease, which will affect production for more than one season, Adaskaveg said.

Blast infections of dormant buds result in bud death. Blossoms may wither suddenly and turn dark brown. When there are multiple blasted flowers, the shoot tip may become necrotic and exude gum. Other signs of infection include necrotic flecks on leaves that may have a chlorotic halo around the lesion. Necrotic tissue may fall out to produce a shot hole–like symptom.

Blast infections are most severe in the lower part of the tree canopy and in low places in an orchard where colder air has settled. Growers who experienced previous bouts with this disease now know which varieties of almonds are most susceptible and orchard locations where trees are most vulnerable due to environmental conditions.

Adaskaveg said almond trees that are stressed due to disease are also susceptible to injury from frost and infection with the blast bacteria leading to bacterial canker infections.

Prevention is Key

Some protection from bacterial blast can come from frost protection practices, including use of sprinklers or wind machines to prevent dew or frost from forming. Copper applications can be phytotoxic to blossoms and green tissue, and previous research completed by Adaskaveg has shown that the bacteria that causes bacterial blast is usually resistant to copper. No biological controls are registered for bacterial blast in almonds.

Kasumin's active ingredient, kasugamycin, has a unique site of activity and mode of action, acting locally as a systemic bactericide. Adaskaveg said it is being tested for effectiveness against other bacterial diseases and may be a new tool for growers.

UPL's Joe Vassios said Kasumin is only effective in preventing bacterial blast if it is applied prior to cold and wet weather.

"Strategy is key going into bloom. If the forecast is for cold and wet weather and bloom is imminent, Kasumin should be applied in the orchard. Think of it as a preventative tool, protecting almond flowers from disease," Vassios said.

The bactericide acts as a protective layer on emerging green tissues and blossoms and is locally systemic. Adaskaveg said an application of Kasumin days prior to a rain/frost weather event would protect the blossoms. The product will remain effective in protecting the plant for seven to 10 days following application, and a second application may be warranted if trees are blooming

> **If the forecast is for cold and wet weather and bloom is imminent, Kasumin should be applied in the orchard. Think of it as a preventative tool, protecting almond flowers from disease.—Joe Vassios, UPL**

or close to bloom and another rain or frost event is forecasted.

If the Section 18 renewal is approved, Kasumin can be applied up to two times from bud break until petal fall. It is not allowed after petal fall.

Applications of Kasumin are made at the rate of 64 ounces of product per acre. Adaskaveg said applications with an air blast sprayer were at 100 gallons per acre. Good coverage is a must, he added.

Adaskaveg said it is not as important to hit the tops of the canopies as it is to make sure there is good coverage within the first 15 feet from the ground, which is typically the frost line. Non-producing almond trees should also be treated because infection can lead to canker and lower the production potential of a tree over its productive life.

Vassios said that as the product registrant, UPL has played a supportive role in the Section 18 process and that Adaskaveg and the Almond Alliance have conducted a large amount of work to pursue this Emergency Exemption on behalf of California almond growers.

Adaskaveg said EPA approved the Section 18 renewal for Kasumin for Bacterial Blast in Almonds in January 2020, and a request to renew with the same use rate was submitted in October. At press time, the renewal application was currently under review at EPA, and Adaskaveg indicated that he was hopeful that it will be approved prior to the 2021 almond bloom.

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

Multiple navel orangeworm larvae in a mummy nut in December 2020. (photo courtesy E.J. Symmes.)

GETTING THE MOST OUT OF MATING DISRUPTION

THE NEW STANDARD FOR NAVEL ORANGEWORM IPM

By **EMILY J. SYMMES** | *Senior Manager of Technical Field Services, Suterra*

MATING DISRUPTION FOR NAVEL orangeworm (NOW) has been a commercial pest management option in California nut crops for several years as the 2021 growing season nears. With both continued use and expansion into acres new to mating disruption since 2014, many growers may be multiple seasons into their implementation. For others, 2021 may be the first year of incorporating NOW mating disruption technology into their overall nut crop IPM program. And some may still be considering whether to adopt this approach on some or all of their acreage. As our collective knowledge about the applied use of NOW mating disruption matures, we are in a good place to reflect on lessons learned from several years of real-world applications and case studies. We can begin to shift some focus from, "Why use mating disruption?" (benefits and efficacy have been consistently demonstrated) to discussing best practices for success and how to confidently work within a mating disrupted system.

Adult male navel orangeworm captured in a pheromone trap (photo courtesy Suterra.)

Mechanism of Action

It is important to understand and trust the mechanism of action of mating disruption. Insect chemical ecology as a field of study is not new, with the first insect sex pheromone identification dating back to 1959. Nor is the concept and applied use of mating disruption as an effective agricultural pest management tactic, first demonstrated in 1967. Successful aerosol-based mating disruption technology research efforts date back to the mid-1990s, and commercialized aerosol mating disruption has been available since 1998. But why is this mechanism of action so reliable? The physiology of

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pheromone-based communication among insects and the behaviors elicited are highly specific to a given species, and innately tied to their evolutionary success (i.e. reproduction). For this reason, we are able to exploit this part of their biology for purposes of pest management, reducing populations in a consistent and reproduceable manner.

This confidence in mechanism of action should be equal to that of insecticides, where specific aspects of insect physiology (whether nervous, metabolic or growth system pathways) are targeted, resulting in the desired effect. It is, however, important to appreciate the differences between mating disruption and insecticide mechanisms. Unlike insecticides, mating disruption does not kill the organism outright, but rather reduces the number of viable offspring in the next generation, and as a result, reduces the population potential in all subsequent generations as well. Mating disruption is considered a non-contact approach, meaning that the active ingredient (pheromone or pheromone blend) must only be in the environment at desired concentrations to confuse males and thereby reduce mating and female fertility. Conversely, the insecticides most relied upon for NOW management require direct contact with or ingestion by the pest at the targeted life stage, necessitating exceptional coverage with each application to maximize efficacy. As opposed to insecticides, mating disruption is highly species-specific, which eliminates negative non-target effects to all other organisms and the environment. The action is also specific to males in the case of NOW, which means that it cannot protect from immigrating females that were mated outside of the disruption-treated area. All of these are essential to keep in mind when we discuss evaluating mating disruption within the overall IPM program.

Aerosol mating disruptant device deployed in an almond orchard (photo courtesy Suterra.)

Choosing a Pheromone Product

There are different pheromone delivery system options ("platforms") available, and consideration should be given to which platform best fits your pest management needs and operation. The three commercially available platforms include aerosol emitters, sprayable microencapsulated formulations and medium-density dispensers. Aerosol emitters (one per acre) and dispensers (15 to 28 per acre) are typically placed just ahead of the first flight in spring and provide season-long pheromone mating disruption coverage. The sprayable formulation, currently only produced by Suterra, is the latest in NOW pheromone release technology and is active for up to 30 days. It can be applied using traditional spray equipment (ground or aerial), low or ultra-low volume spray equipment or drones.

The active ingredient (pheromone itself) is the same molecule across all NOW mating disruption platforms and products. However, even within similar product platforms, such as aerosols, it is important to note that not all products are created equally. Co-formulants as well as the device itself (its durability, stability, release mechanism) can result in differences in getting the pheromone out into the environment reliably, and thus the effectiveness of disruption in reducing populations and crop damage. A dependable pheromone

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Wing trap with bait bag lure to capture adult female navel orangeworm (Peterson trap) (photo courtesy E.J. Symmes.)

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delivery system is critical to achieve the mating disruption mechanism of action as described above. The decision on which platform and product is best suited for a given operation should be based on conversations among growers, their pest control advisers and product manufacturer technical representatives to ensure that everyone is on the same page regarding functionality, reliability, labor requirements and expectations for efficacy. Regardless of chosen platform, mating disruptants should always be deployed according to product-specific guidelines, and for aerosols and dispensers, according to the appropriate map layout for each individual orchard block. Most manufacturers offer mapping services, and some offer individually-tailored deployment trainings.

Successful Incorporation into Your IPM Program

Agroecosystems are complex and exist within broader landscapes. The biology and ecology of NOW make it a very challenging pest to manage to the low levels required due to the direct nature of crop damage and aflatoxin contamination potential. For these reasons, it is understood industry-wide that a comprehensive IPM approach is necessary to achieve damage standards. NOW mitigation strategies often require use of all available management tools to one degree or another (mating disruption, sanitation, timely harvest, minimizing other sources of damage and factors that contribute to mummy development, as well as insecticides as warranted by pest pressure and informed by monitoring.) While a valuable component of an overall NOW mitigation strategy, mating disruption, like every other NOW management tactic, is not a standalone magic bullet in every situation.

Adopting any new or evolving technology within an overall IPM program presents a learning curve and opportunities for continued refinement. Consider the pitfalls and adjustments necessary when shifting from broad-spectrum to more selective insecticides; more attention has been required to achieve efficacy based on precision application timings and coverage requirements. With all NOW management tactics, many factors have the potential to impact efficacy and return-on-investment. For developing and evaluating a successful mating disruption program, specific considerations should include block size and shape, area under mating disruption, duration of mating disruption, historical pressure, information obtained from in-season and dormant monitoring, reliability of the chosen mating disruption platform and product, landscape factors, potential for immigration and efficacy of other tactics (e.g. sanitation, insecticides).

When designing and evaluating a mating disruption program, continue to keep in mind the difference in mechanism of action in contrast to insecticides. With this proactive approach, rather than attempting to directly influence mortality of adults or larvae with insecticide applications, we are preventing the larvae from existing in the first place by reducing or eliminating mating and viable egg-laying during the flight. Season-long disruption tactics like aerosols and dispensers are continually "running in the background" to have this impact, but this is not a "set it and forget it" approach. Mating disrupted orchards continue to require comprehensive boots-on-the-ground monitoring programs to evaluate impacts and determine if, where and when supplemental reactive measures like insecticides are needed. These in-season monitoring activities, along with harvest damage evaluations, will inform the degree to which other management tactics can be reduced or even eliminated during the current season or in subsequent years.

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Monitoring NOW within Mating Disruption Systems

Monitoring to obtain knowledge for decision-support is crucial for any IPM program. There are several options for monitoring NOW, and understanding the utility of each method is important in both mating disruption and non-mating disruption orchards alike. Research has shown that a combination of monitoring methods is the best strategy for informing NOW treatment needs and timing. In mating disrupted orchards, the presence of pheromone in the environment impacts male capture in traps baited with pheromone lures; therefore, additional reliance on alternative monitoring approaches is required. Revisiting the basics of each available NOW monitoring method, particularly in the context of mating disruption, is worthy of an entire dedicated article. For purposes of the current discussion, below is a brief summary of how each can be used in mating disrupted orchards.

> **Mating disruption should be considered a long-term investment toward mitigating the negative impacts of NOW populations in agroecosystems.**

Pheromone traps target adult males only and should be deployed in mating disruption blocks to confirm presence of mating disruptant pheromone activity. Significant trap suppression should be observed as long as aerosol and dispenser platforms are present, and for up to 30 days after a Flowable application. Increases in pheromone trap capture can inform best times to apply or re-apply Flowable. Pheromone traps, along with crop damage, are an effective way to evaluate mating disruption efficacy.

Egg traps can be used in mating disruption orchards as they are used in non-mating disruption orchards because female trap location ability is not impacted by mating disruption. Utility of egg traps includes establishment of biofixes, degree day modeling, larvicide timing, and may indicate relative population abundance (block to block, year to year). Egg traps are not an effective way to measure mating disruption efficacy as eggs deposited on egg traps may or may not be viable. Eggs laid by a virgin female are not viable, and produce no larvae.

Kairomone (e.g. bait bag or Peterson traps) can be used in mating disruption

orchards as they are used in non-mating disruption orchards because female trap location ability is not impacted by mating disruption. These traps target adult females almost exclusively and are considered less sensitive than pheromone traps, meaning they have a smaller attractive radius and often catch a much lower total number of moths relative to pheromone traps (where mating disruption is not present and suppressing pheromone trap capture.) Kairomone-based traps remain useful to track female flight activity under mating disruption, and may indicate relative population abundance. It is unclear whether bait bag trap data is indicative of mating disruption efficacy.

PPO+Pheromone traps have been shown in recent research led by USDA entomologist Chuck Burks to be effective for monitoring NOW in mating disruption blocks. Phenyl propionate lures paired in a trap with standard NOW pheromone lures attract both males and females in mating disruption and non-mating disruption orchards, and can therefore be used to track flight activity and may indicate relative population abundance. It is unclear whether PPO+pheromone trap data is indicative of mating disruption efficacy.

Mummy samples and infest rates over the winter should be conducted to help set sanitation priorities and estimate block-specific pest pressure going into the season. This knowledge can help inform mating disruption platform and NOW mitigation strategy choices.

Crop phenology is monitored to determine timing of peak in-season crop vulnerability (i.e. the onset of hull split through harvest), and can be paired with visual observations of egg laying directly on the crop. This window of in-season crop susceptibility is a critical time for potential insecticide applications as well as possible targets for timing Flowable applications.

Harvest damage evaluations are critical to evaluating the overall IPM program. Processor grade sheets provide good information for the grower but may lack in specificity regarding the exact source of the damage. Obtaining and cracking out in-orchard harvest samples provides the best information about sources of crop damage as well as a more accurate measure of crop lost to NOW as NOW-damaged nuts may not make it all the way through harvest processes for grade sheet inclusion.

Evaluating your IPM Program

Determining the efficacy and return-on-investment (ROI) of your NOW program necessitates a comprehensive review of all of the tactics that were employed. For example, were sanitation goals met? Were insecticides applied at the most effective timing(s)

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and was coverage adequate? Were there impacts from NOW immigrating in from surrounding orchards? Did the mating disruption platform and product perform as expected? While there may be a natural predisposition to desire a strict dollars-and-cents ROI analysis from each crop input individually, it can be difficult in practice to distinguish separate impacts, especially for pests like NOW for which multiple management tactics are often used. Research has consistently shown significant reductions in damage in the first year of mating disruption adoption, often recouping the cost of the product and then some in many cases. Remember, however, that a mechanism like mating disruption, which is based on long-term population suppression, will show compounding financial ROI benefits year-over-year with sustained use. There are also the less directly tangible economic and ecological returns from incorporating mating disruption (e.g. resistance mitigation, preserving beneficials, sustainability certifications, etc.) that need to be considered when evaluating this tactic as a crop input.

Stay the Course

Mating disruption should be considered a long-term investment toward mitigating the negative impacts of NOW populations in agroecosystems. Be cautious when considering discontinuing its use, whether due to reduced pest pressure or necessary cost-saving measures based on crop prices or market uncertainties. Consider the longer-term impacts and your investment to date as well as the fact that mating disruption itself is likely a big reason for the downward trend in pest populations. Carefully evaluate whether other types of less desirable or more costly inputs can be reduced while maintaining a disruption environment. Over the course of 2020, we have heard from academics, extension agents, growers and PCAs alike that NOW IPM programs incorporating mating disruption are working to suppress populations and generate quality bonuses, and that we need to continue to keep the pressure on (not let our foot off the gas, so to speak) when it comes to this pest.

Navel orangeworm eggs on an egg trap (photo courtesy Suterra.)

There are many wonderful resources available for growers, operations managers and PCAs to support successful adoption of mating disruption into your IPM programs. Manufacturer technical service representatives, cooperative extension agents and others are readily available to meet with you and help determine the best fit for your operation and how to get the most out of your investment. Best wishes for a successful 2021!

For additional information, the author can be contacted at Emily.symmes@suterra.com.

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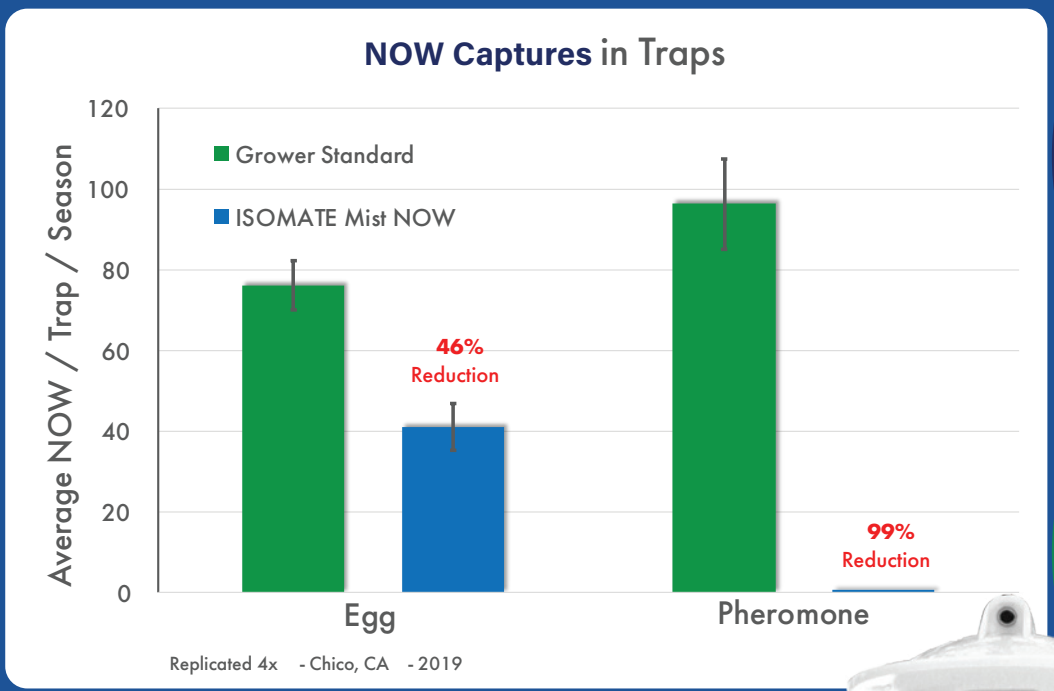

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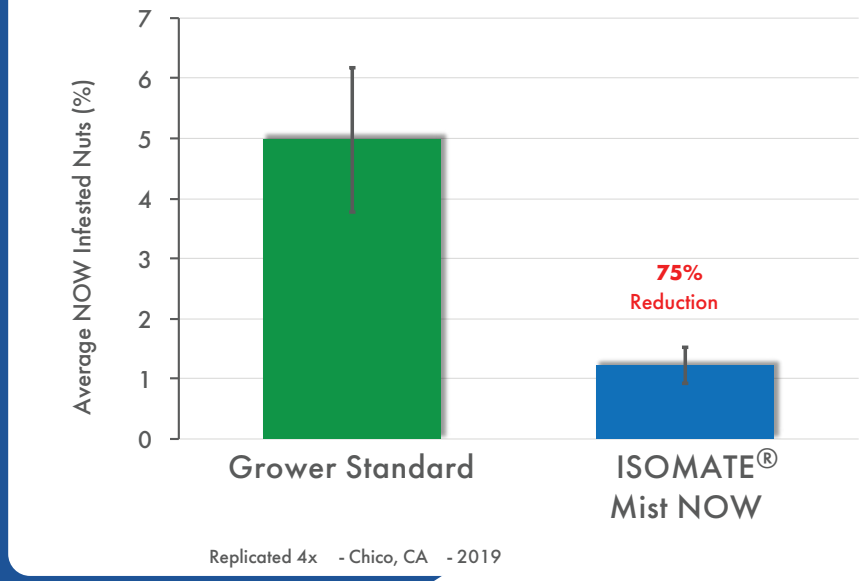

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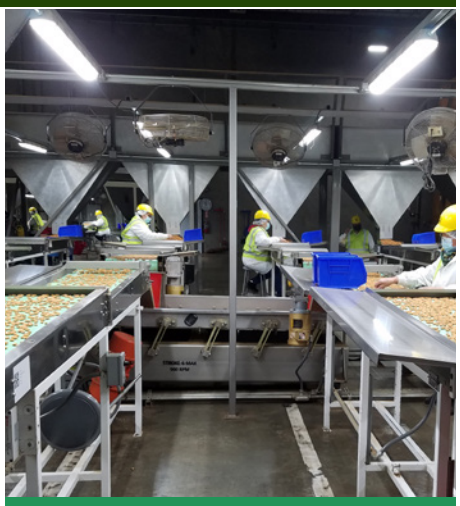
Reports of Lower NOW Damage for 2020

Less Early Pest Pressure and Grower Diligence Help Reduce Overall Damage at Harvest

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

LOW NUMBERS OF NAVEL ORANGE-worm (NOW) at the start of the growing season has been cited as one reason for a trend of lower NOW damage across most of the tree nut sector this year. This is good news considering the complexity of having many more acres of nut trees coming into production across the state and different types of nuts planted in close proximity along with different management styles, including pest control, across all orchards.



Sources reported lower NOW damage at harvest in both almonds and pistachios (photo by Catherine Merlo, contributing writer.)

Adult navel orangeworm, Amyelois transitella, may have three to four adult flight periods per year depending on emergence from the overwintering stage and temperatures throughout the season (photo by Jack Kelly Clark, courtesy University of California Statewide IPM Program.)

Navel orangeworm feeding predisposes nuts to contamination by fungal organisms that produce aflatoxins (photo by Jack Kelly Clark, courtesy University of California Statewide IPM Program.)

Damage Levels

Navel orangeworm, Amyelois transitella, has emerged as the primary moth pest in California nut crops. Without control, successive generations grow larger over the summer and fall, infesting vulnerable nuts. NOW feeding on kernels causes rejection by processors and loss of crop yield and value. NOW feeding also predisposes nuts to contamination by fungal organisms that produce aflatoxins.

USDA-ARS research entomologist Joel Siegel said several factors came into play to lower damage levels in this year's almond and pistachio crops. In almonds, there was low NOW pressure when Nonpareil hull split began, leaving them relatively unscathed.

"This issue was with the pollinators," Siegel said.

NOW pressure did build toward the end of the season and that is where the majority of the damage was sustained. The increase, however, was much less than in past years.

In pistachios, Siegel said hull integrity was good at harvest and kept NOW damage levels lower. Hull split was also delayed, keeping NOW out until just before harvest.

High damage years occur, Siegel said, when hullsplit is earlier and later flights of NOW are larger.

Growers are Learning

More growers are adopting orchard sanitation practices, but as Bob Klein, manager of the California Pistachio Research Board, noted, "It really does matter what your neighbor is doing."

Those growers and managers committed to orchard sanitation in almonds are doing a better job of it, Klein said, but NOW can migrate from orchards where populations have built due to lack of sanitation. Over time, good sanitation will lower resident populations of NOW, and that means fewer of these damaging pests will move into nearby pistachio orchards once the almond harvest is completed.

This year also marks an unprecedented third year in row of low NOW damage in pistachio nuts, Klein reported.

"We've never had three years in a row with low damage, so this was not expected," Klein said. "Growers didn't appear to back off with NOW control after two years of low damage."

There was a bit of an increase in NOW with the second shake, but high quality in the first shake, Klein said. Pistachio growers are incentivized with premiums for lower damage levels and are looking at first shakes to secure that higher price, he said.

Mel Machado, vice president of member relations for Blue Diamond Growers, said total reject levels in almonds are down, but that makes sense with 2020's much larger almond harvest.

As of the last week of November, Machado said that damage was averaging 1%, but that many stockpiles of nuts remain to be processed. Nonpareils are at 1% damage compared to 1.4% in 2019. About 12% of nuts failed to qualify for High Quality Premium designation, compared to 19% in 2019.

Not All was Saved

Nuts that were harvested later and those that took longer to dry on the ground due to lack of sunlight during the wildfires are expected to have more damage. A concern listed by Machado was brown spot coming from large plant bug feeding and ant damage. The higher moisture content of the harvested crop is causing some concern in stockpiles yet to be processed. Machado said huller/shellers expected to be operating into January to sort through the record crop.

Growers who are concerned about the lean prices this year should consider their orchard sanitation costs as the main protection of crop quality, Machado said.

"Be careful which dollar you cut," Machado said.

Late walnuts took a hit from NOW this year, Eric Heidman, vice president of grower services for Diamond Foods LLC, said. Although most of the 2020 California walnut crop was clean, Heidman said that late harvested varieties had about 50% more damage than they did in 2019.

Higher levels of NOW damage were found in second shakes, with a remarkable difference in damage compared to first shakes from an orchard. First shakes were finding NOW damage in the 1% to 2% range, Heidman said, while a second shake three weeks later yielded some loads with nearly 20% damage.

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"WE'VE NEVER HAD THREE YEARS IN A ROW WITH LOW DAMAGE, SO THIS WAS NOT EXPECTED. GROWERS DIDN'T APPEAR TO BACK OFF WITH NOW CONTROL AFTER TWO YEARS OF LOW DAMAGE."- BOB KLEIN, CALIFORNIA PISTACHIO RESEARCH BOARD

Navel orangeworm larvae overwinter in mummy nuts either in trees or on the ground (photo by Jack Kelly Clark, courtesy University of California Statewide IPM Program.)

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There was even a slight uptick in NOW in the Chandler variety, which normally has only 0.5% to 1% NOW damage.

NOW damage was most noticeable in walnuts grown in the southern San Joaquin Valley, but Heidman said Chico area orchards also sustained late damage from this insect pest.

Warm and dry weather throughout September and October likely contributed to more NOW flights over the growing season and higher pressure at harvest.

According to UCCE IPM guidelines, two cultural practices — effective removal with destruction of mummy nuts in fall or winter (sanitation) and early harvest with rapid removal of nuts from the orchard floor — are essential components of an effective NOW control program.

Without sanitation and other controls including mating disruption, insecticide treatments may be necessary to knock down high NOW levels in an orchard. When other tree nut orchards in close proximity are harvested, NOW may migrate into orchards that still have a crop and do their damage.

The guidelines suggest that treating border rows (at least 10 rows) may be adequate to prevent the moths from infesting the almond crop when NOW numbers are low to moderate in a given area. Sprays are timed using egg traps or pheromone traps in conjunction with degree-days and monitoring hull split.

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PEST AND WEED EXPERT JOINS THE ALMOND BOARD TEAM

NEW POSITION WILL PROVIDE OPPORTUNITY FOR ADVANCEMENT IN IPM TECHNIQUES

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

Drew Wolter had his sights set on joining the Almond Board of California (ABC) long before he was hired as the Senior Specialist in Pest Management.

As a graduate student at UC Davis, Wolter conducted research on almond production systems, much of which ABC supported, and his job with UCCE as a junior specialist in 2018 was also partially funded by ABC. These experiences gave Wolter an inside look at both ABC's commitment to California almond growers and the broader industry as well as the people and culture that make up the organization.

He was suitably impressed.

"Since the beginning of my graduate education, I had the goal of joining the Almond Board," Wolter said. "I really wanted to be part of a grower-oriented establishment that looks to keep growers profitable while minimizing the environmental impact of almond production."

ABC's Chief Scientific Officer Josette Lewis said that as part of the Almond Board's Research and Innovation team, Wolter will play a key role in developing the next generation of Integrated Pest Management (IPM) techniques, from pest monitoring technologies that improve precision beyond calendar-based applications to biopesticides and new weed management options. He will also assist in creating outreach materials and learning opportunities that encourage grower adoption of well-tested IPM practices that underpin the industry's Almond Orchard 2025 Goal to increase environmentally friendly pest management practices by 25%.

"Drew will spearhead our pest management research to equip growers and PCAs with the best information and tools that will support our industry in producing high-quality almonds both profitably and sustainably," Lewis said. "He will also join ABC's Field Outreach and Education team to help get those tools in the hands of growers."

Tom Devol, ABC's senior manager of Field Outreach and Education, said Wolter is a welcome addition to the team, which works closely with growers throughout the Central Valley, providing hands-on, in-orchard support as well as connecting growers with experts to address various management problems.

"Drew adds a great skillset to the Field Outreach and Education team, one that I know will be great for our growers," Devol said. "Drew's work with UC ANR also brings a depth of knowledge that comes from working with farm advisors across the state—his knowledge and expertise is going to be a big help to our growers in the areas of pest management and weed control."

"Even though he just started, it feels like he has been on the team for a year," Devol added. "He really embodies the mindset of industry service that runs through the veins of this organization."

Delivering Pest Expertise to the Orchard

When asked what pest and weed challenges he's most excited to take on, Wolter ticked off a long list of familiar issues for almond growers: navel orangeworm (NOW), web-spinning mites, leaf-footed bug, brown marmorated stink bug, Alternaria leaf spot, hull rot and bacterial blast.

"Our objective is to help growers and PCAs combat these pests by developing cultural and biological pest management control options, improving monitoring systems and finding innovative technology that helps our industry manage pests in ways that minimize the overall environmental impact and keep pests under economic thresholds," Wolter said.

As an example of innovative technology up for consideration, Wolter cited the potential to use an electrostatic current to control weeds--essentially zapping weeds--as well as the use of super-heated air to control weeds, as is done in the grape industry.

He also is enthusiastic about new biological control options such as the use of peptides to control pests in the order of Lepidoptera, including NOW.

In December, Wolter received his master's degree in horticulture and agronomy with an emphasis in weed science from UC Davis. He looks forward to sharing the knowledge he's gained as a researcher with growers in practical ways that allow them to easily apply certain methods in their orchards.

"With my background in ecology, I look at the biology of the pest together with the environment and crop to add new approaches to the tried-and-true conventional tools for pest management in almond orchards," Wolter said. "Further, my specific background in weed science will help our ABC team find new ways of thinking about orchard floor management

Drew Wolter was recently hired by Almond Board of California as the Senior Specialist in Pest Management.

by focusing on the biology and phenology of weed species while simultaneously looking to introduce technology and/or products that minimizes the use of conventional herbicides."

While some common applications used to control weeds – specifically, glyphosate and glufosinate – face growing regulatory scrutiny in the U.S. and abroad, Wolter is looking forward to assisting growers in finding alternatives that are effective and affordable. In fact, Wolter has already hosted a webinar on post-harvest weed management that provided growers with insights into how to create their own Integrated Weed Management plans and effectively scout for weeds.

"Proof of concept is key, from a management and efficacy perspective, and an economic perspective," Wolter said. "In my time at the Cooperative Extension, I spent a lot of time working with growers – that was the most exciting part of my job – and I look forward to doing so again in this role, helping growers find solutions that are best suited for their individual orchards."

At The Almond Conference 2020, Wolter hosted a panel discussion on weed control, during which he provided detailed information on how to create weed control goals for each orchard, how weed management fits into the bigger picture of an orchard's IPM strategy and more. Growers interested to view a recording of this session are invited to access "The Almond Conference 2020" video playlist on ABC's YouTube channel. All recorded Conference sessions are available in this playlist.

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

Nutritional Demands for Tree Nuts

Feed Trees Early to See Full Yield Loads in the Fall

By **RICH KREPS** | *CCA, SSp, Contributing Writer*

Fertigate early and often to build those feeder roots over winter.

AS THE LIQUID GOLD FALLS FROM THE heavens in December and January (we hope!), tree nut farmers get a bit of a reprieve from the crazy schedules spring will deliver. We pistachio farmers still make our daily pilgrimage to the computer to check our chilling hours, making sure the requirements will be met. Almond farmers keep a close eye on the temperatures to make sure a deep freeze isn't in the forecast, ruining those delicate, precious little buds so close to bloom. Pecan and walnut farmers laugh at us a bit as they typically have a little less to worry about. It's in this time we often overlook the fact that the ground may not be much below 50 degrees F (if at all) and the roots are still active, although a bit sluggish. Don't forget about them.

As we probe the soil in an early attempt to see what Mother Nature may have already cleaned up in our winter leaching events, we often see those little white hair roots emerging from our main root systems. Energy is being used to push those hungry little growths into our soil. This often requires phosphorus and lots of carbon. Carbon can be thought of like the arms of a quadropus. Okay, I think I just made that up because an octopus has eight arms. Carbon only has four. Those four symmetrically charged and balanced connection points are what makes life happen. Biology feeds on it. Nutrients attach to it. Sugar and fat are made from it. Fungi break down detritus into organic matter which in turn holds more water and nutrients. And fittingly enough, the Good Lord has perfectly created the system whereby the exudates roots secrete are full of it. This feeds the beneficial soil biology which in turn mine and etch the mineral nutrients, allowing them to assimilate into the plant's vascular system. The whole process is pretty elaborate. We always seem to focus on the 17 nutrients we classify as essential. However, none of it happens without carbon, hydrogen and oxygen, mostly in the form of CO_2 and water; 95% of a plant's makeup.

But the phosphorus is much more difficult to come by. Life needs phos-

> **"The quicker a tree's nutritional demands are met, the better chance we have of realizing optimal yields. It takes a bit more effort, but isn't that what we typically do as farmers anyways"**

phorus to create ATP to fuel the fire of life. The problem arises when we realize our fertilizer forms are, typically, mostly polyphosphates that a plant cannot drink. Polyphosphates can break down into orthophosphate in as quickly as four days…in July. What about the cold soil temperatures of January through April? It can take as long as 100 days to cleave the polys into ortho. Furthermore, biology, which drives the transformation, isn't as active or as reproductive in the cold, anaerobic spring. So, what do we do?

Hedge your bet. Start earlier. I'm not saying turn the pumps on and run 24-hour sets. I'm saying use your system to fertigate early in short shots. Apply small amounts of orthophosphate materials. Trees need N and P early for bud break. Our nutrient demand curves tell us that. N and P trend down as the season progresses, unlike calcium, potassium and magnesium that trend up. If we did a good job of replenishing our trees post-harvest, focus on the P. Most of the tree's N demand can be met with the amounts the trees stored in their roots over winter. If not, add a little. By a little, I'm only talking five to ten units, max. Not to beat a dead quadropus here, but applying too much P early (more than a plant can drink in a day or two) will just tie up all that excessive, stable calcium we may have used to amend the soil in the fall. If a tree's P demand is typically 10% of its N demand, those early shots of polyphosphate fertilizers totaling 30 units or more are very ineffective. It needs to be spread out over a few months. When it's cold and wet, it has to be in a form that a plant can actually drink.

Go a step further. Add some carbon. Humic acids, sugars, carbohydrates, etc. all help to feed the plants and the soil biology. Give the roots extra carbon for the spring push. Take one more step. Add some active biology to the soil. When we fertigate, the well water is quite a bit warmer than the soil. Adding some extra biology with a little heat will get things moving in the root zone a bit quicker. As much as we don't want to apply any more of that liquid gold than we have to, using it to get early nutrition at a critical time will get things off to a good start. The quicker a tree's nutritional demands are met, the better chance we have of realizing optimal yields. It takes a bit more effort, but isn't that what we typically do as farmers anyways? Sometimes, we have to work a little bit harder and smarter, but seeing more full loads in our orchards in the fall make it all worth it.

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Ideal canopy is compact and upright and under 15 feet in height (all photos by C. Parsons.)

Canopy Management in Pistachios

Mechanical and Hand Pruning Can be Used to Produce Quality, Consistent Annual Crops

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

THERE ARE TWO REASONS TO TRAIN AND PRUNE A TREE: TO facilitate orchard operations, primarily harvesting, and to produce annual quality crops by controlling alternate bearing.

For the first five years in the ground, canopies are being trained with a mixture of heading and training cuts; the objective is a tree that eventually intercepts maximum light infiltrating the canopy. When trees begin to produce a harvestable crop in years six through eight and full bearing, pruning helps maintain a canopy that intercepts maximum light and produces efficiently harvestable annual quality yields.

Beginning at years six through eight, a pistachio tree benefits from canopy management to capture light and facilitate photosynthesis, keeping the tree trunk accessible to harvest equipment without contacting the branches, controlling canopy height and volume, directing branch and shoot orientation, and producing new bearing surfaces, all with net profit in mind.

"Quality, harvestable yield—how much net return per square foot of orchard floor—should drive canopy management," said Louise Ferguson, UC Davis Department of Plant Sciences and a long-time researcher in pistachio production. Ferguson's presentation on canopy management was part of UCCE's annual Pistachio Short Course.

"The major reason for pruning a mature tree is to produce harvestable annual yields," Ferguson said.

An ideal, efficiently harvestable canopy is compact and upright, under 15 feet in height. The trunk is accessible to the shaker head, scaffolds are upright, short and stiff, and do not interfere with one another or contact the harvester. Trunk shaking transmits force best vertically, less well horizontally and poorly in a downward direction. Therefore, harvest is more efficient on upright branches closer to the trunk axis. Research done by UC engineers and Ferguson demonstrated most nut removal occurs within the first six seconds of shaking. Shaking will not increase harvester efficiency, but pruning to direct branch growth upward, having the crop closer to the tree axis and removing flat branches will.

Hand Pruning

Canopy management, specifically a combination of mechanical and hand pruning, can also be used to produce good quality annual crops and control alternate bearing.

Canopy management can be done by hand or mechanically, but Ferguson noted that even with mechanical topping and hedging, some hand pruning is needed. The advantage of hand pruning is precision. Disadvantages include high cost of labor, time and difficulty teaching correct technique. Mechanical pruning is less expensive and decreases alternate bearing, but cuts are indiscriminate. Although hand pruning is better horticulturally, the decision to use either method of canopy management must be based on sustainability and economics.

Hand pruning for canopy management requires some basic knowledge and understanding of the right tools for the job. Hand pruners must know the difference between fruiting bud and vegetative bud, and recognize the transition on a branch. They must also know the crop is borne on one-year-old wood and understand the apically dominant growth habit of the pistachio tree. And they must know the difference between a heading and thinning cut, and the response from each. Hand pruners must also recognize the tree shape desired.

Ferguson outlined four steps in hand pruning canopy management with hand tools. The first step, using loppers and saw, is removal of low, flat overlapping broken branches that won't shake. These are thinning cuts. Second, outside thinning cuts are used to push the canopy up and closer to the tree by thinning branches growing outward using loppers and pole pruners. The third step is performing inside thinning cuts with loppers and saw, the on-productive 'snakes' that grow up through a tree, branch at the top and block light in the canopy. Finally, whips at the top of the canopy are tipped using pole pruners; these are the heading cuts.

> ***The major reason for pruning a mature tree is to produce harvestable annual yields.***
> *- Louise Ferguson, UC Davis*

Mechanical Pruning

Mechanical pruning uses annual topping to control tree height in every other row, every other year hedging for light interception. If needed for light interception and air circulation, every-other-row middle cross hedging can also be done. Mechanical pruning should be followed by limited hand pruning, specifically steps two and three detailed in the hand pruning directions above; thinning cuts to remove low flat branches that do not shake well and interfere with the harvester and thinning cuts within the canopy center, the 'snakes' that block light.

Ferguson cited retired UCCE Kings County Farm Advisor Bob Beede's mechanical pruning trial conducted from 2012 to 2017. The data reaffirmed

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Mature pistachio trees benefit from canopy management to capture light and facilitate photosynthesis.

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an earlier trial's demonstration that mechanical pruning can mitigate alternate bearing in trees on an Atlantica rootstock by topping and hedging before the low crop year. Beede's trial had Kerman scions on seedling rootstocks, such as *P. atlantica,* Atlantica; P. *integerrima,* PG1; *P. integerrima x P. atlantica* PGII; and P. *atlantica x P. integerrima,* UCB1.

Beede's data demonstrated an interaction between rootstock and mechanical pruning that affected alternate bearing. First, alternate bearing was most severe in the trees on the following rootstocks in this order: Atlantica, PGI, PGII and UCBI. In trees on seedling Atlantica and PGI rootstocks, alternate bearing was decreased by about 50% with mechanical topping and hedging before the low crop year.

Trees on the hybrid seedling PGII and UCBI rootstocks had much lower alternate bearing (about 60% lower) than trees on the seedling Atlantica and PGI rootstocks, and the timing of topping and hedging, before the on or off year, had no effect on the severity of alternate bearing. This suggests the vigor imparted by the hybrid rootstocks has the ability to mitigate the individual shoot level alternate bearing in the Kerman scion. However, the rootstock does not affect the bud abscission within an individual shoot that produces alternate bearing when the shoots on a tree synchronize. Rather, it appears the rootstock and the mechanical pruning produce a more even ratio of fruiting to non-fruiting shoots within a canopy, decreasing the tree's alternate bearing.

Timing and Cuts

Timing of pruning mature trees for canopy management is important. It is important that dormant pruning be done before the lateral bud break suppressing plant hormone, auxin, is produced in the apical bud. When the apical bud begins to break dormancy, auxin is released and starts suppressing bud break of lateral buds. Auxin is a hormone that is a control chemical used to obtain food and or nutrients. Auxins are produced in the stem, buds and root tips to maintain apical dominance. They also enforce dormancy of lateral, sub-terminal, vegetative buds. Removing apical buds stops the auxin distribution that inhibits lateral vegetative bud break. This means pruning should be done before the apical bud begins to break dormancy.

Heading cuts, Ferguson explained, are when the shoot is cut in half and the basal portion with fewer buds remains. A heading cut removes stored carbohydrates, subtending and proximal shoot growth, and alters the carbohydrate to bud ratio, encouraging vegetative bud break of the remaining buds and producing branching and new fruit bearing growth. Thinning cuts remove the entire shoot at the base. There is less of a response from the tree, and the canopy is thinned, allowing more light penetration. A thinning cut enhances subtending shoot growth, forcing the canopy upward.

The cost differential between hand and combined hand and mechanical pruning is approximately 50%.

Ferguson concluded with stating she will never argue that hand pruning is horticulturally better, or that larger trees produce higher yields. But she noted that mature tree canopy management is just that: management. Decisions should be made on the basis of logistics, when and how you can successfully get your orchard pruned during the dormant season, how it affects efficiently harvestable yield, and the net return.

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Hazelnut Society Winter Meeting Goes All Virtual for 2021

By **HAZELNUT MARKETING BOARD**

The Nut Growers Society includes Oregon, Washington and British Columbia growing areas (all photos courtesy Hazelnut Marketing Board.)

ONE OF THE LONGEST-STANDING traditions in the Oregon hazelnut community will look a little different this year. Set for January 21, the 106th Annual Winter Meeting will be all-digital for the first time in history.

Held annually each January, the Winter Meeting is the seminal event on the Nut Growers Society of Oregon, Washington and British Columbia (NGS) calendar. The one-day conference typically brings together upwards of 1,000 hazelnut community members, from farmers to handlers, to sponsors and vendors. Due to pandemic-related restrictions, the conference will now be conducted online via live stream, but the NGS board members and staff have still worked to bring together the best minds and most up-to-date information for growers.

"This year has brought us unprecedented challenges, but the NGS board has done a fantastic job adapting and taking this one step at a time," says NGS president Jason Perrott. "We have been able to secure all of the speakers we originally wanted when this event was going to be in person, and we think we have the best lineup possible for this time in our industry."

Event Features

The event will be a unique combination of pre-recorded presentations and live interaction. Twelve speakers recorded their presentations in advance of the event; these videos will be played at their respective times on the agenda, but the speakers will also be available for a virtual Q&A session after their presentation. Viewers can type their questions into a virtual chat feature, and speakers will answer them after their pre-recorded presentation plays.

Presentations will include: Legislative Outlook for the Oregon Hazelnut Industry; Promotional Efforts, Marketing and the Current State of Tariffs; Research Updates from Oregon State University; USDA/FSA and the Oregon Hazelnut Industry; Hazelnut Pricing Report; De-Rocking a Hazelnut Orchard; OSU Hazelnut Breeding Plot Tour.

In addition to the educational seminars, NGS has created a new feature they hope will become a hallmark of the event—the Seasoned Growers Corner. The NGS team visited with three growers to share their knowledge and wisdom about the hazelnut industry; information from these growers is imperative for historical information and educating new orchardists.

The other cornerstone component of the Winter Meeting, the trade show, will also look different. Sponsor and vendor contact information along with direct website access and company video will be listed in the new Sponsor/Vendor Directory located on the NGS "Growers Corner" website (oregonhazelnuts.org). Sponsors and vendors will be recognized throughout the meeting in between each presentation.

NGS members will receive a link to the event via email in the first part of January. Current membership is required for access. Viewers can watch the sessions on any internet-enabled device, from desktop computers to smartphones. Attendees can also pick and choose which sessions they would like to view; for example, attendees can view the 9 A.M. session, log out to get a few chores in and log back in for the 1 P.M. session. Additional Winter Meeting information and an agenda will be coming out in the NGS Winter Newsletter in the first part of January.

"We are excited to try the event this way," Perrott said. "We hope to be back to our traditional in-person meetings in the near future, but we knew we had to do something for our growers. There is too much valuable information that needs to be shared with our community."

For more information on the Winter Meeting, Nut Growers Society or membership, contact 503-582-8420 or juli@oregonhazelnuts.org.

Twelve speakers will be featured during the virtual conference on topics related to production research, legislation and marketing.

The Nut Growers Society Winter Meeting will be all virtual this year in lieu of the traditional in-person trade show.

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Integrated Pest Management in Hazelnuts

Monitor for Pests and Treat Based on Economic Thresholds

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

INTEGRATED PEST MANAGEMENT (IPM) in hazelnuts starts with monitoring and identifying pest pressures for significant pests, assessing the presence of natural predators in the orchard, and then choosing the most selective, least impactful approach to managing these pests based on economic thresholds.

Identify and Monitor

Learn to identify pests that are causing damage (extension agents are a great source for help in identification.) Learn the life cycle of pests, when to disrupt the cycle and how best to do that.

Once you have identified pests, such as the filbertworm moth, check for the telltale band of iridescent copper coloring across their wings, monitor the moth numbers using pheromone traps. According to Oregon State University (OSU) Extension, filbertworm moths begin flight and damage as early as late May in the Pacific Northwest. There may be two generations of moths per year, and damage to nuts can continue through fall harvest in September and October.

Begin monitoring with traps by late June. Place traps in the upper third of the tree canopy. Use four traps for the first 10 acres. Add another trap for each additional four acres. Do weekly trap checks. Once pests are detected, increase trap checks to twice a week until it is time to use pest control tactics such as pheromone disruption or pesticides.

Evaluate

Results from monitoring will help answer questions such as, "Is this the pest that's causing damage?" Filbertworm damage is obvious since the worms leave small exit holes in nuts. If the worm hasn't yet chewed its way out, inside the shell you'll find frass (worm poop), a damaged kernel and a light-colored worm with legs— not to be confused with filbert weevil larvae, which are cream-colored, less worm-like, more grub-like and legless.

The next questions to ask: "Is there enough evidence of the pest, and is the damage extensive enough that I need to take action?" A few filbertworms aren't worth the cost of spraying pesticide, but if the evidence points to a larger infestation, it's time to take action. Choose the preventative measure that will cause the least damage to beneficial insects to maintain their presence and prevent secondary pest issues.

Prevention Where Possible

Take preventative measures whenever possible. For example, paint trunks of young trees with white paint to deter Pacific flatheaded borers. Although the paint doesn't kill borers, it does irritate them, which will encourage them to move on to a less hostile environment to lay their eggs. Adult borers are red

bronze with copper-colored spots on their wing covers. They are a fairly large insect at a quarter-inch to half-inch long with large eyes.

Pacific flatheaded borders have good eyesight and home in on trunks or bark with sunscald or physical damage from equipment. The Pacific flatheaded borer larva's head is flat and large in comparison to its 0.5-inch body. Female borers lay eggs on the bark of trees. Borer larvae burrow into the wood and feed on the cambium. The grubs can girdle and kill trees.

Filbertworm pupa overwinter in grass or mulch. Raking around trees during winter exposes the pupae to deadly freezes. The Oregon Hazelnut Commission funded an OSU study which is looking at the benefits and drawbacks of winter flailing to control filbertworm.

Carefully select preventative treatments, but don't put all your nuts in one basket. Chances for success increase if you use more than one tactic. When chemical pesticides become necessary, give preference to the most selective options.

Set an action threshold – if two to three filbertworm moths are showing up in your traps, for example, or five moths in any single trap, then you know it's time to act. If pest populations remain low or decrease, further treatments may not be needed. If pest numbers increase past the threshold number, try another IPM tool.

Preserve Beneficials

To take IPM a step further, while monitoring pests such as filbert aphids and hazelnut aphids (filbert aphids are pale white or yellow, hazelnut aphids are darker), also monitor for beneficial insects such as lacewings and ladybugs, also called ladybirds. Both insects have a voracious appetite for aphids. Learn to identify ladybug larvae, also called ladybug dragons or ladybug lions. They eat even more aphids than the adults. Like most insects, the larvae of ladybugs don't look like the adults. Ladybug larvae look more like tiny crocodiles. They are elongated, spiny and dark with bright stripes or spots ranging from yellow to orange and red.

If you have a healthy balance of pests and beneficial insects in any given year, you may not need to spray, or you may not need to spray as often, saving money in both labor and chemical costs.

"For IPM, there's a threshold number for the bad bugs we have as an industry," said Jeff Newton, farm manager for Crimson West/Christensen Farms in McMinnville, Ore. "Take aphids, for example. We count them and come up with an average per leaf."

OSU extension offers the following guidelines for aphid counts: Start sampling when leaves have fully developed. Take samples every other week, three terminals per tree is ideal. Look at the newest fully expanded leaf on each terminal. Sample 20 trees for each two to four acres of orchard. Take action when you count an average of 20 aphids per leaf in April; 30 aphids per leaf in May; 40 aphids per leaf in June and July.

"If we get too many aphids, we spray," Newton said. "At the same time, we're watching the predators. If you don't have any predators, you're probably going to spray a little sooner."

How can you tell which are the "bad bugs" and which are the "good bugs?" When looking for natural predators for aphids or spider mites, for example, one rough rule of thumb that Newton follows is the speed at which an insect moves.

"Predators run around fast," Newton said. "If it's running around, it's a good guy. Predators have to be fast enough to catch their prey. The bad ones just sit there sucking on the leaf."

Spider mites and their predators are so small that it generally takes a magnifying glass or microscope to do an accurate count, although they aren't too small for ladybugs to see. Ladybugs and their larvae eat mites and scale insects as well as aphids.

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

Preparing for the Expected and Unexpected Changes in 2021

Make Sure Existing and Future Regulations are Being Met

By **THERESA KIEHN** | *Acting President and CEO, AgSafe*

THE 2020 SEASON WAS DEFINITELY ONE FOR THE HISTORY BOOKS. To say it was challenging does not even begin to scratch the surface of the issues the nut industry faced this year. However, perseverance has prevailed and now is an opportune time to wrap up 2020 and develop your plan of attack for 2021.

End of Season Employment Documentation

As you are terminating employment of your seasonal workers, ensure you are following your company protocol, individuals receive the appropriate information and that it has been accurately documented. AgSafe highly recommends you develop a checklist to ensure compliant departure; however, if you do not have one, please contact the AgSafe team and we would be happy to assist.

Your checklist should at a minimum include the following:

- Provide final paycheck and include unpaid vacation, PTO, other benefits
- Provide Final Paycheck Acknowledgement Form, signed by the employee
- Provide copy of Change in Relationship Form, signed by the employee and company representative
- Verify employee's mailing address
- Provide For Your Benefit (California Employment Development Department Form 2320)
- Provide company retirement plan paperwork (if applicable)
- Collect any company equipment (if applicable)
- Move Form I-9 to inactive file

Paperwork Refresh

The start of a new year is when many government agencies update employment forms. Agencies expect employers do their due diligence to ensure they use the most current forms available. As such, it's a good idea to double-check and make sure that you are using the most current version of the following:

- Form W-4 (IRS)
- Form I-9 (USCIS)
- Farm Labor Contractor Registration Application/Renewal
- Form: WH-520 (USDOL)

It's also important that you update terms of employment if you will be making any changes, including compensation as minimum wage increases. Employees should receive a current Notice to Employees (California Labor Code 2810.5) with wage rates and other applicable benefits. It is also a good opportunity to ask workers if they need to update their Emergency Contact Information, ensuring you have the most current details should a situation arise.

New Employment Requirements

Before many of us had COVID-19 on our radar, a number of

new regulations came online in 2020 that require time and attention on your part. First and foremost, ensure your operation is compliant with Sexual Harassment Prevention and Abusive Conduct Training. As a reminder, supervisory employees needed to have completed a two-hour training and non-supervisory employees a one-hour training by Jan. 1, 2021. For additional details on this regulation and required training topics, visit the California Department of Fair Employment and Housing at dfeh.ca.gov.

Your To-Do list should also include registering for the CalSavers Retirement Saving Program. The deadline of Sept. 30, 2020 has already passed for employers that have 100 or more employees. California employers with 51 to 100 employees need to register by June 30, 2021, and those with 5 to 50 employees are required to register by June 30, 2022. Employers who already offer an employer-sponsored program are exempt, however they need to be certified through the online registration process. If you do not register your employees within 90 days of the deadline, there is a fine of $250 per eligible employee. The fine increases significantly to $500 per eligible employee once you are 180 days past the deadline. To learn more about CalSavers and to register, please visit calsavers.com.

And finally, be sure to incorporate the new safety standards into your Injury and Illness Protection Plan. This year, the Outdoor Agricultural Operations During Hours of Darkness was initiated as well as the Wildfire Smoke Protection Emergency Standard. Both of these regulations, along with the COVID-19 Prevention Emergency Standard, should be thoroughly reviewed by your team and the elements of the regulations implemented into your safety practices. If you need assistance with developing your safety protocol and trainings for these new standards, be sure to contact the AgSafe team for assistance. Additionally, it would be wise to inventory your personal protective equipment and ensure you are able to secure your safety equipment for next season. As we all know, sourcing N95s was almost impossible during the summer and harvest, but it provided an important lesson in being prepared for the unexpected.

Winding down the busy season can be made much smoother, and the start of next year much easier, by considering these simple but effective steps. For more information about worker safety, human resources, labor relations, pesticide safety or food safety issues, please visit agsafe.org, call (209) 526-4400 or email safeinfo@agsafe.org.

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

New rules around Outdoor Agricultural Operations During Hours of Darkness are among the new regulations growers need to be aware of going into 2021 (photo by AgSafe.)

COLLABORATION IN THE CALIFORNIA TREE NUT INDUSTRY

PANEL OF INDUSTRY LEADERS ACROSS NUT CROPS EXPRESS UNITY AND OPTIMISM DURING CALIFORNIA TREE NUT CONFERENCE

By **TAYLOR CHALSTROM** | *Editorial Assistant Intern*

LEADERS WITHIN THE CALIFORNIA TREE NUT INDUSTRY EX-pressed confidence in the industry's future during a rare meeting of the minds between the industry's top executives.

In a recent panel discussion during *West Coast Nut* magazine's California Tree Nut Conference in November, top industry executives for four tree nut commodities—almond, pistachio, walnut and pecan—came together to discuss issues that the industry is dealing with now and what the future holds.

The executives in attendance were Richard Matoian, president of American Pistachio Growers; Michelle Connelly, executive director of California Walnut Board; Emily Fleischmann, vice president of global marketing for Almond Board of California; and Mark Hendrixson, president of California Pecan Growers Association.

Collaboration is Necessary

Making sure that all segments of the tree nut industry are in tandem with each other is key to succeeding now and in the future. Connelly said, and the executives agreed, that the industry as a whole is "stronger when it works together."

"When it comes to ways that we've collaborated over the years, we have and will continue to collaborate," Connelly said. "We have jointly funded research to continue supporting vital resources for the industry."

A large area of collaboration is funded research into nutritional assets of nut crops. The International Tree Nut Council Nutrition Research & Education Foundation is the main organization that the industry collectively puts money into to study nutrition and health, according to Matoian.

"The goal behind that group is to represent the tree nut industry collectively in the areas of nutrition and health research," Matoian said. "We feel that by putting our monies together [here], we can do a whole lot more than we could individually. Our commodities have a lot of similar properties that are beneficial to nutrition and health, even though we have our own areas that we stand out in."

While nutrition and health research is a major point for collaboration, the tree nut industry works together in *every* aspect to promote and further the entire industry.

"When there are various issues or topics that come up and cut across all of our commodities, we end up talking with one another," Matoian said. "What generally affects one affects all of us."

Current Regulatory Issues

The agriculture industry as a whole experiences endless regulatory issues, and the tree nut industry is no different. The executives noted that the hardest-hitting regulations for the tree nut industry relate to water, food safety and pesticides.

Concerning water regulations, the Sustainable Ground-

Continued on Page 72

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Nut industry executives, from left, Richard Matoian, president of American Pistachio Growers; Michelle Connelly, executive director of California Walnut Board; Emily Fleischmann, vice president of Global Marketing for Almond Board of California; and Mark Hendrixson, president of California Pecan Growers Association, shared their thoughts on the future of the nut industry.

Continued from Page 70

water Management Act, according to Matoian, is a topic that has consistently been on growers' minds. The act went into effect at the beginning of 2020, and growers "likely won't see results for the first few years while it is slowly being implemented," Matoian said.

"Water is going to continue being an issue in California for years to come," Fleischman added.

Food safety is another regulatory issue, and as is the case with regulations in general, cost is a main consequence.

"One example [for food safety] that I can think of are growers that may be looking to roast nuts instead of sell them raw," Matoian said. "Once you roast, that now puts you into the Ready to Eat category, which brings on much greater regulations and higher standards."

It all comes down to cost," Matoian continued. "The cost for implementing more food safety regulations and having a food product that is ready to eat by the consumer will be higher. You have to have the proper kill step for the various pathogens that are out there."

Pesticide regulations also pose some of the biggest challenges for growers. When chemicals such as chlorpyrifos and glyphosate are being heavily scrutinized, growers can have a difficult time finding alternative solutions.

"Growers are losing tools, some of which are good tools with good safety records that don't necessarily have a risk management issue associated with them for consumers," Matoian said. "But because of concerns out there that may be placed in the media, it causes there to be a trickle-down effect back to the grower about what they may or may not be able to use in their field, even if it is a safe and registered product."

"The regulatory environment is not decreasing by any means, but our growers recognize that they are good environmental stewards," Connelly said. "Anything that we can do as industry associations working together to help tell that story is important, and we want to be the most efficient users of resources. The more we can work together, the better."

Silver Linings

The executives were all in agreement that their individual commodities as well as the tree nut industry have bright futures. While regulations, tariffs and COVID-19 have created issues, the industry is still stable.

The pistachio industry has experienced some hardships with competition and tariffs, according to Matoian, but this allows the industry room for vast improvement in the future. COVID-19, on the other hand, may actually help pistachios.

"Relative to COVID-19, it can potentially work in our favor in terms of peoples' eating habits," Matoian said. "We actually did see a consumption and purchasing increase in our products domestically during some of the early COVID-19 months, so that was a positive. I think that long-term, the future looks positive for us."

The pecan industry, while relatively small in California compared to pistachios, walnuts and almonds, has also seen continued success in the market as a result of the Federal Marketing Order, according to Hendrixson.

"The Federal Marketing Order has been able to do research and promote health benefits for pecans that have previously

not been done," Hendrixson said. "That's improving recognition for pecans as a good and healthy choice for consumers."

While tariffs have put a damper on the almond industry's ability to move a three-billion-pound crop, there are some silver linings.

"Tariffs have affected the almond industry tremendously in China, but there is now an exemption that is reducing those a bit and bringing volume back," Fleischman said. "Hopefully those will subside in the long term because there is obviously tremendous opportunity in that market to come.

"The one thing that has been impressive to me is the industry engagement that helps fuel the Almond Board as well as other organizations," she continued. "That's really important. Encourage growers to get involved if they are not already."

Walnuts have also seen a record crop this year at around 1.5 billion pounds, according to Connelly. As are the pecan, almond and pistachio industries, the walnut industry is continuing to find positives within the current world atmosphere.

"Some of the trends that we're seeing come out of the COVID-19 pandemic are really helping to fuel consumption [for walnuts] in different ways, which is exciting," Connelly said. "That's helping to mitigate some of those shorter-term challenges that we're seeing from food service sector retraction.

"We have a lot of room to improve," she continued, "and are continuing to diversify our portfolio to do that as we grow our markets around the world."

Connelly and the other panelists noted that the major associations within the tree nut industry and their executives are working hard to improve the industry for growers and consumers alike and will continue to do so in the future.

"We're advocating, we're out there on your behalf working to fight the tariffs and regulatory hurdles that we encounter on a regular basis," Connelly said. "We're really excited that the programs that the industry has and the investments it makes adds value and has grown our industry."

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FARM ADVISOR PROFILE

RACHEL ELKINS

AS FARM ADVISOR EMERITUS, RACHEL ELKINS STAYS ENGAGED WITH GROWERS

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

Rachel Elkins speaking at a field day in 2007 about a pear rootstock trial (photo courtesy UCCE.)

AFTER 36 YEARS IN THE INDUSTRY, RACHEL ELKINS, UCCE Pomology Farm Advisor, Lake and Mendocino Counties and County Director, Lake County, is enjoying the best of both her working and retired worlds. Elkins returned to work part-time as an emeritus farm advisor the day she retired.

"I still have my office, and I'm doing what I like to do, which is being purely a farm advisor, working with growers and the industry," said Elkins.

As a native of Richmond, Calif., Elkins' early exposure to agriculture was mostly in passing; commercially grown flowers were popular for the area. While she was a student at University of the Pacific (UOP), Elkins did a winter project in Hawaii about ancient Hawaiian agriculture and religion, and the spark of interest was born.

"I learned how their cultural and agricultural beliefs were intertwined with their religious beliefs, and I became interested in agriculture while doing that," said Elkins.

The transition to agriculture wasn't immediate. Elkins did a few semesters at UC Davis to study range management, but found herself back at UOP shortly thereafter. After working as a loan department typist, then secretary, then entomology librarian at UC Berkeley, Elkins earned a second bachelor's degree in agricultural pest management from Berkeley.

She learned from some of the original IPM faculty and practitioners, who would ultimately become icons in the field, such as Ray Smith, Lou Falcon, Bob Raabe and Boise Day. She spent three years working in the entomology department, followed by work with the USDA involving the biological control of weeds.

When that wrapped, she did an internship with pioneer UC IPM advisor Bill Barnett that introduced her to cooperative extension for the first time. This was in 1982. Five years later, she would land her position in Lake County and build her career there.

"It basically evolved. There was no plan," said Elkins of how she found herself in agriculture. "I had to be willing to get out of my comfort zone and go where the opportunity was."

Elkins went to graduate school at UC Davis, where she earned a master's degree in plant protection and pest management. She then earned a second master's in horticulture, specializing in pomology.

How Elkins chose her specialties was also an evolution. "I was involved in an almond cover crop project and I gravitated more towards working with trees," said Elkins. "I didn't know in what fashion, but I had already decided I was going to stay working in trees."

The Pheromone Puffer

One of the biggest and most well-known projects Elkins was involved with was the pheromone puffer.

Elkins began working on pheromones in 1987, when Pacific Biocontrol and pheromone disruption was just getting started and being tested in orchards. They quickly found there were several complications with them. Climbing ladders in the field to place the emitters at 400 units per acre made it very labor-intensive. Additionally, the units had pheromone release issues caused by temperature.

Elkins met Dr. Harry Shorey, a researcher from UC Riverside, at a meeting, and he shared with her a new contraption and concept for widely-spaced "active emission" emitters that used a propellant and released larger quantities of pheromone, instead of many emitters releasing smaller amounts.

Shorey's device was already demonstrating good results in crops such as table grapes and cotton. He suggested trying them for codling moth in pear orchards, and Elkins offered to collaborate.

"In order for them to work really well, we needed a large area, about 160 acres," said Elkins. "But we had tremendous codling moth problems, and we couldn't risk all this acreage on these pheromones when we didn't know if they would work. So, we negotiated a plot design."

That design consisted of 160 acres under four to five original growers. In the center of each plot was a section designated for pheromones only, while the surrounding acreage included

pesticides and pheromones.

The project was intensive and involved a tremendous amount of monitoring, teamwork and involvement from Paramount Farming, now known as The Wonderful Company, to shepherd the puffer device to market commercially. At the end of three years, codling moth numbers were reduced to zero and the insecticide was removed. By the end of the project, 1,500 acres of pears had been treated, which looked promising for the emitter's next use in walnuts.

Elkins began this project in 1996 and finished in 2001. "Then, we published a cost study on the changes and the incredible money savings on pear psylla and mite control," said Elkins. "We didn't have those secondary [pest] problems anymore. We had biological control of our orchards. We do face other occasional localized secondary pests, but none as severe as psylla and mites."

A Changing Market

Once Elkins moved into pomology, her primary crop continued to be pears. Over the course of her more than three decades in the field, she has seen incredible shrinkage of the pear industry.

There are currently three states that are the main pear producers in the U.S.: Washington, Oregon and California, in that order. New York and Michigan also produce. California has a history of being a canning-based industry, but that changed with the public's increasing taste for fresh produce rather than canned. As canned demand decreased, there were fewer remaining canneries, which placed a bigger burden on the pack industry. But this industry is also experiencing a narrowing market as competition increased.

For example, Washington has increased their pear acreage, which contends with California pears, thus shrinking that market. Additionally, U.S.-grown pears have to compete with foreign imports, such as those from Argentina, which are still on store shelves when California pear harvest begins in July. This has forced growers to move toward vertically integrated operations, expanding from being a grower to include shipper and marketer.

It's also labor-intensive and costly to harvest pears.

"There's more emphasis on trying to do labor savings," said Elkins. "Labor hangs everything up, so as change goes, will it be orchard configuration? Mechanical harvesting? The economics of making these changes is not cheap. Growers can't just stop and change everything over. It doesn't work like that, and cash flow is pretty important.

"The industry is going to have to move into mechanization in a big manner," explained Elkins. "There's not a new influx of labor. Many farmers and laborers are approaching retirement age. And many younger workers are not trained or knowledgeable about picking fruit or pruning. There's also more competition for the same labor: a pear grower is picking, a cannabis grower is getting ready to trim, and wine grape growers are ready to harvest, in the same or other locations."

Orchards are changing — from labor to water usage, to rootstock and pest management — and what the orchard of the future will look like has yet to be seen.

"The biggest changes are going to be orchard configuration and labor to fit the new model in order to get work done from beginning to end," said Elkins.

Elkins may now be officially retired, but she and many of her retired UCCE colleagues still receive emails and phone calls from growers. As private research and development is becoming more prevalent in the fruit and nut industry, there is still a need for cooperative extension, and Elkins hopes that industries and growers in California speak up and continue to support the work of cooperative extension.

"It is truly a wonderful and useful career, and a worthwhile one for an aspiring younger generation."

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ROUGH YEAR FOR CALIFORNIA BEEKEEPERS

WILDFIRES, MITES AND FORAGE LOSS ARE CONCERNS, BUT NOT EXPECTED TO IMPACT ALMOND POLLINATION

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

WHILE INDIVIDUAL BEEKEEPERS were impacted by the California wildfires, potentially preventing them from filling their pollination contracts, the overall honeybee supply is expected to meet almond pollination demand in 2021.

Roger Everett with Terra Bella Honey Co. said he can't see the hive loss due to fire as a huge issue for the almond industry, but individual beekeepers in many locations statewide experienced hive loss due to wildfires. Hives placed in foothill areas for the summer and fall forage were lost in some instances, but other beekeepers were able to gain access to the bee yards and remove hives.

The largest of the California wildfires, the Creek Fire, wiped out an estimated 300 hives owned by David Blair Apiaries in Kerman. Vicki Blair said that the hives were placed near the Mammoth Pools at Rock Creek for summer forage. Clay Ford, a beekeeper who provides pollina-

tion services, lost 100 hives as the swift moving LNU Complex fire swept down into the Vacaville area. Oregon beekeeper George Hanson reported losses due to fire.

"We had no warning, no way to move those hives out of danger as the fire approached," Ford said. Several other beekeepers in the area also lost hives, but Ford said they were already working to build boxes and place new colonies to rebuild their bee populations.

Wildfires and Mites

Elina Niño, UCCE Apiculturist, said she knew of several California beekeepers who lost hundreds of colonies to wildfires throughout the state.

"Based on the state of our own colonies, beekeepers seemed to have had a pretty rough year between the fires, lack of forage and the apparent increase in varroa mite pressure," she said.

Niño said that beekeepers who have lost colonies can't do too much to increase colony numbers and expand late in the season as they can't split colonies. Colonies naturally start building up in the spring, she said, and beekeepers can use this natural buildup to increase colony numbers, but that usually ends up happening after almond pollination. This means whatever colonies they are going into the winter with will be the colonies that will they have to work with, assuming no further losses between now and almond pollination.

Niño said she can't estimate the number of colonies that will be available for pollination, but with the growing number of producing almond acres at about 1.5 million and estimat-

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"They see hive numbers as insurance, especially if the weather is wet and cold during bloom,"
- Gene Brandi

Oregon beekeeper George Hanson, who sends hives to California for almond pollination, works to remove hives from a bee yard as fire approaches (all photos by G. Hanson.)

Piles of ash that used to be beehives are seen at a George Hanson bee yard in Oregon.

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ed number of honeybee colonies in the U.S. hovering between 1.6 million to 1.8 million, bee supply is of valid concern.

She said other factors to consider as pollination season nears is colony strength as stronger colonies can deploy more active foragers than weaker colonies.

Lack of forage to begin with and loss of forage due to drought and the wildfires are also concerns, Niño said. Research has shown that bees with access to diverse and plentiful forage are better able to deal with pathogens and even pesticide exposure.

Gene Brandi, a Los Banos beekeeper and past president of the American Beekeeping Federation, said it is too

"Based on the state of our own colonies, beekeepers seemed to have had a pretty rough year between the fires, lack of forage and the apparent increase in varroa mite pressure."

- Elina Niño, UCCE

early to say if there will be a negative impact from recent wildfires on total honeybee hives needed for almond pollination. Brandi said that at least half the bees that pollinate almonds come to California from out of state. Even if an orchard is planted to a self-fertile variety, he noted, growers are contracting for pollination services.

"They see hive numbers as insurance, especially if the weather is wet and cold during bloom," Brandi said.

Brittney Goodrich, assistant UCCE specialist, reports in her Almond Pollination Outlook that 2.4 million honeybee colonies were used for almond pollination in 2020. According to apiary shipment data provide by CDFA, 1.9 million honeybee hives were shipped into California last year, and that was down 3% from 2019. This year, the estimated demand is for 2.5 million colonies, amounting to 88% of the total colonies in the U.S.

Project *Apis* m., a Utah-based organization that funds research into honeybee health, reports that they are directing the Seeds for Bees program to connect with beekeepers and almond growers and provide seeds to put forage back on the landscape. In areas where native habitat restoration is not suitable, the Seeds for Bees seed mixes are meant to provide high quality pollinator nutrition and preserve soil quality until natural habitat rebounds or is restored.

National Impacts on Bee Numbers

Honeybee numbers outside of California have been impacted by fires in the Pacific Northwest, drought conditions in the Midwest and hurricanes that affected Louisiana and Texas – states that supplied almond pollination services in 2020. Adding in Florida and Alabama, states also affected by hurricanes, about 10% of supply for the almond pollination services may be impacted.

The new bee colony report from the USDA notes an increase in the number of colonies across the nation. Nationally, colonies have increased by 14% over the past year. Nebraska, Oklahoma, Michigan and Maine reported the largest percent increases over the last two years. California and Florida, two leaders in honeybee populations, have lost colonies since 2018.

Goodrich's Outlook Report noted that the current USDA Risk Management Agency policy is for a minimum of two colonies with six active frames per acre. Almond growers can deviate from this as long as they have consistently been using the same number of hives per acre and colony strength requirements and have had consecutive non-loss years.

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Maximizing Your Pollinator Dollars

New Research May Shed Light on Stocking Rates

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

Following a few best management practices can help growers protect honeybees in the orchard and also get the most from their pollination investment (photo by Marni Katz.)

AS ALMOND ACRES HAVE INCREASED, so too has the price of pollination. According to the Almond Board of California (ABC), pollination accounts for between 15 and 20 percent of the cost of almond production.

Hoping to lower that percentage, last year ABC initiated research to reevaluate honey bee stocking rates.

"The new research will look at both conventional and self-compatible varieties to see if we can get consistent high yields with fewer bees," said Josette Lewis, chief scientific officer with ABC in a presentation at The Almond Conference of 2020.

In a phone interview after the presentation, Lewis said the pollination working group of the Almond Board, which includes growers, researchers, farm advisors and beekeepers, proposed funding the research, hoping to get a fresh take on stocking-rate recommendations.

"There has been some discussion within the industry about how robust are the stocking rate recommendations, which are commonly understood to be 12 to 16 frames of bees per acre," she said. "There are some folks who feel quite strongly that that is more than we need."

Lewis added, "The research that seems to have led to this common recommendation is pretty old, and maybe this is a chance to revisit that using different methods and also take into consideration the issue of self-compatible almond varieties."

ABC asked UC Davis Extension Apiarist Elina Niño to submit a research proposal early last year, Lewis said. Niño spent the year mining past research and working out the logistics of how to conduct new research on the topic and in the fall presented what Lewis characterized as a promising preliminary report.

"She had some pretty good preliminary data, which leads us to be encouraged about the viability of doing this research," Lewis said.

Niño was expected to present a proposal to ABC in December and the Board was expected to make a final decision on whether to fund the proposal in January.

If funded, Lewis said it will likely take several years "to get data that is

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JANUARY 21 & 22

California WALNUT CONFERENCE

West Coast Nut magazine will host its popular California Walnut Conference this year on Jan. 21 and 22 on JCS Marketing's MyAgLife portal for education and digital content. Publisher Jason Scott said JCS remains committed to continuing the legacy of the conference by holding the conference online, featuring research presentations and a virtual trade show.

> We know growers have relied on the California Walnut Conference to learn the latest in production research for growing walnuts. While we would all be happier meeting in person, we decided to hold the conference virtually so we could still get this important research out to growers. -Jason Scott

Two full mornings of presentations will highlight the latest on managing pests, weeds and diseases in walnuts, offering five hours of continuing education DPR and CCA credit (pending approval.)

> We are happy to work with the California Walnut Commission and Walnut Marketing Board to continue bringing this research to growers and look forward to interacting virtually with walnut growers at this event. -Jason Scott

4.5 hours DPR CEUs (Other)
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robust enough and from enough different grower regions" to be able to inform comprehensive stocking rate decisions. But she added during her presentation, "I do look forward to keeping you informed as that research progresses."

Honeybee BMPs

In the meantime, Lewis said growers can take several steps to get the most from their pollination investment, including adopting the Almond Board's Honey Bee Best Management Practices. Found online on the ABC's website, honey bee BMPs for growers include: establishing good communications to ensure that both beekeeper and grower expectations are fully understood; providing a clear area for bee drop-off; and following precautions when applying pesticides during bloom.

> **The new research will look at both conventional and self-compatible varieties to see if we can get consistent high yields with fewer bees. -Josette Lewis**

Lewis cautioned growers against tank-mixing insecticides and fungicides, noting that recent research has shown that the practice harms bees, even in cases where the individual chemicals in the mixes do not.

"Insecticides should not be applied during bloom time," Lewis said, "and avoid tank-mixing different pesticides."

She added that when fungicides are needed during bloom, they should be applied late in the afternoon or in the evening, when bees are not active.

"That is a very easy way to get both effective control of fungal diseases during bloom and to keep bees safe and healthy," she said. "It should be standard practices for all of us in the industry."

Lewis also noted that recent evidence has shown that some adjuvants can be harmful to bee health. "So, we recommend that you do not add an adjuvant unless it is specifically called for on the label," she said.

Unfortunately, Lewis said, almonds have been linked in the press to other challenges confronting honey bees. "While we have a robust program to correct misinformation, following bee best management practices is the most essential way for us to demonstrate we are responsible," Lewis said.

"Keeping bees safe when they are in an orchard helps you get the most from pollination," Lewis said, "and it is also critical to defending our market for almonds."

Cover Crops

Lewis also encouraged producers to consider whether a pollinator cover crop can work for their operation.

"ABC research shows that cover crops do not compete with almonds for pollination," Lewis said. "In fact, other research shows that competition between honey bees and native bees who are lured by flowering plants can improve pollination. And new ABC funded research shows that hives are even more healthy coming out of almonds when there is a cover crop.

In a video that played during the presentation, John Miller of Miller Honey Farms in Newcastle, California, said that beekeepers appreciate coming into an orchard with a cover crop, because of the extra forage it provides. And, he said, a cover crop can improve pollinator performance. "It was like jump starting the hive," Miller said of one such experience.

"Adding a cover crop provides more diverse nutrition and helps keep the honey bees in the orchard and improves return on investment for farmers," Lewis said.

Cover crops also provide agronomic benefits, such as reducing soil compaction, improving soil water holding capacity and improving soil microbial activity.

Josette Lewis, chief scientific officer with ABC, said the Almond Board is considering new research on stocking rates to perhaps reduce pollination costs.

On a marketing level, cover crops can help growers qualify for Bee Friendly Farming certification from the Pollinator Partnership, a nonprofit dedicated to promoting pollinator health.

"Bee Friendly Farming allows you to use the Bee Friendly logo in your marketing, getting credit for your investment in pollinator forage and habitat," Lewis said.

Lewis also provided information on a cover crop incentive program ABC launched last year in partnership with Project Apis m., a nonprofit dedicated to supporting pollinator health research. Called the Bee Plus Scholarship, the program provided up to $2,000 of free cover crop seeds to participating growers. Growers also were able to use the scholarship to cover the registration costs for obtaining Bee Friendly Farming certification.

As of press deadline, ABC was considering a second round of funding for the Bee Plus Scholarship next year.

"I encourage you to look at these programs now and consider if they might fit with your operation," Lewis said.

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California WALNUT CONFERENCE AGENDA

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JANUARY 21st

7:30 AM TRADE SHOW

8:00 AM Biology, Monitoring & Management of Walnut Husk Fly (0.5 DPR/CCA IPM)
Jhalendra Rijal, UCCE Area IPM Advisor & Associate Director for Agricultural IPM, Statewide IPM Program

8:30 AM Orchard Weed Management Update (0.5 DPR/CCA IPM)
Brad Hanson, UCCE Weed Science Specialist, UC Davis

9:00 AM Walnut Mold & its Management in California (0.5 DPR/CCA Crop Management)
Themis Michailides, UCCE Plant Pathologist

9:30 AM TRADE SHOW BREAK

10:20 AM Research on Warmer Winters & Walnut Production (0.5 CCA Crop Management)
Katherine Jarvis-Shean, UCCE Orchard Systems Farm Advisor, Sacramento-Solano-Yolo Counties

10:50 AM How Can We Best Deal with Nematode Problems in Walnut? (0.5 DPR/CCA IPM)
Andreas Westphal, UCCE Nematology Specialist & Nematology Professor, UC Riverside

11:20 AM Botryosphaeria & Phomopsis Update (0.5 DPR/CCA IPM)
Mohamed Nouri, UCCE Orchard Systems Farm Advisor, San Joaquin and Stanislaus Counties

JANUARY 22nd

7:30 AM TRADE SHOW

8:00 AM Managing Crown Gall with Disease Resistant Walnut Rootstocks (0.5 DPR/CCA Crop Management)
Dan Kluepfel, USDA-ARS Research Leader

8:30 AM Walnut Board Update
Walnut Board Representative

9:00 AM Nematode Management Tools: Importance of Soil Sampling & Fumigation (0.5 DPR/CCA Crop Management)
Kristi Sanchez, Nematologist, TriCal Diagnostics and TriCal

9:30 AM TRADE SHOW BREAK

10:20 AM Identifying & Managing Walnut Diseases Caused by Phytophthora (0.5 DPR/CCA IPM)
Greg Browne, USDA-ARS Research Plant Pathologist

10:50 AM Ecology & Management of Navel Orangeworm in Walnut Orchards (0.5 DPR/CCA IPM)
Houston Wilson, UCCE IPM Specialist

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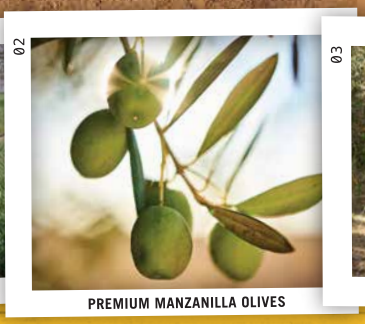
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