

WEST COAST NUT

JUNE 2020 ISSUE

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**BASICS OF A GOOD
HULLSPLIT STRATEGY**

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**FERTILITY AND IRRIGATION TO
MEET YIELD GOALS**

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WEST COAST NUT

By the Industry, For the Industry

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Hullsplit Logistics Prediction and Protection Form the Basics of a Good Hullsplit Strategy

This critical stage of almond development typically begins mid to late June in western Kern County. Splitting of blank nuts, which typically make up about 3 to 5 percent of almonds, according to the Almond Board of California, will occur about a week ahead of hullsplit and serves as a ‘heads-up’ for growers.

Starting on page 10



The "Four Rs" for Nitrogen Efficiency

Nitrogen and Irrigation Go Hand in Hand for a Fertility Plan That Meets Yield Goals

By VICKY BOYD | Contributing Writer

With drip irrigation or microsprinklers, nitrogen can be injected into the system to spoon feed trees.

FOLLOWING THE 4R'S OF NUTRIENT STEWARDSHIP –

Using the right source, at the right rate, at the right time and the right place – is key to ensuring nitrogen is used as efficiently as possible. Irrigation management also comes into play since nitrates are mobile and move with water. As a result, applying the correct amount of water at the correct time is part of the overall nitrogen stewardship equation.

"It's hard to talk about one without the other," said Mark McKean, who grows almonds, winegrapes and row crops near Riverdale. "You have to talk about water management when you talk about nitrogen management and vice versa."

As president of the Kings River Water Quality Coalition, he is acutely aware of the need for agriculture to maximize

nitrogen use efficiency and to prevent it from leaching into the groundwater.

Sebastian Saa, senior agricultural research manager for the Almond Board of California, said nitrogen management and irrigation management are connected like siblings.

"Especially when you talk about fertilization—which is the most efficient way to provide nitrogen to the plant—you need to do it well with the fertility plan but also with the irrigation component," he said.

Right Amount

Even before the season begins, Bill Brush, a certified crop adviser and pest control adviser, works with growers from Red Bluff south to the Grapevine to draft nitrogen management plans. He starts with developing reasonable yield goals.

"If you don't have a yield goal, you won't even know how much to put on," Brush said. "You can always cut back as you move into the season."

Based on work by Patrick Brown, a UC Davis plant nutrition professor, 1,000 pounds of almond kernels remove 68 pounds N. In walnuts, 1,000 pounds of in-shell nuts remove 15 pounds N, and in pistachios, 1,000 pounds of marketable yield remove 28 pounds N.

Multiply expected yields by the respective nitrogen removal to obtain the amount that will need to be replaced.

Then subtract any nitrogen contributions from irrigation water, soil, compost, or cover crops. The result is the net amount of nitrogen needed for production, assuming trees will absorb all of the applied nitrogen.

But nitrogen use efficiency is never 100 percent. An average target is 70-percent efficiency, which means you'll need to add another 30 percent.

Soil types will affect overall efficiency, even under the best

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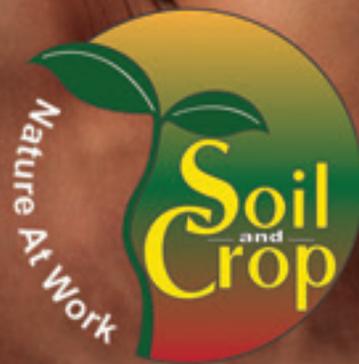
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Flood irrigation requires creativity to optimize nitrogen efficiency, but it can be done.



With drip irrigation or microsprinklers, nitrogen can be injected into the system to spoon feed trees.



Continued from Page 4

management practices, Brush said. It's easier to achieve higher efficiency on heavier textured soils with increased water holding capacities than on lighter soils. At the same time, heavier soils also take longer to dry out after heavy rains, which may influence application timings.

"If you have poor soil conditions and

you're pushing a lot of nitrogen through flood irrigation, your efficiency will go down," said Brush, who also grows walnuts, almonds and pecans west of Modesto.

Right Time

Application timing also is critical. Over the years, Brown and his colleagues have developed budgets for all three nut crops that show optimal

timings that coincide with the tree's nitrogen demand curve.

With all three, nitrogen demand is small early in the season. When the trees break dormancy and begin vegetative growth, they initially draw from nitrogen stored from the previous year in woody tissue. As they move into reproduction that involves shell hardening, kernel or nut fill, and early hullsplit, demand peaks.

Mid-season leaf tissue samples can offer a nutritional report card for your trees. Both the April Early Season Program for almonds and the May ESP for pistachios developed by Brown predict summer N tissue values. Late spring also provides enough time to adjust fertility regimes to impact the current crop.

Brown and UC colleagues are working to develop an early season tissue sampling program for walnuts as the current July timing is too late to make corrections during the current season.

Right Source

The nitrogen source goes hand in hand with irrigation. With drip irrigation or microsprinklers, nitrogen can be injected into the system. Products such as CAN 17 and UN 32 work well because they readily move with the water, Brush said. Because of that, they also have a high leaching potential.

In flood irrigation or solid set sprinklers, growers should apply nitrogen fertilizer along the tree rows and not as a broadcast. During summer heat, ammonium and urea can volatilize into the atmosphere if they aren't incorporated through irrigation or disking

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With drip irrigation or microsprinklers, nitrogen can be injected into the system to spoon feed trees.



In flood irrigation or solid set sprinklers, growers should apply nitrogen fertilizer along the tree rows and not as a broadcast (all photos by V. Boyd.)

within about a day of application.

Right Place

If drip or micro-irrigation is used to deliver the proper amount of water to the roots, it can be a highly efficient way to also deliver nitrogen, Saa said. Common sense should tell you to inject the nitrogen during the second half of the irrigation set.

“The active roots are in the first 2 feet or so. Especially if you’re doing a very long irrigation event, you really want to target (the nitrogen injection) to the last half of the irrigation,” he said. “You want the water to stay in the first 2 feet.”

For walnuts, shoot for the top 2 to 3 feet. Using flood irrigation to move the nitrogen into the root zone takes more creativity and looking at nitrogen forms that don’t move as readily in the soil, Brush said.

Also factoring into the equation are soil type and irrigation supply – how often the district delivers water.

“You tailor a program to your farming needs, and it goes back to getting a plan together,” Brush said.

When the 4Rs are followed with proper irrigation management and with the right orchard situations, Bush said growers may top the 70-percent average nitrogen use efficiency.

“I help my clients go up to 90-percent efficiency,” he said. “That’s taking all of the 4Rs into consideration – the right type of N at the right time in the right amount in the right place. If you do all of those things, you can increase your efficiency. Tissue tests will tell you how much is getting in, but none of

those tell you what’s getting by. That’s what we’re trying to go after. We get our guys squeezed down pretty lean on nitrogen.”

Level of Adoption

To gauge adoption of several nitrogen and irrigation management practices, a UC Davis research team mailed surveys to about 5,000 members of three water quality coalitions: Colusa-Glenn Subwatershed Program, San Joaquin County and Delta Water Quality Coalition, and East San Joaquin Water Quality Coalition in 2018.

Leading the study were Mark N. Lubell, Jessica M. Rudnick, Sat Darshan S. Khalsa and Patrick H. Brown.

The survey asked participants whether they used 11 different soil, fertilizer and irrigation practices. It also asked them for the reasons they might not use a particular practice.

The data can be used to target outreach and educational programs around nitrogen and irrigation

management practices with the lowest adoption rates, said Khalsa, assistant project scientist. It also can help direct future research projects.

Split nitrogen applications, leaf tissue testing and soil testing ranked highest among the practices, with moisture probe use, irrigation water

Continued on Page 8



When developing a nitrogen management plan, account for the nitrogen contained in compost and other sources.

Continued from Page 7

N testing and ET irrigation scheduling placing in the middle. At the other end with the lowest adoption rates were cover crops, pressure bombs and GPS-guided variable-rate application.

Khalsa said he wasn't surprised that leaf tissue sampling ranked near the top. "It's a way for you to verify that the practices you're putting in place are leading to a crop with sufficient nutri-

tion," he said. "It's directly related to productivity."

There also are years of data to back nitrogen thresholds for mid-season leaf tissue sampling for several crops, including almonds, pistachios and walnuts. But less information is available about how nitrogen levels in water and residual soil nitrogen affect tree performance. Research being funded through the California Department of Food and Agriculture's Fertilizer Research and

Education Program should help answer that.

"There's definitely less research in permanent cropping systems that will tell you this is what you need to do now," Khalsa said. "With nitrogen in the water, there are so many biochemical steps to get to your bottom line. There's information about how much to fertilize, but it hasn't been done in a comprehensive way. We've looked at the efficiency of water use, but it hasn't reached a point where we have unified nitrogen studies with irrigation studies hand in hand."

The UC team is currently conducting a similar survey among coalition members in parts of Kern, Kings, Tulare and Fresno counties.

One question they will ask is: "When do you think irrigation influences nitrogen management the most? During fertigation, after fertigation or year-round?"

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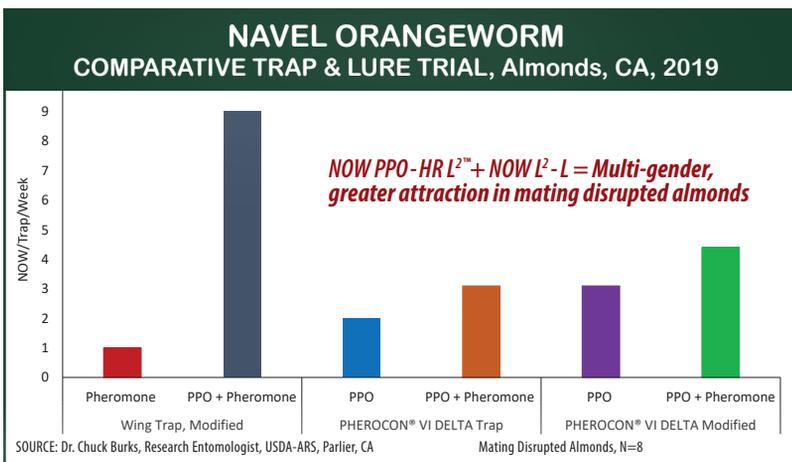
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HULLSPLIT LOGISTICS

PREDICTION AND PROTECTION

FORM THE BASICS OF A GOOD HULLSPLIT STRATEGY

By **CECILIA PARSONS** | Associate Editor

Monitoring and control for NOW after hullsplit should continue until harvest (all photos courtesy Marni Katz.)

THIS CRITICAL STAGE OF ALMOND development typically begins mid to late June in western Kern County. Splitting of blank nuts, which typically make up about 3 to 5 percent of almonds, according to the Almond Board

of California, will occur about a week ahead of hullsplit and serves as a ‘heads-up’ for growers.

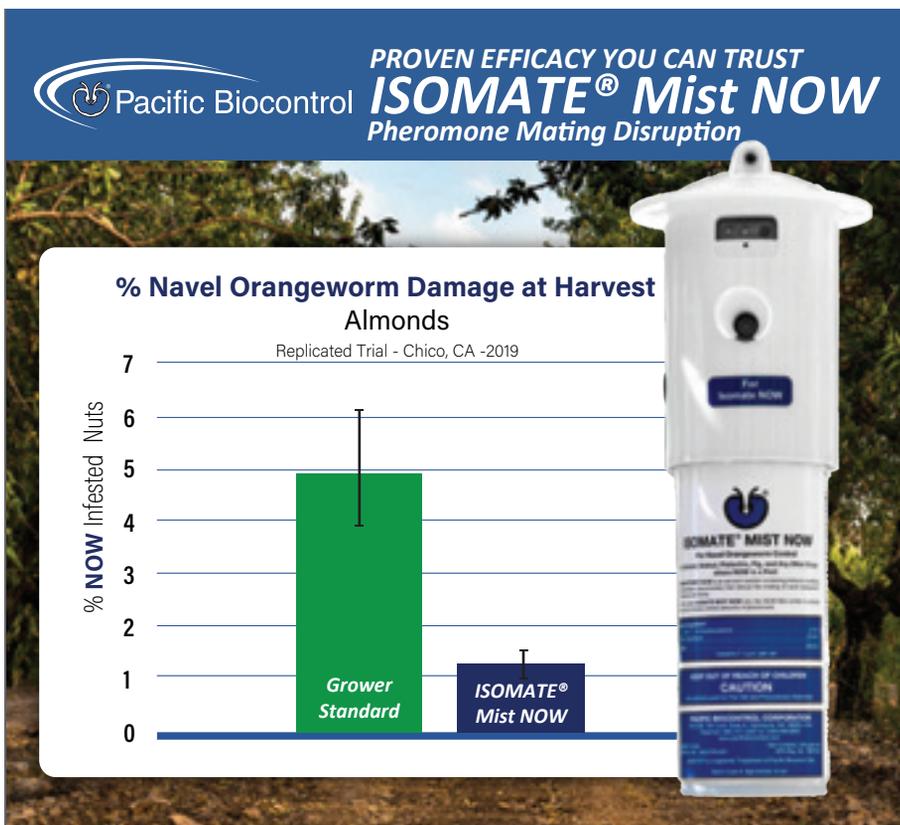
The Almond Board has developed a hullsplit prediction model using data from an eight-year study conducted in

north, central and southern almond growing regions for many of the main cultivars. The hullsplit model is based on the assumption that the rate of fruit development from bloom to 1-percent hullsplit is highly dependent on early spring temperatures. The model predicts a date for almond hullsplit per location, based on input of a date of 1-percent full bloom and temperature readings during the first 90 days after bloom. The temperatures are collected by a specific CIMIS weather station designated by the user. ABC notes that the model will only work 90 days after bloom.

Initial split of the hull happens in the upper and outer portions of the canopy, mostly in the southwest corner of the tree. Once the hullsplits, it is vulnerable to hull rot and infestation by navel orangeworm. The Almond Board notes that the most effective time to spray for navel orangeworm is during its second flight and that often coincides with the initiation of hullsplit.

Navel Orangeworm Control

Navel orangeworm trapping early in the season can give a grower or pest control advisor an idea of the NOW pressure at hullsplit. Brad Higbee, research entomologist with Trece Inc., said using as many different types of trapping systems as possible will provide the best picture of the NOW

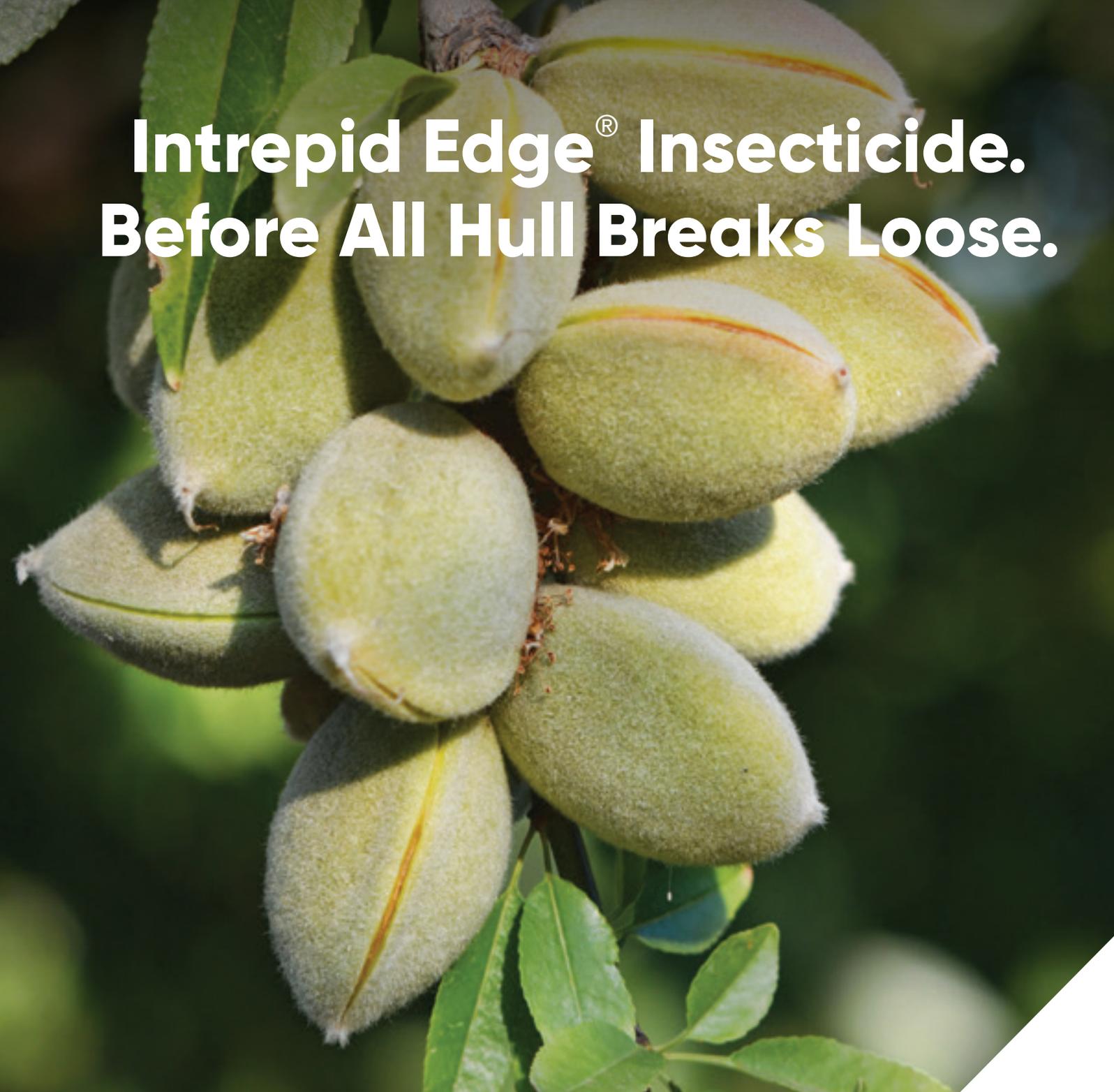


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Continued from Page 10

pressure in an orchard. The single most attractive lure is a combination of a pheromone trap and PPO (phenyl propionate) lure placed in the orchard in the spring. At hullsplit, Higbee said, egg traps are not as sensitive, partially because the splitting hulls compete

with the traps. Pheromone traps tell the real story in a conventional orchard. Populations are typically low during the initial part of hullsplit as it is between flights 1 and 2 and flight 2 is usually small, he added. In August, during the third flight, egg trap counts go up because populations are higher. In orchards where mating disrup-

tion is not used, Higbee suggested monitoring for splits and making a NOW spray at the beginning of hullsplit, knowing that a second spray may be warranted. NOW populations can come on strong before harvest and there is no reason to be conservative with monitoring and control measures, Higbee said. ABC notes that high populations of NOW in an orchard may warrant a second insecticide application 2 to 3 weeks after initiation of hullsplit. Considerations for this action include varieties in the orchard, anticipated harvest dates and pheromone and egg trap counts.

The preferred hullsplit spray materials are Intrepid® (methoxyfenozide) and Altacor® (chlorantraniliprole) according to UC IPM. NOW resistance issues have surfaced with pyrethroid use at hullsplit, plus these broad spectrum insecticides can negatively impact beneficial insect populations.

Knowing orchard history with regard to NOW pressure is useful. Proximity of an almond orchard to pistachios or orchards where winter sanitation was not done is another consideration.

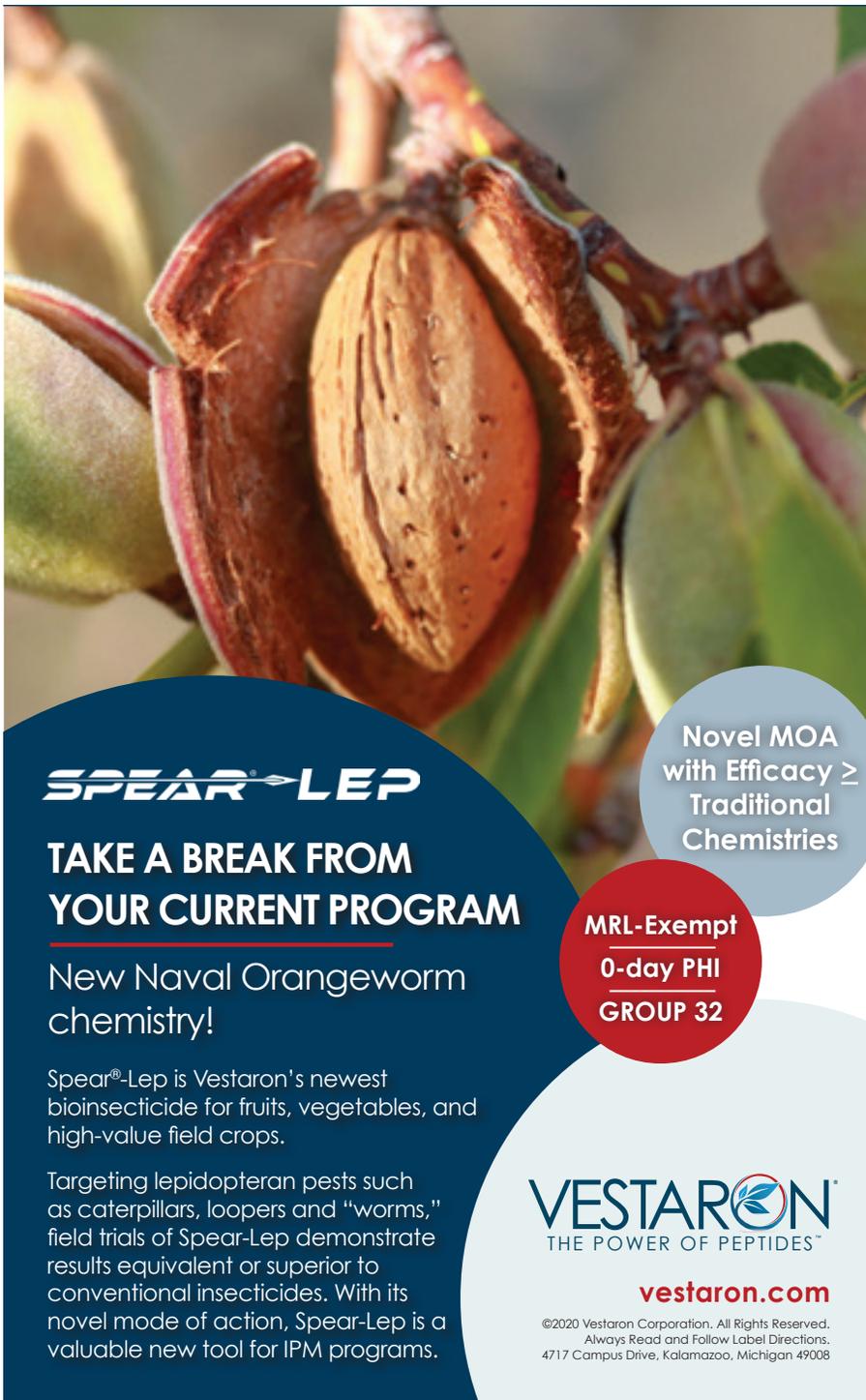
Spray Timing

Spray timing is a critical aspect of control, said Franz Niederholzer, UCCE orchard systems advisor in Colusa, Sutter and Yuba counties. Once the suture of the hull opens, female NOW move in to lay eggs. In four days, with normal temperatures, the eggs will hatch and crawlers can move inside and the damage begins. He advises growers to complete a spray application in an orchard in a week or less.

Early hullsplit starts in the upper canopy and may go unnoticed at eye level. That is why, Niederholzer said, starting spray applications earlier rather than later is always a good bet. The NOW population may not be high at hullsplit, he warned, but there are enough in the orchard to inflict damage.

Matching spray equipment to the

Continued on Page 14



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tree will help achieve good coverage with the spray material. The material not only has to reach the top of the canopy, but the sprayer has to have enough air speed to move air through the canopy, especially where trees are mature and canopies are dense. Recommended ground speed is 2 mph. Niederholzer said that aerial applications may be a consideration to shorten spray timing.

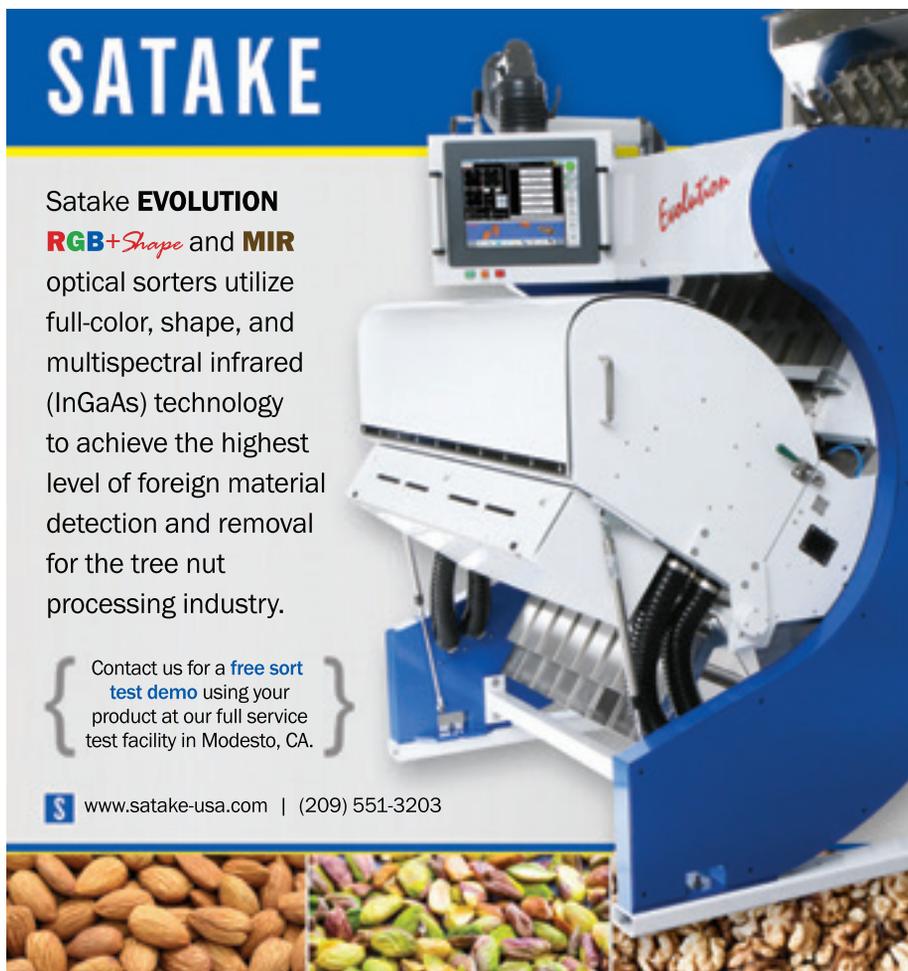
Managing Hull Rot

Beginning at hullsplit, there is approximately a one-month window for hull rot pathogens to infect almonds. Prevention of hull rot damage in an almond crop involves strategic irrigation and nutrition management. Hull rot infections are found in orchards with high rates of irrigation and fertilization. According to the Almond Board, managing water and fertilizer applications can reduce the incidence of

hull rot by 60 to 90 percent. Irrigation strategies to induce moderate stress in trees can also produce a more uniform hullsplit and earlier harvest. The target period for producing moderate stress in trees is from the start of hullsplit through 90-percent hullsplit.

Almond Board funded research has shown that stressing almond trees at specific stages of production through managed deficit irrigation can reduce hull rot (see related story in this issue of *West Coast Nut*.) The target period for inducing water stress is from the start of hullsplit through 90-percent hullsplit—a period of about two weeks. Use of pressure chambers can give an accurate stress level reading, but irrigating at 50-percent of normal tree demand, using ET calculations, can also produce similar tree stress levels.

Achieving the desired stress level at the right time also depends on orchard conditions. Where soils are shallow, stress can be achieved at a faster pace. Under those conditions stress should



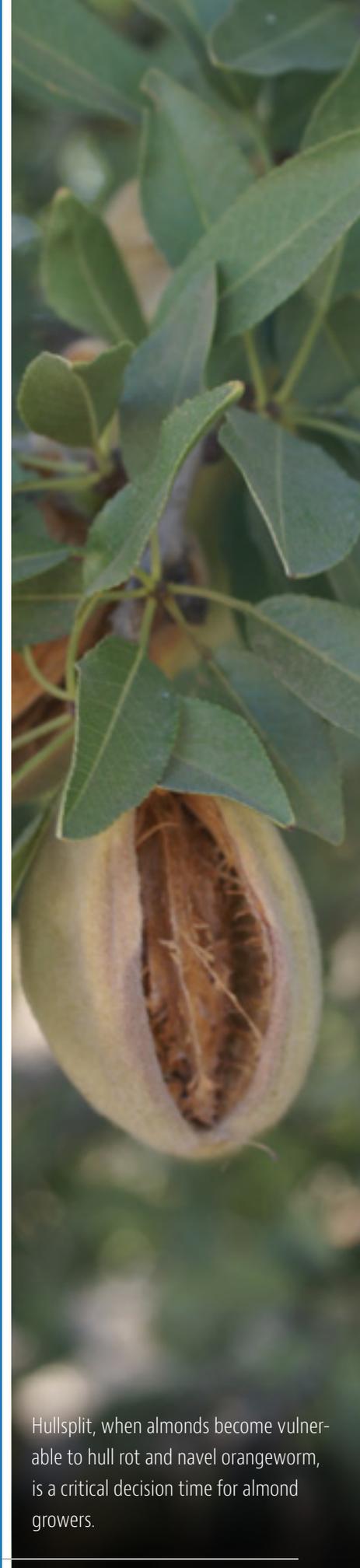
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Hullsplit, when almonds become vulnerable to hull rot and navel orangeworm, is a critical decision time for almond growers.

Beginning at hullsplit, there is approximately a one-month window for hull rot pathogens to infect almonds.

” This is where use of a pressure chamber can assist in determining when the appropriate stress level is reached.

Aflatoxin and Timely Harvest

Due to the threat of crop damage posed by the third generation NOW flight, earliest possible harvest is recommended.

A 95- to 100-percent hullsplit at eye level is the optimum time for getting nuts off the trees. Early varieties are less likely to be NOW egg laying sites when they are on the ground. It is recommended that early maturing varieties such as Nonpareil, be shaken before a third generation NOW flight.

Another reason to determine hullsplit is to make applications to reduce aflatoxin contamination in orchards. Growers looking to apply AF36 Prevail® have a window of 1 to 2 weeks in advance of hullsplit. AF36, an atoxigenic *Aspergillus* mold, is carried on a sterilized sorghum seed and displaces existing toxigenic mold strains when applied to orchard floors. It is proved to be most effective when spread on moist soil in July. Maximum sporulation of AF36 during hullsplit is desired.

be initiated when blanks begin to split. With deeper soils, it may take 20 to 30 days to reach mild to moderate stress.

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Encouraging Beneficial Birds in Walnut Orchards



Study looks at ways to improve predation of codling moth by beneficial birds in walnut orchards.

By **RACHAEL LONG** | UCCE Farm Advisor and Dr. Sacha Heath, UC Davis and Living Earth Collaborative

Researchers placed wire mesh cages over half of the codling moth larvae. This allowed them to compare predation rates between larvae that birds could reach and larvae for which birds had no access (photos by Sacha Heath, UC Davis.)

SOUNDS OF SPRING ARE IN THE AIR WITH BIRDS SINGING TO claim and defend territories during nesting season, which generally runs from February to mid-August. During this time, parents are hunting insects with a vengeance, feeding hungry baby birds thousands of bugs, a high energy food source needed for rapid growth. This is good news for farmers who benefit from pest control by birds in many locally grown crops, including alfalfa, strawberries, and apples. Adding to that growing list of crops where birds have been shown to provide beneficial pest control services are walnuts, where

we found they help control the key codling moth pest.

Codling moth are highly damaging to walnut crops because the larvae feed on developing nuts, causing significant yield and quality losses if left uncontrolled. Adult moths become active in the spring, have three to four generations per year, then go dormant during wintertime, hibernating as larvae in protected areas, like bark crevices. During the growing season, codling moth are challenging to control because the larvae burrow and feed inside the nuts, keeping them safe from natural enemies and insecticides. During the wintertime larvae are more vulnerable to predators, offering opportunities for encouraging biocontrol by natural enemies, including insectivorous birds.

To find out the potential for bug-eating birds to help control codling moth in walnuts, we monitored bird activity in 20 different walnut orchards in the Sacramento Valley during the wintertime. Our focus was on birds that search for insect prey in tree bark as they travel up and down tree trunks, pecking and flaking bark with their beaks, looking for bugs. The most abundant insectivorous birds that we found with this feeding behavior included woodpeckers, flickers, bush-tits, and nuthatches, as well as families of oak titmouse that chattered and called to one another as they moved through orchards.

To measure the impact of bird predation on codling moth control, we obtained larvae from the USDA lab in Parlier,

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Woodpeckers are voracious natural insectivores in walnut orchards.

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Continued from Page 16

CA, where they maintain a colony for research purposes. The larvae were coaxed to spin cocoons in pieces of corrugated cardboard and go dormant by manipulating light and temperature in growth chambers where they were reared. Armed with bags of hibernating larvae, we set out in orchards and glued them individually on tree trunks. Some larvae were available to predators, oth-

ers had cages over them to prevent bird predation, serving as the control group. Field cameras were set up to track avian predators at work.

About a month later, we checked for predation and found that 35 percent of the sentinel codling moth larvae were eaten when exposed to birds. Videos of nuthatches and Nuttall's woodpeckers suggest that these birds are having the greatest impact on pest control in walnut orchards. We also found that

at least another 11 percent of larvae were preyed on by insect predators and parasitoid wasps, for a total of 46-percent control by natural enemies. This reduction in larvae during the winter months by natural enemies likely helps reduce the codling moth springtime flight, helping to reduce pest pressure during the growing season.

We also discovered that the driver behind bird abundance and diversity on farms was the presence of natural habitat near and on farms, including hedgerows of shrubs, tree-lines, and remnant riparian vegetation. Orchards with bare or weedy field margins, especially in areas with no nearby habitat, had few birds. The more habitat around farms, the more beneficial birds were found in orchards, leading to better biocontrol of codling moth pests. Field edge habitat increased bird abundance on farms up to ten fold and the number of species by five-fold.

Birds naturally forage in croplands because in many cases it is among the only remaining available habitat, especially in intensively farmed areas like the Central Valley. Increasing bird activity and pest control benefits can

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Dr. Sacha Heath of the University of California, Davis, checking her experimental codling moth larvae on a walnut tree (photo by Sara Kross, Columbia University.)

be achieved by planting habitat in and around farms. For California, this includes native shrubs like California lilac (Ceanothus), redbud, coffeeberry, Toyon, coyote brush and elderberry that are best adapted to the area. Field edge habitat does not appear to attract more pest birds, like starlings and blackbirds, that feed on seed crops. These flocking species seem to be more attracted to crops and structures, like warehouses and corrals, than field edge habitat, and they are more likely to be on farms with no habitat. For example, studies have shown that bird abundance and feeding damage to strawberry crops are lower on farms with more surrounding natural habitat.

Some songbirds, like finches, are beneficial when they feed on bugs in the springtime, then become pests themselves later in the season when they feed on seed crops or ripening fruit. Learning to know the seasonal habits of birds and when to encourage activity and when to discourage them

is important to harness their pest control services. When birds are damaging crops, deterrents like netting, reflective tape, and hazing can help manage bird pests. The 'inflatable waving man' has also been shown to scare birds away from cereal grain research plots at the UC Tulelake Research and Extension Center. The exciting news is that researchers are working now more than ever to figure out the best ways to manage pest birds while attracting beneficial birds on farms.

Bird abundance and diversity is declining locally and worldwide due to habitat loss and we are losing a valuable ally in helping to control crop pests. Adding habitat on farms makes a difference by providing birds a safe place to forage, rest, and nest, benefiting birds and farmers. For more information on habitat plantings on farms, contact your local Resource Conservation District.

This article is based on research published in Ecosphere, the journal of the Ecological Society of America. The full



Codling moth larva cocoon eyed by a northern flicker, a predator of codling moth pests.

report can be found at [esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.2884](https://onlinelibrary.wiley.com/doi/full/10.1002/ecs2.2884)

Watch a Nuttall's woodpecker eating our experimental codling moth larvae in a walnut orchard:

https://youtu.be/xKEO8WvBv_Q (video by S. Heath.)

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Targeting Early Splits in Pistachios: AVOID THE “ACHILLES HEEL” OF AFLATOXIN CONTAMINATION

By MITCH LIES | Contributing Writer

A healthy pistachio cluster is much less likely to incur aflatoxin contamination (all photos courtesy T. Michailides.)

AFTER MORE THAN A DECADE OF STUDYING AFLATOXIN contamination in pistachios, UC Davis Plant Pathologist Thomas J. Michailides, based at the Kearney Agricultural Research and Extension Center in Parlier, has come up with a list of practices to reduce the contamination.

The list includes multiple practices from irrigation

management and timely harvest, to winter sanitation and insecticidal control. One key goal stands out for Michailides: if growers can minimize early splits to reduce damage from navel orangeworm (NOW), they will dramatically limit aflatoxin contamination in pistachio orchards.

By themselves, early splits lead to increased aflatoxin contamination in pistachios, Michailides said. But because they create an ideal substrate for NOW egg laying, which can lead to as many as three more life cycles for the pest during the growing season, the main drawback to early splits may be their propensity to increase NOW populations.

Recent research has shown that NOW not only inflicts feeding damage on nuts, which increases susceptibility to aflatoxin contamination, but also increases aflatoxin levels by spreading spores of the fungi that produce aflatoxin around pistachio trees.

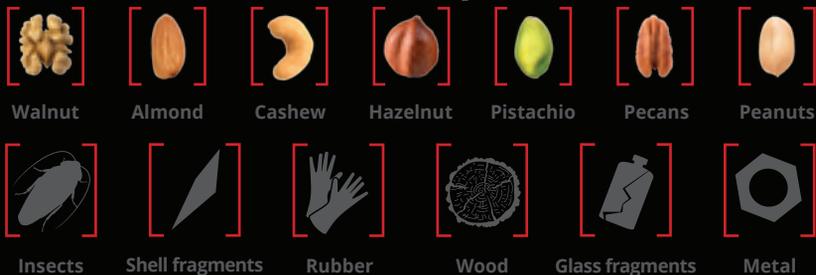
“These results are the first results that justify why the NOW control – the sanitation and the insecticide application – is so important,” Michailides said during a presentation at the 2020 Pistachio Day, held in January in Visalia, Calif. “Because in addition to the damage caused by the larvae, (the moth) is spreading the pathogens that result in aflatoxin contamination upon infection of nuts.”

Research also has found that not only does NOW damage increase the number of positive samples of aflatoxin in pistachio orchards, but also the amount of aflatoxin in the individual positive samples, Michailides said.

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A NOW moth is pictured with sporulation of *Aspergillus flavus* after plating on agar media.



UC Plant Pathologist Themis Michailides called early splits the Achilles heel for aflatoxin contamination in pistachios.

cinogenic compound produced by two fungi, *Aspergillus flavus* and *Aspergillus parasiticus*. The fungi live in soil and produce microsclerotia, which produce spores that enter tree canopies on the breeze and can infect nuts. Research has found that pistachios are particularly susceptible to contamination by aflatoxins.

“It is a major, major headache in pistachios,” said Bob Klein, manager of the California Pistachio Research Board. “Testing alone costs us millions upon millions of dollars.”

Sorting Costs Substantial

Sorting costs also are substantial, Klein said, and not just because of the labor. “You can’t see the aflatoxin damage, so you end up sorting out any nut that has any sort of defect, and those defects may not have anything to do with aflatoxin. But you cannot take a chance. For all you know, you are pulling out 10 nuts that have no aflatoxin to get to one that does.”

Also, Klein said, a clean test doesn’t ensure that lots won’t be rejected.

“Because of the way aflatoxin contaminated nuts are distributed in a lot, there is a high degree of variability in testing,” Klein said. “So, you can test all you want, but that is no guarantee. You can still end up with a single contaminated nut in the sample, and you are out a lot of money.”

In the U.S., the allowable threshold

for aflatoxin in pistachios for direct consumption is 15 parts per billion (ppb) for total aflatoxin and 10 ppb for B1 aflatoxin, which has been linked to

liver cancer. In Europe, the allowable thresholds are 10 ppb for total aflatoxin and 8 ppb for B1.

Among the steps on Michailides’

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lists for reducing aflatoxin levels in pistachios, several are aimed at reducing early splits, including choosing rootstock less susceptible to early split. In his research, Michailides has found that the UCBI rootstock is least prone to early split, followed by the PG1

rootstock.

Maintaining sufficient irrigation, particularly during shell development in May and early June, also is an important step. "We determined that just by skipping one irrigation in early May that we increased the early splits," he said. "So, it is very critical to irrigate in that stage when the shell develops."



Former UC plant pathologist Mark Doster, left, and Themis Michailides examine AF36 on an orchard floor shortly after an application of the biocontrol product.

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In some cases, susceptibility to early splits is outside a grower's control. Researchers, for example, have found that pistachio orchards in Kern County had naturally lower levels of early splits than orchards in Fresno and Madera counties. "We found that not only are there differences in rootstock, but there are also differences among the locations where these trees are grown," Michailides said.

Also, he said, research has shown that off years have higher levels of aflatoxin levels than on years. In the research, one nut in every 5,000 tested showed levels above a certain threshold in off years, compared to one nut in every 20,000 tested in on years.

Winter Sanitation is Critical

Sanitizing orchards in the offseason also is a critical step that growers can take to minimize aflatoxin levels, Michailides said. Mummies on trees and orchard floors create overwintering habitat for NOW, and the residue is ideal for growth of aflatoxigenic fungi that produce microsclerotia. These microsclerotia eventually develop spores that reach the tree canopy, infect nuts and produce aflatoxin.

Applying insecticides in a timely

and effective fashion to control NOW is high on Michailides' list, as is harvesting nuts in a timely fashion. Delaying harvest, Michailides said, provides extended opportunities for the NOW to spread spores of the aflatoxin fungi, infest more nuts and increase aflatoxin contamination.

Use of the biocontrol product AF36 Prevail, an *A. flavus* that does not produce aflatoxin and can displace the aflatoxin-producing fungi when activated by irrigation water, also can help lower aflatoxin levels in pistachio orchards, Michailides said. The product needs water to sporulate, high temperatures and typically needs breezes to carry it into tree canopies, but, despite these limitations, it has provided some positive results. In research prior to the product's 2012 registration, researchers were able to displace 95 percent of the toxigenic strain of *A. flavus* in the soil when using AF36 Prevail. That translated to a 40-percent reduction in positive samples of aflatoxin in the nuts.

Michailides believes that the product could be more effective if growers could get more to sporulate and reach tree canopies. As evidence, in cotton, growers have been able to achieve nearly 100-percent displacement of the toxigenic strain of *A. flavus* through use of AF36 Prevail and an 80-plus percent reduction in aflatoxin levels.

Climatic conditions help explain the higher displacement levels in crops such as cotton and corn, Michailides said, and crop height helps explain why the product's atoxigenic spores are more effective in lowering aflatoxin levels in the plants. "Because the canopy of cotton and corn are very low, it is easier to get the atoxigenic spores on the canopy of those crops in comparison with the canopies of trees," Michailides said.

Michailides noted a new biocontrol product manufactured by Syngenta, Afla-Guard GR, which is not yet registered for use in California pistachios, sporulates in drier soils and at lower temperatures when compared with the sporulation of AF36 Prevail.

"Hopefully we will get the registration of this product either this year or next year," he said.

Going forward, Michailides said researchers in his laboratory are working on different application methods of the nontoxic strains of *Aspergillus flavus*. To date, research has shown that when applying *A. flavus* directly to tree canopies with a polymer, performance is enhanced. Without the polymer, it is not.

The bottom line to date appears that the best tactic for pistachio growers to reduce aflatoxin levels is to avoid early

splits and do all they can to minimize navel orangeworm populations.

"The early splits are what I consider the Achilles heel for aflatoxin contamination," Michailides said. "These are the nuts on a pistachio tree which will be infected by NOW first."

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SUCCESSES IN GROUNDWATER RECHARGE

GROWERS AND WATER DISTRICTS WORK TOGETHER TO POSITIVELY IMPACT GROUNDWATER TABLES THROUGH RECHARGE

By **JENNY HOLTERMANN** | *Contributing Writer*

TEN YEARS AGO WAS A TIME BEFORE THE SUSTAINABLE Groundwater Management Act, and even before many knew what ‘white lands’ were. It was also a time when a Central Valley farmer and an innovator in groundwater recharge had the foresight to start thinking about the future of aquifers on a large scale.

On-farm groundwater recharge is defined as “taking advantage of the water capture, filtration and storage services provided by natural and working landscapes,” according

to the University of California, Agriculture and Natural Resources study titled *Supporting sustainable groundwater management*.

Growers are turning to on-farm recharge to replenish the aquifer below their orchards and capture floodwater that otherwise would be lost. This is not a new concept to Don Cameron, general manager of Terranova Ranch, located in Helm, California.

“In an area that relies entirely on groundwater, I figured pretty early on we needed to correct the problem,” Cameron said. “We were losing 2 feet of groundwater elevation a year due to pumping. We needed to do something if we wanted to continue to farm.”

Terranova is mostly located within the ‘white lands,’ now a common reference to non-districted land or land that is entirely reliant on groundwater with no access to surface water.

Putting Excess Surface Water to Work

Cameron has been working on projects to capture floodwater off the Kings River alongside other local growers for more than 30 years. In late 2010, he received a Conservation Innovation Grant from the Natural Resource Conservation Service to begin work on his biggest recharge project.

In the first year of the project, Cameron was able to capture 5,000-acre-feet of floodwater off the North Fork of the Kings River and began flooding wine grape vineyards for groundwater recharge.

“We proved in 2011 we could grow vineyards without harming them and get water into the ground for recharge,” he said.

Cameron then received a Floodwater Corridor grant from the California Department of Water Resources through the Kings River Conservation District in 2011 to install 4 miles of canals, pumping stations, flood gates and crossings to develop the beginning of the real backbone to phase 1 of his recharge project. The grant funded the process of connecting to flood water access points. Prior to that, Cameron had no connection to surface water. The project also includes 400 acres of flood basins that are farmed in dry



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years with row crops.

In wet years, after the surrounding water districts are satisfied with their allotment, Cameron can capture and recharge with the balance. "Water districts take what they want and need. When the state has a heavy snowpack year and full reservoirs, our farm can take what would otherwise head out to the ocean," Cameron explained.

The completed first phase of the groundwater recharge project supports 6,000 acres and is designed to expand to the neighbors to include 18,000 acres in total. "With the capacity of 1,000-acre-feet a day of floodwater, the mission of the project is taking flood water off the Kings River to protect downstream damage to local communities and at the same time use that water for groundwater recharge."

In 2017 Cameron expanded from flooding wine grapes to experimenting with flooding pistachios, almonds, olives, and other vineyard blocks on their ranch.

"One vineyard block, we were able to put 13-acre-feet of water on and move the water below the ground. We keep experimenting with different crops and see what we can do." Cameron said. "In 2017, we were able to take another 5,000-acre-foot of floodwater. Our monitors on our wells showed the groundwater levels increase. We know we are making a difference."

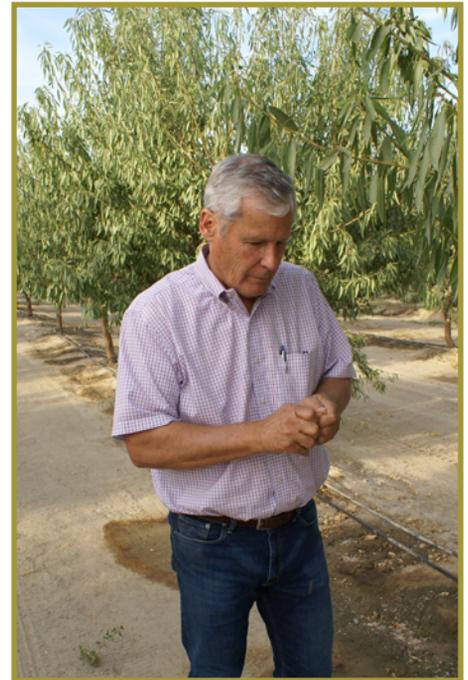
Interest in Groundwater Recharge

Growers across the state have begun thinking the same way about how they can make a difference by investing in groundwater recharge on their farms. Greg Wegis, a partner with Wegis & Young, installed a tile drain system in the spring of 2018. Prior to planting a 40-acre almond orchard in Wasco, Wegis worked with a specialized construction group to install a tile drain system under the new planting. He installed a series of 4-inch corrugated perforated pipe 8.5 feet deep every 96 feet. It took two to three weeks and roughly \$2,500 per acre to install the tile drain system.

The construction group Wegis used has been installing these drains in the Imperial Valley for years, but reversing the idea in the Central Val-

ley. Dana Munn, general manager of Shafter-Wasco Irrigation District, has been researching and implementing recharge and banking projects for most of his water career. He explained that the tile drains are "nothing new to the water world. But we are making them flow in reverse as what they have traditionally been used for. Usually, a tile drain was used to drain excess water off a piece of land. Now we are trying to keep excess water and store it below ground."

Wegis was able to use the existing filter station to help filter water and send it through a standpipe, which uses gravity flow to distribute into the tile systems. There is a rock ring layer around the corrugated pipe to keep it free from plugging with foreign material or excess silt. The orchard was then planted on top of the tile drain and farmed normally.



Don Cameron of Terranova Ranch has been working on projects to capture floodwater off the Kings River for 30 years (photo by Marni Katz.)

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As with Terranova’s project, Wegis’ system operates on water availability in wet years. Utilizing a smaller system, Wegis can recharge with lower risk, all while continuing to farm.

“The tile drain is designed between the tree rows, and as far away from the root zone as possible. We don’t want the trees to uptake the moisture. We want that moisture being percolated and recharged,” Wegis said.

Almonds’ shallow roots make it an ideal crop for the deep 8.5-foot-deep tile drain.

“There are monitoring wells 10 feet deep to ensure water is used for recharge, not irrigation,” Wegis said.

Wegis has a relationship with Semitrophic Water Storage District for purchasing flood water and utilizing district water for on-farm recharge projects. Utilizing Article 21 water, Wegis can keep 90 percent of the recharge water with the balance going to the

district.

“In the end, recharging with tile drains ultimately is aiding the district as well as the grower,” he said.

Water Districts across the valley are looking for innovative ideas to solve the groundwater problem and are encouraged to see more landowners dedicated to recharge projects.

“Currently in our district, we are working with on-farm recharge, not flooding recharge projects as you may see up north. We focus on landowner dedicated recharge ponds and farmers who are implementing below ground tile drain systems,” Munn said.

Munn is reassured to see landowners develop their own projects that aid in recharge as well as keep farmland in production. When projects allow a farmer to continue to farm as well as recharge, it is a win, he said.

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Waiting for the Opportunity to Recharge

In the Central Valley, there is not always the capability for utilizing recharge.

“One out of every four years is wet,” Munn said. “In that one year, you have three to four months of recharge opportunities with one month of prime utilization time.”

As a result, for growers like Cameron and Wegis, their projects will not be productive every year. Cameron had a series of four years during the drought where he couldn’t store any water. Wegis wasn’t able to utilize his system until year two because of water availability. The idea is to have the systems there for wet years and to take advantage of surplus off-season water that would otherwise be lost.

The projects may sound simple but they—and the grant process—can come with challenges. Even before a 40-acre project can begin, a landowner needs to prove the project will work for



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recharge. Wegis had to drill a 50-foot core sample to fully categorize the soil types. Determining sand or clay type soils will help engineers and districts involved calculate the effectiveness and structure needed for the project.

“There can be limitations by pipeline distribution capacity in the area,” Munn explained. “Irrigation deliveries will always come first. Recharge projects will receive water when capacity is available. Come late winter and early spring and into summer, the run-off period is prime to use.”

There are multiple factors landowners need to evaluate when considering whether recharge projects may work for them.

“The geography and geology of your basin is a huge element before you start a project,” Munn said. “Utilization of water in-district or land contiguous to another interconnecting district is a factor. Landowners can be limited to where water credits can move. Understanding the costs of the projects and whether grants, landowners or districts will cover costs.”

Landowners and water districts more and more are evaluating project ideas and concerns together to find projects that can work for individual situations.

Cameron said the stakes are high for getting it right to help improve the groundwater situation before regulations make it impossible to farm in affected areas.

“It is our hope to correct some of our overdraft. We have 20 years to figure this out and our project will be key. The last thing any of us want is to idle farmland. The growers in our areas are committed to finding a solution to overdraft.”

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



Terranova was able to apply 5,000 acre feet of floodwater to pistachios and other crops starting in 2017 and has found groundwater tables rise (photo courtesy Don Cameron.)

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AN INTEGRATED APPROACH TO MANAGING SPIDER MITES IN NUT ORCHARDS

By JULIE R. JOHNSON | Contributing Writer



Spider mites are the most common pest in California nut orchards (photo courtesy UC IPM.)

NOW IS THE TIME TO SCOUT AND MONITOR SPIDER MITES IN both walnuts and almonds as warm weather continues throughout California. One way to do this, according to Emily Symmes, former UCCE Sacramento Valley area integrated pest management advisor, is to examine 10 leaflets from 10 trees (five should be from higher branches), weekly May through August. If more than half the leaflets with spider mites don't also have predators (predaceous mites and/or six-spotted thrips), this is cause for concern. A scouting form is available at ipm.ucanr.edu/PMG/C881/walnut-mitemon.pdf.

Spider mites, also called webspinning mites, are the most common mite pests in California nut orchards. Although there are a variety of spider mites, there is little need to distinguish one from the other since their damage, biology, and management are virtually the same.

To the naked eye, spider mites look like tiny, moving dots. They live in colonies, a single colony containing hundreds of mites, mostly on the undersurfaces of leaves. The presence of webbing is an easy way to distinguish them from all other types of mites and small insects such as aphids and thrips, which can also infest leaf undersides.

Sixspotted Thrips

One of the most effective, and cost-effective, ways to fight spider mites is with biological control, such as predator mites and sixspotted thrips, Symmes said. Other techniques include cultural practices and miticide applications when needed.

Symmes said growers need to use biological control to their advantage by knowing what natural enemies are out there.

“Do this through scouting and monitoring,” she added. “Also, choose the least hazardous materials to the natural enemies and minimize risk through treatment timing, coverage and providing refuges.”

Continued on Page 30

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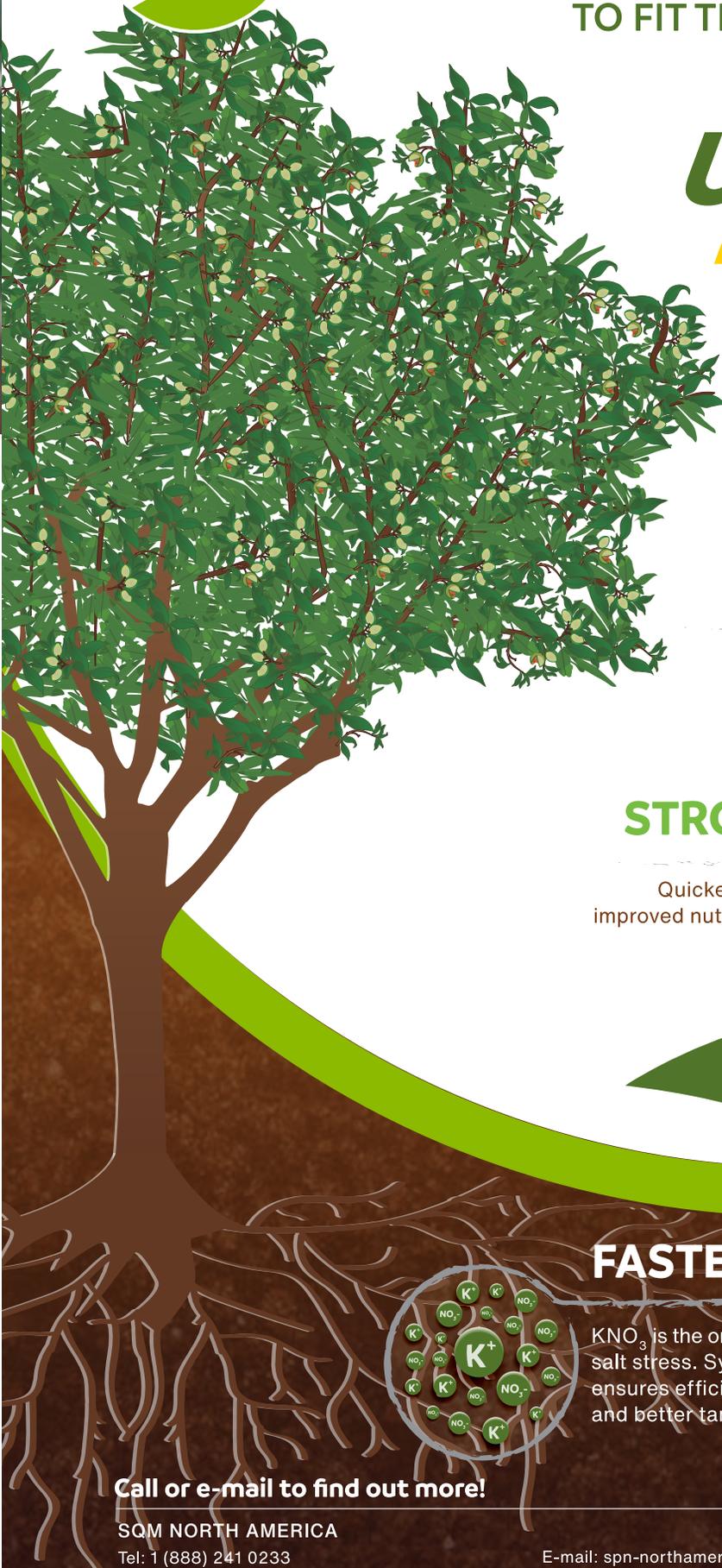


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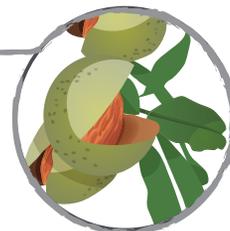
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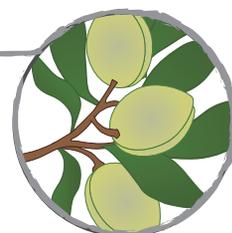
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Avoid broad-spectrum pesticides (e.g., pyrethroids and organophosphates) at critical times of natural enemy population surge during the season. Symmes offers a graph (see Table 1) that provides a listing of pesticides and their impacts on bees and natural enemies.

"Why should the sixspotted thrips be your new best friend?" Symmes asked.

Here is why:

- They feed almost exclusively on spider mites.
- They thrive in hot dry climates
- They are thigmotaxic (not afraid of tight spaces, thrive in mite webbing).
- They can eat 50 mite eggs per day at 86 degrees.
- They experience rapid population increase (can quadruple in one week). They are out there and they are free.

Don't Starve Them, Don't Kill Them.

If predators are present in the orchard and have some food to eat, such as spider mites, they will stick around and the numbers of beneficials will increase.

"This means that we have to be willing to tolerate some level of food source in the orchard to maintain predator populations. Food sources may come in the form of other mite species early in the season, as well as sub-economic populations of spider mites themselves throughout the season," Symmes said.

Monitoring for the sixspotted thrips can be done with thrips sticky strip cards.

"Thrips card monitoring is better at sixspotted thrips detection than leaf counts," according to results from Sacramento Valley almond and walnut 2019 studies, she added.

Spider Mite Treatment Thresholds

In general, the goal is to manage the ratio of predators-to-spider mites (not just spider mite numbers alone) to achieve a balance in which predators

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Pesticide Impacts on Natural Enemies

Common name (Trade name)	Mode of action ¹	Selectivity ² /affected groups ³	Predators mites ⁴	General predators ⁴	Predators ⁴	Honey bees ⁵	Duration of impact to natural enemies ⁶
Bacillus thuringiensis sp. kurstaki	11A	narrow (caterpillars)	L	L	L	0	none
benzoylurea (Azaflor)	16	narrow (spider mites)	L	L	L	0	short
carbaryl (Sevin) 80	1A	broad (insects, mites)	L/H	H	H	0	long
carbaryl (Sevin) 24R Plus	1A	broad (insects, mites)	L	H	L	0	long
chlorpyrifos (Dursban)	1B	broad (insects, mites)	H	H	H	0	moderate
dicofol (Kelthane)	1B	broad (insects, mites)	L	H	H	0	moderate to long
diflubenzuron (Novus)	15	—	L	H	L	0	—
imidacloprid (Triumph)	2A	broad (insects, mites)	L	H	H	0	short
spinetoram (Azaena)	3A	broad (insects, mites)	H	H	H	0	moderate
fenbutathion oxide (Fenitron)	12B	narrow (pest mites)	L	L	L	0	short
fenprophos (Stragen, Savex)	15B	narrow (mites)	L	L	L	0	short to moderate
fenitrothion (Fenitron)	3A	broad (great bugs, beetles, caterpillars)	H	H	H	0	moderate
methidathion (Fulcrum)	1B	broad (insects, mites)	H	H	H	0	moderate to long
methoxyfenozide (Onion)	18	narrow (caterpillars)	L	L	L	0	none
neem oil (FertiCo)	16	broad (soft bodied) insects)	L	L	L	0	short
permethrin (Deltam)	3A	broad (exposed insects, mites)	L	L	L	0	short to none
phenothiazine (Anton)	1B	broad (insects, mites)	H	H	H	0	moderate to long
pyridaben (Nover)	21A	broad (insects, mites)	—	—	—	0	short
pyrimorfin (Ectosol, Solene)	7C	narrow (scale, beetles)	L	H ⁷	L	0	long
spinosad (Zenpro, Zenpro)	5	caterpillars, thrips, whiteflies, aphids, scales, leafminers	L	H ⁷	L/H	0	short
sulfur	16	narrow (mites and citrus thrips)	L/H	L	H	0	short
thiophan-methyl (Foliar)	46	narrow (sucking insects)	— ⁸	—	H	0	moderate

L = high H = moderate L/L = low — = no information —H = unknown or question mode of action

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Table 1: This chart shows the pesticide impacts on natural enemies (image courtesy E. Symmes.)

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can provide free control services.

When using sixspotted thrips cards, 2.6 thrips on a card per week for every one mite on a leaf equals no change in mites seven days later, according to Symmes, citing a 2017 study by UCCE Entomology Advisor David Haviland

in Kern County.

From mid-season to hullsplit, if a grower has 25 to 33 percent spider mite infested leaves with three thrips on a trap per week, he is breaking even with 50-percent chance mites will be the same or lower in 14 days. If there are six thrips on a trap per week, that is good news, and the grower should see

73-percent chance mites will decrease in seven days and 97-percent chance mites will decrease in two weeks.

With this method, Symmes says spider mites are treated once economic thresholds are reached (not before) and the overall goal is to maintain a balanced ratio of natural enemies-to-spider mites that will allow the beneficials to help suppress spider mite populations.

She shares the following guidelines:

- Monitoring and treatment thresholds take into account the abundance of both the pest spider mites and their key natural enemies (predator mites and sixspotted thrips).
- Early season destruction of natural enemies and/or their food sources will likely mean that they will not be present, or not present in enough numbers at the right time, to provide measurable impacts later in the season when growers need them to help fight flare-ups.
- Predators alone may not be sufficient to keep spider mites below



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Spider mites can be found on the undersides of leaves in almond and walnut orchards (photo by J. Johnson.)

economically damaging levels, and miticides may be needed based on site-specific monitoring of treatment thresholds. Know which predators are present and choose materials accordingly. Using a miticide that is softer on beneficials helps keep them around to suppress spider mites missed by the pesticide.

- Best practices for getting the most out of threshold-based miticide application include choosing the right material for the job (i.e., those softer on predators if they are present, desired residual activity and pre-harvest intervals, quick and effective knock-down if needed, etc.), obtaining optimal coverage (high volume, slow speed), and applying with oil or the recommended adjuvant.

Timely Miticides

Symmes said managing spider mites in almonds in recent years has typically taken one of two general approaches in conventional orchards: applying a prophylactic early-season treatment or utilizing threshold-based treatment timings (later season) and conserving biological control. Both have pros and cons, and each method can be used to successfully manage spider mites. Which is “better” depends on a number of factors in the particular orchard operation, the typical abundance of natural enemies and how effectively they are conserved and may vary depending on the environmental conditions year-to-year.

According to Haviland, there are a variety of miticides to choose from, with the key factor to miticide efficacy being how it is applied. He said a slow, steady application provides the best results.

With a successful biocontrol threshold in place, growers have found they can reduce their use of sprays, and if the ratio of enemies to spider mites is balanced, eliminate sprays for spider mites altogether.

Symmes said early abamectin treat-



Spider mites can be controlled by natural enemies, such as predaceous mites and sixspotted thrips (photo courtesy UC IPM.)

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ments (May), once a popular option in many almond orchards, seem to be waning over the past few seasons. Growers and PCAs are increasingly reporting concerns about efficacy and resistance-management considerations. When applied properly and at the appropriate time based on spider mite populations, abamectin can be an effective miticide and these early treatments can control mites into summer.

Following are some key considerations Symmes provides regarding the most effective use of abamectin:

- Abamectin functions as a nerve toxin that must be ingested by mites. Once applied, the material must move into the leaf tissue, where it can then be picked up by feeding mites. This translaminar movement of the material works best prior to leaf hardening and when leaves are mostly free from dust and other

residues. Applications before leaf hardening can be quite effective.

- Applying abamectin after leaf hardening (i.e., with hullsplit sprays) may seem like an inexpensive insurance policy, even if the effectiveness of the material at this timing is greatly reduced. However, bear in mind two additional issues: this is the time when natural enemies tend to be more abundant if preserved early in the season and, from a resistance-management standpoint, two applications of the same active ingredient within the same season is not advisable.
- Abamectin is highly toxic to spider mite natural enemies, particularly sixspotted thrips and predator mites. Use of abamectin early in the season may contribute to later season spider mite flare-ups due to reduction or

elimination of these beneficials in the orchard by direct toxicity and/or by reducing their food source (spider mites, European red mites, brown almond mites.)

- Without beneficials to at least slow a mite flare up as the abamectin wears off (expect 60 days of activity if applied properly and at the tight time,) spider mite populations can jump to damaging levels in just a couple of weeks with summer heat and water stress.
- In years when spider mites are slow(er) to develop, “May sprays” of abamectin may be of very little value, as additional later season sprays often become necessary regardless of early-season intervention, and natural enemies are unnecessarily disrupted. Weigh the pros and cons of the inexpensive insurance policy in treating below-threshold populations vs. destruction of natural enemies and consider how overuse of a particular chemistry over time can increase the likelihood of resistance development. Best to use practices that help maintain all of the tools in the toolbox so that they are available and effective when particular situations call for it.

Avoid Prophylactic Approach

Avoid applying prophylactic spider mite treatments before economic thresholds are reached, Symmes advises.

UC IPM guidelines suggest the following treatment thresholds based on whether pyrethroid or organophosphates applied to target other pests have been or will be used this season: In orchards where pyrethroid or organophosphate applications are not used, consider treatment if samples show 30 to 40 percent spider-mite infested leaflets and predators on less than 10 percent of the leaflets or 40 to 50 percent spider-mite infested leaflets and predators on 20 to 50 percent of the leaflets. No treatment is warranted if predators are on 50 percent or



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more of the leaflets. In orchards where pyrethroid or organophosphate applications are used, consider treatment if samples show 10 percent spider-mite infested leaflets and predator mites on less than 10 percent of the leaflets or 20 percent spider-mite infested leaflets and predators on more than 10 percent of the leaflets.

Monitoring for the presence and absence of mite pests and natural predators, paying attention to treatment thresholds, and applying selective chemistry to maintain beneficial populations, make up an effective, and cost-effective, season-long approach for managing mites in nut orchards.



Mite damage on almond leaves (photo by Marni Katz.)

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Almond Board Takes Breeding to the Next Level

Accelerating development and outreach of diverse almond varieties for a diversity of uses through strategic breeding program

By ALMOND BOARD OF CALIFORNIA | *Contributing Writer*

ALMONDS HAVE BEEN A CONSTANT throughout human history. From the Bible's Old Testament to our present era of emails, e-books and e-commerce, you'll find almonds are referenced in various places across multiple countries, consumed by each new generation over hundreds of years.

While it's thought that almonds were introduced to California as early as the 1700s, it wasn't until the mid-1950s that production expanded significantly in the Central Valley as seedlings along roadsides and commercial orchards propelled the discovery of new almond cultivars. Alongside these discoveries, California maintains the oldest continuous almond breeding program in the world. In 1923, the University of California (UC) at Davis and the United States Department of Agriculture (USDA) initiated a cooperative breeding program to conduct early pollination and cultivar studies.ⁱ Together with private breeders and nurseries, USDA and UC Davis have built a robust pipeline of new cultivars and rootstocks to serve the California almond industry.

The Almond Board of California (ABC) began funding almond varietal research at UC Davis in the early 1970s and expanded to rootstock development in the late 1980s, investing an estimated \$8 million over the past 40 years. In the last 20 years, this research has delivered three new varieties—Kester, Winters and Sweetheart—and supported testing of most commercial varieties and rootstocks for overall performance, resistance to pests, diseases and abiotic stresses, providing growers with information on options for different growing conditions.

Today, ABC has established a holistic approach to develop the varieties of tomorrow. In November, ABC hosted

various stakeholders—public and private breeders, growers and handlers, hullers/shellers, UC Cooperative Extension researchers and farm advisors, and nursery representatives—for an opportunity to sample more than 60 varieties of almonds at its Crack-Out Day.ⁱⁱ Now, after considering each industry sector's valued almond characteristics, from the grower to the handler, the manufacturer to the consumer, ABC has developed a five-point plan detailing how it will coordinate with actors throughout the industry to find better varieties that can achieve greater, higher quality yields with reduced management costs and horticultural inputs in the areas of pollination, water use and pest management, among others.

"The Almond Board is excited to lead the California almond industry in this community-wide effort to find improved varieties, and it is truly a team effort. We want to work in lockstep with each industry stakeholder every step of the way," said Dr. Sebastian Saa, senior manager of Agricultural Research at the Almond Board.

Innovation to Speed up Varietal Development

Unlike annual crops, breeding of tree crops such as almonds can take multiple years. To accelerate breeding for traits such as self-compatibility, ABC has initiated new investments in the development of molecular markers for use in conventional breeding.

"To be clear, this is not related to GMOs [Genetically Modified Organisms]. We are still using conventional breeding approaches, but rather than waiting for a tree to grow each time we cross two varieties, breeders can use

molecular markers to see very early on if the trait of interest will be in the progeny of that cross," said ABC's Chief Scientific Officer Dr. Josette Lewis.

The benefit of molecular markers on time and development is astronomical. With the previous process, a breeder would cross two varieties, grow the seedling and wait until it produces. That process could take up to seven years. Using markers, however, when the plant is only four months old the breeder can already send a leaf to the lab to determine its molecular makeup.

Molecular marking technology is being used in almond breeding programs across the world, including Israel, Australia and Spain. ABC is looking forward to incorporating these tools into the California almond industry's breeding program. In December ABC issued requests for proposals to the best researchers in this field of study and projects are now underway.

Accelerating Evaluation of New Varieties

In addition to speeding up development, ABC will increase the rate at which new varieties are evaluated, allowing researchers to weed out the "winners" from the "losers" at a more efficient pace.

In the 1980s, the Almond Board began supporting long-term regional variety trials (RVT) in various locations to test the performance of new varieties in a semi-commercial manner across diverse almond growing regions and soil conditions. These varieties are compared to standard varieties such as Nonpareil.

In the industry's current RVTs taking place in Butte, Stanislaus and Madera

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counties, UC researchersⁱⁱⁱ are collecting performance data on a total of 29 varieties in the areas of bloom and hullsplit timing, disease and insect susceptibility, tree canopy size, kernel quality and yields.

With ABC's new process, top varietal candidates will be evaluated in interim orchard plots in combination with newly developed material from other sources

(i.e. private breeding programs). Here, researchers will gather data and determine the strongest, most viable varieties, which will then go onto a longer term RVT, remaining at that site for 15 years. During those 15 years, researchers will continue collecting data on seedling performance, growing habits and horticultural factors, data that will then be provided to growers and other industry stakeholders to help them make the most informed decision possible.

"Streamlining this process so that all

potential new varieties are screened in the same manner allows us to be more strategic and thoughtful about which varieties we pursue—those which have the best qualities," Saa said. "For the benefit of all involved, we want to ensure that the varieties that reach the 15-year RVTs are the best of the best."

In addition to incorporating these interim orchard evaluations to the breeding equation, Saa said ABC is working with funded researchers to design the next generation of RVTs to provide outputs to the industry every five years instead of every 15 years (once the design is fully implemented).

"RVTs will need to run more frequently, initiating every five years or so, to ensure we can increase the frequency of the outputs without sacrificing the quality of the information," he said.

Soliciting Input on Breeding Priorities

The multiple uses of different varieties and types of almonds have long been understood in the industry. Selling into Japan? You're shipping your best product—Nonpareil J-spec—for a consumer demographic that demands perfection, a nut without blemishes. Sending a load to Germany for confectionary use? You're likely shipping a variety that's easy to blanch for marzipan and can easily be used for multiple purposes. Ultimately, different markets want different almonds.

While handlers, in particular, know these details well, for many years the California almond industry has bred almonds not with the end user as top of mind but with a focus on the growers' priorities: harvesting implications, pest management, bloom timing, etc. However, in order to keep California almonds ahead of the competition—to ensure continued demand—the industry needs to produce different varieties that are not only productive for the grower but also provide versatile, high quality kernels that work well for the ingredient and snacking markets.

To meet this need, the Almond Board is soliciting input from growers, hullers/shellers, handlers and food companies to inform public and private breeders on horticultural, processing and demand priorities. This guidance will provide a list of "priority" traits, such as self-com-



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patibility, high yield, certain kernel specifications, harvest shake efficiency, etc., and then a list of “desired” traits, including disease resistance greater than Nonpareil and flavor development.

“Developing this guidance is an ABC and industry-wide effort,” said Dr. Karen Lapsley, senior director of Nutrition Research and Special Projects at the Almond Board. “We’re working with ABC experts in nutrition profiling, almond quality, trade and marketing, as well as a vast amount of industry stakeholders through our industry-led workgroups and committees to determine what should be included in this guidance.”

Sharing Research Outcomes

ABC-funded research cannot support the industry if it never reaches the eyes and ears of growers, nurseries, handlers and other stakeholders. Constant, timely communication and hands-on events are required to share research outcomes and demonstrate how those outcomes may be applied in the orchard.

At present, industry members have access to RVT outcomes and other breeding projects through ABC’s Research Database and annual Research Update. ABC is looking to give the industry an earlier and fuller look at varieties coming through the pipeline of both the public breeding and commercial nursery programs. Learning how varieties in those programs are performing will give industry members helpful data on which varieties may maintain improved production, quality, or processing value.

“Increased outreach is particularly important to public entities, such as the UC and USDA breeding programs, as they do not have the marketing capabilities that private nurseries do, which keeps them from broadly promoting new varietal releases,” Dr. Saa said.

The Almond Board has already started to execute on outreach events and communications, such as the Crack-Out Day, from which ABC plans to create and distribute an industry report sharing the results, which includes how attendees rated each variety on taste, texture, etc., as well as findings from RVTs and other breeding research. The Almond Board is also planning to arrange field days during which results from RVTs will be shared and craft more broad communi-

cations via industry newsletters.

“Not only do we want to increase outreach, but we want to make it more user friendly and approachable,” Saa said. “New varieties are being constantly evaluated, but if we don’t do more to work with researchers in planning field days and communications to the industry then growers and stakeholders won’t have the full picture.”

ABC also recently formalized its strategic collaboration with the UC Davis Fruit and Nut Center, with whom ABC will partner to develop specific outreach tools in upcoming years.

Evaluate Almond Quality in Context of Market Demand

From almonds as an ingredient to almond butter and almond milk, the industry is seeing continual growth in almond uses across multiple categories. Because different almond varieties can be optimized to best suit the end user, food manufacturers look for a wide slew of attributes when selecting almonds for purchase, attributes including kernel shape and size, surface color (light to

dark), surface texture (smooth to deeper groves) the ability to be blanched (for milk and baking) and more. Flavor is also a factor—in almonds, the compound Amygdalin gives the nuts their signature amaretto-like flavor—and while flavor does not drastically vary between California almond varieties, those with a keen palate will notice a distinct difference in taste.

Beyond the almond in all its forms, of course, is the whole almond, which in recent years has taken the lead ahead of other nuts in the realm of “snackification.”

“Driven by busy millennials, this growing trend of ‘snackification’ demonstrates that people are rapidly trading in their three daily meals for smaller snacks consumed throughout the day. Growth in the snack aisles is one of the largest drivers of almond consumption worldwide,” said ABC’s Associate Director of Trade Stewardship and Marketing Harbinder Maan.

Parallel to this increase in global

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demand is an increase in supply. For the third straight year, the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) is predicting a record California almond crop, estimating orchards will produce 3.0 billion pounds of nuts in the 2020-21 crop year, up 17.6 percent from last year.^v

What does this mean for the California almond industry?

According to Guangwei Huang, associate director of Food Research and Technology at ABC, “As supply and global competition increase, demand for certain almond characteristics and quality properties becomes more and more relevant—no exceptions.

“For instance, in the walnut industry when global supply is higher than demand, the ability to produce extra-light walnuts really matters, and in cherries, we know that producing fewer, big fruit is more desired than producing more smaller fruit,” said Huang.

With this mantra in mind, ABC is working with professor and food chemist Dr. Alyson Mitchell of UC Davis and

sensory experts from The National Food Laboratory to define flavor and sensory quality characteristics of different almond varieties to better understand how the aforementioned “priority” and “desired” traits impact consumer liking or preference of almonds.

“Carrying out profiling and quality evaluations in the early stages of varietal selection and RVT evaluations will expedite the development of new varieties and allow us to best meet the end user’s demand for common and unique applications,” Huang said.

Looking to the future of ABC’s strategic breeding program, Lapsley said she’s excited to see future varieties and the research backing them drive the industry toward a more advanced, successful future.

“Thorough evaluation of new varieties gives confidence in their value across the industry,” said Lapsley.

“For instance, the reason you know Monterey consistently has more doubles is because of an early RVT that demonstrated that result year after year. With improvements in the variety evaluation process, we have an opportunity to

exponentially increase the knowledge of growers and other industry members to help them make decisions about the varieties of the future. And by supporting the industry in its efforts to produce better quality, highly productive varieties at a faster pace, the Almond Board is continuing to support the California almond industry in its mission to expand global consumption through leadership in innovative research.”

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

ⁱGradziel, T. M., & Company, R. S. i (Eds.). (2017). Almonds: Botany, Production and Uses. CABl.

ⁱⁱLearn more about ABC’s Crack-Out Day at newsroom.almonds.com/content/almond-board-brings-together-growers-manufacturers-to-taste-more-than-60-almond-varieties.

ⁱⁱⁱUC researchers involved with current RVTs include Bruce Lampinen, Phoebe Gordon, Roger Duncan, Luke Milliron and Sam Metcalf.

^{iv}To access the Almond Board’s Research Database, please visit almonds.com/growers/resources/research-database.

^vFor more information, visit newsroom.almonds.com/content/usda-nass-predicts-third-straight-record-breaking-almond-crop.



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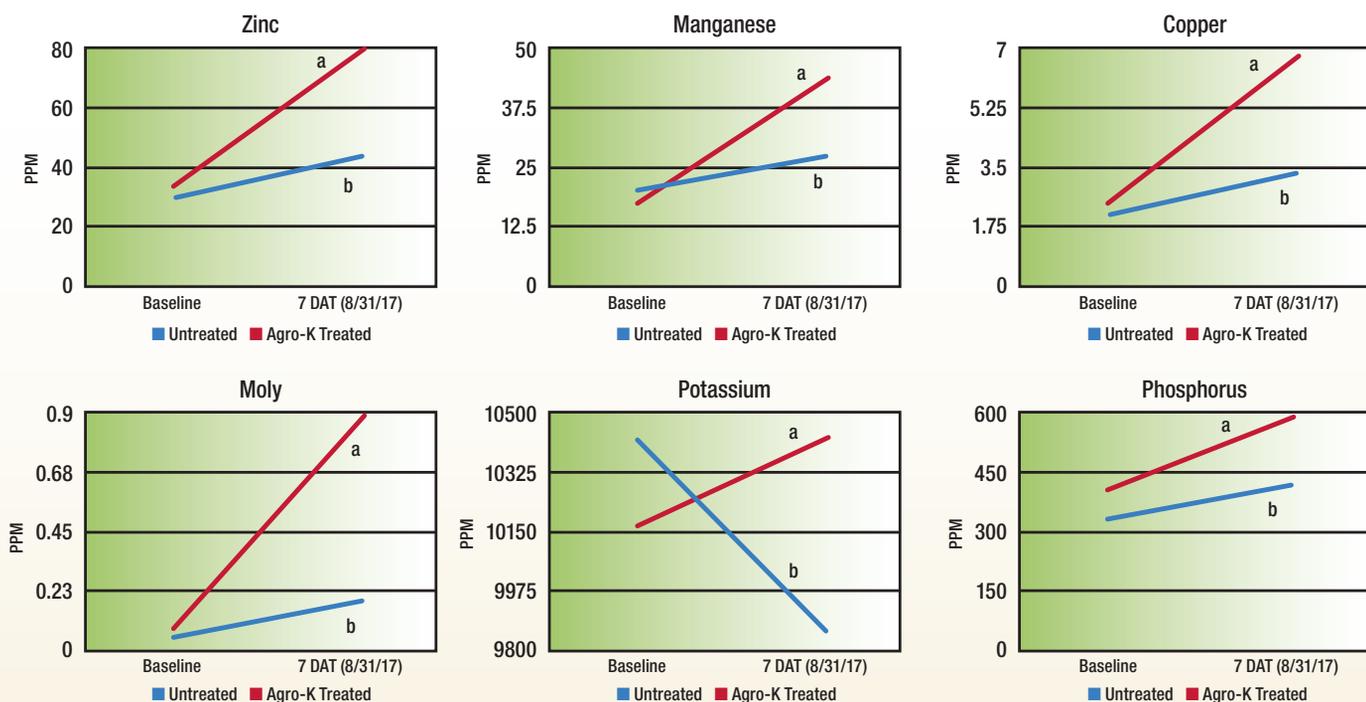
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Data by Bisabri Ag Research



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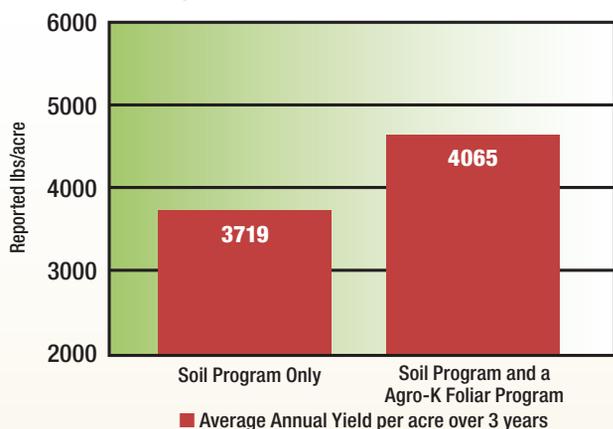
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Building nutrient levels this year sends trees and buds into winter with more strength and carbohydrate reserves that will be available to the tree next spring at bud break when cool soils limit uptake and nutrient availability. Poor chilling hours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

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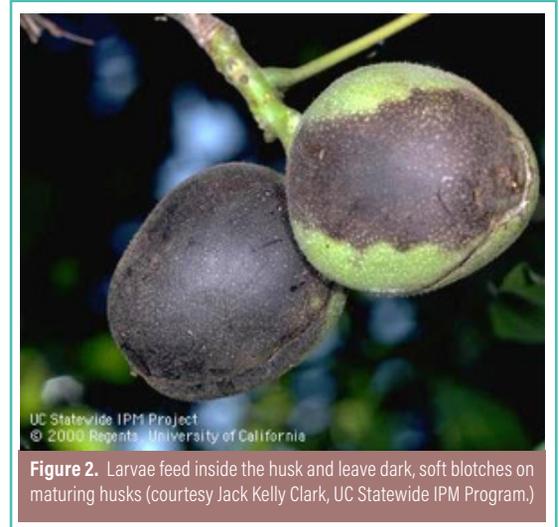
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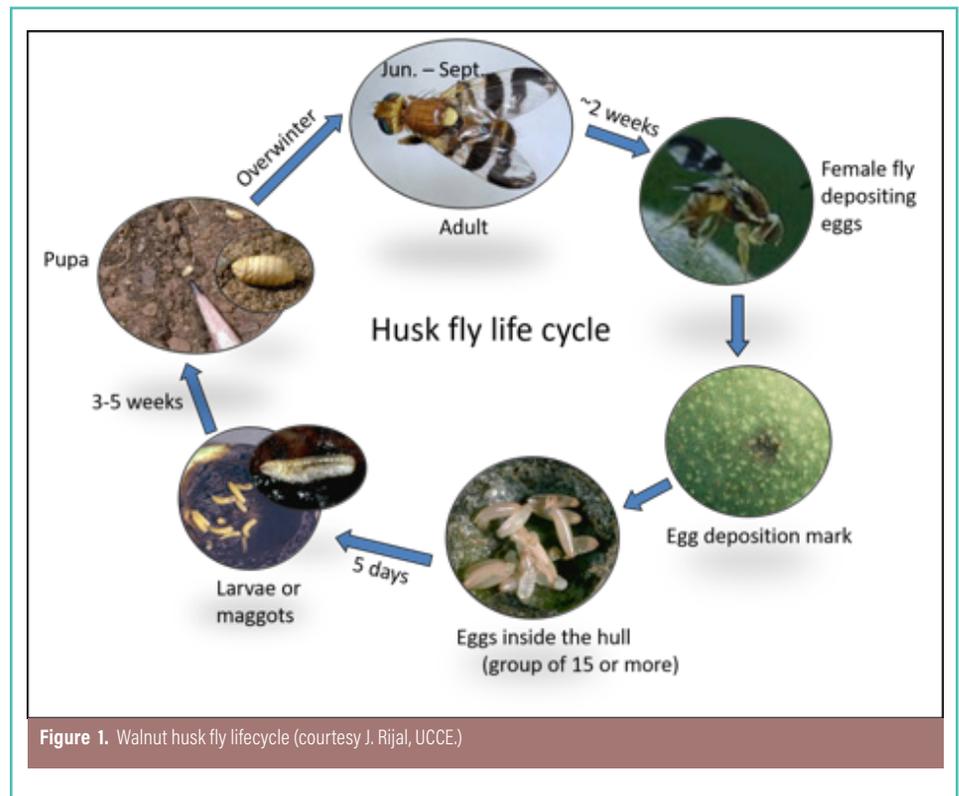
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WALNUT HUSK FLY: UNDERSTANDING THE BIOLOGY, MONITORING AND MANAGEMENT OF THIS COMMON PEST IN WALNUT



By **JHALENDRA RIJAL** | UCCE Area IPM Advisor, Northern San Joaquin Valley

THE WALNUT HUSK FLY, *RHAGOLETIS COMPLETA* (Diptera: Tephritidae), is a colorful fly of about the same size as the house fly but has iridescent greenish eyes, and banded wings. Walnut husk fly adults have a yellow spot below the wing base, and a dark triangular band at the wingtip, which distinguishes the husk fly from other Tephritid flies. Walnut is the primary host of this insect, although there have been reports of an occasional attack to peach trees that are near walnuts. The walnut husk fly has been an increasing problem in the Sacramento and San Joaquin Valleys, major walnut growing regions in California. Female flies deposit white eggs resembling rice grains, just underneath the walnut husk and the larvae (i.e., maggots) feed on the husk upon hatching within five days. The maggots continue to grow inside for the next three to five weeks, and the mature maggots drop to the ground and burrow several inches into the soil to pupate. The majority of the walnut husk fly has one generation per year, and these overwintered pupae emerge as adults the following summer—June through September in the Central Valley. Still, some may remain in the soil



for two or more years. (See the complete life cycle in **Figure 1**.)

Nature of Damage

Larvae feed inside the husk and cannot be seen from outside; however,

the presence of dark, soft blotches on maturing husks (**Figure 2**) indicate potential husk fly presence in the fruit. The maggots feed inside the husk, enlarging the affected fleshy part of the

Continued on Page 46

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Continued from Page 44

fruit inside, but leaving the outer skin of the husk usually intact. Early season feeding by the walnut husk fly results in shriveling and darkening of the kernels, with the increased potential for mold growth. The mid-to late-season infestation causes negligible direct damage to the kernel, but can stain the shell (**Figure 3**), and that reduces the marketable yield for in-shell walnuts and also creates issues during the shelling process.

Factors Affecting Husk Fly Infestation

Although the husk fly can attack all major cultivars of walnut grown in



UC Statewide IPM Project
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Figure 3. Mid-to late-season infestation causes negligible direct damage to the kernel but can stain the shell (courtesy UC Statewide IPM Program.)



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'Based on various studies in California, the most susceptible cultivars reported are Eureka, Payne, Hartley, Serr, and Tulare. However, local environmental and ecological conditions are the major driving factors related to the husk fly infestation in walnut orchards.'

California, the susceptibility can depend on several factors such as fruit size or other fruit morphology, the presence of trichome or hairs, and the maturity time of the cultivars. Based on various studies in California, the most susceptible cultivars reported are Eureka, Payne, Hartley, Serr, and Tulare. However, local environmental and ecological conditions are the major driving factors related to the husk fly infestation in the orchard. Husk fly damage seems to be aggregated, or patchy, in distribution within the orchard with higher infestation occurring in the cool, shady, moist part of the orchards. Orchards that are near a water body such as a river, stream, creeks and other hosts including black walnuts favor walnut husk fly infestation. Various factors that might

affect the husk fly emergence timing and duration have an important effect in monitoring and managing this pest. Recent studies from Dr. Nick Mill's lab at UC Berkeley showed that insufficient winter chilling hours during the winter results in extended and unsynchronized adult emergence in the summer. In our study looking at the depth of the overwintering pupa in walnut orchards, we found that majority of the husk fly pupae (85 percent) overwinter within the top 4 inches of the soil. The knowledge about overwintering biology of this pest can be utilized to explore some alternative control options such as cultural practices that include disc-

ing to expose the pupae, use of cover crops, and potential use of soil-based entomopathogens. These are some of the areas that future research needs to be focused on.

Monitoring in June

The flies are attracted to yellow sticky traps supercharged with ammonium carbonate as they search for the nitrogen-based food source that is critical for the development of their eggs and, thereby, egg-laying capability. It is important to put these traps in the orchard at least by June 1, before the be-

Continued on Page 48

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ginning of the adult emergence in the orchard. Since the patchy occurrence of the husk fly within the orchard, finding a suitable place to ensure catching flies is important. Hang the traps as high as possible on the north side of the tree under the dense foliage area and check the traps 1-2 times per week. After catching flies, identify the female (light-colored first leg segment, pointed abdomen and slightly larger), and gently press the abdomen to squeeze out the content to determine the white 'rice grain' looking eggs (Figure 4). Although monitoring the oviposition mark on the nut provides an idea about the husk fly activity in the orchard, this is the least preferred method as the eggs have already been laid inside the fruit at that point.

Timing Insecticide Sprays

Although natural enemies of the walnut husk fly may be present, these are not effective in suppressing the husk

fly population in commercial walnut orchards. Current husk fly control is primarily dependent on insecticide sprays targeting the flies after emergence and before laying eggs on the fruit. The first application begins as

soon as a single female fly with eggs is captured in the trap, and often requires multiple sprays depending on the time of the beginning capture. Duration of the adult emergence, and damage history of the orchard.. Husk flies are not a problem after the husk split, and treatments are not necessary if the harvest will occur within three weeks. All insecticides except GF-120 (already has bait mixed) should be applied with bait, which attracts adult flies. Several bait types such as Nu-Lure, Monterey, or molasses are available. Since bait is used, coverage may not be critical for low to moderate populations and spraying alternate row applications or aerial applications are also effective for those orchards. However, if the orchard has a history of heavy infestation, and trap capture indicates high pressure, full coverage with high volume sprays may be needed. Similar to other pests, consider efficacy, cost, and potential impact on natural enemies when selecting insecticides for husk fly control. Follow the UC IPM Pest Management Guidelines for walnut husk fly, for insecticide selection and other additional information go to ipm.ucanr.edu/agriculture/walnut/walnut-husk-fly.

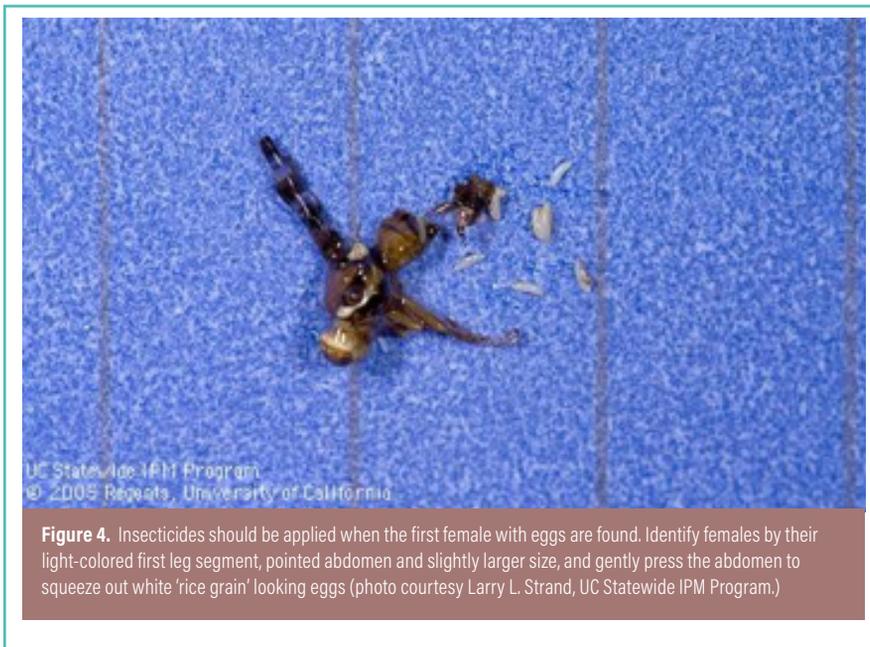


Figure 4. Insecticides should be applied when the first female with eggs are found. Identify females by their light-colored first leg segment, pointed abdomen and slightly larger size, and gently press the abdomen to squeeze out white 'rice grain' looking eggs (photo courtesy Larry L. Strand, UC Statewide IPM Program.)

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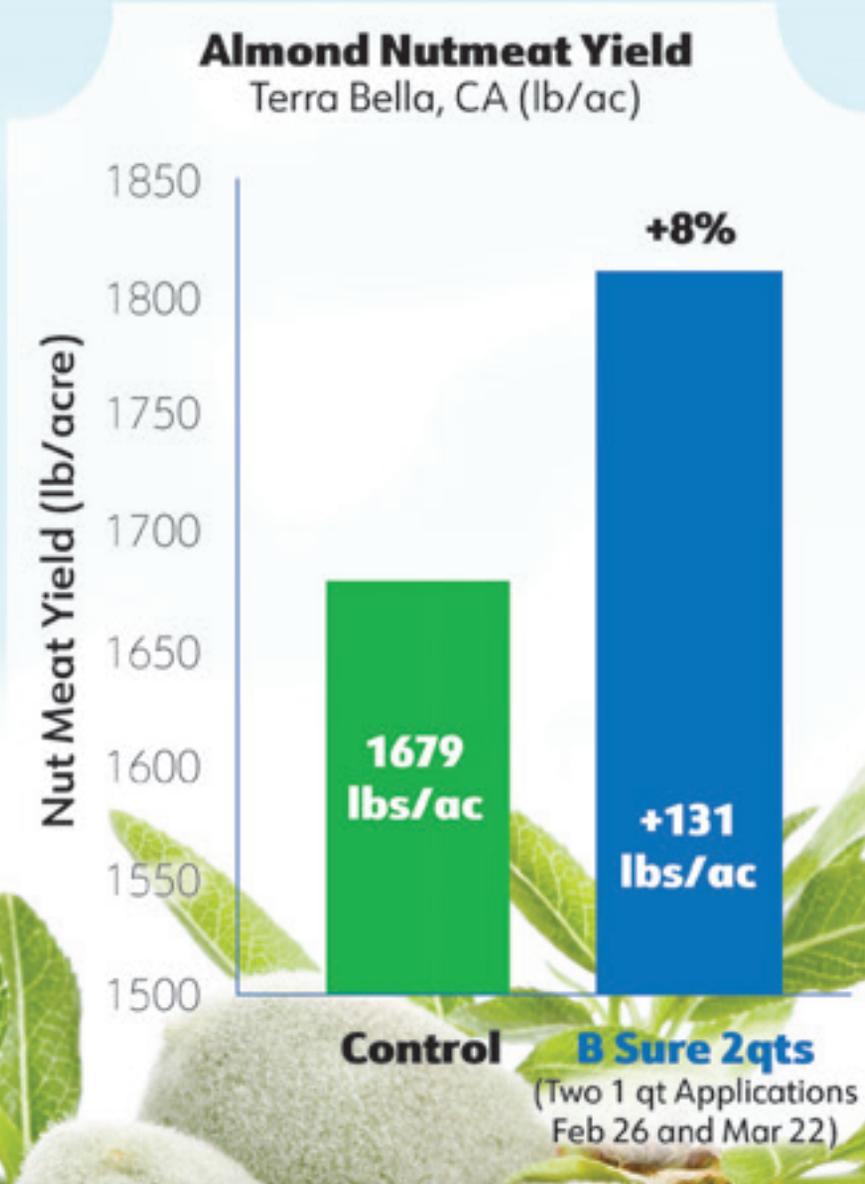


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Nitrogen and Irrigation to Reduce Hull Rot Infections

By CECILIA PARSONS | Associate Editor

PLANNED DEFICIT IRRIGATION AND balanced nitrogen applications have been proven to reduce the incidence of hull rot in almonds. Inducing moderate water stress at the right stage of nut development along with cutting off pre-harvest nitrogen applications are cultural methods of reducing hull rot infections.

Phoebe Gordon, UCCE orchard crops farm advisor in Madera County recently reported that while there are effective fungicides that can be applied to reduce the severity of hull rot, nitrogen and irrigation management at the right time can help reduce the disease in an orchard. The UC IPM web site includes almond fungicide registration and efficacy tables with the appropriate timing to apply the material.

Hull rot is an infection of almond hulls caused by the fungal pathogens *Rhizopus stolonifer* and *Monilinia* spp., and *Aspergillus niger*. When almond hulls begin to split, the pathogen invades and colonize hull tissues. Infected nuts can become sticktights at harvest and if not removed can become navel orange worm overwintering sites. Infection of the hull can also result in death of the spur and attached shoot, and may affect next year's yield depending on the severity of the disease in the orchard, leaving less viable bearing surface on the tree. Some growers have reported that *Aspergillus* infection can lead to staining of the kernel and reduction of nut quality. Hull rot caused by *Monilinia* causes a tan lesion on the outside of the hull. This symptom is hard to see once hulls dry.

The most susceptible varieties are

Nonpareil, Sonora and Winters. Monterey has relatively low susceptibility relative to Nonpareil, Sonora and Winters.

Mohammad Yaghmour, UCCE farm advisor in Kern County, said other factors that can contribute to severity of the disease in individual orchards include dust and over fertilization with nitrogen.

"Every year is different in regard to severity of this disease. It is important to manage nitrogen in the orchard by following the nitrogen management plan and avoid over-fertilization along with following proper irrigation practices. Previous research had shown that over fertilization increases disease incidence in the orchard. However, applying regulated deficit irrigation (RDI), allowing moderate stress to the trees, significantly reduce the incidence of the disease." Yaghmour said.

Well irrigated and fertilized trees are more susceptible to hull rot because the plant tissue is more vulnerable to infection.

According to UC's Drought Management for Almonds, leaf out is a time of rapid vegetative growth that leads to establishment of fruiting positions and carbohydrate reserves for future needs. Fewer daylight hours and relatively cooler temperatures in the spring mean water demand may be met by soil water stored in the root zone.

Well-Timed Irrigation Deficit

Post kernel fill through 90 percent hullsplit is the target time for regulated deficit irrigation. Research has shown that hull rot can be reduced by moderate water stress during this phase of nut de-

velopment without affecting crop quality. This roughly three week period depends on the season and almond variety along with weather patterns.

Almond Board of California reports that a 10- to 20-percent reduction in applied water will be needed, but must correspond to individual orchard soil type and environment.

Robert Smith, a crop consultant with UltraGro, said deficit irrigation in combination with nitrogen management keeps hull rot infections low. Orchards where humidity is high, with susceptible varieties can be the hardest hit with hull rot. Moderate stress is the goal. Excessive stress will also lead to sticktights as well as defoliation. Prior to harvest, full irrigation can be done. Post harvest stress is not recommended.

Determining the right amount of water to achieve moderate stress can be done several ways.

Pomology Farm Advisor Roger Duncan, UCCE Stanislaus County, said a pressure bomb is the preferred tool for determining tree stress and timing regulated deficit irrigation. This tool applies pressure to a severed leaf and stem inside an airtight chamber. The pressure required to force water out of the stem is shown on an external gauge. There is also a protocol to follow for timing and selecting leaves for sampling (watch for a more detailed article on using pressure bombs coming in the September issue of West Coast Nut.)

Prior to hullsplit, almond trees should be maintained between -6 to -10 bars. During the RDI period, stress levels should be maintained at -14 to -18

bars. Post-RDI, trees should be fully irrigated to reduce stress prior to harvest.

Growers and farm managers also have the option of using evapotranspiration data from weather stations and crop coefficients to determine how much water trees are using.

Micro irrigated trees can be reduced to 50-percent ET for 3 to 4 weeks depending on the speed of hullsplit. In flood irrigated orchards; the dry period can be extended 4 to 5 days longer than normal. This should be done for two irrigation cycles, but Duncan warns that flood irrigated trees can go from moderate stress to severe stress in a short period of time.

Using soil moisture sensors to determine tree water stress may result in over or under irrigation when soil types vary across an orchard.

There are also visual and timed strategies for RDI. Deficit irrigation can begin when the first blanks begin to split. Noting soil variations, variety of tree and growing region can help with timing of the regulated irrigation strategy.

Regulated deficit irrigation should begin sooner in heavy soils with more water holding capacity. Growers and farm managers also must be mindful of fertilization schedules.

Growers can be 'in the ballpark' of initiating moderate stress by reducing their normal irrigation by around 50 percent. An orchard getting four inches a week in early June can be cut back to 2 to 2½ inches for that three week period, Smith said.

Cutting back irrigation further can result in shriveled kernels and tree defoliation. Trees that enter the post kernel fill to 90-percent hullsplit stage under stress will not benefit from regulated deficit irrigation.

The key to successfully managing hull rot through cultural practices is to manage stress at the right time to reduce incidence while protecting the crop.

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Post kernel fill through 90 percent hullsplit is the target time for regulated deficit irrigation to manage hull rot. Using a pressure bomb can help determine tree stress and time deficit irrigation for hull rot management (photos by Marni Katz.)



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FARM ADVISOR PROFILE

KENT DAANE UCCE IPM SPECIALIST

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

Farm Advisor Kent Daane emphasizes biological control that can preserve beneficial insects and protect pollinators (all photos courtesy K. Daane.)

KENT DAANE, UC COOPERATIVE

Extension entomology specialist at the Kearney Ag Center in Parlier, always had an interest in insects and the forest. But he became enamored with biological control through the extravagant stories of Dr. Carl Huffaker, a key figure in UC history in terms of biological control, who was not only the father to one of Daane's high school friends, but also became one of Daane's mentors.

"Carl would travel to all kinds of exotic places," recalled Daane. "He was with the first scientific group to go to Russia after WWII, in one of the first groups to go to China as it opened up after Nixon's trip there."

Huffaker came back with stories of being constantly followed around in China, Russian KGB agents going through his room and suitcases, and of being served vodka to get US agriculture secrets. "It seemed like this incredible life."

Daane would ultimately experience his own travels, including to China, South Korea, and most of the major winegrape growing regions on the globe.

Upon the advice of Huffaker, Daane earned his undergraduate degree from UC Santa Barbara in the zoology/ecology program and started his career as an insect ecologist, with an initial goal of forest entomology. After graduating from UC Santa Barbara, he got a job at UC Berkeley as a lab assistant and spent nearly a year in Klamath Falls, Ore., where he studied the spruce budworm. His team camped most of the time and worked out of a makeshift lab beneath a

local restaurant.

"We'd drive out to the forest and climb 80 to 90 feet up into the tops of trees to collect samples, and then bring them back to the lab to look at the life history of this forest insect pest," said Daane.

Budgetary constrictions resulted in Daane being let go for a few months, only to be hired back on for the same project and assigned to Jemez Mountains, New Mexico. But, upon his return, he received the harsh news that there just weren't any jobs in forest entomology at the time.

Daane turned to the Entomological Society of America (ESA) news bulletin he received in the mail. "Orchard IPM was the most common field being advertised," said Daane.

Don Dahlsten, a mentor in forest entomology, had encouraged Daane to get an advanced degree, and Daane decided it was time for graduate school. He selected UC Berkeley, coming from a family in which two previous generations also attended Berkeley.

"My father drove me around and showed me the places he had lived as a child and when he was a student [at Berkeley]. He said, 'Why don't we buy a house together? That way, if you're ever hired by Cal, you'll have a place to stay,'" said Daane.

Daane declined on the grounds that the university never hired its own people. Shortly after graduation, he was hired by Berkeley.

"It was the worst financial decision I ever made."

Crash Course in Farming

When Daane began working at the Kearney Agricultural Center (now the Kearney Agricultural Research and Extension Center) in 1989, he received a crash course in farming from his staff research associate, Glenn Yokota, who was bold enough to educate Daane on farming when everyone else was too embarrassed to mention it.

"He kind of taught me about all the things I was so stupid about. I knew nothing until I actually started working with farmers," said Daane.

He and Yokota started projects on grapes and stone fruit, worked a lot with the team at Kearney, helped upgrade integrated pest management (IPM) practices, and, finding that there seemed to be a constant evolution of invasive pest species, he moved from grapes to almonds, to pistachios, and more.

For Daane, who's as entrenched in academia as he is with advising growers and farm advisors, the change in faculty is a constant. Where there were once roughly 20 faculty on the Berkeley campus who worked with insect pests in urban, forest, and agricultural settings, there are now only a few, with some of them holding significant administrative positions.

"There's still a great group of entomologists in the UC system, both on campus and in the counties. I just wish there were more," said Daane. "The budget is a little tighter than it was before, but we need more positions and more support."

Retention of cooperative extension farm advisors and specialists is simply



An adventurous traveler, Daane is seen here in 1980 climbing into the tops of trees in Oregon and New Mexico to sample insect pests.

becoming harder. It's not for lack of interest, but rather UCCE budget constraints are not only up against California's cost of living but the offerings of larger, private companies.

This also comes on the heels of a significant shift in the family farm. Family farms, while they still exist, are fewer in number, but much larger in size.

"A lot of the farmers we work with are still family farms, but they just happen to own thousands of acres," said Daane.

This has changed an aspect of traditional farms calls, where several smaller growers would need the help from UCCE experts. Now both family farms and corporate farms have highly skilled workforces, with employees often having post-graduate degrees in agricultural related fields. This has upped the communication level between growers and farm advisors and specialists, allowing them to communicate more as colleagues.

Farm Advisors Spread Thin

The reduction in UCCE personnel may have simplified some aspects of communication amongst groups, but it has also increased the territories for which UCCE farm advisors and specialists are responsible, often up to four counties for some farm advisors. Aside from this, administrative duties required by CE specialists and advisors are becoming more complicated and time consuming. While the younger, incoming classes may take this as today's norm, those who have been with the university system

for the last few decades, like Daane, have struggled more with the changes.

Despite this, Daane remains a champion for the hiring of more farm advisors that work directly in agriculture. Once focused more on farm-based based issues, UC's Agriculture and Natural Resources (ANR) has grown to include more advisors and specialists focusing on a different set of issues, including air and water quality, landscape ecology, and other urban and urban family concerns.

Daane applauds the efforts in this newer arena but also doesn't want to see the loss of farm-oriented extension, or the continuity between his soon-to-be-retiring generation of experts and those just entering the field.

"I'd like to hire someone I can work with before I retire, so I can introduce them to the different commodities and cooperating farmers to make those initial introductions, which could really help out a young person's career getting started in the right direction," explained Daane.

Academia aside, Daane dedicates himself to his clientele of growers and farm advisors. He notes that there's a shift in mentality in terms of pest damage and sustainability, with more legislative restrictions on pesticide use, and growing public interest in organic produce.

"I think that if we're going to start adopting sustainable practices, we have to accept some crop damage levels that are a little higher than what we've been accepting recently," said Daane. "It seems like we have these zero tolerances out there still."

Though his career may have been sparked by fantastical stories of the East, Daane's career has always circled back to the farms, growers, and advisors right here in California. "California is one of the great agricultural centers of the world."

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Sharing the Good News About Pistachios: American Pistachio Growers Relies on One-Two Punch of Tariff-Busting and Aggressive Marketing to Build Markets

By JUDY HIRIGOYEN | Vice President of Global Marketing, American Pistachio Growers

BUOYED BY POSITIVE RESEARCH NEWS, A BOUNTIFUL HARVEST in 2019, and robust exports to key markets, American Pistachio Growers (APG) maintains its focus to build

and sustain long-term profitability and sustainability.

Pistachios now rank as California's fifth leading commodity with a 2018 value of \$2.62 billion, and the state's number-two ranked export crop at \$1.73 billion (Source: CDFA 2018-19 Agriculture Statistics Review Exports Report.) Current bearing acres and the surge in new orchard plantings in California positions the industry to produce more than 1.4 billion pounds of pistachios by 2026. This upward trajectory in production will test APG's marketing acumen in domestic channels as well as in important export markets where the lion's share of production is sold.

To help on the export front, APG earned more than \$3.8 million in federal grant funds for FY 2019-20 to further expand exports in the key overseas markets of China and Europe, as well as to jumpstart marketing programs in growth markets like India.

China remains the top customer for U.S. pistachio exports in spite of the prolonged U.S-China trade dispute that started in 2019. However, a shift in shipping destinations is spreading volume amongst other countries, including India, which will result in less dependence on China in the long run. Some industry members view India as a growth opportunity with high potential over time and balancing the portfolio of Asian markets.

APG targeted India as prime for export growth in 2019, due to favorable trade conditions and its 1.3 billion consumers. With a grant award from the *Agricultural Trade Program*, APG launched its first nationwide campaign in India in September, in advance of Diwali, the highly popular Hindu festival of lights. The campaign was immensely successful with grocery retailers, importers, consumers, and high-profile health experts. The goal here is to educate consumers on the health benefits of pistachios and move them from a special occasion food to an everyday plant-based protein option.

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In-store branding in India is helping build demand for U.S. pistachios.



Health Benefits of Eating Pistachios

APG has focused its U.S. marketing efforts worldwide on communicating the health benefits of pistachios, capitalizing on a growing mountain of positive nutrition research. In early March of this year, APG announced at its Annual Conference the finding that U.S. grown roasted pistachios meet the criteria as not only a “good source” of protein but also a “complete protein.” The results of a University of Illinois study presented at the Federation of European Nutrition Societies Conference in Dublin, Ireland last October found that, for people over five years of age, adequate levels of all nine essential amino acids are shown to be present in roasted pistachios, based on a Protein Digestibility Corrected Amino Acid Score (PDCAAS) for pistachios, thus qualifying them as a complete protein, alongside meat, fish, dairy, eggs, and a few plant proteins.

Pistachios now share this important categorical distinction with a small number of other “complete” plant proteins including quinoa, chickpeas, and soy—foods that have become popular among vegetarians and consumers who wish to reduce their consumption of animal proteins. Dr. Mehmet Oz, keynote speaker at the 2020 Pistachio Industry Annual Conference, likened pistachios to eggs that grow on trees. And with as much protein as an egg, the marketing communications programs of APG has gone to work to bring that information to consumers and health professionals in the U.S. and in key export markets.

APG is now leveraging this very positive news in a new consumer advertising campaign, *Game Changer: Pistachios are a Complete Protein.*



Indian consumers are developing a preference for U.S. grown and branded pistachios (photos courtesy APG.)



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Continued on Page 56

THE QUANTIFIED VALUE OF AMERICAN PISTACHIO GROWERS

ELIMINATING BARRIERS TO TRADE

A recent study* quantified the impact of American Pistachio Growers' efforts on export shipments resulting from the reduction or elimination of barriers to trade in the prioritized markets of Israel, Mexico, China, Hong Kong and the European Union.

► INCREASE IN U.S. EXPORTS

Comparing Pre- and Post-Tariff Periods 2009-2017

European Union	1.2 Billion Pounds
Hong Kong	913 Million Pounds
Israel	61.3 Million Pounds
Mexico	46.6 Million Pounds
China	31.5 Million Pounds

Total

2.3 BILLION POUNDS

Average Increase in Shipments/Year

187.5 MILLION POUNDS ANNUALLY

INCREASE IN VALUE OF U.S. PISTACHIOS

Exported to Prioritized Export Markets (Israel, Mexico, China, Hong Kong, and the EU)

TOTAL INCREASED VALUE OF SHIPMENTS

\$3 BILLION



AVERAGE ANNUAL INCREASE

\$172.5 MILLION



American Pistachio Growers (APG) is the United States' pistachio industry's generic trade association. It has more than 865 contributing members, and represents the interests of its growers and member processors located in California, Arizona and New Mexico.

*Tootelian, Dennis, "An analysis of the effects of American Pistachio Growers' program to reduce/eliminate tariffs on U.S. pistachios" 2019

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Continued from Page 55

Reducing Trade Barriers

"It's an exciting time for the U.S. pistachio industry," said APG's Chairman, Brian Watte. "Clearly, we have plenty of marketing challenges on the horizon as the industry accelerates production and secures new markets both here and abroad, and we've built solid marketing and trade promotion programs to meet these challenges head-on."

One of the most important areas of APG's marketing strategy is confronting tariff and non-tariff barriers. In 2019, APG commissioned a study by Dr. Dennis H. Tootelian, an emeritus professor of marketing, to determine what shipments of U.S. pistachios would have been if tariffs had not been lowered or eliminated in five geographical regions—Israel, Mexico, China and Hong Kong, and the European Union.

Comparing the period to when tariffs were in effect in these five export markets to when tariffs had been reduced or eliminated altogether through the effective efforts of APG, Tootelian found that the volume of shipments increased by 2.3 billion pounds. The



value of the increased shipments added nearly \$3 billion more than what would have been expected had the trade barriers remained. Had tariffs remained in place, Tootelian concluded that 1.7 billion pounds would have been diverted to storage—an average of 192 million pounds per year from 2009 through 2017 alone.

Tootelian's data (**Table 1**) for the first time has quantified the direct benefits that U.S. pistachio growers receive from APG's aggressive stance to confront tariffs whenever and wherever they exist.

With the sudden onset of the global situation that brought on “stay at home” orders, pistachios have filled the bill as a nutritious, shelf-stable pantry item. As consumers continue to seek out health and nutrition information during this timeframe, APG is focused on providing science-based research results that show their value in the human diet.

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Grower Profile

After Four Generations, Changes in Dairy Industry Drive Giacomazzi Farms to Stake Its Future on Almonds

By JENNY HOLTERMANN | *Contributing Writer*

IT'S PRETTY RARE TO FIND A FARM THAT IS OLDER THAN THE COUNTRY it is farmed in. What about being the oldest dairy in California, or the oldest dairy west of the Rockies? It might be even more rare to have only one family to have ever farmed the same soil. The Giacomazzi family can say they have done all of these. They are a family rich in history and agriculture heritage.

Luigi Giacomazzi came to Hanford in 1893 to do what he knew best, milk cows. On January 17, 1893 Luigi purchased property from the southern pacific railroad. At that time, it was nothing but dirt and tumbleweeds. The Giacomazzi family are the first and only ones who have farmed their soil. They literally built their family legacy from the bare soil and created a farm that has lasted generations.



Dino Giacomazzi stands with the original water tower used for the family's four-generation dairy (photo by J. Holtermann.)

In fact, the Giacomazzi land is older than the county of Kings. The original deed of their farm was in Tulare County. Kings County was created in June 1893, six months after the Giacomazzi family purchased the property. The Giacomazzi Dairy and the city of Hanford then became part of Kings County. For generations, the Giacomazzi family milked cows and operated a mid-size dairy in the heart of California's dairy land.

Dino Giacomazzi is the fourth generation on their farm, managing F&D Giacomazzi Farms. He explained the turning point when he knew he needed to transition out of dairy and into something new.

"In 2011, the dairy industry changed. The dairy industry evolved from a local and regional market to a global market, and in 2011 it became apparent something needed to give. The industry was consolidating, and dairies were getting bigger."

Giacomazzi said he had a tough decision: "Should we double down and go from 1,000 to 2,500 head of cows or do something else?" It was a decision he didn't take lightly. They needed to consider all options and make the best decision for the family and the future of the farm.

He knew that after 126 years, things on the dairy needed to be updated. Would a complete overhaul of the dairy be worth it?

"Our buildings, our corrals, are all old style. They are very inefficient. We were spending a lot of money to keep the old dairy from crumbling apart. It would probably take \$10 million just to update the milking parlor," he said.

"The opportunity for a return on the investment was risky. Instead we decided to upgrade our land to permanent crops,"

An advertisement for Swanson Timber Company. The top half features a background image of a young tree in a field. Overlaid on this is the text "NEED STAKES?" in large green letters, with a circular logo containing a stylized tree and the letters "STC". Below this is the website "www.AgStake.com". The bottom half of the ad shows stacks of wood stakes. At the very bottom, a green banner reads "SWANSON TIMBER COMPANY". Below the banner, there is a list of products: "• Pressure Treated and Untreated Round and Square Wood Stakes for Walnuts, Pistachios, Almonds, etc.", "• Wood Posts and Poles for fencing and trellis", and "• Other lumber & wood products". Contact information includes "Call or Text (530) 979-7821" and "2984 Seventh St. / PO Box 10, Biggs, CA 95917".



Miro and Gio Giacomazzi started their flavored almond business as a project for learning during the Coronavirus lockdown, and ended up soliciting help from handlers to provide snack packs to food banks (photo courtesy D. Giacomazzi.)

Giacomazzi continued. “I looked into almonds, pistachios, walnuts, grapes, I wanted to make sure I knew my options. After a lot of research, I decided that almonds would be the best fit for our ground and area.”

Between 2014 and 2015, Giacomazzi planted 400 acres of almonds on land that they previously grew to alfalfa for their cows. Instead of growing feed for their cows and selling some extra to neighbor dairies, he was planting trees. Over the course of the two years they would invest in planting almonds trees and figure out how to become almond farmers.

Planting almonds was a learning curve and a bit different from milking cows, but Giacomazzi was used to trying new things. After graduating high school in Hanford, he went away for college and didn't return until 2003, when his father needed help with the dairy while battling cancer. He managed rock bands on tour for 10 years before working in San Francisco in the internet software industry for five years. Hanford drew him back home and 17 years later, he can't see himself doing anything else.

During that decision-making process back in 2013, Giacomazzi decided once the trees were profitable, they would sell the cows and plant more trees. It was a decision they were ready to stick with.

In 2019, the Giacomazzi dairy auctioned off their 2,100 cows and heifers. People came from around the country came to buy their herd. The last cow was milked and left their property on Oct.

30. Now the stalls and corrals sit empty. After the sale of the cows, heifers and the dairy equipment the farm will make a slow transition. They are currently planting wheat on all the acres for the winter. In April they will harvest the wheat and prepare the soil for planting. Setting up irrigation systems will take most of the summer and the goal is to plant almond trees in the fall. In Fall 2020 Giacomazzi plans to plant 500 acres of almonds. The following year, the milking parlor and corrals will be torn down to make room for more trees.

When asked if it was a hard decision to finally sell the cows, he replied “One hundred and twenty-six years in one business is long enough. I don't know too many other people who have done the same thing for 126 years. I think change is good, its positive. My job as the manager of this family business is to make sure it sees another 126 years. I am committed to my kids and their future, not the cows.”

They very easily could have kept the dairy going, because that is what the family has always done. The Giacomazzi family instead, decided to do what was best for the future and to keep the family involved in agriculture.

“I am making a commitment to the next 25 years of growing almonds and at that time my kids can make the decision of what to do next,” Giacomazzi said.

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

Nut Growers and Processors Give Back During COVID-19

Doing nothing was not an option for the Dino Giacomazzi's children Miro, 12 and Gio, 7, during their extended break from school due to COVID-19.

With some direction from Dino, it was decided they would start their own business selling flavored almonds. After choosing some 'kid friendly' flavors including nacho cheese, churro and glazed donut, the brothers found a start-up nut processor, Natsu Nuts in Ballico, that would roast, flavor, package and label their almond products.

A few weeks later, the brothers were selling their uniquely flavored almonds along with flavored almond butter on their website. With some added outreach, they also secured some local outlets for their almond products.

That was the first part of their business plan. The second part of the plan expanded into contributing to the community. The brothers, realizing that many of their peers were not experiencing the time off from school in good way, decided they wanted to donate snacks to the Central California Food Bank. They solicited donations of almonds for their project and landed enough almonds for 40,000 kids in the South Valley. The generous processors were Nichols Farms of Hanford, Harris Woolf of Coalinga, Campus Bros. of Caruthers, Supreme Almonds of Wasco, Sierra Valley Almonds of Madera, Star Nut Co. of Stockton and Panoche Creek Almonds of Fresno.

The packages of almonds, the very first donation of almonds to the food bank, were added to backpacks that also contained supplies for needy families during this time of high unemployment. The food bank delivered the backpacks to nearly 10,000 families.

By **CECILIA PARSONS** | Associate Editor



THE FUTURE OF ORCHARD SPRAYING

SPRAYER TECHNOLOGY RAPIDLY PROGRESSING FOR NUT GROWERS

By **SETH HANSEN** | *Independent PCA, Contributing Writer*

New technologies are being integrated into conventional airblast sprays through upgrades and modifications (photo courtesy Peter Larbi, UCCE.)

EXPERIENCED NUT GROWERS AND PEST control advisers (PCAs) understand the importance of orchard spraying to the production of a high-quality crop. Missing the mark on a crop protection spray can have a devastating impact on yield or quality. Most have experienced the gut-wrenching feeling of walking into an orchard and seeing damaged nuts on the ground due to an application error. These painful losses usually cause growers to look for ways to im-

prove their sprays next season, either in timing, coverage or material selection.

Unfortunately, implementing these types of improvements in spray programs is becoming more of a challenge. In addition to lower nut prices, the increase of labor and input costs, loss of registered active ingredients, greater pest pressure and regulatory restrictions have made it more difficult to maintain an effective spray program, let alone improve it. Often equipment

and personnel constraints can translate into sacrificing optimal spray timing or coverage.

In light of these growing challenges, innovative companies and university researchers have responded with new spray technologies for orchard crops. These technologies are transforming the way orchards are sprayed, which has remained largely unchanged for the last 50 years. Many of these sprayer technologies have been made possible by adapting more advanced sensor, communication and computing technologies now available to orchard spray equipment and processes.

Sprayer Automation

One of the most promising areas of development has been the automation of orchard spraying. Essentially, this means that instead of equipment being controlled manually by an operator, it operates to some degree automatically. Some companies have built sprayers that automatically target just the tree canopies, for example, in young plantings. The advantage of this technology is reduced per-acre spray volumes and therefore, more acres sprayed per tank.

Targeting systems are not limited to airblast sprayers only. Post-emergent weed sprays are an opportunity for automation in spraying as well. Neil Knaak, owner of West Coast Weedit, describes precision herbicide applicators as, "Basically a mechanized hand-spray". Unlike hand sprays, though, the processing power on board, combined with the right sensors, is one of the big factors making precision weed



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Continued from Page 60

spraying a reality.

“With this technology now, the system is sampling the ground 40,000 times per second for target tissue,” he said. “It’s a tremendous amount of processing going through the sprayer.”

It is easy to understand the potential chemical savings on post-emergent herbicide applications in situations when weed pressure is low or varied throughout the field.

Autonomous Sprayers

Another company, GUSS Automation, has combined a variety of advanced technologies to pioneer the first autonomous, air-blast sprayer. Developed out of a vision to improve the efficiency, precision and safety of spray applications, the GUSS (Global Unmanned Sprayer System) sprayers are being used by commercial applicators and orchard growers in California, Florida and soon in Australia. Though the company originally assumed only growers large enough to purchase multiple sprayers would be interested

since one operator can control up to 8 units, they have been surprised to find some purchasing just one. GUSS COO Gary Thompson said, “It is amazing to see how much benefit in efficiency that those guys pick up. While GUSS is spraying, the operator can be at the pump, monitor GUSS on the laptop, fill the nurse tank and mix into it, and drive back to the field before the sprayer is ready for a refill.”

Besides the efficiency gains, growers may also benefit from the precise controls, tracking and safety features autonomous sprayers are equipped with. Other companies are taking a different approach, and developing autonomous controls for the tractor instead of the sprayer. Brent Davis, President of Air-O-Fan Products, shared, “I don’t want any one implement to be an expensive tool that doesn’t get used all the time. Ultimately, the tractor needs to be the autonomous piece, as it will have multiple tasks throughout the year.”

This approach may benefit growers with current PTO- or engine-driven sprayers that they are not ready to replace, or other implements regularly utilized in the orchard.

Aerial Platforms

Ground-based sprayers are not the only type of system experiencing a surge of innovation. Aerial systems, particularly Unmanned Aerial Systems (UAS), are in development or commercial use on a number of crops. But when it comes to orchard crops, including tree nuts, Peter Larbi, a UC Cooperative Extension specialist in spray application engineering said, “One of the primary limitations for UAS spraying in orchard crops is the payload.”

UAS systems do not currently have the tank capacity to meet coverage or label requirements in an efficient manner. However, he does see drones playing a greater support role in the future as adoption increases. Chandler Bennett of Parabug, a biocontrol application service, has found a valuable niche for UAS technology in tree nuts. Though not technically a sprayer, the

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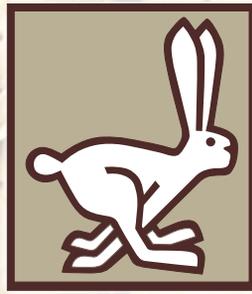
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UAS system is capable of delivering a variety of biocontrols to tree canopies for insect pest management, covering up to 1,800 acres per day, per drone. Regarding the initial skepticism that the UAS biocontrol applications would be effective, Chandler observed that, "Although a lot of the growers were a little bit worried about that, at least on trees where the canopy was not fully enclosed in the rows, they have all been very happy with the results." He does advise growers, though, "If it's going to be affordable, it must be done on a preventative basis."

The light payload, mobility of the beneficials, and application speed has proven UAS systems to be a highly efficient method of augmented biocontrol in tree nuts, both organic and conventional. UAS systems are also supporting spray applications by collecting imagery and identifying areas of fields for additional monitoring or spot applications.

Evaluating Performance

Although grower adoption of new sprayer technology is increasing, there are still significant barriers to overcome before widespread adoption is seen in tree nuts. First and foremost is the cost, including the initial purchase and setup costs for automated sprayers, as well as the long-term operating and maintenance costs. You know the costs for operating your sprayers. Factor in maintenance costs for employee training, sensors and other hardware when making ROI calculations on automated systems. Second, growers must have confidence in the performance of the technology.

"A lot of growers find it difficult to adopt new technology until they can trust that it will positively impact the bottom line, and would not want to change anything until they know that it will be useful; because change is hard," said Larbi.

Try to connect with growers or applicators who are using the application technology already. Ask about operational changes they needed to make

in order to maximize the technology's benefit. See if there are performance issues that need to be addressed. Find out if they are experiencing break-downs and getting prompt service.

When it comes to spraying orchards, it is exciting to see experienced ag companies pioneering the future of sprayer technology. At the same time, the basic principles of effective spraying still apply, regardless of sensors and controls. Equipment calibration and maintenance, nozzle selection, air volume, droplet size and distribution, ground speed, and, of course, timing are all just as critical. Larbi summarized it well when he said, "No matter the technology that is used, at the end day we want it to be working, and it should be effective, delivering the material to where it is needed, so it can do the job. Otherwise it is just cool."

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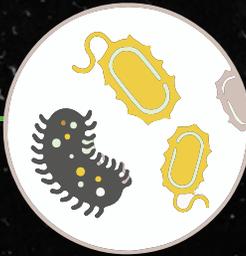
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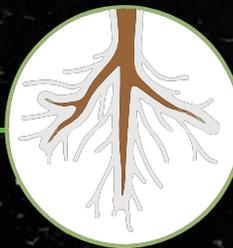


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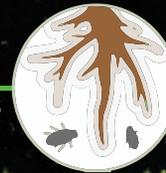
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Walnut blight infections in peduncles can lead to twig cankers during the growing season (photos courtesy Jack Kelly Clark, UC Statewide IPM Program.)



Surveying and recording damage in trees is an important part of integrated control. Survey 10 trees per acre. Damage below an average of 50 infected nuts per tree put the orchard in the low risk category.

Predicting and Managing Walnut Blight

Assessing blight damage levels in June helps prepare for the next growing season.

By **CECILIA PARSONS** | Associate Editor

TIMING SPRAY APPLICATIONS TO PROTECT walnut trees from blight infection can be done based on orchard history with the disease and monitoring buds along with the forecasting tool Xanthocast.

UCCE Orchard Systems Farm Advisor Luke Milliron said that timing the first spray depends on the level of disease risk in a particular orchard. If the orchard has high disease history and rain is forecast, a spray at 20- to 40-percent catkin expansion is recommended. In an orchard with low to moderate disease history, a spray is advised at 20-percent prayer stage. In orchards with very low walnut blight infection rates or young orchards with no blight history, growers should consider a spray application at 40-percent prayer stage.

Coming back with a second spray 7 to 10 days later to cover new unprotected foliage is important, Milliron said. Additional sprays are made based on disease pressure, but the first two or three spray applications are critical in protecting trees from spread of this disease.

Walnut blight is a devastating bacterium that can overwinter in between scales of healthy buds. Dormant buds, along with twig canker infections, foster survival of the pathogen from one season to the next.

Rain acts as a carrier, delivering the pathogen to all green tissue including developing flowers and leaves. Spread of this pathogen to developing nuts will cause loss of production and nut quality.

The Sacramento Valley Orchard Source reports that bud infection can result in bud death, and infections in

peduncles can lead to twig cankers during the growing season. In a recent study, healthy buds near twig cankers harbored significantly more bacterial cells than buds not near twig cankers, indicating that twig cankers are a source of inoculum.

Milliron said spraying for blight is a protective measure and does not cure the disease.

“Once an orchard has a high inoculum, it is very difficult to claw your way back to a low infection rate. You need an excellent spray program and favorable weather in future seasons.”

Common mistakes with walnut blight control include waiting too late for the first spray application, material rates that are too low to be effective, and poor spray coverage or shortcuts including skipping every other row.

Assessing walnut blight damage levels in June is important in understanding disease pressure in the orchard and timing of the first spray for the next growing season. Milliron advises surveying 10 trees for infected nuts. If there is less than an average of 50 infected nuts per tree, the orchard is in the low risk category. Fifty to 150 infected nuts per tree places the orchard in the moderate category. More than 150 infected nuts per tree places the orchard in the high-pressure category. High disease levels generally mean high bud infection rates and potentially the presence of twig cankers. Mowing orchard middles complicates disease level assessment and means that you must go out multiple times to properly assess the drop of blighted nuts.

Jim Adaskaveg, plant pathologist and professor at UC Riverside, said walnut blight is a disease that requires wetness and favorable temperatures and a susceptible host. Other cultural factors include the three bloom cycles of walnuts, and leaf production in the first month after dormancy, which can form a dense canopy.

Monitoring weather conditions, including temperatures and leaf wetness from dew or rainfall, can provide information about the number and severity of infection periods for a given location. In general, Adaskaveg said, high density plantings take longer to dry out compared to low density orchards.

Growers should be prepared to apply bactericides to trees every 7 to 19 days from pistillate flower emergence (prayer stage) until the last cycle of flowering. This can take 4 to 5 weeks for early blooming varieties like Vina and Ashley, and 3 to 4 weeks for later blooming varieties like Chandler. If dry weather occurs during bloom, the interval for spray applications can be lengthened to 10 to 12 days. If covering the orchard

takes longer than 3 to 6 days, use of a second sprayer should be considered, Adaskaveg said.

Growers and PCAs need to know their orchards in terms of cultivars, density, dry times after rain, low areas where dew occurs as well as disease history. Carrying out a good spray application means slower speeds and a pattern that reaches to the top of the canopy.

Besides a survey of infected nuts, bud monitoring and Xanthocast are two forecasting tools. Sacramento Valley Orchard Source states that checking for blight inoculum levels involves sampling dormant buds. Early samples allow more time to develop a disease control strategy. Samples can be collected starting in December and can be collected through early April for late leafing varieties. Buds can be sampled from the time they start to open. Spurs reachable from the ground represent a good sample.

The number of samples to collect depends on orchard history, but 100 3-inch spurs with a fat terminal bud is desired. The spurs should be stored in a paper bag and sent to a plant pathology lab.

Xanthocast forecasting tool uses three temperature ranges and accumulates wetness periods for each temperature range to model for risk of walnut blight. The index for walnut blight is a seven-day cumulative index based on temperature and leaf wetness. The index will range from 0 to 35.

Adaskaveg said that the current rotation program of A) copper plus mancozeb; B) kasugamycin and mancozeb; C) copper plus mancozeb; D) kasugamycin plus mancozeb; or E) copper plus mancozeb, in a four to five application schedule, can provide 90- to 95-percent control of walnut blight under high disease pressure. Three applications in an ABC rotation program can also work well if there is not rain in the 30 days following pistillate flower emergence. Early blooming varieties will need the first two schedules in most years, while later blooming varieties will follow the ABC program.

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A Look at Salinity Research in Pistachio Projects Aim to Develop Better Salinity Management in California's Soils and Water

By **GARY BANUELOS** | USDA-ARS Research Scientist, Water Management Research Unit, Parlier,
PHOEBE GORDON | UCCE Farm Advisor, Madera County,
 and **LOUISE FERGUSON** | UC Extension Specialist, Department of Plant Sciences, UC Davis

THIS IS THE SECOND ARTICLE IN A MONTHLY SERIES DISCUSSING research funded by the California Pistachio Research Board and California State University-Agriculture Research Initiative. This month we are featuring projects addressing salinity in the soils and water of the California's Central Valley. When choosing an orchard site climate is the first and most important factor, little or nothing can change climate. The second factor in site selection is soil borne pathogens which, if they cannot be controlled, eliminate

planting sites. Those with a long history in the pistachio industry will remember the threat posed by *Verticillium* wilt, (*Verticillium dahliae*) the soil borne fungus that decimated the pistachio industry in the late 1970s. *Verticillium* wilt is now virtually unknown due to the introduction of the tolerant Pioneer Gold I (*Pistacia integerrima*) and the resistant UCBI hybrid (*P. Atlantica X P. integerrima*) rootstocks. The third most important factor in choosing an orchard site is soil and water quantity and quality. Unfortunately, in California, where the climate is good for pistachio production, the water quantity and quality are both becoming marginal. Quantity may not be under our control but quality can be managed within limits. The two research projects featured this month are investigating salinity with the final objective of developing information that will result in better salinity management practices. The first, "Long Term Saline Irrigation Strategies for Pistachios on PGI Rootstock" is led by USDA Research Scientist Dr. Gary Banuelos. The project is jointly funded by the California State University-Agriculture Research Initiative. The second, "Evaluation of Salinity, Boron and Soil Hypoxia on Pistachio Tree Growth" is led by UCCE Madera County Farm Advisor Dr. Phoebe Gordon.

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Long Term Saline Irrigation Strategies for Pistachios on PGI Rootstock

Dr. Gary Banuelos is cooperating with Drs. Kaoming Vang, Gurreet Brar and Sharon Benis of California State University Fresno, Monika Sommerhalter, California State University East Bay Ph.D. candidate, Irwin Arroyo of UC Merced, and Drs. Giulia Marino and Louise Ferguson of UC Davis in the project "Long Term Saline Irrigation Strategies for Pistachios on PGI Rootstock", now in the second year of field experiments. To understand the why this project is important it is helpful to understand the geology that produced the composition and structure of the San Joaquin Valley soils. When first formed, the San Joaquin Valley was an inland sea between two mountain ranges, one, the Coastal Range is sedimentary in origin. When this inland sea filled with sediments from the sea and the surrounding mountains it became the sediment filled depression, or basin, that is now the Central Valley. The origin as a seabed and the runoff

"Developing management and reclamation strategies are the objective of the Long-Term Saline Irrigation Strategies for Pistachios on PGI Rootstock project."

from the Coastal range concentrated salts in the soil, sodium, boron, chloride, and selenium. Irrigated agriculture added more salt to the soil. Finally, unlike most coastal lands that have drainage to the ocean, the Valley has inadequate or no drainage. The San Joaquin Valley's geologic origins with high natural salts, the addition of salts with fertigation, and no natural drainage, has resulted in increasing salinity, a concentration of sodium, boron, and chloride ions in the soils and water, in California's best tree crop climates; a situation that will only get worse.

Retired Kern County Farm Advisor Blake Sanden and University of California Extension Specialists Steven Grattan and Louise Ferguson began investigating the salinity tolerance of pistachio rootstocks in the 1990s. They demonstrated differences in rootstock salinity tolerance ranking; *Atlantica* > *P. atlantica* x *P. integerrima* (AKA PGII) > *P. integerrima* x *P. atlantica* (AKA UCBI) > *P. integerrima* (AKA PGI) and decreased yield on the two currently commercial seedling rootstocks, PGI and UCBI. In the most recent field study, 10-year-old trees over the three final years of full bearing had a statistically significant cumulative marketable yield reduction of 145 lb./acre (1%) for trees on UCBI rootstocks and 352 lb./acre (3%) for every unit ECe > 6.5 dS/m. Based on this accumulated research approximately 150,000 acres of California pistachios are now planted in saline ground and irrigated with saline water. As the soil and water supplies are not going to change, and pistachio orchards will continue to be fertilized, retired USDA Soil Scientist, Dr. James Ayars quote; "Salinity ... is irrevocably associated with irrigated agriculture..." has become even more pertinent. Salinity will not go away. But it can be managed within limits. Thus far, salinity research has focused on the effects of salinity, but not the management, or reclamation.

Developing management and reclamation strategies are the objective of the Long-Term Saline Irrigation Strategies for Pistachios on PGI Rootstock project. To do this requires the ability to measure changes in soil salinity and soil moisture in real time, as it is changing, and correlate these changes with tree responses. Instrumentation to measure tree responses has been available for some time, but accurate salinity soil monitoring techniques are only now becoming

available. Previously in-orchard salinity experiments relied on laboriously collected soil samples, collected after the effects of salinity had been exerted on the tree, to determine ion levels and movements in the soil. Now in-dwelling sensor technology can measure salinity and ion concentrations in real time. These real time soil measurements, coordinated with measurements of tree response, will give a much better

Continued on Page 70



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Continued from Page 69

assessment of when, and how, to manage salinity.

The trial is located in three blocks of Kerman pistachios on PGI, the rootstock most sensitive to salinity, in the Panoche Drainage District, grown in saline soils with saline water (EC of 4-6 dS/m, B of 5-8 mg/L, Na of 950-1250 mg/L and Cl of 960-1400 mg/L) since 2002, 2009, and 2011, respectively. The project has two objectives. First, to determine the effects of long-term saline irrigation on the movement and accumulation of Na, Cl, and B ions in saline soils and correlate with salinity's effects on the physiology, growth, and yield of trees of Kerman pistachios on a PGI rootstock. The second objective is to compare the recovery of saline soils and trees when initiating irrigation with non-saline water (~ 1.0 dS/m) versus soils and trees continuing to receive saline irrigation. An example of the sensing technology results is given in **Figure 1**. For clarity, soil salinity was expressed in the figures as saturation paste Ec (dS/m) to more clearly represent measurable soil salinity for growers. Generally, irrigation with non-saline or saline water initially leaches soluble salts past the sensors and results in a temporary increase of soil salinity at time of irrigation but over time, the overall salinity decreases with non-saline water and increases with saline water irrigation. For only one irrigated season, it is understandable that these effects were most clearly observed at the 30 cm depth. With time, clearer responses to non-saline and saline irrigation are to be expected at 90 cm. No responses were observed to either form of irrigation at 180 cm, indicating that it will take more irrigation for a longer time period but also indicates that groundwater upwelling did not contribute to the soil salinity.

The overall experimental strategy will be to simultaneously monitor the

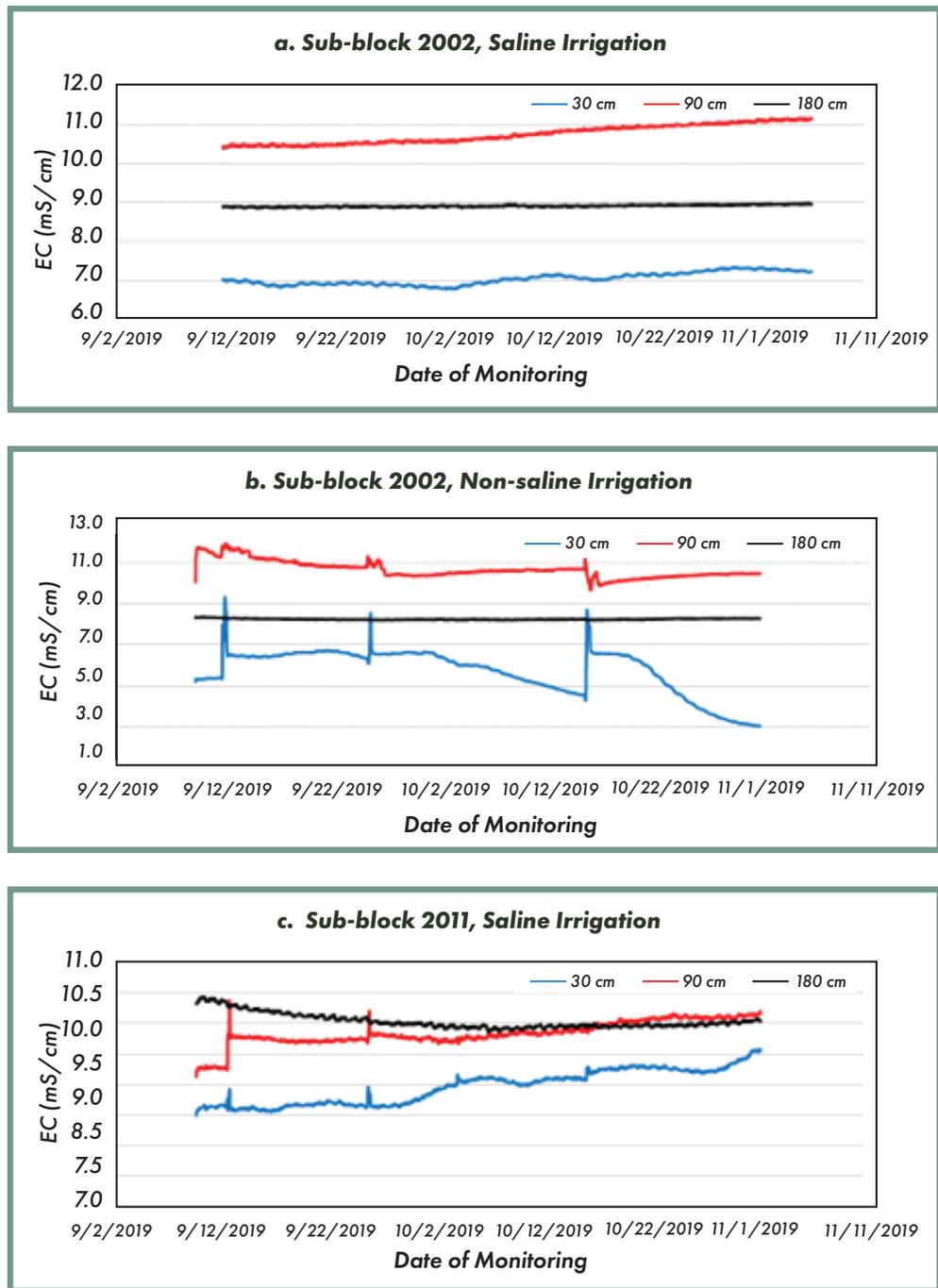
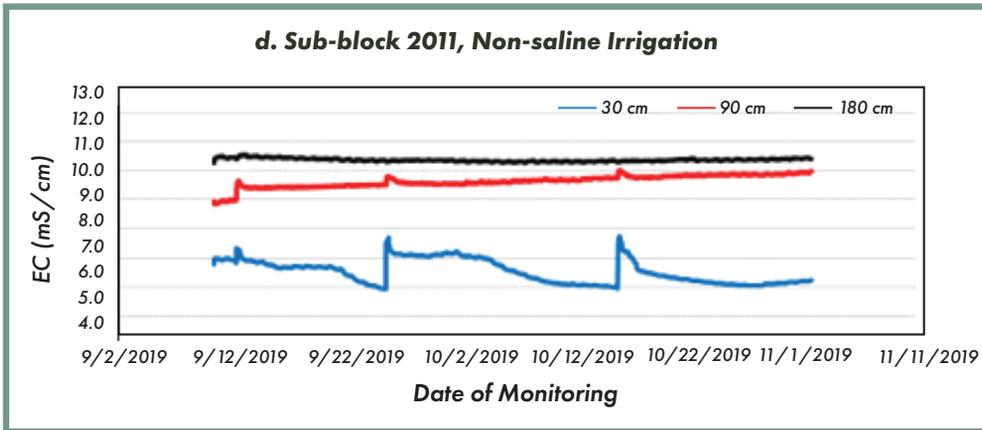


Figure 1 a-d. Real time data collected from soil sensors in saline and non-saline irrigated sub-blocks in blocks 2002 and 2011. The soil sensors indicate real-time responses in soil salinity (saturation paste Ec) at 30, 90, and 180 cm depths after irrigation from September to November in 2019 with non-saline and saline water for blocks 2002 and block 2011. The greatest response to irrigation treatments occurred at the 0-30 cm depth (blue line). At this depth, decreases and increases in saturated paste Ec were measured with non-saline and saline irrigation, respectively, in both treatment sub-blocks. A similar response was measured at the 90-cm depth (red line) in Block 2002, while Ec generally increased with both saline irrigation in block 2011. At the 180-cm depth (black line), no irrigation treatment effects were observed, indicating minimal influence from irrigation and/or ground water upwelling in both experimental blocks. Effects from irrigation treatment should become more pronounced after a full season of treatment application in 2020.



real time changes in soil EC and the physiological responses of the tree; tree water status, photosynthesis, photosynthetic pigments, total phenolics, uploading of proline for salt tolerance, anti-oxidant activity and ion accumulation. This coordinated information will enable a real time assessment of the efficiency of saline reclamation strategies. The data collected in 2019 verified the ability of in-dwelling sensor technology to monitor soil salinity. Now the experiment must be continued for at least two bearing cycles to determine irrigation and reclamation values and verify the reliability of the sensing technology.

In addition to determining the coordinated soil and water salinity, and tree responses, required for saline irrigation management and reclamation, this experiment is important for the possibilities it suggests. This experiment is among the first steps toward implementing precision agriculture in orchard crops. Currently the sensing technologies deployed in this experiment are research tools, but in time these technologies will become cheaper, more user friendly, coordinated in real time, and ultimately can be digitally coordinated to direct irrigation and fertigation. This experiment is among the first steps in developing precision agriculture for orchards.

Evaluation of Salinity, Boron, and Soil Hypoxia on Pistachio Tree Growth

The second project highlighted in this issue is “Evaluation of Salinity, Boron, and Soil Hypoxia on Pistachio Tree Growth.” This new project is led by Dr. Phoebe Gordon, UCCE Madera County Farm Advisor, Dr. Gary Banuelos of the USDA-ARS, Water Management Research Unit in Parlier, Dr. Giulia Marino from the Department of Plant Sciences, University of California Davis in collaboration with Advisor Joy Hollingsworth and Professor of Plant Nutrition Dr. Patrick H. Brown, and Orchard Systems Extension Specialists, Drs. Bruce Lampinen and Louise Ferguson. Similar to Dr. Banuelos’s project, the overall objective of this project is a better understanding of how salinity interactions in soil

and water affect plant performance. And, like Dr. Banuelos’s project, it has a final objective of developing better salinity management practices.

The multiple pistachio greenhouse, lysimeters and orchard trials of salinity have all demonstrated decreased

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Figure 2. A second salinity related project “Long Term Saline Irrigation Strategies for Pistachios on PGI Rootstock” is led by USDA Research Scientist Gary Banuelos.

Continued from Page 71

growth with increasing salinity due to osmotic effects of reduced water uptake and specific ion damage in the leaves. Thus far tree crop salinity research has relied upon a final single integrator of salinity, ECe, and a final single indicator of tree performance, marketable yield, and at times, visible leaf damage. However recent research suggests that the traditional method for measuring salinity, soil electroconductivity, ECe, does not consistently correlate well with in-field growth and yield responses. To address this inconsistency Dr. Gordon will investigate the specific effects of sodium in saline soils. Sodium destroys soil structure precipitating saturated, low oxygen conditions. Little research on pistachio salinity tolerance has examined root zone oxygen levels. The first research objective of this trial is to separate the effect of periodic, short-term low oxygen conditions from the osmotic effects of salinity, on pistachio growth and yield.

Salinity is also linked with high boron, particularly in the soils of the Saa Joaquin Valley’s lower Westside where runoff from the sedimentary Coastal Range has produced a broad alluvial fan with high sodium, chloride and boron levels. Little information has been developed on the salinity-boron interaction effects on pistachio growth and yield; a situation that is likely to worsen as the current pistachio rootstocks have a high boron requirement resulting in frequent soil and foliar boron applications. Boron is difficult to leach, quickly building up in soils. The second objective of this trial is to determine the interaction of boron and salinity in soils and on pistachio growth and yield.

The trial is being conducted within the USDA San Joaquin Valley Agricultural Sciences Center (Parlier, California), where trees have been planted in concrete pipes approximately 1.2 to 1.5 meters in depth, essentially individual lysimeters, have been buried in the field (see **Figure 2.**) In this initial year the



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trees will be established and the saline treatment delivery system, hypoxia inducing structures, and sensing instrumentation will be installed and tested for the ability to produce the desired treatment levels and accurately monitor the soil and trees.

This trial will better define the interaction of hypoxia and boron in saline soils and how they affect pistachio tree growth and yield. The final objective is to develop irrigation and fertilization management strategies for pistachios grown in saline soils. This trial will run for 4 to 6 years.

Conclusion

The California Pistachio Research Board has continuously supported salinity research since 1994; producing the most exhaustive set of long term tree crop salinity trials in the world. The early results generated by these trials have already had a major effect

on the California pistachio industry with about 150,000 acres planted in saline soils with saline water supplies.

The investigations discussed here will extend this impact with better monitoring and management practices. And the recent more basic physiological results produced by Drs. Jessie Godfrey, Maciej Zwieniecki, Georgia Drakakaki and Louise Ferguson of the Department of Plant Sciences at UC Davis demonstrating how different pistachios rootstocks exclude, sequester and cycle sodium and chloride will have an even greater impact. This research demonstrating



the greater long-term impact of this salinity research will be discussed in next month's column featuring the rootstock breeding programs of UCCE Kern County Farm Advisor Craig Kallsen in cooperation with plant breeders Drs. Patrick H. Brown and Dan Parfitt, Professors in the in the Department of Plant Sciences at UC Davis.

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PRODUCE SAFETY INSPECTIONS

During and After COVID-19

By **PRISCILLA RODRIGUEZ** | *Director of Regulatory Affairs, Western Agricultural Processors Association*



DURING THE COVID-19 PANDEMIC, things are everchanging in our everyday lives and work environments. However, even during these times, farms are expected to meet the requirements set forth by the Food and Drug Administration's Food Safety Modernization Act. But what does that mean for farms during and after the pandemic? We will discuss what you should know.

One of the adjustments made during this time is how the Food and Drug Administration will be enforcing the Food Safety Modernization Act (FSMA) rules. After COVID-19 cases started rising in the U.S., the FDA announced it would temporarily postpone all domestic routine surveillance facility inspections both for the health and well-being of inspectors, and because of industry concerns about visitors. In keeping with the White House Coronavirus Task Force and cross-government guidance, FDA directed all its eligible employees to begin teleworking, and has temporarily postponed all domestic routine surveillance facility inspections.

However, during the pandemic, the following still continue:

- Domestic for-cause inspection assignments will continue to be evaluated and will proceed if mission-critical;
- FDA will continue to respond to natural disasters, outbreaks and other public health emergencies involving FDA-regulated products;
- Those carrying out non-portable activities, such as certain lab activities or the monitoring of imported products, will continue to perform their work.
- Specifically, for California, the California Department of Food & Agriculture (CDFA), who conducts routine inspections for the Produce Safety Rule (PSR) for farms, also postponed routine inspections. At the direction of FDA, CDFA will be only performing mission critical or "for cause" inspections during this time.

Safety Rule Inspections Underway

Produce Safety Rule inspections began in April of last year for large farms

over \$500,000 in average annual sales and this April for small farms with less than \$500,000 and over \$250,000 in average annual sales over the last three years. The CDFA inspectors had been conducting inspections throughout the state for commodities that were in their harvest season, but this changed right before the pandemic began, so expect this to be different when inspections begin after the COVID-19.

Inspections will now also be conducted during the harvest or growing season, so there will be a larger time frame for inspectors to inspect your farm. Previously CDFA was focusing on conducting inspections during harvest. However, given the short harvest times for some commodities, it is now extending inspections to the growing activities typically right before harvest as well. The PSR inspections are scheduled inspections, so you will be contacted by CDFA and a date will be set about a week after it has made contact with you.

The inspections are approximately 3 to 5 hours long, depending on the operation size and if the farm is prepared and following the requirements of the

rule, especially documentation. The inspections are broken down into three parts: introductions, walkthrough and exit interview.

Insights on What to Expect

We have worked closely with CDFA and have recently discussed some of the most common findings of PSR routine inspections.

1. Documentation, documentation, documentation! Be sure you are documenting the activities that are required by the rule, like sanitation activities, trainings, etc. Be prepared and ready to show the required documentation. We have learned, of the inspections that have occurred, the most frequent finding has been the lack of documentation or missing elements in the documentation. Inspectors have found farms comply with the activity but fail to document.

2. All records must have the business address of the farm. You must include the farm company name and physical office/business address as well as location (i.e. lot or ranch #). It is not acceptable to simply write the farm name and farm lot number, there must be an address for the business.
3. Another missing and yet simple element on records is making sure to include the time the required activities took place.
4. If you are using synthetic fertilizers, ensure the blends are free of animal origin products (i.e. chicken pellets); otherwise ensure you are meeting the 120-day interval between time of application and harvest.

Although a food safety plan is not required, we highly recommend having a plan that collects all the necessary

documentation and create an easy flowing inspection.

Although most farms are now required to be under compliance with the PSR, CDFA is still offering On Farm Readiness Review (OFRR) for the Produce Safety Rule for very small farms. The OFRR is set to measure the readiness of the farm or secondary activities on farm for the Produce Safety Rule. OFRR's are offered to farms that are considered very small, less than \$250,000 and more than \$25,000 in average annual sales. The OFRR's will begin after the pandemic and provide a good way to find out your deficiencies and be prepared for a routine inspection.

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Almond Outlook: Preparing for a Record Crop

New methods improve crop estimating for almond.

By **MARNI KATZ** | Editor

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THE ALMOND INDUSTRY IS WELL POSITIONED TO MOVE AN anticipated third consecutive record crop as strong domestic demand and ideal growing conditions have converged to create a banner year for the almond industry.

The USDA's National Agricultural Statistics Service (NASS) in May released the 2020 California Almond Subjective Forecast predicting almond growers in California will produce 3.0 billion pounds of nuts. If realized, this production would constitute the third consecutive year of record production, reflecting increases in bearing acreage and an anticipated high per-acre yield of 2,380 pounds, up 10 percent over last year.

Banner Conditions, Banner Crop

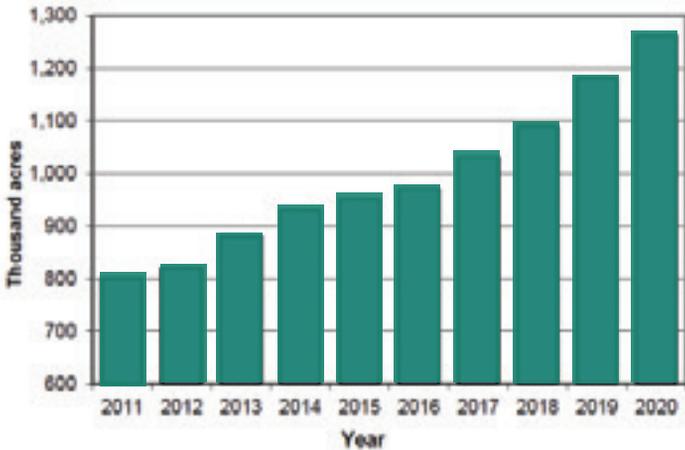
Almond Board President and CEO Richard Waycott said the crop estimate came in higher than expected, thanks to a combination of orchard management improvements and Mother Nature.

"This (2,380 pounds per acre) is a big number, it's on the high end of what was expected," Waycott said. "For many of us, it's the highest yield we have ever seen if you make adjustments to older NASS acreage that we think was understated."

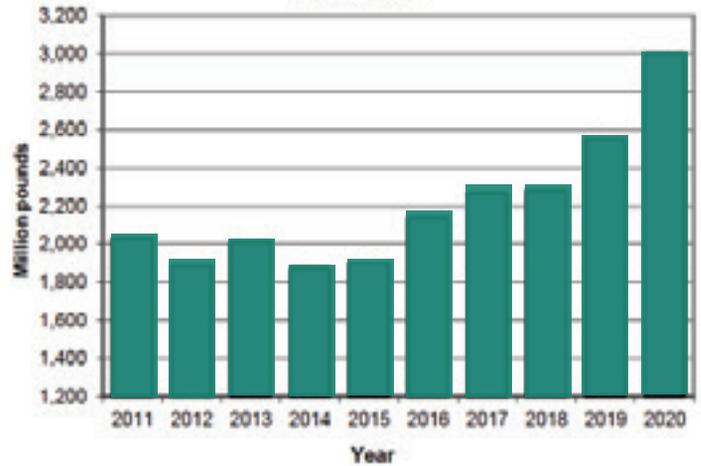
In contrast to recent seasons, almond growers this year enjoyed ideal pollination weather and growing conditions through May that were free of weather events that might impact production.

"So far this year we have seen pretty ideal pollination weather, subsequent good growing conditions and we have

**California Almond Bearing Acreage
2011-2020**



**California Almond Production
2011-2020**



had adequate water up and down the state for producing the crop,” Waycott said.

In addition, over time, almond growers continue to plant higher density orchards and manage crops through fine-tuned irrigation, nutrient and pest management to optimize yields per acre.

The subjective forecast also projected preliminary bearing acreage for 2020 would hit 1.26 million acres, reflecting a continued annual increase of about 7 to 8 percent in bearing almond acreage.

The 2020 crop and acreage estimates represent the first year that NASS incorporated data gleaned from almond industry efforts to improve almond acreage estimates.

Industry Improves Crop and Acreage Estimating

The almond industry has been working with Land IQ to produce aerial satellite acreage surveys that can more accurately estimate bearing and non-bearing almond acreage based on physical assessments. Land IQ surveys estimate current bearing acreage at 1.26 million acres, which means there is consensus between Almond Board data and the numbers coming out of NASS, said Waycott. The Almond Board released both the Land IQ and the Almond Acreage Report together in April.

The Almond Board annually

commissions NASS to produce four different estimate reports. In April, NASS releases the California Almond Nursery Survey, based on surveys and sales data from most major nurseries in California. This information, along with several other data points, includ-

ing pesticide use reports and surveys of growers, goes into the concurrently released annual California Almond Acreage Report. Those reports are followed by the May California Almond

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Subjective Forecast, which estimates production for the coming year based on a survey of growers, and the final Objective forecast which is released each July to provide a revised estimate as the season progresses and is based on actual nut counts on trees. Each of those reports will also now include the physical survey data from Land IQ.

The 2019 California Almond Acreage Report released in April put 2019 bearing acreage at 1.18 million acres and total acreage for last year at 1.39 million acres.

Getting accurate data has been a priority of the Almond Board, Waycott said.

Industry leaders for years have questioned the accuracy of forecasted yield data coming out of NASS reports, suspecting that estimates of bearing acreage were being underreported, leading to an inflation in estimated per-acre yields. The physical observation data provided by Land IQ has helped

"I think everyone is confident we have the right acreage numbers now," - Richard Waycott

increase the accuracy of acreage data.

"I think everyone is confident we have the right acreage numbers now," Waycott said. "Since we started sharing Land IQ summary numbers with NASS in 2016, we are starting to see our numbers merge."

Waycott said maintaining the integrity of the reports has been a priority for the Almond Board. Land IQ in 2018 created a "living map" of California almond orchards based on more than a decade of research, which the Almond Board expects will to at least 98-percent accuracy.

"We have improved the work we are doing with NASS and statisticians and looked at improving the fundamentals

and methodology of the subjective estimate. We increased our grower sample size from 800 orchards to 1,000 and doubled the number of samples we are taking from each orchard. Now the yield component is the only variable," said Waycott.

Strong Domestic Demand

Despite the production of a record crop amid a global pandemic, Waycott said almond handlers and marketers are well positioned to manage and sell the crop. Grower and harvesting operations have relatively low labor requirements and handling operations are also highly automated.

"With some adjustments for safety and health guidelines, things are operating pretty normally," Waycott said.

Port operation glitches in the early days of the pandemic by May had normalized.

From a marketing standpoint, almond shippers saw a surge in domestic demand in the early days of the pandemic. March 2020 domestic volume was up 30 percent from the same time in 2019.

"That's a surge we never see," Waycott noted. "Position reports for April put domestic volume up 15 percent from last year, so we are continuing to see U.S. consumers buying more almonds at this time."

That volume increase should help offset logistical difficulties in India, the leading export market for California almonds, or retaliatory tariff issues that are affecting demand in East Asia.

"The rest of the world regionally has increased over last year, so we are having a good year so far," Waycott said. "We're seeing some softening in certain places, but that is balanced by strengthening in others. This large crop estimate will provide a good opportunity for growth in consumption but it will and has also put pressure on prices."

"The resiliency of the almond industry is strong as ever as we think demand is also as strong as ever."

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Cal OSHA Passes Night Work in Agriculture Standard

By **AMY WOLFE** | *President and CEO Emeritus*



AFTER YEARS OF DISCUSSION, STAKEHOLDER meetings and financial review, the Cal OSHA Standards Board finally passed the Outdoor Agricultural Operations During Hours of Darkness standard at its April 18, 2020 meeting. The concept, first discussed back in 2013, was initially raised when worker advocacy groups asserted that the industry was subverting compliance with heat illness prevention regulations by conducting work at night. In reality, certain segments of the agricultural industry had been working at night for decades, as it proved most beneficial for the crop. Regardless of the impetus, all of California's agricultural industry now finds itself navigating a new safety standard for night work.

Lighting Requirements

At the cornerstone of the new standard is the need for an agricultural employer to ensure adequate lighting is available during the period between sunset and sunrise.

It is important to note that Cal OSHA makes reference to foot-candles and lumens, both of which are units of measuring light. Foot candles refers to the amount of light produced from a source at a distance of one foot. In simpler terms, it is the distance unit of measurement from the source of light. However, lumens measure brightness and from a practical perspective, are the unit of measurement found on lightbulbs. As employers look to address compliance, they will find that most lighting source measurements will be provided to them in lumens.

Another essential distinguishing factor in the standard is that area light will be measured 30 inches off the ground or surface on which the employee walks.

Foot-candles	Lux	Areas or Tasks
0.09-0.19	1-2	Poultry harvesting or catching operations
3	32.29	Meeting area and meal/rest area
5	53.82	Outdoor agricultural operations except where otherwise specified in this table. Pathways leading to and around restrooms and drinking water. Inside restroom facilities. Storage areas accessed by employees.
10	107.64	Intermittently exposed or exposed point of operation equipment covered under Group 8: Points of Operation and Other Hazardous Parts of Machinery. Operationally visible moving parts of machinery covered under Group 6: Power Transmission, Prime Movers, and Machine Parts of the General Industry Safety Orders. Task lighting for agricultural operations that involve the use of tools that can potentially cause cuts, lacerations, or punctures.

The following table, taken directly from the standard, addresses the amount of area lighting that must be provided by the employer:

This means that employers must have the capability of measuring the amount of light relative to where employees are working, to ensure the aforementioned table of task lighting requirements is being met. A light meter is the most common tool used to accurately measure the amount of light being produced.

In correspondence with Cal/OSHA earlier in the year, the following details were provided regarding the types of light meters enforcement staff would use in the field when conducting investigations:

- Light meter brands: Davis, SPER or Extech
- Meter range (difference between lowest level and highest level it can record): max

50,000 Lux to 400,000 Lux

- Max. Resolution: 0.1Fc / 1Lux
- Basic Accuracy: ±5%

Employers are highly encouraged to purchase light meters in alignment with these specifications to ensure consistency with those who will be enforcing the regulation.

The last two items of note relative to lighting is that area lighting must be set up in a manner that minimizes glare to workers. This furthers the need for employers to test lighting options prior to implementation to ensure that brightness issues are addressed, along with the potential for glare, based on the work being done. The other lighting requirement is that the employer must provide

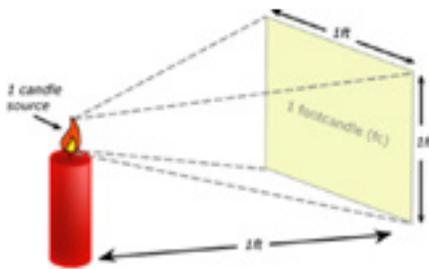
hands-free personal lighting, along with area lighting, as needed to ensure the task lighting requirements. Ultimately, the expectation is that all work to be conducted at night is well lit, whether through area lighting, personal lighting, or a combination of the two.

Additional Standard Requirements

Lighting is not the only requirement of this new standard. Employers will be required to train workers at the start of each shift, reviewing:

- Location of restrooms and how to safely access them in the dark.
- Location of drinking water and how to safely access it in the dark.
 - Location of designated break areas and how to safely access it in the dark.
 - Location of bodies of water and other potential hazards, including high traffic areas.

As with any training, this must be documented, and records appropriately maintained. In addition, employers must provide at no cost and require employees to wear Class 2 high visibility safety



Foot candles refers to the amount of light produced from a source at a distance of one foot (photo courtesy AgSafe.)

clothing. This could be a vest or jacket; the type of clothing is at the discretion of the employer.

Lastly, while the standard does not specifically state as such, Cal/OSHA has an expectation based on the Injury and Illness Prevention Program regulation, that employers document the specific program elements that are unique when working at night. In simplest terms, an employer needs to evaluate their operating procedures and make note of how work is done differently at night to ensure the health and safety of workers. This includes identifying new hazards,

which are addressed during employee training, as well as considering how emergency response procedures would unfold outside of “normal” business hours. Ultimately, as the agricultural industry continues to use the hours between sunset and sunrise as a viable time to work, it will soon be incumbent upon us to comply with a standard designed to ensure continued workplace safety.

For more information about worker safety, human resources, labor relations, pesticide safety or food safety issues, please visit www.agsafe.org, call (209) 526-4400 or email safeinfo@agsafe.org.

(AgSafe is a 501c3 nonprofit providing training, education, outreach and tools in the areas of safety, labor relations, food safety and human resources for the food and farming industries. Since 1991, AgSafe has educated over 85,000 employers, supervisors, and workers about these critical issues.)

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AN INNOVATIVE TRAINING PROGRAM TO ADDRESS LABOR SHORTAGES

Program Looking to Nurture Nut Orchard Farm Managers Through an Apprenticeship

By **BRIANNE GROSSKOPF** | *Center for Land-Based Learning*



Enrique Navarro, recent graduate, conducting maintenance work on a grape harvester at Wilson Vineyards in Clarksburg, California (photo courtesy M. Alcorta.)

WITH RISING WAGES AND GROWING labor shortages, farmers are faced with difficult decisions as the older generation of their workforce retires. As if finding labor wasn't hard enough, finding skilled workers to take on essential positions such as management is proving more difficult and time consuming. This was the challenge David Ogilvie at Wilson Vineyards was facing when he realized his labor manager would be retiring soon, and he needed to start training someone to take his position. One employee stood out as a possible replacement but he would need some training before they could advance.

Ogilvie and his employee Enrique Navarro discovered a local apprenticeship program that provided training and curriculum to equip Enrique with necessary skills for management. The Beginning Farm and Ranch Management Apprenticeship Program was developed by the Center for Land-Based Learning in 2017 to address the shortage of highly skilled workers in farm management. While agricultural apprenticeships have been a tradition throughout the nation as a way for beginners to learn the ropes of agriculture, this is the first registered apprenticeship for ag management in California and has been approved by the California Division of Apprenticeship Standards.

The Center for Land-Based Learning connects pre-screened, qualified individuals with experienced farmers for on-the-job training and mentorship, with the goal of post-apprenticeship employment—ideally into some type of management position on the farm. In addition to

enrolling current employees, farmers can also choose to hire a new employee from a competitive pool of applicants. Program staff review applications to filter for highly qualified candidates with transferable skills that will benefit the farm operation. Farmers then choose who they would like to interview and hire. The apprentice starts at minimum wage and receives a \$.50 promotion every six months as long as program requirements are being met.

Enrique became an apprentice in the Beginning Farm and Ranch Management Apprenticeship Program in 2018 after working at Wilson Vineyards for 20 years. Enrique's main responsibilities were as a tractor driver for harvest and doing equipment maintenance in the shop. But David saw more potential in him. Enrique held the respect of his coworkers, was curious but not pushy, and was reliable. David saw that Enrique had the character, intelligence and temperament to be a manager, but he needed to expand his understanding of the farm operation, practices and business decisions. The Apprenticeship Program offered Enrique a unique opportunity to gain these skills and other fundamental experiences needed to be a successful manager. As the employer, David could further invest in someone who already knew his operation instead of looking for a new labor manager in the future.

The program, which takes roughly two years to complete, provides apprentices with the fundamentals of agriculture in California and requires 3,000 hours of on-the-job training and 250 hours of coursework. The program tries

to meet the educational needs of both apprentice and employer. If the apprentice already has the basics of plant science, soil science, and pest management down, topics can be more tailored to their needs. On-the-job training gets them hands-on experience with things like tractor skills, tree care, irrigation, and even requires them to gain experience with regulatory paperwork, among other things. Some coursework is also individualized to meet the apprentice's career goals. This could look like the Leadership, Management and Best Practices Program that Enrique took through the Napa Valley Farmworkers Foundation.

Enrique graduated from the program in February of 2020 with a journeyworker card certifying him as a Beginning Farm and Ranch Manager. Now he continues to work on David's farm to further refine his skills as he gears up to transition to management when the current manager retires. Of the many things he learned throughout the program, Enrique noted marketing and soil health as among his favorite topics. He had never thought about microbes or nutrients in the past and he really enjoyed learning about soil texture by doing a ribbon test to evaluate the soil.

For David, participation in the program meant that he needed to provide Enrique with a diversity of tasks outside of his usual role so that he could gain exposure in all aspects of the operation. David received support from program staff to ensure that Enrique acquired hands-on work experience in different competency areas. Program costs aside from hourly wages were also covered.



Apprentice Alex Hasbach examines grape vines at Rominger Brothers Farms in Winters, California (photo courtesy M. Alcorta.)



Bobby Ragan, a Navy Veteran and current apprentice at Soil Born Farm in Rancho Cordova, participating in a Beginning Farmer Training tractor class at the Western Center for Agricultural Equipment on the UC Davis campus (photo courtesy Maureen Thompson.)

While some apprenticeship programs require employers to pay for the training curriculum, the Center for Land-Based Learning has procured funds through 2021 to pay for any tuition.

Other farms that have mentored apprentices include Rominger Brothers Farms in Winters, Soil Born Farms in Rancho Cordova, Full Belly Farm in Guinda, SB Voelz Farming, Inc. in Dunnigan, and Blue House Farm in Pescadero. The program is currently focused in the Central Valley but is looking to expand across the state with future developments. This would include making curriculum available at community colleges and online. While coursework is currently only offered in English, Spanish or bilingual versions are also being discussed for the future.

The program is also looking to add new occupations in addition to the Beginning Farm and Ranch Manager. Through a partnership with the nut industry, the Center for Land-Based Learning is exploring essential roles at all levels of orchard and processing operations to determine if an apprenticeship pathway would be beneficial in growing a pipeline of workers for any of these positions. This would also allow current employees the opportunity to master a range of new experiences and be promoted to higher-skilled jobs.

For now, the hardest challenge has been recruiting growers to take on an apprentice. While it would be great to enter into retirement knowing the operation has an accomplished team, the prospect of mentoring sounds like a lot of work that farmers just don't have time for. But

it actually isn't much more than training a new employee, and program staff conduct the initial recruitment. More than adding a dynamic leader to the team, participating in programs like this provides a much needed space for new beginners and aspiring farmers to grow. After all, there is no better way to learn than from the experience and knowledge of seasoned farmers.

Nut growers and processors can help the Center for Land-Based Learning determine if an apprenticeship pathway would be a viable option for other positions in the industry by filling out a Nut Producer Survey at <https://www.surveymonkey.com/r/NutLaborSurvey>.

About the Center for Land Based Learning: The mission of the Center for Land-Based Learning is to inspire, educate and cultivate future generations of farmers, agricultural leaders, and natural resource stewards. Combining innovative hands-on experience with classroom learning, participants in Land-Based Learning programs develop

leadership skills, learn how sustainable agriculture practices contribute to a healthy ecosystem, and create connections to agricultural, environmental, and food system careers. For more information, visit www.landbasedlearning.org

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