

WEST COAST NUT

JULY 2020 ISSUE

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WEST COAST NUT

By the Industry, For the Industry

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SPECIAL SECTION: Spotlight on Hazelnuts

This month West Coast Nut features several articles dedicated to the hazelnut industry in the Pacific Northwest, which is currently experiencing a renaissance after years of decline.

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Reducing Dust at Almond Harvest

Grower Works to Be a ‘A Better Farmer’ through Dust Reduction

By MITCH LIES | Contributing Writer

Photo by Marni Katz.

MALLVINDER KAHAL, OPERATIONS manager for Kahal Farms in Madera, Calif., said reducing dust at harvest has saved money on labor, decreased wear-and-tear on machinery and reduced harvest passes.

“It is only to your benefit,” Kahal said about adopting best management practices for reducing dust at almond harvest. “It’s not just about being a good neighbor, which is important, it is about being a better farmer.”

Nearly twenty years after the Almond Board of California (ABC) began researching ways to reduce dust at harvest, growers are finding multiple benefits in adopting the recommendations.

ABC began researching ways to reduce dust at harvest in the early 2000s. Findings from that research are driving the recommendations that farmers like Kahal are using today, according to Jesse Roseman, principal analyst of environmental and regulatory affairs for ABC.

“We tested fan speeds, machine speeds, sweeper-head height, wire tines, number of sweeper passes, and even equipment manufacturers contributed and started developing machinery that by design would reduce dust,” Roseman said. “The studies went on for six or seven years.”

In the mid-2010s, ABC shifted its efforts from research to outreach, Roseman said, and growers responded.

“What happened is we got really clear on the research and we really trusted what we were seeing and we had the tool kit. Then we pivoted toward doing more outreach and communicating those results to growers,” Roseman said.

The outreach has included the creation of videos and brochures, meeting presentations and media reports. In 2018, ABC announced a goal of reducing harvest dust by 50 percent by 2025.

Start with a Clean Orchard Floor

Kahal said his dust-reduction

program starts after harvest, when the farm removes crowns that settle on orchard floors, and continues through the offseason with weed control. Even prior to harvest, the farm levels orchard floors and fills in holes so nuts don’t get stuck.

“Our big thing is, right off the bat, we make sure the orchard floor is clean,” Kahal said. “That is going to minimize your passes. If you leave nuts behind, you are going to feel obligated to go back and pick up anything left behind and those extra passes are going to create more dust.”

“When you have a clean orchard floor, you are working less at harvest,” Kahal said. “And when you are working less at harvest, it turns out you are saving money, and you are reducing dust.”

Calibrating harvest equipment is another important pre-harvest practice, Kahal said. “If you are taking

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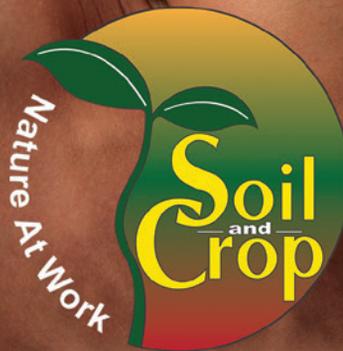
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The Almond Board of California has been working on dust-reduction strategies for nearly 20 years, beginning with extensive research activities in the early and mid-2000s.



Good orchard-floor management can go a long way toward reducing dust at harvest (photos courtesy Almond Board of California.)

Continued from Page 4

the time to make sure everything is calibrated right, you are putting less wear and tear on your machinery, as well as minimizing your passes,” Kahal said. “The actions that disrupt the soil are the same actions that wear out your machinery.”

When calibrating equipment, Kahal said he shoots for “that sweet spot,” where sweeper bristles are not too high, not too low and air pressure is just right.

Too little air pressure, Kahal said, will result in nuts being left behind. Conversely, he said, “If you have too much air pressure and are aggressively scraping the ground, you are blowing dust around and getting more wear and tear on your equipment than is necessary. You want to be in that sweet spot where everything is at the right level, so you don’t leave anything behind, but you also aren’t overly aggressive to where you are chipping away at the soil.”

According to an Almond Board

brochure, sweeper heads can be set as high as 0.5 inches off the ground and still do a good job. The Board also recommends growers use wire tines on sweepers, if possible.

Plan Harvest Routes

ABC also recommends that growers devise harvest routes ahead of time in a way that ensures as much dust as possible is blown back into orchards.

“Plan your passes and travel direction to direct dust away from roads, homes and sensitive locations, such as schools, hospitals and day-care centers,” states an ABC brochure. The Board also recommends growers consider placing traffic signs at strategic points to warn motorists of harvest activities if harvesting near a busy road.

Going slow during harvest is another ABC recommendation, and one Kahal advocates.

“Slowing down will ensure you are going to capture everything you can capture and it can decrease your liability and increase worker efficiency,” Kahal said. “Sometimes you have people working 12-hour shifts, it is hot and fatigue is a problem. Slowing down ensures you get more throughput from your machine operators.

“It is easier said than done,” he continued. “We have been in spots where you need to get things done quickly for a variety of reasons. I understand the urgency. You’ve got to find a steady place between what you consider acceptable efficiency and what you consider a good, methodical process where you aren’t wearing out your machinery, you aren’t creating too much dust, and your guys are working at a sustainable level.”

After harvest, Kahal said he often applies water on orchard perimeters

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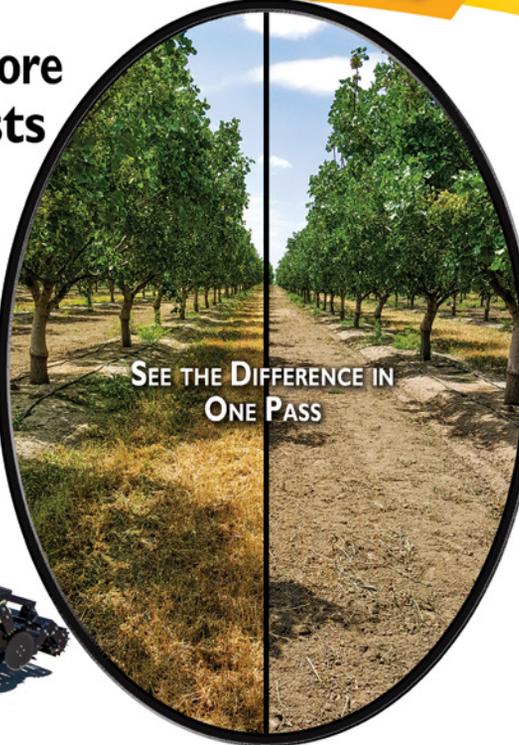
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to settle soil. “A lot of the dust you create at harvest makes it to the perimeter and that is where the traffic and air currents can push it around further,” he said. “Throwing water down on that soil is a way for us to capture and contain that dust to our orchards.”

Roseman pointed out that cost-share programs through the USDA’s Natural Resources Conservation Service and San Joaquin Valley Air Pollution Control District, and other incentives are now available that can help growers invest in new machinery designed to reduce dust at harvest.

As part of its effort to reduce dust, the Almond Board of California in recent years also has funded research into off-ground harvesting and nut-drying alternatives—research that is showing promise.

“We see above-ground harvest as a component that is going to help us reach our goal of reducing dust by 50 percent by 2025, but it won’t be just above-ground harvest that enables us to do so,” said Sebastian Saa, senior manager of agricultural research for ABC. “It will be the sum of all the different actions.”

“We feel excited about continuing this journey that started back in the early 2000s with developing best management practices and has since evolved into working together with the San Joaquin Valley Air Pollution Control District to develop incentives and now includes trying to understand how we can harvest almonds without producing even minimal dust.”

Kahal, for one, believes the industry has a real shot at achieving its dust-reduction goal.

“I think we are really fortunate in the almond industry to have a board that is very proactive in trying to provide us the resources and the education on what can be done to reduce dust,” he said. “I absolutely think we can achieve the goal.”

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



From left, Satgur Kahal, Mallvinder Kahal and J.T. Kahal at their Madera, Calif., farm. Mallvinder said that adhering to dust reduction recommendations makes him a better farmer (photo courtesy Mallvinder Kahal).

Taking the Leap to Off-Ground Harvest | By Mitch Lies

For the past decade, Patrick Brown, University of California Davis plant sciences researcher, has been “banging the drum,” as he puts it about the benefits of off-ground harvest of almonds.

While many growers are hesitant to make the leap, his reception is generally positive.

“When I speak to almond growers at various conferences, you can see several people thinking, ‘I wish I had done this in the first place, but it is going to be hard to do now,’” Brown said. “Then you get folks who are putting in orchards, and they are thinking, ‘I better space my trees a little differently and graft them a little higher and make sure I am ready when it happens.’”

The technique offers several advantages over conventional harvest techniques, Brown said, including opportunities to reduce use of herbicides and insecticides, lower fuel and labor costs, better opportunities to improve soil health, and far less dust creation.

A handful of growers today have incorporated off-ground harvest into their operations, Brown said, but several obstacles are standing in the way of widespread adoption, including capital costs associated with purchasing new equipment, difficulties in drying the crop and the fact that most orchard systems aren’t designed for the practice.

Still Brown, who has researched the practice for the last two years and monitored its adoption in several Australian almond orchards, believes that at some point a majority of growers will be harvesting almonds above ground, and the almond industry will be better off for it.

“Obviously, the drying process has to be worked out,” Brown said, “but leaving nuts on the ground in an orchard and occasionally turning them over and hoping it doesn’t rain and that the sunshine and wind dries them doesn’t sound like the ideal solution to drying.

“I think you can get a more consistent product if you take control all the way through the process,” he said.

Variable Rate Irrigation Pays Off in Water Use Efficiency for New Almond Orchards

By CECILIA PARSONS | Associate Editor

Variable rate irrigation systems can help contend with inconsistencies in soil type and other variables to improve uniformity (all photos by Marni Katz.)



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IT IS RARE THAT AN ALMOND ORCHARD OR A SITE to be planted to almonds will have just one type of soil.

“There will be sand streaks or clay streaks in every site. It is rare to find just one soil zone in a block,” said Bill Loflin, president of Hydratec, a division of Laurel Ag and Water. “Go to Google Earth and look, you can see the sand streaks.”

Soil variability across an orchard block poses challenges with irrigation and fertigation efficiency. Pressurized irrigation systems, set up to deliver the same amount of water for the same length of time, do an adequate job, but depending on the soil variability, can end up over or under watering parts of the orchard.

A more complex irrigation system, called variable or differential rate irrigation system, is designed to closely match the amount of water delivered with the soil’s water holding capacity.

The range of soil types, combined with the shallow rooted nature of almond trees, makes variable rate irrigation systems a serious consideration when developing a new orchard. It is a more expensive consideration for an established orchard, but still has advantages in water and fertilizer savings, especially in challenging soils. Soil type differences are more

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pronounced on the western and eastern edges of the Central Valley with hardpan being one of the most challenging soil types.

Loflin, who has designed and installed variable rate irrigation systems throughout the valley, concedes that the value of the crop being irrigated has to justify the expense of installing and operating a variable rate system. The more intricate the system, the higher the cost. Less intricate systems that aim for a happy medium, but still address significant differences in soil types, is an option.

Meeting Tree Needs

Advantages of a variable rate irrigation system include more efficient use of water, by more precisely meeting the water needs of trees. Avoiding over watering can help with disease control. Trees stressed for water can lose production. Water saving can also reduce pumping costs in groundwater delivery. Fertilizer applied through a VRI system will also be used more efficiently.

Tom Devol, ABC's senior manager for Field Outreach and Education, said growers who opt to install VRI in a new orchard are convinced the added expense of this irrigation system will pay off in terms of water use and efficiency. There is also a practical approach to considering how intricate of a



Different drip lines can be operated independently in a variable rate irrigation system.

system is needed. Looking at the predominate soil types and variability across the orchard site can help with that decision.

Devol said the process of designing an irrigation system involves breaking the site into sets. Traditional systems are often designed to match the amount of water available with the delivery via sets. With the variable rate system, the sets are broken down by soil type. Multiple sets in an orchard can be problematic due to management, but Devol said the advent of more affordable valve control systems plus the ability to remotely turn them on and off, makes such systems doable for growers.

Operating each set independently allows for pulse irrigation on the sandy soils and longer sets on soils with more holding capacity. Prior to availability of control systems, there was labor involved in turning valves off and on.

There are higher costs involved for the additional plumbing need for a VRI system, but as Devol pointed out, "It's a 20-year decision." Water savings and improved fertigation efficiency are driving decisions to consider VRI systems. The systems can also help ABC achieve a 2025 goal of reducing water use by 20 percent. Cost of installing a system in an existing orchard is higher than with a new planting, but savings in water and fertilizer over 20 years an incentive.

Many almond growers who opt for VRI are first obtaining aerial imaging data, Devol said. With an existing orchard, data collected over a couple of seasons can show how uniformly the irrigation system is operating. With that information, a decision can be made about the practicality of VRI system.

Irrigation engineer and almond grower Matt Angell notes that each system is site specific and one of the keys to designing a highly efficient system is to accurately determine the soil variability across the block to be planted.

Matching the System to the Orchard

He suggests using a Veris or EM 38 system which takes soil electrical conductivity measurements to determine soil variability. The soil EC sensors generate EC variation maps

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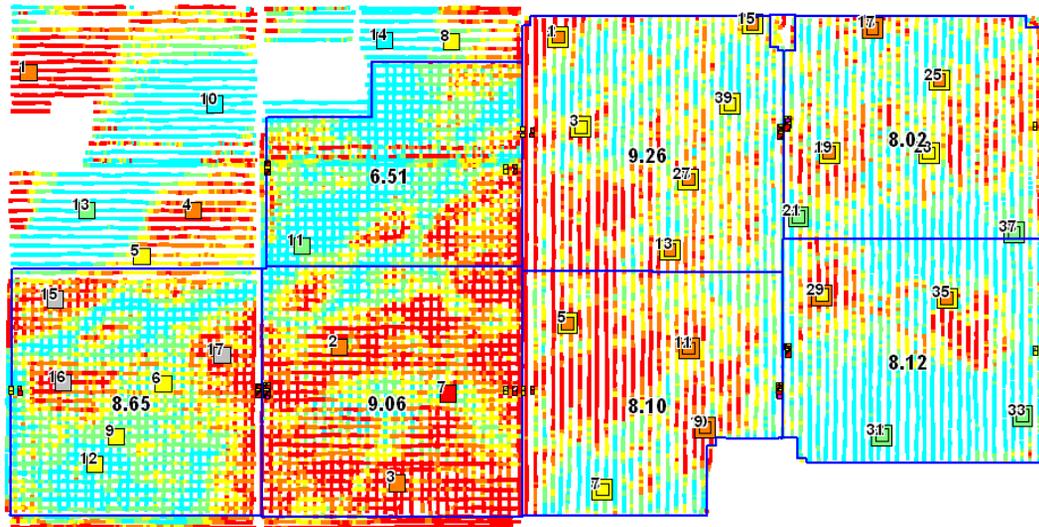
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This soil map of soil EC sensors on Matt Angell's home ranch shows how irrigation blocks can operate in 10-acre sections or as a conventional system to run the entire 80-acre orchard (courtesy M. Angell.)



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that are used to design the system. The soil EC information is recorded with a data logging device that records both soil EC and tags them with position information provided by a GPS unit.

Other considerations with a VRI system are matching the system to the pump capabilities and the orchard design. Breaking the system into smaller sets can involve more labor and cost, but it can help with higher distribution uniformity and the ability to irrigate in site specific blocks. Spacing the trees closer down the row in sandy soils with dual line drip will help normalize the yield as weaker soils typically grow smaller weaker plants, Angell said.

Angell adopted an irrigation strategy called partial root drying (PRD) that was developed at the University of Adelaide I South Australia for wine vineyards. The strategy uses two drip lines with one dripper on opposites sides of the vine. In 2009, he planted 100 acres of almonds and applied the strategy to almonds using a dual line drop with one line on each side of the tree. In a north to south facing planting for instance, Angell can irrigate

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either the east or west side of the tree row independently. The concept forces the tree to use both water and fertilizer more efficiently. American Farmland Trust is preparing a trial to validate the amount of water and fertilizer savings. Angell estimates he has saved 5 to 10% in water and 15 to 20 % in fertilizers while still maintaining in the top 10 percent of state average almond yields.

The Sustainable Groundwater Management Act will be driving irrigation decisions in the future, Angell noted. Efficient use of water and fertilizer will be critical with groundwater pumping restrictions. Knowing soil variability and optimizing water use will be vital for growers, he added.

ABC highlighted Kern County almond grower Kent Stenderup who installed a VRI system to deal with three distinct soil types.

Stenderup's differential irrigation

system places him at the high end of the Almond Irrigation Improvement Continuum, which was developed in consultation with University of California irrigation specialists as part of the ABC Accelerated Innovation Management program.

In his 160-acre VRI block, irrigation consultants layered results from electroconductivity testing, soil mapping, global infrared mapping and soil tests, and then configured drip laterals and manifolds to establish three distinct irrigation zones.

Stenderup received matching grant funds from the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) to cover the additional \$500 to \$600 Per acre installation costs in excess of his investment in a standard drip irrigation system.

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



Kern County almond grower Kent Stenderup installed a variable rate irrigation system to contend with distinct soil types in the orchard (photo by M. Katz.)



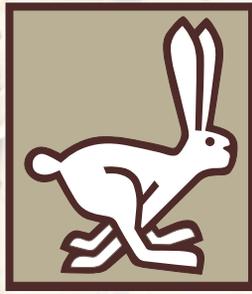
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In a basin irrigated orchard, the producer has little control over their water (all photos courtesy C.A. Pierce.)



Drip and other micro-irrigation methods reduce losses through runoff, deep percolation and evaporation.



REVISITING DRIP IRRIGATION FOR NEW MEXICO PECANS

RECENT STUDIES AT NMSU LOOK AT REGULATED DEFICIT IRRIGATION REGIMES IN PECAN ORCHARDS.

By C.A. PIERCE, PHD CANDIDATE | *New Mexico State University*

PECAN PRODUCTION IN SOUTHERN NEW Mexico is growing. Every year, additional acres of new trees can be spotted around Doña Ana County. According to the USDA, New Mexico produces approximately 35% of the total U.S. pecan production, and roughly 70% of that comes from Doña Ana. No other single county in the U.S. produces more pecans.

It is an economic engine for the state. Relatively poor when compared to other states, New Mexico relies on its agricultural cash receipts. Pecans contributed more than \$170 million to state coffers in 2018. With oil prices currently very low (New Mexico also benefits strongly from its fossil fuels,) the economic impact of pecan production on the region is difficult to exaggerate.

But southern New Mexico is semi-arid. Annual precipitation at New Mexico State's Leyendecker Plant Science Research Center was 7.7 inches in 2018 and a mere 5.7 inches in 2019, approximately 15% of the annual evapotranspiration (ET) needs of pecan trees in the area. These differences in water needs are, of course, satisfied with regular surface and groundwater irrigations.

In a region where pressures on water supplies are all too real, it surprises some that basin (flood) irrigation remains the most widely used method of irrigating pecan orchards. Community acequias are a vital component of local agriculture and have been for many hundreds of years. As surface waters have become less dependable, however, producers have had to pivot more to groundwater supplies for their surface irrigations. This has led

some to revisit drip and the benefits it can afford.

Better Control with Drip Irrigation

In a basin irrigated orchard, the producer has little control over their water. Apart from the crop being produced, weeds and other vegetation are supported in their competition, ultimately resulting in the need for additional water and pesticides for both unwanted vegetation and the insects they harbor. Orchard floor vegetation can lead to overall increased orchard transpiration, and pesticides need to be moved through the soil.

One of the primary arguments for flood irrigation in the region is the flushing of salts out of the root-zone. Salinity buildup in soils is a genuine challenge for producers worldwide and is not particular to any single irrigation method. Surface irrigation can indeed be very effective at moving salts further down the soil profile. Of course, it assumes that the water source is low in salts. Unfortunately, in south-central New Mexico, this is decreasingly true. Surface water sources can carry the salts leached from upstream production, and heavily utilized subsurface water can carry high total dissolved solids (TDS) loads when brought from the lower depths of many of the new, deeper wells being drilled.

Add to this the oft-used practice of stopping the flow of water onto a field once it has moved across the orchard and reached the far end, or "foot" of the field, and salt buildup can still easily become an issue for producers using basin irrigation. Under this practice, water flows to the "head" of the field for the entirety

of the irrigation, but onto the foot for a relatively short time. The result on a typical level field is a sub-surface gradient of infiltrated water where the wetting front "pinches out" near the foot of the field. This is likely to result in less water being available to those trees, but this wetting front is also the accumulation zone for leached salts. Over time, this can leave high concentrations within the effective root depth of trees located farthest from the irrigation points, inhibiting their production and threatening their long-term viability. Back at the head of the field, depending on the length of the irrigation, water may infiltrate well past the effective root depth of orchard trees, an additional, and avoidable, loss of water resources.

Drip and other micro-irrigation methods afford a much higher level of control to the producer, and far less opportunity for losses through runoff, deep percolation and evaporation. Water is applied directly where it is needed, supporting the crop and little else. Transpiration from orchard floor vegetation and other weeds is reduced, as is evaporation and the introduction of salts into the soil. Fertilizers and other inputs can be combined with irrigation waters prior to application, reducing application costs. Leaching fractions can be used to maintain a wetting front below the plant's root-zone.

Deficit Irrigation in Pecans

The effects of micro-irrigations have the potential to go beyond these frequently referenced benefits. Deficits can also be targeted to encourage several possible and beneficial responses. Whereas simple deficit irrigation generally refers to the



With a partial root-zone (PRD) regime, water is applied to only one side of a tree row for approximately four weeks before alternating back to the other side.

practice of applying irrigation water in amounts less than the orchard ET, regulated deficit irrigation, or RDI, involves specific deficits aimed either temporally or spatially to provoke a particularly positive response or mitigate a negative one. Two possible examples of this recently studied by our team at NMSU were growth-stage based deficit irrigation (GSDI) and partial root-zone drying (PRD) regimes on Pawnee pecan trees.

For our GSDI study, we had a 25% reduction in water, compared to the fully irrigated control, applied during the initial growth stage. For pecan, this can be generally defined as running from the start of irrigation in spring until roughly the beginning of July when the "water-stage" or kernel filling, gets underway in the pecan fruits.

With water availability being the driving developmental force behind the water-stage, deficits there are ill-advised. So too, when the nuts are out of the water-stage and hardening, as deficits there may have an impact on the return bloom in the following season (a topic for another article on its own). By applying the deficit in the initial growth stage, we are able to focus valuable water resources on the growth stages where they have the most impact on the successful production of nuts over excess vegetative growth.

Partial Root-Zone Drying

Partial root-zone drying goes a bit further. In a PRD regime, water is applied to only one side of a tree row for approximately four weeks before alternating back to the other side. This approach provides the same amount of water to the trees, but by leaving roughly half the root-zone in drying soil, a drought response may be stimulated in the tree where transpiration is reduced via a physiological response in the canopy. When the sides are alternated and the previously dry soil is watered again, affected roots may experience a

flush of growth, leading to larger masses of young roots better suited to uptake water and nutrients than may otherwise occur. Meanwhile, the previously watered side begins its dry-down cycle, maintaining the physiological response.

PRD has been widely used in grape production throughout the world with many positive effects and has produced similar results in other crops. Improved water use efficiency (WUE), increased yields, and higher quality factors have all been reported in association with the practice. However, in our study, the more favorable initial returns have been with GSDI. Over two seasons, both the average nut weight and overall yield were higher than those under partial root-zone drying alone, with the average nut weight exceeding that of our control for both seasons, with total yield only slightly less than the control. Physiological performance of the GSDI trees also tracked very closely with those in the control group, indicating little to no apparent stress response to the deficit, all excellent indicators of long-term viability.

We continue to analyze both root growth and return bloom data relating to the two approaches and will be able to report on those results soon. Still, for producers wanting to maximize their water resources, and perhaps exercise greater control over their tree's development, the time may be right to reconsider drip for pecans.

This material is based upon work that is supported by www.the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2015-68007-23130. Pierce can be reached at capierce@nmsu.edu.

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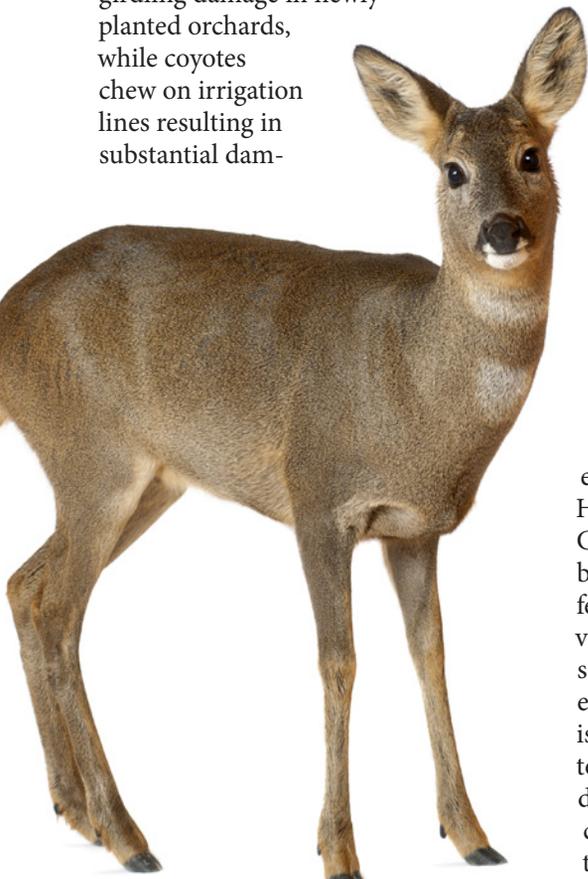
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DEER, RABBITS, AND COYOTES, OH MY!

HOW TO MANAGE COMMON WILDLIFE PESTS IN NUT ORCHARDS

By **ROGER A. BALDWIN** | UCCE Wildlife Specialist Department of Wildlife, Fish, and Conservation Biology, UC Davis

WILDLIFE SPECIES ARE WELL known for causing damage in nut orchards. Burrowing rodents such as ground squirrels, pocket gophers, and voles are the bane of many growers given the extensive damage they cause to trees, nuts, and irrigation infrastructure. Many bird species directly damage nut crops, and some can damage irrigation systems as well, but how about other terrestrial wildlife? Along riparian corridors and foothill regions, deer commonly damage young tree crops through browsing activities, rabbits cause extensive browsing and girdling damage in newly planted orchards, while coyotes chew on irrigation lines resulting in substantial dam-



age in orchards. Management strategies vary substantially for these species with potential options highlighted in the following sections.

Deer

Mule deer and black-tailed deer (a subspecies of mule deer) are found in mountainous and riparian locations throughout orchard production areas in the western U.S. Deer regularly browse on younger trees, and bucks can sometimes damage trees when rubbing velvet off their antlers during late summer. Deer damage often occurs from dusk until dawn, so searching for deer signs is often needed to identify them as the culprit. This includes looking for hoof prints, fecal pellet groups, and signs of browsing; deer lack front incisors, and as such, browsing damage generally looks ragged from tearing rather than cleanly clipped off. Deer are considered a game species by wildlife management agencies. As such, management focuses primarily on exclusion and repellents.

Exclusionary fencing can be quite effective at reducing damage from deer. However, fencing is quite expensive. Generally, the whole orchard should be fenced to exclude deer. A common fence design involves the use of woven-wire mesh. Deer jump really well, so fencing is generally recommended to extend 8 feet above ground. If fencing is built on a slope, the fence may need to extend to 11 feet or more to keep deer from jumping over. Deer can also crawl under fencing, so it is important to make sure that the fence is flush



Deer regularly browse on younger trees, and bucks can sometimes damage trees when rubbing velvet off their antlers during late summer (photo courtesy W. Paul Gorenzel, Regents of the University of California.)

with the ground. Electric fencing can also be used to keep deer out of smaller areas. Electric fencing is often a bit cheaper but may not be as effective, and care must be taken to ensure that the fencing does not short out. Many other designs for deer-proof fencing have been developed. I encourage anyone considering the use of exclusionary fencing for deer to check out the handbook, "Prevention and Control of Wildlife Damage", from the University of Nebraska, Lincoln, available at digitalcommons.unl.edu/icwdmhandbook.

Repellents are also commonly used for deer, often relying on objectionable odors or unpleasant tastes to deter deer from browsing on treated trees. Many repellents have been developed and marketed for deer, and generally fall into "contact" and "area" categories. Contact repellents are those that require contact or ingestion of the product, while area repellents attempt to keep deer out of the general area. Efficacy of repellents varies substantially depending on a number of factors

Continued on Page 18

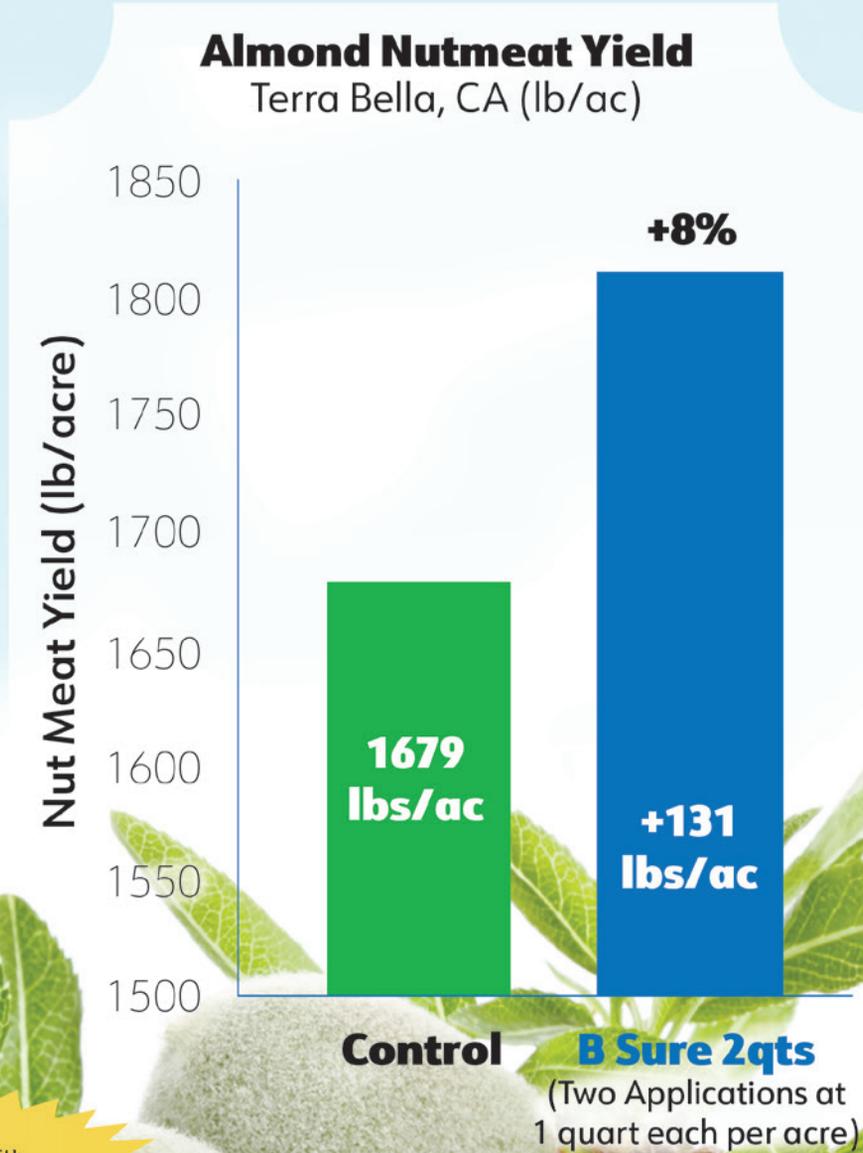


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Exclusion is the best method of protection against rabbits such as the black-tailed jackrabbit (left) and desert cottontails (photos courtesy Regents of the University of California.)

Continued from Page 16

including availability of alternative food resources, abundance of rainfall (which can wash away some repellents,) and how rapid new vegetative growth occurs. Products containing putrescent egg solids have often tested well, but other options are available. Many repellents are not suitable for use in food crops, so careful selection will be required to determine what is appropriate in your situation.

Lethal removal via shooting is a

last resort for mitigating deer damage. Given their protected status as a game species, a depredation permit from your state wildlife agency will be required to lethally remove deer from your property. These are generally approved only after the landowner or agent has documented that all other non-lethal options were attempted and were unsuccessful.

Rabbits

Common examples of rabbit pests include black-tailed jackrabbits and

desert cottontails. Jackrabbits technically are hares, and are quite a bit larger, have longer ears, and are generally a bigger pest in agricultural areas. Cottontails are smaller and are more common in landscaped areas. Common damage caused by rabbits includes girdling of newly planted trees and browsing on young vegetative growth. Rabbit browse damage is characteristically marked by a 45-degree cut on stems, while tooth marks from girdling damage are generally at a diagonal to the trunk. In many states, rabbits are classified as non-game species, although in California, they are classified as game species. Even so, they can generally be lethally removed from property by the landowner, tenant, or agent without any special permitting. Be sure to check your local restrictions before implementing lethal control.

As with deer, exclusion is a commonly used tool to minimize rabbit damage. Rabbit-proof fencing usually extends about 2½ to 3 feet above ground and is generally buried 6 inches below ground to keep rabbits from digging underneath the fence. Poultry fencing provides a good option. Rabbit fencing can be combined with deer-proof fencing to minimize their collective costs. Hard plastic or wire mesh tree protectors are sometimes used around the base of newly planted trees as well. They need to extend at least 2 feet above ground to eliminate browse and girdling damage.

Repellents are also effective against rabbits. As with deer, repellents can be “contact” or “area” in nature, and they are limited in utility in some settings (e.g., less effective when alternative foods are limited, must be periodically

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reapplied, etc.). Again, repellents that contain putrescent egg solids have often tested well. Keep in mind, repellents are usually not allowed for use on plants or parts that are to be eaten. They are most practical for rabbits when protecting young orchards that have yet to produce nuts.

Lethal control for rabbits is an option if alternative tools have been ineffective or impractical. Most states allow the use of traps or shooting to reduce rabbit numbers. Trapping is far more practical for cottontails. A variety of live and kill traps can be used. Jackrabbits are generally far too challenging to trap to consider it a viable option. Shooting can be used, although its utility is greatest when dealing with a small population of rabbits.

In California, a couple of toxicant baits containing either chlorophacinone or diphacinone can be used in self-dispensing bait stations to control jackrabbits and cottontails, although their use is only allowed along orchard field edges; use is not allowed within orchards. Please see the website for the Vertebrate Pest Control Research Advisory Committee for more information on this process at: <http://vpcrac.org/files/5314/7612/0598/Rabbits.pdf>



Coyotes can wreak havoc on drip irrigation lines (photo courtesy Regents of the University of California.)

Coyotes

Coyotes are quite common throughout the western U.S. The primary concern with coyotes is their proclivity to chew on irrigation lines. We do not know the primary driver for this chewing damage, but it is not water related. As such, providing supplemental water is not likely to solve the issue. Unfortunately, few options are effective. Wire mesh fencing can be used, but fencing must extend at least 5½ feet above ground and should be buried at least 6 inches below ground. Stays between wire meshing should be no more than 6 inches. Adding an electrified wire can increase the effectiveness of mesh fences. More detail on fence designs can be found in the UC IPM Coyote Pest Note at ipm.ucanr.edu/PMG/pestnotes.

Coyotes are considered a non-game animal. As such, they can be lethally removed through shooting and trapping. Regulations for coyote removal vary extensively across states, and even within states. As such, you should check with your local wildlife agency to determine what is allowed in your area.

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New Requirements to Protect Ag Workers from COVID-19

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



COVID-19 HAS BEEN DEVASTATING. MORE THAN 100,000 LIVES in the United States have been lost and the State of California's budget has plummeted to more than \$54 billion in debt. And in early May, unemployment claims in California exceeded 4 million! But through it all, agriculture in California continued. It continued because it had to.

According to the California Department of Food and Agriculture (CDFA), California produces about one-third of the nation's vegetables and approximately two-thirds of fruits and nuts. Recognizing the obvious importance of agriculture, Federal and State governments designated agricultural operations as essential businesses and the workers at those operations as essential employees. With that declaration comes a responsibility to protect these workers against the spread of COVID-19 in the workplace.

Recently, Cal/OSHA released new guidance and checklists for Agriculture and Livestock, and for Food Packing and Processing. This new guidance is intended to support a safe, clean environment for workers in these areas. The update now

mandates a "written worksite specific plan" for these operations to protect workers. Included in the guidance is information on what is required in the written plan, training topics, individual control measures, cleaning and disinfecting protocols, and physical distancing guidelines. As I write this article, it is only guidance: however, there is legislation (AB 2043 by Assemblyman Robert Rivas) that would mandate agricultural employers (and only agricultural employers!) take this "guidance" from Cal/OSHA and mandate that it be implemented and for it to be considered a "crime" if not carried out. On top of that, a petition by "Worksafe" was filed recently with the Cal/OSHA Standard Board to require written plans and protections for all workers potentially exposed to COVID-19.

With all that said, there most likely will be some type of mandate to implement a written plan and protections for workers from COVID-19.

To view the actual guidance documents and inspection checklists for farms and food packing or processing facilities, please go to the State of California's dedicated COVID-19 website at covid19.ca.gov/industry-guidance and view the following documents:

- COVID-19 Industry Guidance: Agriculture and Livestock
- Cal/OSHA COVID-19 General Checklist for Agriculture and Livestock Employers
- COVID-19 Industry Guidance: Food Packing and Processing
- Cal/OSHA COVID-19 General Checklist for Meat, Dairy, or Produce Packing or Processing

The guidance documents are focused on four key prevention practices:

1. Physical distancing to the maximum extent possible.
2. Use of face coverings by employees (where respiratory protection is not required) and customers/clients.
3. Frequent handwashing and regular cleaning and disinfection.
4. Training employees on these and other elements of the COVID-19 prevention plan.

Continued on Page 22

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- Developed FSMA food safety plan for hullers
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David Hamilton,
Hamilton Ranches, Inc.



The guidance references the need to have a worksite specific written plan. The plan must contain contact information for the local health department. The plan must also include information on training and communicating with employees on COVID-19 and regularly evaluating the workplace for compliance with the plan. It also requires the company to investigate any potential COVID-19 illness

and determine if it was work related. If so, it must specify what actions are to be taken to prevent any further occurrences.

The training for COVID-19 must provide information on COVID-19 including how to prevent it from spreading, self-screening and what to do if they believe they have the symptoms of COVID-19. It must also include information on the importance of frequent handwashing, physical distancing and the proper use of face coverings.

In terms of individual control measures and/or screening, employers must provide temperature and/or symptom screenings for all workers at the beginning of the shift. This includes anyone entering the facility! Employers must encourage workers that are sick or exhibiting symptoms of COVID-19 to stay home. Employers must provide the proper personal protective equipment (PPE) including face masks and gloves when necessary.

Employers should develop specific cleaning and disinfecting protocols (most likely already in place for most tree nut processors,) for all critical areas of high traffic and frequently touched surfaces including time clocks, bathroom fixtures, tables and chairs. Tools, equipment, vehicles, phones, desks should all be cleaned and sanitized. It is important to ensure that sanitary facilities, including restrooms and handwashing stations, are clean and stocked.

One area that could present a challenge is maintaining physical distancing of at least 6 feet. This is not limited to work time, so it is necessary to think of this for breaks and meal periods as well. This can be challenging especially on sorting lines, so facilities may have to consider physical barriers between employees such as Plexiglas sheet dividers. Another option may be to stagger employees, possibly into different shifts, but certainly for breaks and meal periods to limit the number of people congregated at any one time.

There are several resources available from the Centers for Disease Control (CDC), Federal OSHA, Cal/OSHA, California Department of Public Health (CDPH) and the Western Agricultural Processors Association (WAPA). In addition, we are helping our members as staff are currently developing a template plan, inspection checklist, training materials and conducting a supervisorial training webinar on this topic. So, as agriculture goes about its business, we must continue to care for and protect our employees. Hopefully, through the use of the reference guidance, employers can formulate a reasonable game plan and put it in motion.

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GROWERS AND HANDLERS PREPARE FOR HARVEST AMID PANDEMIC

NEW COVID-19 GUIDELINES ADD EXTRA CHALLENGE TO AN ALREADY STRESSFUL TIME FOR THE INDUSTRY

By **CECILIA PARSONS** | Associate Editor

THIS YEAR'S ALMOND, PISTACHIO AND walnut harvests may look a little different than they have in the past.

While stakes are high every year for bringing in a high yielding harvest and delivering a quality crop to the processor, adding COVID-19 and Centers for Disease Control and Prevention guidelines to the mix will change some priorities and make efficiency much more critical than it has in years past.

Protecting employees, health screening and heightened sanitation measures will be paramount in fields and process-

ing facilities, said Roger Isom, president of Western Association of Ag Processors (See Isom's related article in this issue of *West Coast Nut*.)

Keeping a Safe Distance

Spreading out harvest equipment in the orchard will be easy compared to making sure employees in processing are adhering to Covid-19 safety requirements. Isom said that workers will undergo a health check upon arrival and will have to be provided protective gear. There will also be extra training involved to make

sure the plant is in compliance. Sanitation measures will be stepped up, and commonly touched equipment will have to be sanitized between uses.

Sorting line crews may have to be spread out, slowing the process, Isom warned. Little things like fans to keep air moving when temperatures rise will be problematic as they could increase the risk of spreading the virus through the air.

There is also the question of being able to hire enough workers. Isom said there are instances where workers have traveled to Mexico and now are not able to return. If schools remain closed, parents without childcare alternatives will have to stay at home.

Zack Raven, farm manager at Keenan Farms Inc. of Kettleman City, said protection protocols for employees as well as their pistachio products were adopted early in the pandemic.

"We have already been abiding by CDC rules, distance between employees, sanitizing things, breaks between shifts. We are doing what we need to do to keep everyone here safe," Raven said. Following those protocols does take time, he said, but it hasn't had a big effect on their plant efficiency.

Keenan Farms has also implemented health screening for employees prior to their shift. Temperatures will be taken to make sure they are not coming to work ill. Masks are being provided.

Raven said he expects to implement the same protection protocols with the harvest crews later this summer. Anticipating continuing protective measures through the 2020 harvest, he said Keenan Farms will be using posters to remind workers to wash hands frequently, distance themselves and to minimize any contact with the crop which are all



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practices already in place with Good Agricultural Practices guidelines.

The last of Carriere Farms' 2019 walnut harvest is being processed under the recommended safety guidelines and Bill Carriere said he expects to continue following those guidelines with the 2020 harvest.

Doubling Down on Sanitation

Carriere said the Glenn, Calif., walnut processing plant has doubled down on sanitation and hygiene in the processing plant. Break rooms and lunchrooms for employees have been configured to help with social distancing. He said he does not anticipate any issues but already has a protocol in place to segregate one part of the plant if an employee tests positive for the virus.

"If we would have to shut down the in-shell side, we can still run the sheller," he said.

On the harvest and hulling side, Carriere said workers do not generally work in close proximity, but they will be asked to maintain distance and to adhere to sanitation requirements. Employees sharing tools or equipment will be ad-

vised to sanitize them after use.

"There will be lots of training," he added.

Mike Kelley, president and CEO of Central California Almond Growers Association, said the prevention plans supplied by WAPA would be followed at the Kerman area hulling plant.

In preparation for the upcoming harvest, he said employee restrooms and office areas have undergone remodels to maintain distancing and protect employees. Good Management Practices have been in place at the plant, he said, and the current situation with COVID-19 has given them an opportunity to re-engage and make sure the practices are followed. Employees will be required to wear masks on the property and to practice social distancing. Persons who need to enter the main offices will have to have their temperature taken and fill out paperwork confirming their health status.

Harvest crews should have no trouble maintaining social distance requirements, Kelley said, but if farm labor contractors are used, they must mandate that the required procedures to maintain worker safety be followed.

Sanitizing harvest equipment driver cabs between drivers will be necessary, as will sanitizing any tools used by more than one person each day.

The rules are in place to protect workers, Kelley said, and they are not too onerous.

Cal/OSHA has issued new guidance on workplace safety to protect against the spread of COVID-19. The checklists are for agriculture and livestock and food packing and processing.

The update mandates a written worksite specific plan for operations to protect workers.

WAPA has developed a template plan that includes information that is required in the written plan, training topics, individual control measures, cleaning and disinfecting protocols, physical distancing guidelines and inspection checklists. The Cal/OSHA guidance documents can be found at www.agprocessors.org COVID-19 Resources tab.

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Understanding pH is important because it directly affects nutrient availability. Most nutrients are available in good quantities of around 6.5. The main elements affecting soil pH levels are the following:

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11
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By RICH KREPS | PCA, CCA, Contributing Writer

TEND TO ASK A BUNCH OF QUESTIONS

with my growers. It really bothers me when a new farmer client asks me to give them a proposal on a specific budget and I get no other information with the request. What are your historic yields? What were your last three year's budgets? What were the last three year's tissue tests from spring and pre-harvest? What are the last three years of soil test reports?

What were last year's spring and fall water tests? How much surface water? How much is from the well? Did you apply nutrients post-harvest? When? I'm sure they think I'm like their 4-year-old nephew that can't ask enough "why's." But it's like playing solitaire with a deck of 51. Without all the cards, you can't win.

I recently spent a few days calculating nutrient budgets for a grower

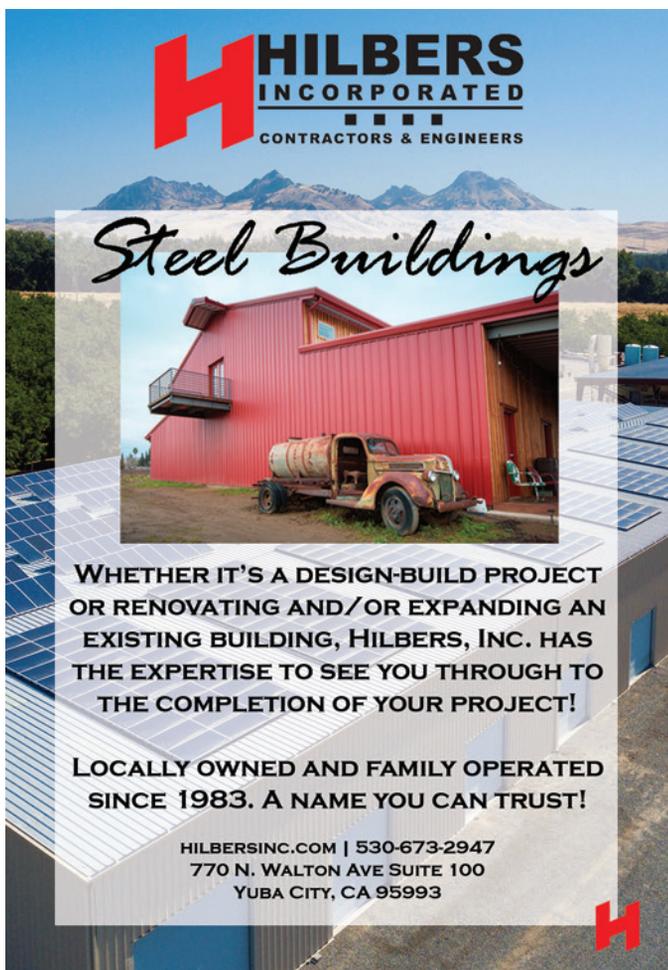
and asking even more questions than my original list. Previous years budgets had gotten out of hand without generating larger returns. I am a huge proponent of getting your phosphorus right, and especially early in the season. This can come with issues. Poly Phosphate doesn't stay or turn into ortho phosphate easily when it's wet and cold in the spring. In the fall, late heat will make poly-phos digest/decompose to ortho-phos in mere days, making it plant ready. But less plant ready, less soluble or less pure triple mixes tend to lead my clients to apply too much.

Balanced Phosphorus Approach

Too much phosphorus will have detrimental effects on soil chemistry, particularly when the biology isn't abundant and active. Here's some math for you. In pistachios, we typically apply about 150 units of N. Done correctly this will lead us to a spring tissue level of around 3.5 % and end at about 2.5 % pre-harvest. The UC says P levels should be from .14 to .4 %. I prefer a balance and not a range. The range is too broad a brush to paint with. I say P should be 10% of N. If N is at 2.5% then it follows by my estimate that P should be .25% in the tissues. Assuming a 70% Nitrogen Use Efficiency, about 105 units of applied N are going into the tree. At 10% applied N, 15 units of P should suffice to get 10 units of P assimilated in the tissue. And that can't happen all at one shot!

Going over the math with this grower, I saw 60 units of soil-applied P, all in the plant ready ortho form, and all very close together. Unfortunately, the P levels were still less than 10% N levels. All that extra P applied and not assimilated has a really good chance of becoming Plaster of Paris with the gypsum, calcium bicarbonate and lime in the soil. They just lost two nutrients by spending too much and over applying one. Of course, their calcium levels were also low. Imagine that.

These farmers actually care and were closely watching and monitoring their nutrition and budgets. They just weren't getting the proper guidance. The point is, "Ask not what you can do



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The heavy gypsum application in this orchard will likely react with soil applied P and tie up both calcium and phosphorus (photo by R. Kreps.)

TYPES OF PLASTER AND THEIR USES

Gypsum plaster. Plaster of Paris mixed with clay, lime, and other materials in combinations covered by trademarks or patents. Mixed on the job with water, sand, lime putty, hair or fiber for two or three-coat finish surfaces for interior walls and ceilings; or used dry as ingredient for hard or sand float finish with lime plaster (see above).

High-strength gypsum plaster. Same as gypsum plaster but mixed to meet established standards. Mixed on the job with water, sand, lime putty, hair or fiber for two and three-coat finish surfaces for both exteriors and interiors.

Hard Finish: 1/4 lime putty to 1 part high-strength gypsum plaster by volume

A recipe for disaster: How gypsum and lime combine to form plaster of Paris. Excessive applied P that is not assimilated has a good chance of becoming Plaster of Paris with the gypsum, calcium bicarbonate and lime in the soil (courtesy R. Kreps.)

for your Crop Advisor, but what your Crop Advisor can do for you!”

When this particular grower had 2.8% N levels pre-harvest, I saw potential savings. We can drop our N applications a bit, saving some money. Drastically reducing our P inputs using smaller shots more often early in the season offered even more savings. Applying soluble calcium immediately after the first water application post-harvest will exacerbate a stronger root flush and lessen Cal-P tie up. Not waiting until November to apply less soluble soil amendments (gypsum, SOP, compost, etc.), and working them into “active” soil, will enhance breakdown, uptake and soil health. Adding early fall organic matter, such as humics, fulvic acid, compost, cover crops, mulch, etc., will drastically enhance the soil’s biome. This in turn will greatly improve water retention and nutrient holding capacity.

Active Soils Assimilate Nutrients

More active soil equals more nutrient assimilation. With better nutrient assimilation, we can typically use less nutrients and put our money to more soluble and plant ready nutrition, only applying what is needed and not taking the “more-on approach” that assumes if a little is good, let’s put more on!”

Often, we can make quick changes to nutrients with properly timed foliar applications. Many of today’s surfactants, acids and emulsifiers are very effective at getting nutrition into the

Continued on Page 28



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MAJOR NUTRIENTS (%)					VERY LOW	LOW	GOOD	HIGH	VERY HIGH
Nitrogen	3.58	2.2	2.9	+	[Progress bar: ~85% in GOOD range]				
Phosphorus	0.27	0.15	0.4		[Progress bar: ~75% in GOOD range]				
Potassium	0.95	1.3	2.5	-	[Progress bar: ~45% in GOOD range]				
Calcium	1.12	1.7	2.5	-	[Progress bar: ~40% in GOOD range]				
Magnesium	0.54	0.6	.5	-	[Progress bar: ~55% in GOOD range]				
Sodium	BDL*		0.25	-	[Progress bar: ~5% in VERY LOW range]				
Chloride	0.23	0.1	0.3		[Progress bar: ~80% in GOOD range]				
Sulfur	0.23				[Progress bar: ~5% in VERY LOW range]				

This tissue test result shows adequate P, but not compared to a 10% N level. Cal, K and Mg appear to be tied up (courtesy R. Kreps.)

Continued from Page 27

leaf or young tissue. They may be a little more expensive, but quick fix foliar applications can often bring a 7-fold increase in nutrient assimilation compared to a similar soil shot.

A plant doesn't walk to the fridge to get food. It is designed to take in nutrition from the soil it's planted in. How-

ever, when the levels are out of whack, or early spring nutrients aren't up at the spurs yet, foliar quick fixes can get us through a critical time. When we over-apply a specific nutrient or in the wrong form, we often upset the apple cart. By the time we get them all picked up and stacked again, we may have missed key windows where specific nutrient uptake was essential, but un-

"A PLANT DOESN'T WALK TO THE FRIDGE TO GET FOOD. IT IS DESIGNED TO TAKE IN NUTRITION FROM THE SOIL ITS PLANTED IN."

available, tied up or blocked.

A good program will address these issues and show them in test results. Proper analysis will return greater yields and orchard health. If you're way out of whack, it may take a bit more money upfront to balance your soils. The good news is, it doesn't have to cost you more money in the long run if it's done right. Healthy, balanced soils will not only produce more but ensure better nutrient uptake, with more efficient applications.

To quote a great line from Cheers, Woody asked, "What's going on Mr. Pederson?" With urgency, Norm replied, "No Woody, its what's going in Mr. Pederson that matters. Pour me a beer!" If you're spending the money to feed your trees make sure they have the chance to drink it when they need it.

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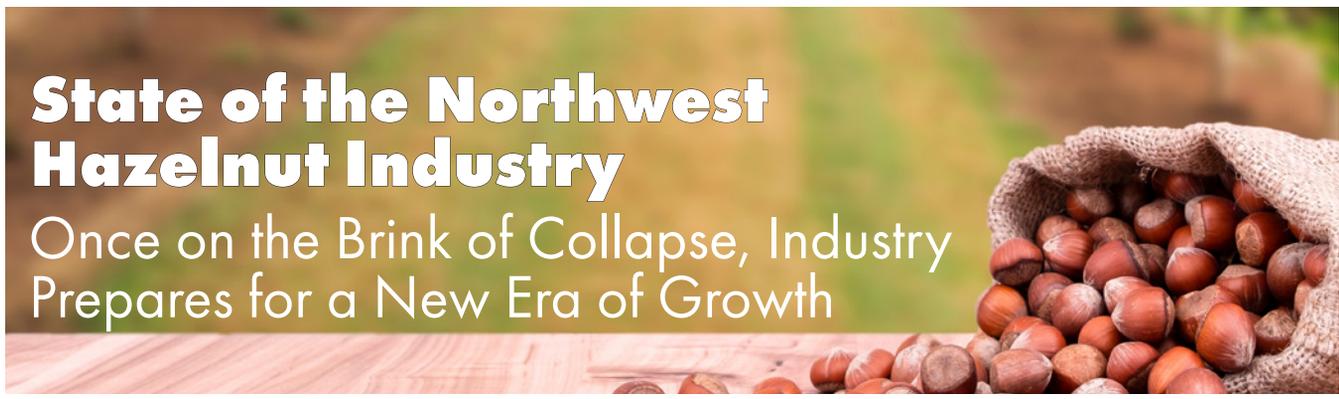
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A WORD FROM THE BOARD: THE HAZELNUT MARKETING BOARD

State of the Northwest Hazelnut Industry

Once on the Brink of Collapse, Industry Prepares for a New Era of Growth



By **THE HAZELNUT MARKETING BOARD** | CONTRIBUTING WRITER

THE OREGON HAZELNUT INDUSTRY IS IN THE MIDST OF a renaissance. After being on the brink of collapse in the wake of the Eastern Filbert Blight outbreak that decimated orchards from the late 1980s through the 2000s, the industry has battled back and is primed for a new era never seen before.

It is a brave new world for Oregon's hazelnut growers, a group whose numbers have burgeoned in recent years. Oregon hazelnut acreage has ballooned since 2011; the industry plateaued around 30,000 acres for many years, but the advent of new varieties resistant

to EFB spurred enthusiasm amongst growers—both multi-generation hazelnut growers and farmers converting from other crops in the Willamette Valley. Since 2011, the total estimated acreage in Oregon has risen from approximately 33,000 acres to nearly 85,000 acres. The industry set a single-year growth record in 2017 with an estimated 11,000 new acres of hazelnut trees.

Research and Education Drive Success

The key has been the release of new varieties. The Hazelnut Breeding Program at Oregon State University has worked arm-in-arm with growers for decades to ensure the vitality of hazelnuts in the state, and their work reached a critical new level of importance during the EFB outbreak. A team of researchers, led by Dr. Shawn Mehlenbacher, worked diligently to find a solution and discovered the Gasaway gene—the first known gene resistant to EFB.

After this discovery, the breeding program then cultivated and released varieties that have become staples in the industry. Jefferson was the first major variety released in 2009 and has been widely planted since. Other new varieties include Yamhill, Wepster, McDonald and PollyO, plus numerous pollinizers. Thanks to these releases, the industry grew more in the last 10 years than it did in the previous 100.

As with any agricultural commodity, research is eternally important to the Oregon hazelnut crop. Largely through funding provided by the Oregon Hazelnut Commission, researchers and scientists continue to seek out answers to the ever-evolving issues facing hazelnut growers. Garry Rodakowski, a grower near Vida, Ore., has been actively involved with the Oregon Hazelnut Commission, currently serves as Chairman, and has witnessed many breakthroughs made by these researchers. Combatting a new potentially dangerous pest has come to the forefront in recent years.

“A newer issue we are addressing through our

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research is the brown marmorated stink bug—an invasive insect species that has already caused major damage to hazelnuts in Italy and Georgia,” said Rodakowski. “Oregon State University is propagating the samurai wasp, an approved biological control, and distributing the wasp to growers throughout the Willamette Valley. The wasps feed on the eggs of the stink bug.”

Education has proven paramount for the slew of new growers entering the fray. Not long ago, Jason Perrott was one of those new growers entering the field after never previously working with hazelnuts; today, he is the president of the Nut Growers Society of Oregon, Washington and British Columbia—a grower-led group focused on strengthening the industry through grower-to-grower collaboration. Perrott is excited about the horizon awaiting Oregon hazelnuts.

“We have a dedicated group of growers, processors, and researchers that are working together as we continue to grow into what could be our largest crop ever. Oregon hazelnuts continue to have a reputation as a premium flavor nut on the world stage. Our cultural practices, research and stewardship programs are all on track and moving in positive directions. We are focusing more on marketing which will be a real positive for the growers,” said Perrott.

Preparing for Larger Crops

More trees being put into the ground mean more nuts entering the marketplace. Hazelnut trees typically take five years to reach full maturity and produce a harvestable amount of nuts, thus most new plantings are just now hitting their productive life. In 2018, the industry set an annual production record of nearly 52,000 tons. With so many new trees expected to have their first harvest in 2020, growers are optimistic that that record could be broken—and the upward trend can continue.

These new volumes mean more work for the hazelnut handlers. These companies purchase the hazelnuts from the growers and process them before selling them into the various food and consumer sectors. Denfeld

Packing has been processing hazelnuts since the early 1980s, and Sean Denfeld has spent his whole life in the industry. He sees this new era as an opportunity for innovation.

“I think we are getting close to the critical mass point for the industry—the point where we are going to look at doing things a little differently. It’s an exciting time for creativity and each handler is looking for ways to be efficient as they prepare to take on unseen volumes of hazelnuts,” said Denfeld.

In the eyes of consumers, all nuts have steadily been growing in popularity, and hazelnuts are no exception. Confections continue to be a driving sector for hazelnuts, with companies like Ferrero featuring hazelnuts in their popular chocolates. Hazelnut butter has also been a surging niche. In addition to the widely recognized Nutella, many other companies, like Eliot’s Nut Butters, Ground Up and Wild Friends, have launched hazelnut butter products. From beers to protein/

energy bars to milk alternatives, hazelnuts are finding a place in more and more aisles of the grocery store.

While the overall recent growth has been great, growers don’t anticipate much of a slowdown. Rather, they advocate for responsible growth. Growers and handlers see a bright future for hazelnuts in Oregon, and critical to that future will be proactively addressing pest issues as they arise, managing natural resources responsibly and a united marketing effort to ensure there are sales channels available for the thousands of new tons that will be entering the market.



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Mid-Willamette Farms' employees do heavy pruning in a mature Barcelona orchard (all photos by D. Cahill.)

Training and Pruning Basics for Hazelnut Trees

Selecting the right cut at the right time can build a solid structure for years to come.

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

PROPER TRAINING OF young hazelnuts helps build a solid support structure that can stand up to ice, snow and heavy nut crops. Training young hazelnut trees is done in the first four or five winters. Continued pruning of older trees maintains a solid framework, increases production and encourages vigorous new growth.

Training Trees

There are two types of pruning cuts for hazelnuts: thinning cuts and heading cuts. Thinning cuts remove an entire branch. Heading removes only

part of a branch. According to Oregon State University (OSU) researchers, after planting trees, it's best to top the tree with a heading cut 28 to 34 inches from the ground. Since transplanting is hard on the root system, topping the new trees helps reduce their water needs. Topping will also encourage new growth below the cut. The trees will grow many new leaders, and grow larger more quickly.

During the first winter, carefully consider which three to five limbs will become scaffold limbs. Scaffolds will form the tree's framework. Look at the crotch angle between the trunk and limb when choosing scaffolds. A 45- to 60-degree angle makes the strongest limb.

Remove suckers growing from the ground as often as necessary. Cut out

suckers (or carefully spray) when they are still young and green. Suckers are tougher to get rid of once they harden off.

During the second winter, choose one or two additional scaffold limbs. Look for limbs that are spaced evenly around the trunk and have approximately 6 inches of vertical space between them. Prune out the rest of the branches. If the primary scaffold branches have put on a couple of feet of new growth, but haven't sent out lateral shoots, make a heading cut on those branches to encourage shoot formation. The leader is the highest point of a scaffold limb. Train central-leader trees with one leader, or train trees as multiple leaders, which generally have three, four or five leaders.

Continued on Page 34

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Continued from Page 32

General Pruning Tips

Pruning Young Trees

- Don't use heavy pruning on young trees. According to OSU researchers, that is a common mistake made by new hazelnut growers.
- Continue to remove branches to keep center of tree open. Besides letting in more light, which helps tree produce more nuts, this will also allow for better spray coverage.
- Prune to develop a strong and balanced branch framework.
- Remove poorly positioned branches—ones that rub together, cross or are positioned too low.
- Remove unwanted branches when they're small. Small pruning wounds heal faster than large wounds.
- Continue removing suckers.

Pruning Mature Trees

- Most pruning on older or maturing trees is done with thinning cuts.
- Growers can use a heavier pruning hand on mature trees, especially if the trees showed poor growth the previous year. Pruning stimulates new growth.

- For best production, hazelnut trees should put on at least 6 to 8 inches of new growth every year. Measure the growth of branches that are at shoulder height.
- Remove low-hanging branches.
- Prune out dead or diseased wood.
- Remove sucker and water sprouts.

Prune in winter, spring or summer months. Pruning during the dormant season from December to February will produce vigorous growth the next spring. Use summer pruning to remove suckers and dead or dying limbs. Leave bottom branches longer so tree forms a triangle shape.

If trees have been neglected, it's best not to try and catch up on all the pruning at once. Oregon State Extension recommends that growers remove no more than 25 to 30 percent of live canopy in any single year. Regular pruning may help some hazelnut varieties to produce more evenly from year to year, instead of a heavy crop one year, and light the next. Since nuts set on 1-year-old wood, instead of pruning an entire mature production orchard in one winter, Extension recommends pruning one-fifth of the orchard each year. Wounds on hazelnut wood are especially susceptible to fungi and rot. It's important to prune at the branch collar—the raised area at the base of a branch. It's hard to see the branch collar on hazelnuts, but it's important not to prune flush with the trunk. It's equally important not to leave a stub, which won't properly heal. The branch collar contains special cells that seal off wounds. Don't paint or spray wounds.

Sacrificing Early Yields for Long-Term Gain

Hazelnut grower Ryan Glaser of Mid-Willamette

Farms in Tangent, Oregon has a unique take on pruning. He's willing to sacrifice his earliest crops in order to grow a strong, bowl-shaped structure on his young Jefferson trees.

"I'm not so concerned about the initial yield," Glaser said. Instead, he believes in laying the correct tree structure, knowing that higher yields are coming in the future.

"We prune hard early. I work on a solid tree and a good trunk," he said. "I push nutrients hard."

Glaser's youngest orchard is planted in blocks. He has 56 acres of 4-year-old trees, 40 acres of 5-year-old trees, 40 acres of 6-year-old trees, 40 acres of 7-year-old trees and 80 acres of 9-year-old trees. All are Jefferson.

"I really like this tree. For me, it has a great structure," Glaser said.

Jefferson is the first Eastern filbert blight (EFB) resistant release from OSU. It was released in 2009.

When training young trees, Glaser makes sure to get good branch spacing and correct notch angles.

"I prune them hard the first four years. I think it pays dividends in the end. I topped my four year olds at four and a half to five feet." Glaser said, noting that he realized his yield will initially be poor.

Next year he'll just do some clean-up pruning to keep the trees' bowl shape. One year, Glaser waited for his pruning advisor until March. His young trees grew top heavy without enough root structure.

"I grew too good of a tree," Glaser said.

He topped those trees hard to get a solid root structure and a good trunk caliper. Hazelnut trees tend to get loose in the ground in wet and windy areas, like Glaser's orchard. His pruning program helps counterbalance that problem.

The data's not all in, but Glaser says his trees are out-yielding trees in different pruning and nutrient programs by a couple of percentage points.

"It's a lot of work," Glaser said about his aggressive pruning, "but I think I'll have a better tree in 40 years."

Glaser's dad, Dennis Glaser, planted Barcelona trees in the early 1980s. It's one of the varieties hardest hit by EFB. The Glasers continue to prune out diseased branches on their mature Barcelonas.

"Growers who are trying to fight Eastern Filbert Blight are pruning heavily and basically growing new trees," said Pacific Northwest hazelnut grower Telly Wirth.

Three years ago, the Glasers heavily pruned on their mature Barcelonas and had nice new growth coming along. This year, they noticed the blight had come back and hit that new-growth wood. Eventually they plan to replace their 1120 or so acres of Barcelonas with Jefferson. In the near future they will retille and replant 15-20 acres to replace flooded trees.

"Maybe put in some Polly O's," Ryan Glaser said.

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Cover Crops Catching on in Hazelnuts

Practice helps control erosion, manage weeds and improve soil health on Oregon hazelnut farms.

By MITCH LIES | Contributing Writer



A variety of cover crops are being used in hazelnut orchards. Fall seeded pocco barley is pictured in the spring at an orchard near Monmouth, Ore. (photos courtesy Nik Wiman, OSU.)

WITH ITS CLAY SOILS and hilly terrain, Ioka Farms didn't think it had much choice but to plant a permanent cover crop in its hazelnut orchards.

"We had to have it, because we have this sticky red soil up here in the hills, and if you happen to have a wet year, it is really difficult to pick hazelnuts," said Doug Duerst, an executive with the Silverton, Ore., farm. "And if we worked everything up and leveled it out, our topsoil would just erode right down to the rocks."

About 30 miles southwest of Ioka, Matt Hamilton of Rainbow Hill Ranch in Monmouth, Ore., also knows a bit about farming on steep slopes. Even though much of the ground the Hamilton family has converted to hazelnuts is on the farm's flatter ground, the Hamiltons also prefer to keep their orchard floor covered during winter months.

"It is nice to keep the ground covered," Hamilton said. "It helps prevent erosion, and you can go out there and you aren't going to cause soil compaction like you would on bare ground if you have to get

out there and spray when there is some moisture."

The use of cover crops on Ioka Farms and Rainbow Hill Ranch may at one time have been unusual in Oregon hazelnut circles. According to Oregon State University Extension Hazelnut Specialist Nik Wiman, however, that no longer is the case.

"There is a new class of growers coming on now that are using permanent perennial cover between their rows," Wiman said. "This is kind of a seed change in the industry."

For the most part, grass crops are the preferred cover crop among hazelnut growers, Wiman said, but that's not always the case. Some are using nitrogen-fixing crops, like vetches and clovers, to nourish the hazelnut trees.

"They can actually fix a substantial amount of nitrogen that way," Wiman said. "But it comes with some risk in that meadow voles also really like the legumes, and voles can be a serious problem for orchardists."

Other growers are letting cover crops volunteer between rows of hazelnut trees. Still others are growing barley or pollinator species like phacelia.

Cover Cropping Tradeoffs

The cover cropping occurring on Oregon hazelnut farms is providing multiple benefits in addition to erosion control, Wiman said. The crops suppress weeds, increase soil's capacity to take up water and nutrients and they benefit soil health by adding organic matter to soil over the winter months.

"Just soil health in general is improved," Wiman said.

But there are tradeoffs, he added. Cover crops can compete with trees for available moisture, and harvest can be more difficult when picking nuts up off a cover crop.

As Duerst said, "You kind of have to put a value on what your topsoil is worth, and then figure out if you need to do it or not."

Growers who are embracing cover crops are finding ways to minimize the downsides. To reduce issues with water competition, some orchardists are ramping up water inputs at certain times of year, or flailing down the cover crop late in the season to encourage its dormancy, something that works particularly well in drought years, Wiman said. Keeping crops mowed and free of thatch and other debris can also minimize issues with harvesting nuts off cover crops.

Certain grass species, such as fine fescues, are better than others at staying clean.

"There are a few different species that are working pretty well particularly when using some of the newer harvest equipment," Wiman said.

Managing the Cover Crop

Ioka typically will mow its fine fescue cover crop between three and five times a year, cutting it particularly low in the final cut before harvest.

"We want to get in there as close to nut drop as possible," Duerst said. "Usually we will get in there in early September,



OSU research assistant Heather Andrews seeding a hazelnut orchard with a winter cover crop near Gaston, Ore.



Phacelia makes a nice weed-resistant cover crop that pollinators love.

mow it hard, right down to the ground. Prior to that, you just try to keep it at bay.”

Keeping ground level also can be difficult when working with a cover crop.

“We start out with trying to be as level as we can,” Duerst said, “but as you start spraying your trees and driving through those rows, eventually, with the wet weather and everything, you get an unevenness in there, just from the tire

tracks. So, we are going to have to deal with that at some point, maybe put in some sand or rejuvenate it.

“We can still pick off it, but if it gets to a point where you can’t, then you are going to have to do something about it.”

Because fine fescues have a long stand life, Ioka has been able to keep its initial cover crop in place since planting its first hazelnut orchard nine years ago. Other growers are pulling out cover crops each

year to improve harvest efficiency and reestablishing them after harvest, something that can be difficult given the short duration between the end of harvest and the start of cold, wet winter temperatures that are inconducive to plant development.

“One of our biggest frustrations in research we’ve done into cover crops was

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Intercropping Hazelnuts

Many Oregon growers are intercropping during the establishment years of hazelnuts, both to minimize issues with erosion and generate some revenue off ground while the hazelnuts mature to bearing stage.

"Intercropping continues to be a popular practice, especially with grass seed growers that are diversifying their farms with hazelnuts," Oregon State University Extension Hazelnut Specialist Nik Wiman said. "It is a good economic model for getting into nuts."

In addition to grass seed crops, some growers are intercropping with row crops like strawberries, Wiman said. "People have gotten creative," he said. "There were a couple of farms last year that had hemp intercropped in hazelnuts."



Cover crops can help prevent erosion, pictured here (photo by N. Wiman.)



Matt Hamilton, left, with his father, Steve, and brother, Ben, in a hazelnut orchard that the Monmouth, Ore., farm intercropped with a perennial ryegrass seed crop. Intercropping is common in young hazelnut orchards throughout the Willamette Valley (photo by M. Lies.)

Continued from Page 37

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getting something to grow," Wiman said. "Usually for a winter cover crop, you want to plant it in September in the Willamette Valley.

"Maybe this will change a little over time because all the new varieties that we are planting are harvesting earlier than the old Barcelona," he added. "So, hopefully, that will give us more of a window for planting things."

Going with a volunteer cover crop can overcome that issue, Wiman said. "The volunteer crops are adapted to coming up pretty fast in the fall."

Overall, Wiman said he is encouraged to see more growers keeping soil covered in their hazelnut orchard systems.

"I would like to see more orchards with cover," he said. "We are getting a lot of scrutiny of our industry because people are seeing bare ground and thinking that is a bad thing. But then again, any imperfection on the orchard floor is a place to possibly lose nuts during harvest.

"I understand the grower apprehension, that they feel they need to have the smoothest possible orchard floor for efficient harvest so there are the opposing needs there," Wiman added. "It is just a matter of figuring out the right combination that is going to work to conserve the soil, enhance soil health and also provide for efficient harvest operations."

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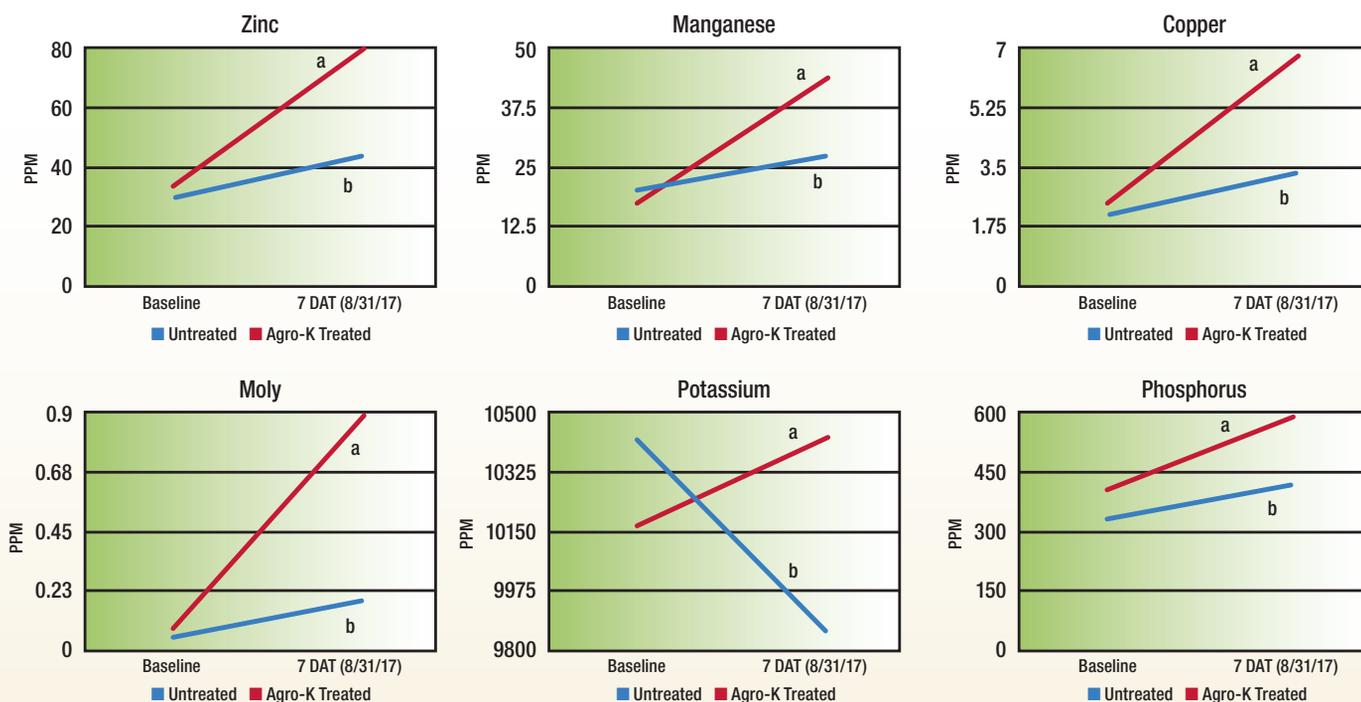
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Hull Split N.O.W. Applications – A

Increase Yield And Improve Yield



Data by Bisabri Ag Research



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

do not penetrate well, especially from mid-summer onward after the pistachio leaf has hardened off and developed a thick waxy cuticle, making them ineffective. But Agro-K's Sysstem® and Dextro-Lac® foliar product lines are designed to rapidly and completely move through even the toughest, hardened off, waxy pistachio leaf – even in late summer, making them extremely effective nutrient delivery tools.

Agro-K's penetrating formulations allow growers to capitalize on the freeride available with a summer Hull Split Navel Orange Worm spray to apply the right nutrients, in right form, at the right time, in the right mix and in the right place – the 5 R's for foliar nutrition. Applying effective nutrients based on a "Science Driven™" approach which can penetrate leaf tissue will help maximize nut size and splits on this year's crop, increasing per acre returns. In addition, foliar nutrient programs added

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

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

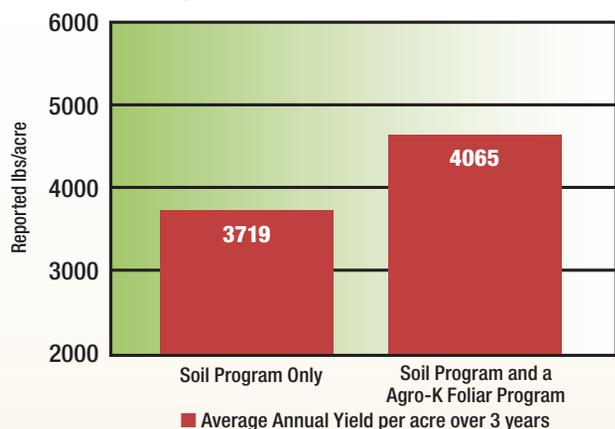
This year, take advantage of your Hull Split NOW application to feed your pistachio trees the key nutrients they need to maximize yield this season and deliver higher yields next year.

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Bisabri Ag Research - 'Gold Hills' Pistachio - 2017-2019



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

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

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

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

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

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NEW RESEARCH LOOKS AT THE IMPACT OF TRUNK GUARDS IN HAZELNUT ORCHARDS

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

Opaque trunk guards on young hazelnut trees (photo by D. Cahill.)

NEW RESEARCH AT THE Oregon State University North Willamette Research and Extension Center in Aurora is evaluating sunburn, trunk growth and other effects of trunk guards in new hazelnut plantings. OSU Extension Orchard Specialist Nik Wiman presented findings from the 2018 trial at the Nut Growers Society Winter Meeting, in Corvallis.

Hazelnut growers are under pressure to apply trunk guards to young trees to prevent herbicide damage. Wiman's study produced mixed results

and he said the negative consequences of using trunk guards may not be worth the protection and benefits.

"I think they cause a lot of problems, but I understand that they give growers peace of mind and may increase spray efficiency for large operations," Wiman said.

"Herbicides can potentially have a negative effect on the bark and health of young trees," he added. As a result, some herbicide companies want farmers to use trunk guards. They are starting to recommend using trunk guards on their labels. "They want to take away some of that liability," he said.

Researchers started with bare root Jefferson variety trees planted in two long strips. The 300 trees were planted at 48-inch density. Each was mulched with

5 gallons of sawdust. Five different trunk guard types were randomly installed on 40 trees each with 10 trees left untreated. All trees were irrigated with drip tape. Trunks were measured at 12 inches and stems were headed off at 32 inches.

Trials looked at the following types of trunk guards; Corrugated white and black plastic wraps, paper cartons, blue translucent, peach translucent, clear "grow tubes," and painted trees.

In addition to tree growth, sunburn and other trunk damage, researchers measured the number of suckers and water sprouts. They also took a look at how the timing of guard removal affects tree health and growth patterns of young hazelnut trees.

Key Takeaways

Based on Wiman's research the following pros and cons can be generalized about trunk guards in Northwest hazelnuts:

Trunk Guard Pros:

- Most trunk growth and healthier cambium happen when little to no light is reaching the trunk.
- Water sprout growth is cut by two-thirds when opaque trunk guards are used. Paint also reduced the number of water sprouts.
- More opaque trunk guards helped reduce suckering after two seasons.
- Trunk guards help protect bark from herbicide spray.
- Trunk guards help prevent sunburn in young trees.

Trunk Guard Cons:

- Trees can still sunburn at top of the trunk guard. Pacific flathead borer sometimes attack trees right at the top of the tree guard. "They are attracted to sunburn," Wiman said.
- Bark under tree guards is tender, so when exposed to sun, it tends to burn easier and is more susceptible to injury.

- Trunk guards are attractive to mice – shelter and food all in one spot. Inside the guards, mice can girdle the tree. Guards also harbor wasps.
- Water sprouts that do grow under trunk guards are trickier to remove.
- Trunk guards may cause an interaction with trunk diseases including bacterial blight.
- Guards may increase labor costs because they must be opened, lifted or removed to manage suckers.
- Guards can hide problems with borers and rodents.

Water Sprouts and Suckers

“Essentially, we found that when trunk guards let in light, more water sprouts and suckers grow,” Wiman said. “Any treatment that allowed light to touch the bark of trees had more water sprouts.”

Even after the second season, that general trend continued – the more light the trunks received, the more water sprouts.

After one growing season, there was no noticeable difference in the number of suckers sprouting from the roots, but significant impact in the number of water sprouts growing from the trunks. The white and black plastic wrap guards showed the fewest water sprouts. The clear grow tubes showed the most water sprouts, followed by the untreated trees. Third most water sprouts came from both the peach and blue translucent guards. Fourth most was the paper cartons, and then the painted trunks.

The water sprouts that grew under the trunk guards created problems making it harder to remove than trees without guards because the sprouts tended to grow closer to the trunk. Removing difficult sprouts growing parallel with the trunks may cause trunk damage. That damage could become infected with pathogens, such as bacterial blight, eventually killing the tree, Wiman said.

Trunk Damage

The bark under trunk guards that let in little light was more tender. So, once the trunk guards were removed, and the bark was suddenly exposed to the elements, it was more susceptible to sun-



Scrape tests in research plots look at potential sunburn and heat damage to the cambium (photo courtesy N. Wiman.)

burn and herbicide damage.

“Bark under the trunk guards is sometimes still juvenile,” Wiman said.

The tender bark might also be more susceptible to freeze damage, Wiman noted. Not only hot summer sun can cause sunburn – tender bark could also sunscald in the winter if there’s snow cover on the ground, and the sun reflection is bright and harsh.

Researchers did scrape tests in the spring of 2019 and again in the fall of that year to look at potential sunburn

and heat damage to the cambium.

Results showed more sunburn damage to untreated trees. Trunk condition appeared best in painted trees and those with the plastic white and black wrap.

Possible cambium damage showed up in all the treatments. Some happened when guards were on, some after removal. The most damage happened to untreated trees.

Continued on Page 44

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New research at the Oregon State University North Willamette Research and Extension Center is evaluating the benefits and effects of trunk guards in young hazelnut orchards (photo courtesy N. Wiman.)

Continued from Page 43

Tree Growth

Most trunk growth happened with the plastic white and black wrap, followed by paper cartons, then clear, translucent peach, translucent blue, and then painted trees. Least trunk growth was recorded in the untreated control group.

The highest growth rates happened with opaque trunk guards. The white and black plastic wrapped trees outperformed both painted and unpainted trees in growth rate of trunks and canopies.

Researchers rated appearance of canopies, which weren't affected by trunk treatments.

The temperature inside the tree guards was monitored for two weeks in July 2018. Findings showed that temperatures inside any guards that let in light – clear, peach and blue translucent – were often 20 degrees higher than the outside air temperature. Temps inside the clear “grow tubes” sometimes reached higher than 125 degrees Fahrenheit.

The lowest number of suckers and water sprouts produced over two growing seasons were from the trees with white and black wrap, when those guards were removed in spring of the second leaf.

The worst results, as far as trunk ratings and health, occurred when trunk guards were removed during the first winter.

The last set of trunk guards were removed in the fall of 2019.

In all aspects, unpainted trees did the worst.

“I have heard growers say they don't need to paint, that their bare trees do fine without it,” Wiman said. “But I can say with one-hundred-percent confidence, that their trees would do even better with painted trunks.”

The biggest increase in growth determined by trunk caliper increase was with trunk guards that block the light, especially the white and black wraps. Wiman's concern with that result is the trunks may be bigger because of a lower density of that hasn't been put to the test from the environment.

“But with the opaque guards there are less of these undesirable sprouts, and any treatment that reduces suckering and water sprouts is likely to increase growth in the main trunk because of the energy saved,” Wiman said.

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Words of Caution

Wiman also points out that farmers can't see what's going on under the tree guards. They spend a lot of time opening and closing the guards to check the tree health underneath. "That's time wasted in my book," Wiman said.

One farmer went to buy tree guards from the company he'd gotten his last supply from. They were out of the type he'd purchased before, so they sold him clear ones instead. "He lost all those trees," Wiman said. The clear plastic had a greenhouse effect and overheated the trees.

To stretch money, some growers will cut trunk guards, maybe trying to get two guards for the price of one. Unfortunately, that leaves 6-8 inches of unprotected bark that can sunburn.

Researchers will continue to monitor the trialed trees for at least another year to learn about longer-term effects on bark, tree health and growth. They may also take a look at how hazelnut trees do when planted as a hedgerow.

"We will evaluate trees one to two more times and continue to follow sunburn damage to determine longer-term effect on tree health," Wiman said in the report.

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"I think they cause a lot of problems, but I understand that they give growers piece of mind and may increase spray efficiency for large operations."

—Nik Wiman, OSU Extension



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Almond Growers and Handlers Navigate Market Uncertainty

Strong Consumer Demand and a Return to Normalcy Could Help Correct Downward Price Pressures

By JENNY HOLTERMANN | Contributing Writer

THE LAST SEVERAL MONTHS HAVE BEEN nothing short of an economic roller coaster ride. The consumer has been bulk buying, causing a break down in the supply chain domestically and internationally. There was uncertainty in markets, and buyers were juggling supply and demand. The almond market has been faring the storm and continues to make strides, though not

without challenges.

“It has been a rough go,” said Paul Ewing, Partner & Sales Manager for RPAC, an almond grower and processor in Los Banos, Calif.

Multiple elements play a role in the current state of the almond market and the future that will play out. According to Ewing, the uncertainty started last year, well before almond harvest of the

2019 crop.

“First of all, we need to look back at the 2019 July objective estimate at 2.2 billion pounds. People started doubting their ideas of what they thought was a 2.5 billion pound crop and they started marketing for a 2.2 billion pound crop. The prices last fall, getting this season going, were too high and didn’t stimulate enough demand growth. By December, we were getting surprised by the crop receipts every month. January came and the crop just kept getting



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**“Retail plant-based food sales, like other retail food sales, experienced a significant spike in mid-March during peak panic buying. During this time, plant-based foods were up a whopping 90% compared to last year’s sales.”
—Plant Based Food Association.**

Top Global Destinations for California Almonds

crop year 2018/19 | million pounds



Source: Almond Board of California. July 2019 Position Report

bigger. A lot of the price decline came from the objective estimate being inaccurate and the crop actually being closer to 2.5 billion pounds,” said Ewing.

March 2020 brought the spread of COVID-19 and the crumbling economy that came with it. Combine the increase in yield growers had for the 2019 crop with impacts of COVID-19, and the almond market saw the decline no one could expect. There was a trade disruption internationally as well as domestically. Americans saw hoarding and stockpiling occurring, and the grocery store shelves empty. This same model occurred overseas as well.

“Economies closed down. Businesses had to shut down. There was a point in time where Indian buyers, for example, couldn’t operate their business and they weren’t going to the port to clear their containers,” said Ewing.

According to the Almond Board of California, shipments to India grew 16% in Fiscal Year 2018-2019. For the first time, India became the No. 1 export market of almonds, buying 231 million pounds. The industry predicted further increases with India this year. The Almond Almanac outlines almond consumption in India as strongly driven by tradition and many of those traditions were impacted by COVID-19.

“With the onset of COVID, India saw a reduction in weddings. Almonds are a customary gift during weddings, drawing a large reduction in demands across the country,” said Ewing.

The Almond Board of California’s India marketing program reinforces traditional uses in India as well as a focus on almond consumption as a snack.

The biggest issue with trade in India was getting product out of the port and into store shelves. Overall, demand remains strong, consumers just didn’t have product on the store shelf to purchase. Marketing efforts based on health, appear to be favoring the almond industry and consumer demand for product.

“Slowly they started to open up, but real consumption has slowed down a lot and buyers didn’t have the cash flow to purchase,” said Ewing. “Then a shut down in parts of the Middle East, like Dubai, came. Which did hurt their trade and lack of cash flow. At the same time, the U.K. and U.S. had a surge in shipments to refill those empty shelves. However, that has come and gone and shipments remain slow.”

He remains hopeful, however, that the agriculture economy will bounce back.

“It hasn’t been as big of growth as we like to see with the big crop we foresee coming,” Ewing said. “We believe that the growth is coming, as prices work their way down the chain and buyers work through some of the expensive inventory.”

He was hopeful the price will adjust, but expected it will take time. Growers have been here before, as prices change from a high to a low that wasn’t expected.

As the grower price fell below \$1.60 a pound at the end of May, it was close or below growers’ breakeven point. Growers

Continued on Page 48



face tough decisions moving forward, Ewing said.

“We will likely see orchards being removed. The yield per acre is likely to drop next year. We expect the acreage growth rate to slow significantly with additional removals,” he said.

Growers ultimately, have to do what’s best for their business. With older orchards at the verge or beyond the decline in yield, growers could be deciding to take orchards out of production early.

“There are positives in this situation, as well. We just have to choose to look for them,” according to Ewing. The price of almonds fell from \$2.60 per pound at the beginning of the year down to \$1.60 per pound at the end of May.

“Growers hope it doesn’t fall below that, but it is important to remember low levels spur demand. A lot of times we forget these tough times can bring an upswing in prices. For reference, during the 2015-2016 crop year, demand grew from 1.8 billion pounds to 2.1 billion pounds in shipments. The pricing dropped \$1.70 from the high 2015 price above \$4. That drastic drop in price grew demand back to a more stable price,” Ewing said. A stable price that almonds could very well be moving toward again soon with the onset of increased demand in the plant-based product sector.



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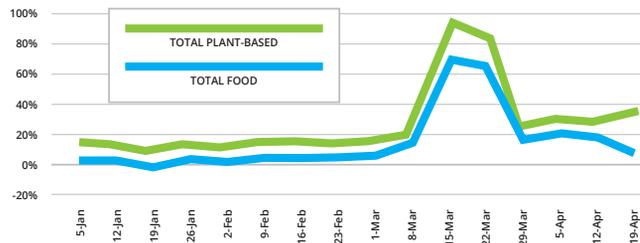


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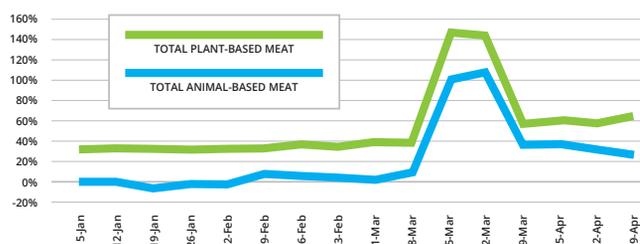
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Plant Based Foods Association, sales of plant based food spiked during COVID-19 compared to the same time last year and other food categories (courtesy Plant Based Foods Association.)

Plant-based vs. Total Food Retail Sales



Plant-based vs. Animal-based Meat Retail Sales



Refrigerated Plant-based Meat Retail Sales



Tofu and Tempeh Retail Sales



Some believe COVID-19 ramped up the demand for plant-based foods in their diets. According to the Plant-Based Food Association, “U.S. retail sales of plant-based food grew 11.4% last year to a record \$5 billion.” This growth continued during the first part of this year as well.

Plant-Based Food Association's recent study shows a significant growth in the plant-based food category as this trend continues to climb. “Retail plant-based food sales, like other retail food sales, experienced a significant spike in mid-March during peak panic buying. During this time, plant-based foods were up a whopping 90% compared to last year's sales. Throughout the four weeks following peak panic buying, total plant-based foods sales grew at 27%, which is 35% faster than total retail food,” the group said. With a projection continuing for plant-based food demand, it is hopeful almonds remain part of consumers' top of mind.

Internationally, there is also growth to consider in China with their Phase 1 trade agreement scheduled to reach \$36 billion in agriculture goods by December 2020. According to the USDA, “China is on the path for \$13 billion of agriculture purchases between October 2019 and October 2020, putting them on the hook for the balance of \$23 billion by December 2020 to uphold their end of the trade deal.” This forecast is not just crucial to agriculture in general, but largely to almond marketing as well.

As the third-largest international destination for almonds, China plays a massive role in almond exports. China's growth and trade targets make them an ideal export partner going forward and a country with the potential for increased trade. The Almond Board of California's current program in China focuses on highlighting the skin benefits of snacking on almonds.

The Almond Board of California stated, “With China's \$22 billion skincare market continuing to grow, it's meaningful to consumers to know that the Vitamin E in almonds can be a helpful part of a skincare routine from within. Research reflects almond usage as a snack product had a 6% gain in consumption.”

Ewing referenced an increase in yield this year, noting “Combining the situation of COVID, very good bloom weather, we expected the north and east side to rebound from their low yields last year, but we didn't expect the south and west side to come back with a strong crop this year as well. We aren't sure until we get real data at harvest.”

Only time can tell where the almond price will lead and the future growth of

the industry. Demand appears healthy and Ewing remained hopeful the price will improve. So, while there may be some uncertainty in this roller coaster ride, there are several pieces in place for a smooth landing.

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A WORD FROM THE BOARD: AMERICAN PECAN COUNCIL



Marketing During a Pandemic: American Pecans Target Social Distancing Food Trends

By **AMERICAN PECAN COUNCIL** | *Contributing Writer*

According to CNN, banana bread was the most searched for recipe on Google for the month of April. American Pecans targeted those searchers with a paid search campaign for its Pecan Banana Bread on the APC website (all photos courtesy APC.)

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AS WE HONOR OUR NATION'S INDEPENDENCE, many of us are celebrating differently this year—familiar routines may be upended due to restrictions or continued concerns for safety. As consumer behaviors have changed in recent months, successful marketing programs have likewise adapted. At American Pecans, remaining nimble in marketing strategy has allowed us to successfully adjust to the latest consumer trends and behaviors.

Stay-at-Home Content

As stay-at-home and social distancing measures began to spread across the nation, social media became an even more critical point of connection. This new dynamic of distance and digital has made consumers more conscious of how brands can best meet their current needs.

According to the latest reports from Sprout Social, consumer goods, health care, and media and entertainment content on social channels such as Instagram and Facebook saw dramatic upticks in engagements per day as consumers spent more time on social media while at home.

While many brands chose to pull back on advertising, we had a different



Plant-based proteins continue to be popular, and American Pecans worked to get information out about pecans as an important high-protein meat substitute.

perspective. We knew people were cooking and baking much more at home and looking for at-home activities the whole family could enjoy, so we could be a valuable resource by offering easy, on-trend recipe inspiration and nutrition information with our target audience via paid social and search campaigns. Our strategy paid off, with increased results at a lower price point. We significantly reduced CPM (Cost Per Thousand Impressions, our primary cost-efficiency metric) from a forecasted \$3.52 to \$0.85, and we garnered more than 45.7 MM impressions.

Feeding the Baking Frenzy

As consumers began seeking new ways to keep themselves entertained during quarantine, internet searches for cooking and baking ideas skyrocketed. According to CNN, banana bread was the most searched for recipe on Google for the month of April, and related web searches increased by 54 percent.

American Pecans targeted those searchers with a paid search campaign, serving up our own Pecan Banana Bread on our website. This resulted in one of our most successful paid search terms of the month, at more than a

3-percent click through rate—more than 50 percent higher than industry averages. By leveraging a popular trend and well-loved favorite, we were able to introduce audiences to a wider range of pecan uses on our website.

These trends have opened new doors to reach interested audiences and educate consumers through our own social channels, paid search advertising and influencer partnerships at a time when consumers are increasingly open to new ingredients.

Leaning into Plant-Based Protein

We've seen many of the pre-COVID-19 trends continue in recent months, including the increasing popularity of plant-based diets. American Pecans continues to remind consumers that there are 3 grams of plant protein in every 1-ounce serving of pecans and that they can be substituted in many meat-based dishes.

We've served up recipes through paid search advertising where consumers are already searching for plant-based inspiration. This resulted in more than 1,400 visits to AmericanPecan.com in April alone, driven to the site through search terms like "vegan protein" and "plant-based protein."

A pivot towards alternative eating styles is expected to permeate the market far beyond the first aftershocks of the COVID-19 pandemic. As consumers seek information on how best to take care of themselves and their families, interest in balanced diets as a form of general wellness has dramatically increased.

Looking Ahead

While it has been a difficult season for our nation and the world, we remain hopeful in our industry outlook and encourage readers to adapt to the latest consumer trends and research. For pecan growers and shellers, we invite you to visit the Industry Toolkit on AmericanPecan.com (password: pecans18) for ongoing updates and resources that you can leverage in your own marketing.

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Different types of soils can be found in a single orchard, such as this pecan orchard in Tehama County, which is home to a variety of soil types, particularly Arbuckle gravelly loam and Tehama silt loam. When developing a water budget, getting the big picture-point of view is important for soil water balance across the variability of soils (photo by Julie R. Johnson.)

Irrigating Nut Crops using Evapotranspiration

Consider the Soil in Putting Together ET-based Water Budget

By JULIE R. JOHNSON | Contributing Writer

WESTERN NUT GROWERS INCREASINGLY RELY ON WEEKLY evapotranspiration rates to create a water budget for irrigating nut crops. Allan Fulton, UC Irrigation and Water Resources Advisor in Tehama, Glenn, Colusa and Shasta counties, said growers should also consider the soil when putting together ET-based irrigation budgets.

During the COVID shutdown, Fulton hosted an online virtual tutorial series to help agricultural water users learn how to apply weekly crop ET reports in guiding irrigation management decisions. The tutorial was held in response to a grower survey led by UCCE Farm Advisor Katherine Jarvis-Shean, Yolo, Solano and Sacramento counties, and Kit Alviz, program planning and evaluation analyst with the UC's Agriculture and Natural Resources Division, that indicated growers would like more information to better use crop ET reports.

UC Cooperative Extension in the Sacramento Valley sends out weekly ET reports to growers, with each report giving evapotranspiration (ET) information, the measure of water leaving the orchard in the form of evaporation or transpiration through plants. The reports can help growers decide when to start irrigating and how much to apply, based on the idea of replacing the water that has been lost from the soil and plants by ET.

"It is part of conducting a water balance or a water budget, or essentially tracking or trying to estimate accurately the amount of water leaving the field and comparing it to the amount of water coming in, either as precipitation or irrigation," Fulton said.

In the second tutorial, Fulton focused on putting weekly crop ET reports to work "from a soil perspective."

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Fulton said irrigating according to ET without considering the soil's perspective runs the risk of over-irrigating. Soils store water from the rainy season for use during the growing season; depending on soil profile, water can be preserved in the soil for use in May, June, July, and even later.

That storage may or may not be a substantial part of the seasonal crop water demand, depending on crop root zones, soil characteristics, the weather for the year in question, amount of rainfall received. Understanding that availability through understanding the impact of soils can potentially impact power bills and water savings.

"Soils are also important from the standpoint that it controls how water infiltrates and percolates through the root zone, which, in turn, affects soil aeration as the roots are growing, and the tree and crop root health," Fulton said. "So, if we were to just blindly budget our irrigations by matching ET 100 percent, based on irrigation system design, we would increase our chances quite a bit of over-irrigating by not considering the soil storage capacity and the root zone capacity of a crop."

Creating a Water Budget

The concept of water budgeting is something Fulton believes is generally easy for growers to grasp as it is something they do day-to-day with their monetary budgets and finances.

"It's an accounting process where we account for the crop water demand with our ET reports, and we compare it against, and balance it against, all the water supplied to the crop, that being irrigation water, as well as rainfall, and sometimes other sources of water like seepage if you happen to be in the proximity of a river, creek, or have some kind of shallow water table effect," Fulton said. "We are looking for a balance, not a surplus or overdraft."

He explains that a water budget is also a method of estimating or tracking the soil moisture depletion. The goal is to not over-supply the soil with water making it too wet and saturated, nor under-supplying it and having it

be too dry for too much of the season.

"We're trying to strike that balance for the soil moisture condition for the best chance of a sustainable crop from one year to the next," Fulton added. "So, the question is, why use a water budget to estimate soil moisture depletion?"

He said for the grower who is just getting introduced to using sci-

ence-based techniques for irrigation management, this is among the simpler techniques and a good place to begin trying to figure out how to integrate technology into irrigation management decisions.

"With our crop ET reports and with

your knowledge of your irrigation system, and as you'll learn about evaluating your soils, it is a relatively inexpensive on-farm management approach," Fulton explained.

In addition, a water budget is a way to estimate and anticipate soil

Continued on Page 54



Crop ET reports can help growers decide when to start irrigating and how much to apply, based on the idea of replacing the water that has been lost from the soil and plants by evapotranspiration (photo by Julie R. Johnson.)

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Continued from Page 53

moisture conditions and irrigation needs, as a mechanism for planning ahead. A budget lends itself to tracking and reporting irrigation management practices.

“The reality is that those in agriculture are being asked more and more to report our practices for various regulatory reasons,” he added.

Another positive about a water budget is it offers a farm or orchard-wide picture of irrigation management, the “big picture-point of view,” and techniques for soil water balance across the variability of soils in any given piece of property.

“A water budget gives growers an estimate of the water and the soil water balance from a completely different perspective than provided by soil moisture sensors,” Fulton said.

He explained, with soil moisture sensors, the mechanism only tests the soil it touches.

“There is a very sharp contrast be-

tween the water budget approach and soil moisture monitoring as far as the scale of what we’re actually monitoring,” Fulton said.

Water Budget Step One

“To form a water budget and con-

Step 1:

To perform a water budget, the water holding capacity of the orchard soil must be assessed.
Depends on site specific soil characteristics



In creating a water budget for a crop, be it a nut orchard or any other type of crop, the first step is to determine soil type and its water holding capacity (photo courtesy Allan Fulton, UCCE.)

sider the soil conditions, we have to, as a first step, assess the water holding capacity of your orchard soil,” Fulton said. “This is a site-specific characteristic. Soils can come in many kinds,

Continued on Page 56



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Step 2:

What is the effective root zone of a perennial tree crop?



- Lots of observations and opinions
- Less quantitative data
- Certainly deeper than can be evaluated quickly with a shovel
- Fulton suggests using at least four feet for three year old trees and older
- UC ANR Pub 8571 suggests eight feet
- Some California experiences suggest root systems can be ten feet or deeper

The second step in water budgeting is determining the effective root zone of the tree, and that determination isn't always easy to establish as different researchers have come up with different conclusions (photo courtesy Allan Fulton, UCCE.)

Continued from Page 54

with many characteristics. What we're trying to evaluate by assessing the water holding capacity of the soil is its ability to

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hold water in the unsaturated phase.”

Soils have two phases of water soil capacity.

“There’s the saturated phase, which is occurring during heavy rainstorms or during significant irrigations,” Fulton explained. “That is when the porosity of the soil is completely filled with water and there is no air in the soil. It’s the condition that we do not want to prolong, particularly when the trees are growing and transpiring. It’s one of the conditions that within 48 hours can do some pretty serious damage and harm to the root health of the trees that are leafed out and growing actively.”

Through gravitational pull, the water in the saturated phase should move the excess water within 24 to 48 hours. At that point, the soil will be in the field capacity state, which is the optimum combination of high water content and aeration, the pore space being 50 percent water and 50 percent air. From that point the soil moves into the wilting point, where no more water is available to plants.

There are several online and UCCE resources available to use as tools for understanding soil textures and water holding capacities and levels of those soils.

Water Budget Step 2

After assessing the water holding capacity of the soil, Fulton said growers should try and determine the effective root zone of the perennial tree crop.

“There are a lot of observations and opinions, but less quantitative data,” he added. “Scientists are using cameras and counting roots and learning they actually come and go in flushes and regrow, and learning a lot more, and hopefully in times ahead, we’ll be able to add, get more quantitative information about how to assess and judge our root zone for our crops.”

Fulton said he has learned root zones are certainly deeper

than can be evaluated quickly with a shovel or by observing moisture that is often not supporting the resident vegetation in the orchard.

He suggests using at least four feet as an effective root zone for 3-year old trees and older.

UC ANR Publication 8571 suggests 8-feet, and some researchers have worked in some experiments on farms in the Sacramento Valley with evidence that the root systems can be as deep as 10 feet or more, Fulton said.

“Judging the effective root zone is really a tough call,” he added. “You do the best you can and you remember that if things don’t quite add up after a year of running a water budget that this may be one of the most pivotal points to reconsider.”

Calculating the math for hours of irrigation to match two inches of ET, Fulton explained:

Solid set sprinkler = 2.0 ET divided by 0.14 inch/hour = 14.2 hours per week. Fulton suggested this is easily accomplished with one irrigation per week if intake rates allow.

Microsprinkler = 2.0 ET divided by 0.06 inch/hour = 33.3 hours per week. He said with this calculation, the grower may need to split into two irrigations per week to manage infiltration limitation and utility TOU rates.

Fulton said he is often faced with the common question from growers asking if they don’t irrigate the entire orchard floor, do they need to apply more water to compensate?

“No, it is not necessary to apply more water to compensate for a smaller wetted pattern, but it is necessary to irrigate differently,” he said.

Smaller wetted areas translate to lower water application rates. This

translates to more hours of irrigation to apply equal amounts of water and match the same weekly ET. Consequently, it may be necessary to irrigate more often each week.

In summary, Fulton said to remember the basic crop ET concept: The rate of ET is not greatly affected by the wetted area because the applied water is primarily taken up by the crop and transpired out the canopy surface, which usually covers more area than a partial wetting pattern.

“If anything, reducing the wetted area will reduce the rate of ET by reducing soil evaporation and slightly lessen (not increase) the amount of applied water needed,” Fulton said.

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SCIENCE-BASED APPROACH TO PLANT BUG CONTROL

MATING DISRUPTION AND OTHER IPM STRATEGIES ON THE HORIZON FOR LEAFFOOTED PLANT BUGS IN NUT CROPS

By **VICKY BOYD** *Contributing Writer*

DEVELOPING A LEAFFOOTED PLANT bug (LFB) monitoring system, which ultimately could lead to integrated pest management strategies, is similar to the age-old riddle about what came first, the chicken or the egg.

“It’s hard to test lures without a good trap, and it’s hard to test traps without a good lure,” said Houston Wilson, a UC Cooperative Extension assistant specialist based at the Kearney Agricultural Center near Parlier.

To that end, he has conducted three years of field trials that narrowed trap designs from five down to one. Further behind are efforts to identify one or more pheromone attractants or plant volatiles that could be used as lures in an LFB trap.

Together, the trap and lures could be used to monitor LFB migration initially into almond orchards in the spring and later into pistachios. Along with developing treatment thresholds, creating a predictive model and gaining a better understanding of the pest’s behavior, the system could help growers take a more science-based approach to plant bug control.

Know Thy Enemy

Of the three LFB species in California, two cause the bulk of damage in almonds and pistachios: *Leptoglossus zonatus*, also known as the western leaffooted plant bug, and *L. clypealis*. Of the two, *L. zonatus* has overtaken *L. clypealis* as the most abundant.

Ranging between 0.75 and 1 inch

long, both have narrow, dark brown bodies with white zigzag markings across the wings. They also have telltale leaf-like projections on their hind tibia.

Both the adults and nymphs feed by using a needle-like stylet to insert into developing nuts and suck plant juices. As they feed, they also inject an enzyme cocktail that can discolor or shrivel kernels.

Part of their feeding behavior includes probing leaves, shoots and fruit, which can leave entryways for plant pathogens.



Leptoglossus zonatus, also known as the western leaffooted plant bug, is the most prevalent plant bug in almond and pistachio trees (photo courtesy UC ANR.)

Better Trap

For the past three years, Wilson has been conducting field trials in heavily infested pomegranate orchards, since reliably large populations of LFB are necessary to evaluate candidate traps without lures.

In his first effort, Wilson compared five trap designs that included 2- and 4-foot pyramid traps, a sticky trap, a



Hanging panel traps outperformed four other trap designs in catching leaffooted plant bugs in field trials in heavily infested pomegranate orchards but were less effective in nut crops (photo courtesy Houston Wilson, UC ANR.)

bucket-shaped UniTrap and a hanging panel trap. Each of these traps was additionally baited with either 50 grams of almond meal with 10% crude almond oil (similar to what is used in a navel orangeworm egg trap), 50 grams of split pomegranate or were left unbaited as a control. Data from this study demonstrated that the hanging panel trap performed far better than the other four, regardless of bait.

As such, subsequent experiments were carried out to refine the use of the hanging panel trap. They found the addition of fluon, a surface lubricant, significantly enhanced capture of LFB adults. In addition, Wilson looked at red, white, yellow, black, blue and green-colored traps to determine whether LFB had color preferences. Yellow proved to be the most attractive, followed by blue and green traps, while red and white were the least attractive.

While the hanging panel traps caught a lot of LFB in heavily infested pomegranate orchards, they weren't effective in attracting the pest in almond or pistachio orchards where infestations are much more localized. This emphasizes the need for a lure.

"If you place something like five traps in a 160-acre quarter section of almonds, without a lure it's going to be hard for that trap to draw in leaffooted plant bug," Wilson said.

In the meantime, he is working to set up an olfactometer and wind tunnel at the Kearney Ag Center to screen potential chemical attractants.

"Field trials are great, but LFB populations can be so unpredictable that we decided it would be better to just take a step back and focus on lab assays before bringing anything else out into the field," he said.

Fatal Attraction

A hunt for LFB pheromone attractants began about 20 years ago. Scientists at the time found chemicals that were aphrodisiacs rather than attractants, said Jocelyn Millar, UC Riverside entomology professor. The project was suspended until more promising leads could be found.

About 15 years later, researchers decided to take another look at identifying LFB attractants. This time,

they began to tease apart the chemical profiles contained in a scent bouquet emitted only by sexually mature male LFB.

"What we know is these reproductively active males are producing this bouquet of compounds," he said. "We're sure this has got something to do with mating."

The chemicals also differ from aggregation pheromones LFB emit in late



An adult leaffooted plant bug feeds on an almond (photo courtesy Kris Tollerup, UC ANR.)

Continued on Page 60

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A leaffooted plant bug sits on the tip of a shovel (photo by V. Boyd.)



Signs of leaffooted plant bug damage in almond

Continued from Page 59

fall to signal to others to come together in large masses for overwintering.

So far, Millar and his colleagues have characterized eight different compounds within the bouquet and are working on a ninth.

As part of their work, they tested each compound using electroantennography. Minute electrodes attached to LFB antennae measure an insect's response to different chemical stimuli. Although the results don't indicate whether the insect's reaction is due to an attractant or repellent property, Millar said he's confident the compounds are attractants because they are produced only by sexually mature males.

Identifying the different molecular components of each compound is just one step; then the compounds have to be synthesized and tested on larger scales.

"With nine compounds, we need to narrow them down to the ones that are the overall best – maybe just three or four," Millar said. "That would make it much simpler and cheaper to formulate."

The real acid test will be putting candidate compounds in traps to attract LFB. Although Millar doesn't have an exact timeframe for that, he remains cautiously optimistic they'll be successful in finding a lure.

"We don't have the smoking gun quite yet," he said. "We need to demon-

strate these compounds are involved, and all indications are they very likely will be. There's at least a wisp of smoke coming out of the barrel."

Much of Millar's work that involved live LFB has been slowed by coronavirus protocols. Until he can ramp back up, he is reviewing research results and plans to have a colleague in the United Kingdom also look them over. In that country, as well as in the Western United States, the related western conifer seed bug - *L. occidentalis*- feeds on seeds within pine cones, reducing production from seed plantations.

The Sweet Smell Of Host Plants

John Beck, a research chemist with the USDA Agricultural Research Service, began evaluating host plant volatiles as possible LFB attractants in 2014 when he was at ARS's Albany, California, laboratory. Of the 140 or so volatiles emitted by pomegranates, pistachios, almonds, tomatoes and oranges, Beck and fellow researchers narrowed it to 20 compounds common to at least four of the hosts.

"The hard part is then identifying the compounds that attract (or repel) the LFB and if they need to be mixed in a blend of other compounds," Beck said. "The ratio of these compounds is often very important to produce a good behavioral response from the insect pest in question."

Although Beck relocated to an ARS facility in Gainesville, Florida, he continued to collaborate with Wilson and UCCE Entomologist Kent Daane from 2017 through 2019.

In collaboration with Ted Cottrell and David Shapiro-Ilan at the ARS

"We don't have the smoking gun quite yet. We need to demonstrate these compounds are involved, and all indications are they very likely will be. There's at least a wisp of smoke coming out of the barrel." — Jocelyn Millar, UC Riverside



(photo courtesy Kris Tollerup, UC ANR.)



A leaffooted plant bug nymph probes a pistachio (photo courtesy Kent Daane, UC ANR.)

facility in Byron, Ga., Beck has since turned his focus to the leaffooted bug, *L. phyllopus*, that causes problems for Georgia and Florida growers. But he theorizes potential candidate attractants or blends for it may also have activity on other *Leptoglossus* species. Beck said he plans to share verified candidate volatiles or blends with Millar and Wilson for pheromone studies they may be conducting.

Early Warning System

An early warning system is needed to replace current practices by growers and pest control advisers that entail time-intensive scouting techniques that don't necessarily reflect true LFB populations.

In March or April, before almond shells harden, plant bug feeding may cause aborted or shriveled nuts that drop to the ground. Clear-colored gummosis on the hull of nuts in the trees or on the ground also is a sign that plant bugs were probing as part of feeding.

Even after shells have hardened, leaffooted plant bug feeding can cause dark spots on nuts or shriveled kernels. It only takes a few of the voracious pests to cause significant losses.

In pistachios, leaffooted plant bugs typically arrive in May or June. Feeding damage early in the season can produce epicarp lesions. Nuts damaged

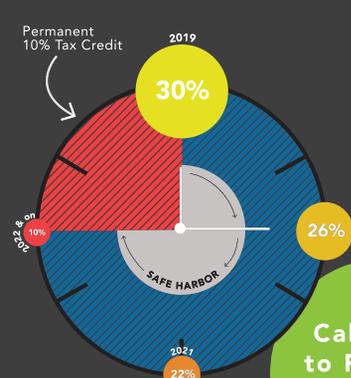
during or shortly after bloom blacken and drop. Without an action threshold, growers and PCAs typically treat when they see damage. Unfortunately, damage signs are after the fact, and there's

usually a seven- to 10-day lag between the time feeding and nut drop occurs.

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UCCE ADVISOR PROFILE

JHALENDRA RIJAL

By CRYSTAL NAY | Contributing Writer



(photo courtesy UC Cooperative Extension.)

GROWING UP ON A SMALL, 10-ACRE farm on the other side of the globe gave Jhalendra Rijal, UCCE Area Integrated Pest Management Advisor, a broad but unique perspective on agriculture an early interest in bugs. The tropical environment of his native Nepal allowed his family to grow an assortment of crops on the land, including rice, corn and a variety of vegetables.

“It was small, but I learned a bit about the ins and outs of the agriculture production system,” said Rijal.

A small farm was all it took to launch Rijal’s curiosity and pursuit of his career in the industry. He obtained his Bachelor’s degree in agriculture, and then went on to earn a Master’s degree in entomology, which complemented his upbringing, his boyhood interest in bugs, and his desire to learn something that would help farmers. Insect pests were encountered every year, resulting in some crop damage in some years. Rijal knew this was the best area to focus his studies and efforts.

“I knew that, even at home, we always talked about ‘how to control these bugs.’ So, I thought this would be something where I could do some good or find something that would be helpful for the growers and for my father, who was doing his production and pest management things at home at the time,” said Rijal.

After spending years studying the effects of insect pathogenic fungi *Matahizim anisopliae* and *Beauveria bassiana* in order to control *Helicoverpa armigera*, one of the world’s most destructive crop pests, Rijal worked with the Nepalese plant protection extension service for three years. It

was then that he realized he wanted to push his education even further, and made the leap to the United States for his doctorate, which he earned from Virginia Polytechnic Institute and State University (Virginia Tech).

While at Virginia Tech, Rijal studied grape root borer, a grape pest, in vineyard systems extensively, and worked in over 20 different vineyards, which not only offered Rijal data for his thesis, but also kept him in constant connection with the perspective of a grower. Jumping to the West Coast after his degree, Rijal began working at UC Davis, where he spent one year before taking a position with UCCE in 2015.

Even in the few years Rijal has been in California, he has seen an incredible increase of nut crop acreage within the state, with some years seeing a 50,000- to 70,000-acre increase. Because of the increase, there has also been a shift in pest control advisors and the amount of land they cover. It has yielded an increased use of new technology and tools, such as GPS-based tech for farm monitoring and electronic traps that work in conjunction with computer or phone apps to read and record data.

Smart spray tech is also nudging its way into the industry with more efficient and precise equipment, application of drone use, and unmanned sprayers commercially available in some areas. “Obviously, the industry is heading in that direction,” said Rijal. “There’s a lot of acreage, a limited number of consultants, and a shortage of labor.”

The combination of these three factors alone will push the industry into new territory. But as the industry

is changing, UC Cooperative Extension has changed within the last few years as well.

Interactions between growers and farm advisors were once more person-to-person during farm calls, where advisors would often spend days out in a grower’s field if there was an issue. In the case for Rijal, an insect-related issue doesn’t always require a farm call, as a majority of these issues can be resolved through a photograph or video sent to his cell phone.

“It makes it a lot easier for us, and for growers, too. It also doesn’t cost a trip to the field, or a day out on the farm for a known issue, which is just not possible anymore when one advisor covers such a large area,” said Rijal. “At the same time, walking into a field and observing with the human eye what’s going on in that field has a great value. So, balancing the role of technology and human judgement in the field is important.”

While pest management advisors are scarcer, attention to pest management and available tools is only going to increase in importance. Having worked in Virginia’s agricultural industry for a few years before immersing himself in California’s, Rijal has seen differences in how IPM can be so different from one side of the country to the other, and how IPM is used much more in California. However, the preservation of the currently available tools is something Rijal finds uniquely important.

“There are a lot of IPM practices that we use to make decisions [about management], but at the same time, IPM also needs insecticides and all the other

tools and tactics. We're very limited on the use of pesticides in crops, and while we need to follow these ideals more and more, we also need to think about what tools are available, and how we can preserve them by efficiently and effectively using them, so that we're not only managing pests, but also preserving our tools so that we can use them in the future."

For example, navel orangeworm in nut crops is a persistent issue. There are a few active-ingredient pesticides available that focus on navel orangeworm and are effective against the pest. However, the general understanding is that the use of insecticides can only do so much. More importantly, if these tools are used repeatedly without considering the pesticide resistance issue, the efficacy of these pesticides could be lost.

In the last three to four years, collaborative research from the University of California has established that the use of navel orangeworm mating disruption, in conjunction with one or two insecticide sprays, can reduce crop damage in almonds by about 48 percent. This "greener" control tool does little-to-no harm to other non-targets and fits well into the industry's focus of sustainable production.

Rijal knows a balance must be reached, where the pesticides are not overused, but are still available in times of need. Mummy sanitation is still the foundation of navel orangeworm control in nut crops, and used with mating disruption and other best practices, all these options can work very effectively together.

But every year presents something new, either to the industry as a whole, or to its professionals on a personal level, which creates value in the ability to adapt.

"Before I began my career in the nut industry, I didn't even know there was a shaker used to harvest tree nuts," joked Rijal. "Coming from Virginia and working on vegetable crops, I just didn't know."

Rijal quickly adapted, gained a significant understanding of these new systems, has since become well-versed in the almond production system, and is constantly learning new things from



Jhalendra Rijal uses a microscope/screen combination to show field meeting attendees different stages of brown marmorated stink bugs (photo courtesy Michael Rosenblum, UCCE Stanislaus County.)

growers, consultants, farm advisors, and other people he interacts with. He recognizes that every day is a new day that can present things of intrigue even for the most experienced grower or farm advisor.

"Based on the expertise, we are here to help growers and farmers, pest con-

trol advisors, and all of the agriculture industry and community with whatever help they need."

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By **MIKE WADE** | *California Farm Water Coalition*

Raising Shasta Dam would increase the available water supply for farms, homes and businesses, as well as increase the cold water pool for salmon. (all photos courtesy CFWC.)

AS THE NEWS CAUTIOUSLY TURNS TO A DISCUSSION OF GETTING back to work, we're all trying to envision, and plan for, what our new world will look like.

In California, one issue we still must deal with is ensuring an adequate water supply for people, farms and the environment. And while there are hopeful signs of a new, cooperative path forward between all water users, putting a new policy structure in place is just part of the solution. The good news is, there are things that can be done to improve our existing infrastructure that could produce benefits now.

As the federal government considers another round of stimulus legislation, one of the things on the table is a list of shovel-ready water projects. Californians are used to thinking of water projects as massive undertakings that

could be in process for decades. While these larger projects are still important, there are a host of smaller projects, ready to go, that could make an immediate difference in the state's water supply—if only they had funding.

Much of our existing water infrastructure is aging and in need of repair. Some of the fixes would be small in overall dollars when you consider the breadth of the federal stimulus effort, but significant in terms of benefit.

Install Concrete Canal Linings

Many of our canals that move water around the state were built decades ago. California loses a significant amount of water when it seeps out of these aging conveyances. Lining canals with concrete could save thousands of acre-feet of water. One proposed project estimates that lining 10,000 linear feet of canal would save 5,000 acre-feet of water every

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Upgrading to automated canal gates can help conserve water and improve irrigation management (all photos courtesy CFWC.)



Repairing or replacing underground pipelines can reduce the amount of water lost through leaks.



The California Aqueduct cannot deliver its full capacity due to subsidence and leaking sections of its concrete liner.

“
‘Californians are used to thinking of water projects as massive undertakings that could be in process for decades. While these larger projects are still important, there are a host of smaller projects, ready to go, that could make an immediate difference in the state’s water supply—if only they had funding.’
 ”

year. That’s enough water to meet the household needs of 31,000 people or produce 80 million salads.

Repair Cracks in Tunnels

Tunnels have carried water throughout California for more than a century and are another example of water conveyance in need of repair. As they age and develop cracks, we can lose significant amounts of water. Repairing those existing tunnels can be accomplished relatively quickly and could save a lot of water that would otherwise simply be lost.

Upgrade Gates at Dams and Reservoirs

Water stored in reservoirs is managed with gates and valves that regulate its flow. But when the parts of these structures begin to wear and start leaking, that leaked portion of our water supply is no longer efficiently managed. Making overdue repairs to ensure this vital infrastructure doesn’t leak is just common sense.

Increase Storage Capacity of Existing Structures

Californians have witnessed the shifting weather patterns in our state. When precipitation does come down, we’re seeing a tendency towards more rain and less snow. And our water years tend to boomerang between very wet and very dry, making water storage even more critical. Capturing water in wet years for use when it gets dry is something the public supports, and it can take decades to plan and build the infrastructure we need. While larger projects are in process, there are things we can do to increase storage now. One of them is increasing the storage

capacity of existing dams, which is cost effective and can bring quicker results.

Fish Screens and Other Environmental Protections

Increasing our ability to protect fish allows us to more safely move the water that is needed by all Californians. The science behind fish screens shows us they work, and installing them where they can improve fish protections is an investment in both water supply and the environment.

California farmers produce more

than 50 percent of the nation’s fruits, nuts, and vegetables and we’ve seen throughout the coronavirus pandemic how critical it is to keep our food supply moving from farm to grocery store. Supporting these cost-effective, timely, common sense measures will help make our water supply more reliable for all Californians. And that’s something we can all get behind.

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Almond Sustainability Supply Chain Program

Voluntary initiative allows growers and handlers to provide aggregated sustainability information to buyers.

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

A NEW PROGRAM OF THE CALIFORNIA Almond Sustainability Program (CASP) aims to improve communication between handlers and buyers about specific sustainability practices in the California almonds they are purchasing. The sustainability program has been in place for the last decade, and the new CASP Supply Chain Program should streamline the delivery of aggregated sustainable production practices that handlers can deliver to their buyers.

“We’ve had growers filling out crop assessments since the fall of 2009 with the first two modules,” said Gabriele Ludwig,

Almond Board of California’s Director of Sustainability & Environmental Affairs.

CASP has been focused on encouraging growers to do the self-assessment to share information about what practices they are or aren’t using. The Almond Board received this aggregated data and shared it in different ways, or it is used to determine where additional resources are needed, Ludwig said.

Questions continually arise from European markets about sustainability as well as some North American markets. “I would only say it’s been in the last two to three years that American companies

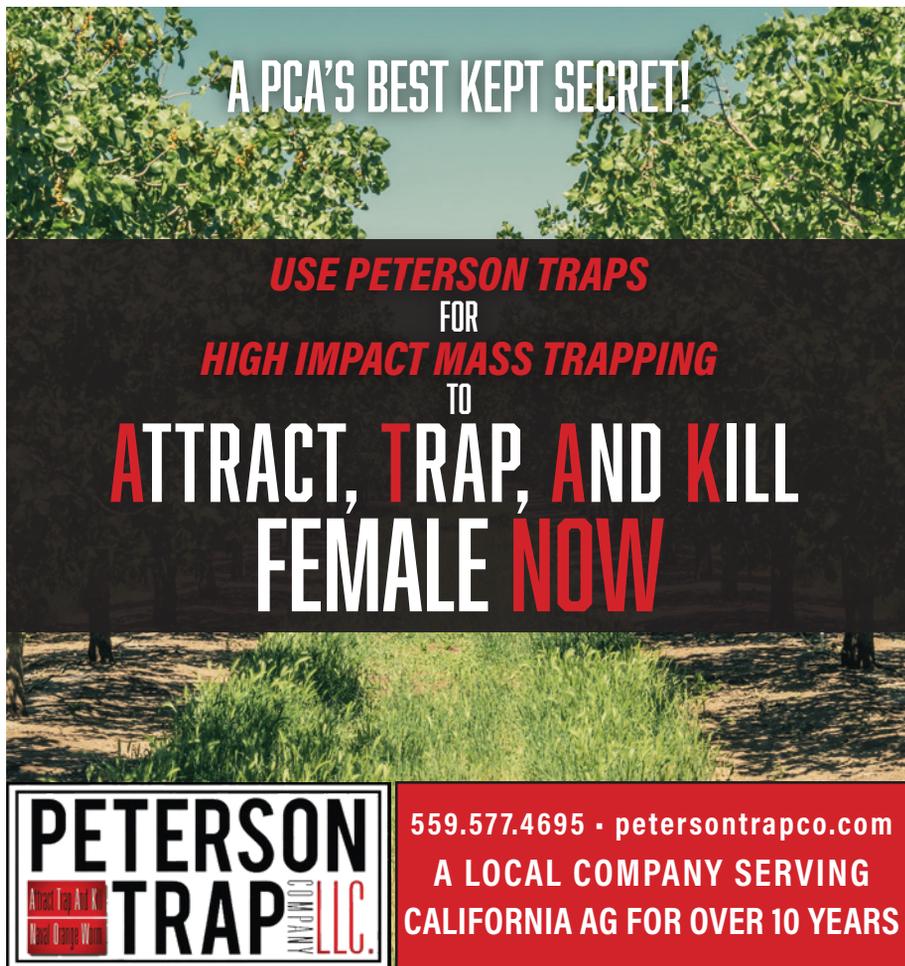
have been asking questions about sustainability,” Ludwig said.

CASP Supply Chain Program

After more than a decade of collecting information on sustainability from growers, ABC is currently working on the best way to make it available to handlers. Handlers are the ones interfacing with companies like General Mills, Walmart and Marks & Spencer, and these companies want to know growers of the products they are buying are doing something in sustainability, Ludwig said.

“The question really is, how do we help take the CASP program that growers have been participating in and have a way of providing that information so that handlers can speak to what their growers are doing—not just what the industry is doing, but what their growers are doing or not doing,” Ludwig said.

In early 2018, ABC launched the CASP Supply Chain pilot program. The program’s main objective is to allow growers to share data on their grow-



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CASP surveys show more than 70 percent of almond growers irrigate their orchards with drip or micro-sprinkler irrigation systems (photo courtesy of the Almond Board of California.)

ing practices anonymously with their handlers so they can provide that data to buyers.

ABC collaborated with the Sustainable Agriculture Initiative (SAI) Platform, a global membership organization of large food and beverage companies. The SAI Platform, Farm Sustainability Assessment (FSA) has 112 questions on good farming practices. It was compared with over 200 assessment practices from CASP. After comparing CASP and FSA practices, the SAI Platform recognized CASP at gold-level equivalency. CASP also became the first nut-specific sustainability program to be benchmarked against FSA.

Growers currently participating in CASP are able to generate a report showing how their practices compare to those in the FSA. They also have the option of sharing that comparative data and the broader results from CASP with their handlers through the Supply Chain program. This is a voluntary program and growers participate anonymously. If enough growers opt-in and choose to share CASP data with their handler, that



Cover crops in almond orchards have several benefits related to sustainable almond production (photos courtesy of Almond Board of California.)

handler receives a summarized report on how the practices were utilized by their growers and compared with state averages.

Handlers can then share details from the report with buyers and food companies. These companies are increasingly asking for this data to help them meet their sustainability goals and answer questions from consumers wanting to know how their food is grown.

ABC has developed what Ludwig calls translation tools with the Supply Chain Program.

“So, how do we translate the practices that are relevant to the almond world, to these more generic broad-based questions about sustainability or practices that others require, and that’s where we’ve done this benchmarking with this FSA tool,” Ludwig said.

“The benchmarking exercise has also been an important component of this supply chain effort to help translate into metrics that companies may already be using for their broader sustainability

Continued on Page 68

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Continued from Page 67

definition,” Ludwig said.

These are broad reports, on a range of practices, Ludwig continued. There is a lot of information, so it can be hard for a handler to determine how to best use it, she added.

The number of growers participating depends a lot on the handler. Some handlers have literally been begging their growers to participate, and there are two or three that have a fair number of their growers participating, Ludwig said.

Sustainability and the End User

To gain an even greater understanding of CASP and how it relates to almond organizations’ sustainability initiatives, Jonathan Hoff, grower, processor and CEO of Monte Vista Farming Company in Denair, Calif., recently led a group on a tour of his facility. He explained CASP’s vital role in sharing the industry’s responsible growing practices with businesses who need that information to satisfy consumer demand.

Hoff, an ABC board member, was one of the first handlers to participate in the CASP Supply Chain program, which officially moved from a pilot program to an industry-wide effort in 2020. Hoff explained how the program allows growers to share their data anonymously, in aggregate, with Monte Vista, who then can share it with their buyers.

Hoff told the group he was most impressed by the type of reporting CASP

generates. Food companies must be able to measure progress toward increasingly sustainable growing practices for each of their products in a way that is meaningful to the supply chain and consumers; information from CASP can do just that for almonds. Representatives from SureHarvest, the organization ABC partnered with to develop and maintain CASP, and the SAI Platform, the organization that benchmarked CASP and translated the almond-specific program to international sustainability standards, were also on the tour to demonstrate how industry data gathered and analyzed by CASP can help food manufacturers meet sustainability goals and help companies address growing demand from conscious consumers who want to know how their food is grown.

Crop of Choice

“Fundamentally, CASP is an educational program,” Ludwig said.

“If I look at the larger program, I think, ultimately, it’s really about if we want to be able to grow almonds in California, and almonds have to be a crop that growers want to grow, meaning it has to make economic sense. It also has to be a crop that Californians will let us grow, which means we have to deal with the environmental component and the resources,” she added.

“We have to show that we’re using California resources wisely, and we have to be a product that consumers want to eat.”

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“THE QUESTION REALLY IS, HOW DO WE HELP TAKE THE CASP PROGRAM THAT GROWERS HAVE BEEN PARTICIPATING IN AND HAVE A WAY OF PROVIDING THAT INFORMATION SO THAT HANDLERS CAN SPEAK TO WHAT THEIR GROWERS ARE DOING—NOT JUST WHAT THE INDUSTRY IS DOING, BUT WHAT THEIR GROWERS ARE DOING OR NOT DOING.”—GABRIELE LUDWIG, ALMOND BOARD

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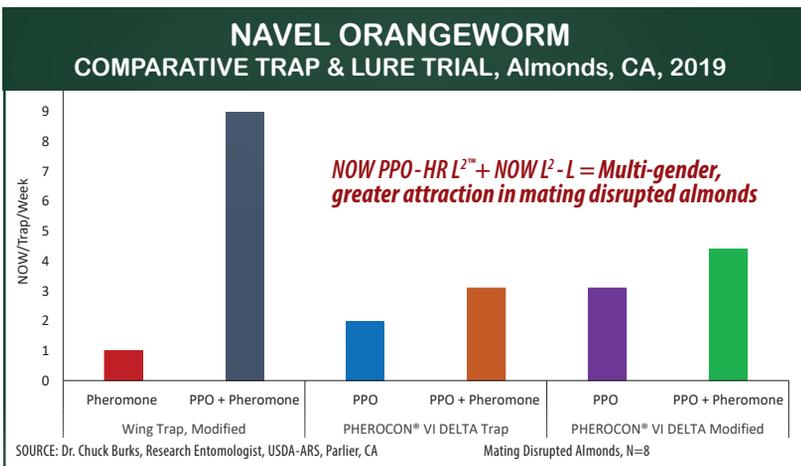
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ENSURING A SAFE HARVEST

Understanding rules and risks to help bring crops in safely.

By **AMY WOLFE** | MPPA, CFRE President, AgSafe

HARVEST IS RAPIDLY UPON US AND given the challenging circumstances of the last few months, it is easy to be sidetracked while focusing on those timely issues. Nonetheless, it is critical to remember that this time in the season exposes our operations to some of the greatest risk and as such, we must be vigilant in the steps we take to mitigate those potential problems. There are four areas to consider as you prepare your team for the safest possible harvest: night work, moving equipment between orchards, operation of equipment in the orchard, and ground crew risk.

Night Work

As previously shared, CalOSHA has developed a new night work in agriculture standard that took effect July 1. Many nut growers use the time between sunset and sunrise to manage a variety of tasks, not only connected to harvest, but the overall operation of the orchard. As such, it is essential that the elements of this new regulation be followed. Ensure that all workers, both operating equipment or working in a ground crew, are provided Class 2 high visibility clothing, such as a vest or jacket.

In addition, workers that must be trained at the start of each shift where they will be working at night in the hazards of that particular orchard, including water hazards and high traffic areas, as well as the location of restrooms, drinking water, handwashing facilities, rest and meal break areas, and the designated area for parking their personal vehicles. Keep in mind that this training must be provided to a crew or a lone worker and, as with all employee training, must be documented.

Lastly, and most importantly, is the provision of light through hands-free portable personal devices, such as head lamps, and/or area lighting. One source, the other or a combination of the two is

satisfactory to meet the requirements of this standard. The following table, taken directly from the regulation, outlines the amount of light that must be present given the type of work being conducted:

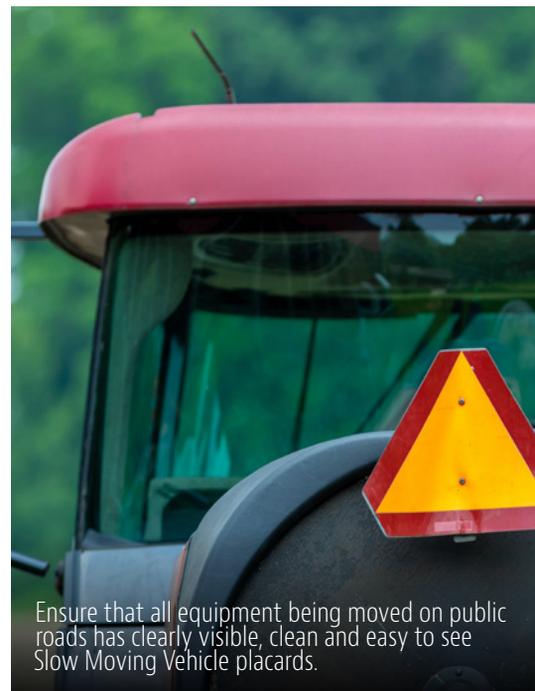
It is important to note that the standard requires lighting for tractors, self-propelled farm equipment and trucks. David Hornung, MPH, CIH, Cal/OSHA Heat and Agriculture Program Coordinator, clarified that in this instance, “truck” is referring to an automotive vehicle, or pick-up truck. In email communication with AgSafe, he noted that “the goal here is to have trucks and other farm equipment moving in private roads and fields turn on their headlights an hour before sunset. They should also have functioning rear lights or tail lights.” For more information on the night work in agriculture standard, visit www.dir.ca.gov/OSHSB/Outdoor-Agricultural-Operations-During-Hours-of-Darkness.html.

Moving Equipment Between Orchards

Movement of harvest equipment on public roads is commonplace this time of year and requires thoughtful planning, operator training and compliance with motor vehicle laws. Develop a system for which employees will be responsible for moving equipment and ensure those individuals not only possess proper driver’s licenses, but also have been trained in the safe operation of the equipment being moved. This is true if the equipment itself is being driven on public roads or if it is being hauled on a trailer. Ensure that the equipment has clearly affixed Slow Moving Vehicle placards that are clean and visible.

Other important elements to consider and include in annual training for workers moving the equipment include:

- Develop and enforce a company policy prohibiting the use of cell phones, texting, or wearing earbuds while operating equipment, both on public roads and in



Ensure that all equipment being moved on public roads has clearly visible, clean and easy to see Slow Moving Vehicle placards.

the orchard.

- Be mindful of your surroundings, including traffic flow.
- Determine and review the pre-determined driving route so as to ensure there is ample room, wide enough roads, minimal congestion and overall better traffic conditions.
- Ensure the Slow Moving Vehicle sign is installed, clean and easy to see from a reasonable distance by other drivers.

Operation of Equipment in the Orchard

Over the last few decades, the nut industry has become increasingly innovative when it comes to developing custom harvesting equipment. That creativity has also created a dependence on large pieces of machinery, which pose some of the greatest risks to workers. The complexity of the machines, in combination with the dust that they generate, is the perfect storm scenario for potential accidents in the orchard.

The most impactful tool to mitigate this risk is the proper education of equipment operators. The Cal/OSHA regulation specific to the operation of agricultural equipment requires annual training of operators, regardless of their years of experience. In addition, those individuals should be trained when new equipment is introduced over the course of the season.

It is prudent to conduct pre-harvest refresher education, reviewing company-specific safety protocol, recommen-



dations from the manufacturer on the correct way to operate the equipment, and important steps to follow to help minimize the issues caused by dust. Require operators to

assess the orchard for hazards, including overhead power lines, fencing, irrigation valves and other potential obstructions that may not be obvious when driving. Lastly, ensure that equipment operators have a clear understanding and when and

how ground crews will be in the orchard and their potential interaction.

Ground Crew Risk

Equipment operators are not the only workers that are in the orchard during harvest. The ground crew plays an equally important role and it is essential that both groups of workers have a clear understanding of their responsibilities, as well as how they will interact. As with equipment operators, ground crew members need to be trained in how to perform their specific jobs safely. They also must understand when and where the equipment will be in use and the steps to take to avoid inadvertent interaction.

The ground crew must also understand the role that dust plays in limiting their visibility, along with that of the equipment operators. Ensure there are designated areas for restrooms, hand-washing facilities, meal and rest breaks, and parking personal vehicles so all employees know to be mindful of traffic. In addition, all employees should be

provided high visibility clothing, such as a vest or jacket, to increase the likelihood that they will be seen. Finally, workers should be reminded of a company policy that should be developed and enforced, prohibiting the use of cell phones, texting while working, or wearing earbuds, all of which inhibit an individual's ability to be responsive and alert.

As the demands of harvest continue to grow, it is imperative that growers take the time to ensure workers are prepared to safely and successfully bring this season to a close. Invest the time, energy and effort needed, all of which will be for the benefit of your operation.

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.

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Protect Walnut and Other Nut Trees from Pacific Flathead Borer

Damaged and young trees can be especially vulnerable to the pest

By **CECILIA PARSONS** | Associate Editor



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SUNBURN, GRAFT UNION OR PRUNING wounds on young walnut trees can all be entry ports for the destructive Pacific flathead borer.

Walnut and hazelnut trees are just two of the major plant species targeted by PFB, *Chrysobothris mali*, a pest beetle with a larval stage that bores into trees and feeds on the cambium layer, killing or weakening the tree. Newly planted walnut and hazelnut trees are most vulnerable to infestations of this

pest, though there are more than 200 known host plants. Besides walnut and hazelnut trees, fruit trees and berry vines can become infested with PFB. Shade and ornamental trees are also targets.

Jhalendra Rijal, UCCE area integrated pest management specialist in Stanislaus County, has observed a number of PFB infestations in young walnut orchards in the Central Valley. He said PFB is not an invasive pest and



has been in the state for a long time. Pacific flathead borer infestations have also been found in mature walnut trees due to openings from pruning wounds or equipment damage. Rijal said those infestations might go unnoticed or have symptoms attributed to another cause unless growers are looking specifically for the distinctive larvae.

Rijal reported that he observed more than 10 walnut orchards with PFB infestations last fall, in San Joaquin, Stanislaus, and Merced counties. Infested trees were from first-year plantings to mature orchards and in different varieties. PCAs and growers reported PFB in walnut orchards in other counties as well, as far south as Tulare County.

Monitor for the Pest or Symptoms

When PFB is suspected as the cause of weak or dead limbs in older orchards, monitor for PFB by looking for water soaked areas on the bark. Larval feeding will cause the bark to split and

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frass-filled feeding areas can become exposed. Tree limbs affected by PFB feeding should be cut out and removed from the orchard as they can serve as an overwintering site.

Pacific Northwest Pest Management Handbook notes that symptoms of borer-infested trees include excessive wilting, yellowing and other signs of stress in individual trees during hot periods. Borer larvae have already done most of their damage by the late summer and the symptoms of girdling will be most apparent in the leaves and appearance of the tree at that time. Trees that are exhibiting these symptoms should be examined for borer damage starting at the soil line and up the trunk to a height of approximately 2.5 feet. If the stresses of a partial girdle do not kill the tree, then there are serious risks that tree limbs will ultimately snap off as the tree grows top heavy and begins to put on a nut crop.

Mature PFB larvae are about ¾-inch in length and whitish colored. The body is flat and the head is amber colored. The larvae have a broad flat area

behind the head and the body tapers toward the posterior. According to UC IPM Guidelines, nearly the entire larval state is spent feeding in the cambium layer of the bark. Later in the fall, larvae tend to move inside the heartwood of the twigs and branches. Adults are metallic reddish bronze beetles with copper-color spots on wing covers, and about ¼-inch to ½-inch long. The female is considerably larger than the male. The adult beetle is rarely observed and it is not destructive.

Adult PFB beetles emerge from April until July. Rijal found the majority of the adults emerged mid-June in the northern San Joaquin Valley. After mating, females lay eggs on tree sites that are weak or exposed to the sun. They prefer weak or injured trees. Stressed, newly planted trees are also vulnerable. In older trees with infestations, the structural integrity of the tree can be compromised and limbs are susceptible to breakage or infestation by another pest.

Rijal said there is currently no insecticide treatment for PFB. Although some insecticides targeting other pests such as codling moth, walnut husk fly or others, might have some value in reducing PFB neonates if timing matches with hatching time, there have been no trials on their efficacy against PTB.

Avoid Stress in the Orchard

Avoiding stress in newly planted walnut trees, through adequate water and nutrition, can minimize chances of a PFB infestation. Research done at Oregon State University found that if the host tree is growing vigorously and full of sap, the PFB larvae cannot thrive inside and will cease feeding.

Sunburn is also a precursor. Because the graft union is often targeted by PFB, OSU research found that positioning the union away from the sun could prevent an infestation. Painting young trees with white wash or a 50-50 mixture of latex paint and water helps prevent sunburn and may inhibit egg laying on the trunks. The trunk should be painted from 2 inches below ground



Pacific flathead borer larva bore into trees and feed on the cambium layer, killing or weakening the tree (photo courtesy N. Wiman.)

to two feet above. Pruning young trees during the summer months should be avoided as it opens up infestation sites. Tree training should leave scaffolds shaded to prevent sunburn. Horizontal scaffolds should be removed when pruning or thinning.

There are also some biological controls. Birds peck the larvae from under the bark with their beaks. Some wasp parasites attack the borer by drilling the ovipositor through the bark to lay the egg on the flathead borer larvae. Carpenter ants eat both larvae and pupae from the wood. Generalist predatory mites can also feed on overwintering larvae and pupae.

These natural predators and cultural controls to avoid stress can help minimize impacts of Pacific flathead borer. Ultimately, though, Rijal said, more research on controlling this economically damaging pest is needed.



Adult Pacific flathead borer on hazelnuts (photo courtesy N. Wiman.)



Pacific flathead borer larvae feeding will cause the bark to split where frass-filled feeding areas can become exposed (photo courtesy N. Wiman.)

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Whole Orchard Recycling Can Increase Yields Over Time

By ALMOND BOARD OF CALIFORNIA | Contributing Writer

EXCITING NEW RESEARCH SHOWS THAT CONDUCTING WHOLE Orchard Recycling (WOR) in almonds can increase crop yields in subsequent orchards, provide long-term benefits to soil health, such as improved water retention and nutrient levels, and increase carbon sequestration.

Conducted by researchers from the University of California (UC) Davis and UC Agricultural and Natural Resources, with funding in part by the Almond Board of California (ABC), this study identifies significant advantages to practicing WOR, the breadth of which are detailed in a report recently published in the journal PLOS ONE.

The study spanned over a decade and compared plots within a 9-year-old orchard where WOR took place with plots where trees had been burned and their ashes tilled into the soil. At ninth leaf, researchers also tested the impact of deficit irrigation mid-growing season by reducing the amount of water applied by 20% for some of the trees.

When the results were placed side by side, the plots where WOR took place consistently bested the plots where old trees' ashes were tilled into the soil. Among other benefits, researchers discovered:

- A 19% increase in yields at ninth leaf and 15% increase in cumulative yield over five years,
- A 30% increase in soil water holding capacity (water retention), and
- A 17% increase in total soil nitrogen levels.

“Almond growers have long been told that implementing practices to improve soil health will provide all these benefits, but until now there had been very little data demonstrating that a focus on feeding the soil with organic matter can make a meaningful difference in yield and crop quality,” said Gabriele Ludwig, Ph.D., director of Sustainability and Environmental Affairs for the Almond Board.

Potential Yield Increases

Key among the multiple positive outcomes discovered by this WOR study is the potential for increased yields. This finding not only brings good news for a grower's bottom line, but it also has positive implications on the industry's effort to produce “more crop per drop,” an effort it is striving toward as part of its Almond Orchard 2025 Goal to reduce the amount of water used to grow a pound of almonds by an additional 20%.

“The increased water holding soil capacity that occurs as a result of Whole Orchard Recycling means that trees are subject to fewer extremes in terms of water availability, as more water is held in the upper layer of the soil where the majority of the tree's roots are, and where tree uptake takes place,” Ludwig explained.

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Research shows that WOR increased water retention in the soil by up to 30%. While Ludwig cautioned that this data does not lend itself to a recommendation that growers can use less water if they practice WOR, it does indicate that applied water is used more efficiently by trees in orchards where WOR has occurred.

Amélie Gaudin, Ph.D., an associate professor of agroecology in the UC Davis Department of Plant Sciences and a co-author of the WOR research report, said that by allowing more water to penetrate and remain in the soil, WOR also reduces potential irrigation-related losses caused by runoff or evapotranspiration.

“In plots where WOR occurred, water was more likely to reach and be used by the trees, allowing for increased yields as trees experienced less short-term stress and therefore achieved greater water use efficiency,” Ludwig said.

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—Gabriele Ludwig, Almond Board.

Hedge Against Deficit-Induced Stress

This study also demonstrates that by increasing soil organic matter, WOR helps insulate orchards from negative impacts of deficit irrigation, which involves a delicate balance between stressing one’s trees just enough to pre-

vent too much moisture and potential for disease in the orchards with not overstressing the trees to a point where yields and overall health are compromised. According to the research, the deficit-irrigated trees in the WOR plots

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Whole Orchard Recycling involves grinding up old trees and returning their woody biomass to the soil. This provides a slow release of organic matter to the soil that can bring benefits year over year to a new orchard (photo courtesy Almond Board of California.)

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maintained higher stem water potential compared to the deficit-irrigated trees in the burn plots, indicating trees in the WOR plots were less water stressed.

“We forget that trees can get stressed enough to shut down photosynthesis, whether that’s because they can’t keep up with water demand in the hot

afternoons, for a day or two before irrigation, or during harvest,” Ludwig said. “So, when the upper layers of the soil can hold more water, the trees are better buffered from those stresses.”

Gaudin said that by improving water holding capacity, WOR also helps orchards retain nitrogen, one of almond trees’ most necessary nutrients. This has positive implications for

groundwater quality in areas where nitrogen leaching is a concern. It also may contribute to yield increases as trees in the WOR plots were shown to have greater access to nitrogen for longer periods of time.

Another supplementary benefit, Ludwig noted, is that over time, as microorganisms in the soil break down the woody biomass, both macro- and micronutrients contained within the wood are released for reuse by the next generation of trees. This allows growers to “recycle” those nutrients so that they may be used throughout the lifetime of their newly planted orchard.

Future WOR Research

Next steps for researchers working on this WOR research, Gaudin said, include further study of carbon sequestration and its implication for greenhouse gases, gaining a better understanding of nitrogen retention, optimizing WOR in different soil conditions, and the impacts of integrating WOR with other responsible growing practices such as cover crops or anaerobic soil disinfestation.

In addition to Gaudin, co-authors of the study include Kelsey Brewer and Emad Jahanzad of UC Davis; Brent Holtz, Sean Hogan and Cameron Zuber of UC Cooperative Extension; and David Doll, a former UC Cooperative Extension farm advisor.

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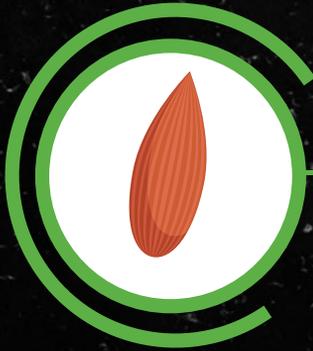
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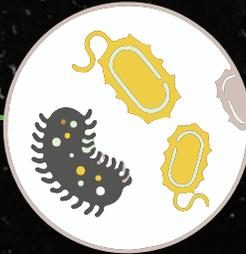
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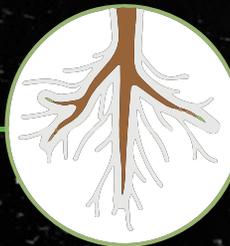


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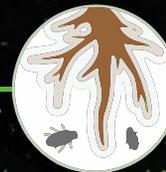
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