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APRIL 2021 ISSUE

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NUTS AND THE TRADE WAR

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$P_m = IV$

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$I_1 V_1 = I_2 V_2$

$K = \frac{1}{4\pi\epsilon_0}$ Brown rot

$Eff = \frac{P_2}{P_1} \times 100\%$

$P_m = \frac{I_m V_m}{2}$

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By the Industry, For the Industry

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SPECIAL SECTION: Nuts and the Trade War

California's ag industry has borne the brunt of the trade war. Here's how different nut crops have been impacted.

See page 4



CALIFORNIA'S AG AND FOOD INDUSTRY HAS BORNE THE BRUNT OF THE TRADE WAR

MFP PAYMENTS NOT ONLY FAILED TO ADEQUATELY OFFSET THE GOLDEN STATE'S TRADE LOSSES, BUT OVERCOMPENSATED CROPS IN OTHER STATES.

By CATHERINE MERLO | *Contributing Writer*

CALIFORNIA TREE NUT PRODUCERS were among the biggest losers of the trade war that began under the Trump Administration, a UC study has found.

In fact, California's farmers and food processors were hit harder than their counterparts in any other state. And, despite compensation from USDA's Market Facilitation Program, most California farmers were not made whole by the aid, said lead author Colin A. Carter, a Distinguished Professor of Agricultural and Resource Economics at UC-Davis.

"California's losses from the trade war far exceeded the government compensation payments," Carter noted.

The study, "2018 Trade War, Mitigation Payments, and California Agriculture," was released in late 2020. Jiayi Dong, a doctorate student at UC Davis, and Sandro Steinbach, an assistant professor at the University of Connecticut, co-authored the report with Carter.

Before the trade war, California's share of the tree nut market in China had been growing rapidly. But almost all California products exported to China— one of the world's largest importers of agricultural products—lost significant market share due to the trade war and resulting retaliatory tariffs. The U.S. market share for almonds, pistachios and walnuts fell from 94% to just 53%.

Overall, tree nuts suffered substantial trade war losses of about \$239 million, with the MFP payments accounting for just 52% of the loss, the report found.

The Imbalance of MFP Payments

President Trump launched the trade war against China in 2018, protesting unfair trade practices by the Asian superpower. The U.S. imposed tariffs on more than \$550 billion of Chinese products. China retaliated with tariffs on more than \$124 billion of U.S. goods between July 2018 and August 2019. The result? U.S. farmers lost billions

Table 1. Government Payment vs. Net Farm Income, 2019¹, Selected States, \$ Millions

States	Net Farm Income	Total Government Payment ¹	Total Government Payment as % of Net Farm Income	MFP Payment as % of Net Farm Income
	\$ Millions		Percent	
California	11,071	420	4	2
Texas	5,646	1,788	32	18
Nebraska	4,158	1,122	27	21
Iowa	3,229	2,066	64	47
Illinois	2,770	1,738	63	52
Georgia	2,676	700	26	11
Florida	2,575	232	9	1
Pennsylvania	2,315	173	7	4
Kansas	2,319	1,410	61	43
North Dakota	1,762	1,056	60	41
Mississippi	1,420	599	42	23
Alabama	1,174	231	20	11
Arkansas	974	990	102	48
U.S. Overall	83,721	22,447	27	17

Note: 1 Government payment refers to federal direct farm program payments, mainly MFP payments for 2019; Data are for 2019 calendar year.

Source: USDA ERS, Farm Income and Wealth Statistics, 2020

California received the lowest total government payment in terms of percentage of the net farm income.

Continued on Page 6

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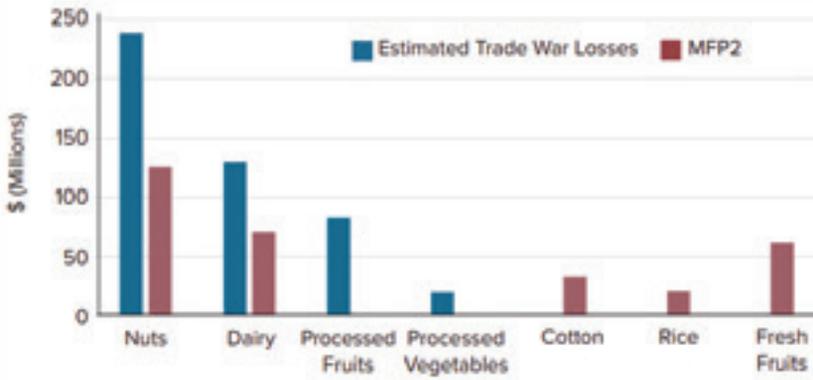


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The U.S. tree nut industry took the biggest hit from trade war losses in the 2018 fiscal year.

Figure 2. MFP2 Payment vs. FY 2018 Trade Loss for California Products, \$ Millions



Source: USDA FSA MFP payment data; authors' analysis

Continued from Page 4

of dollars in export sales to China due to retaliatory tariffs, according to the report.

“The trade war caused economic pain on both sides of the dispute,” said Carter, who holds a doctorate in Agricultural Economics from UC Berkeley.

The 2-year MFP distributed \$8.6 billion in 2018 and \$14.4 billion in 2019. The direct payments went to farmers who were considered financially harmed by trade war disruptions and tariffs. But the reality was that the MFP payments were “mostly about political patronage, especially for producers of certain commodities in certain states,” the study’s authors noted.

During its first year, MFP covered five non-specialty crops: corn, cotton, sorghum, soybeans and wheat. The program also provided payments to the specialty crops of fresh sweet cherries and shelled almonds. Dairy and hogs were also eligible for MFP subsidies.

MFP’s second year “greatly inflated payments compared to 2018,” said Carter.

In 2019, MFP’s commodity coverage expanded to 27 non-specialty crops, including grains, oilseeds and cotton. It also increased the number of specialty crops, expanding coverage to non-shelled almonds, fresh grapes, pecans, pistachios and walnuts. Dairy and hogs remained covered.

Before the trade war, California was the major exporter of walnuts to China, but with the retaliatory tariffs, China shifted to Chile and Argentina for imported walnuts.”

—Colin A. Carter, UC Davis

Under 2019’s MFP, California farmers received a total of about \$355.4 million. That amounted to about \$31,733 per eligible farming operation. Yet California’s MFP payments were small compared to the state’s share of ag commodities impacted by the trade war and the losses incurred, the report pointed out. The Golden State’s losses during the trade war’s first year of 2018-19 reached \$875.1 million, while both years of MFP payments totaled just \$451.4 million—\$96 million for 2018 and \$355.4 million the next year.

“So even if we combine the MFP compensation for two years, it’s only about one-half of the California trade losses in a single year,” Carter said.

California farmers were undercompensated compared to producers in the Midwest and the southern U.S., he added. While nuts and dairy failed to receive adequate compensation, commodities such as rice and cotton were overpaid. Processed vegetables and fruits received no payments at all.

U.S. Food and Ag Hit Hardest

Of all retaliatory tariff impacts against the U.S. from the trade war, the agricultural and food industry was affected more than any other sector of the economy, the report said. In all, 908 U.S. ag and food products were targeted

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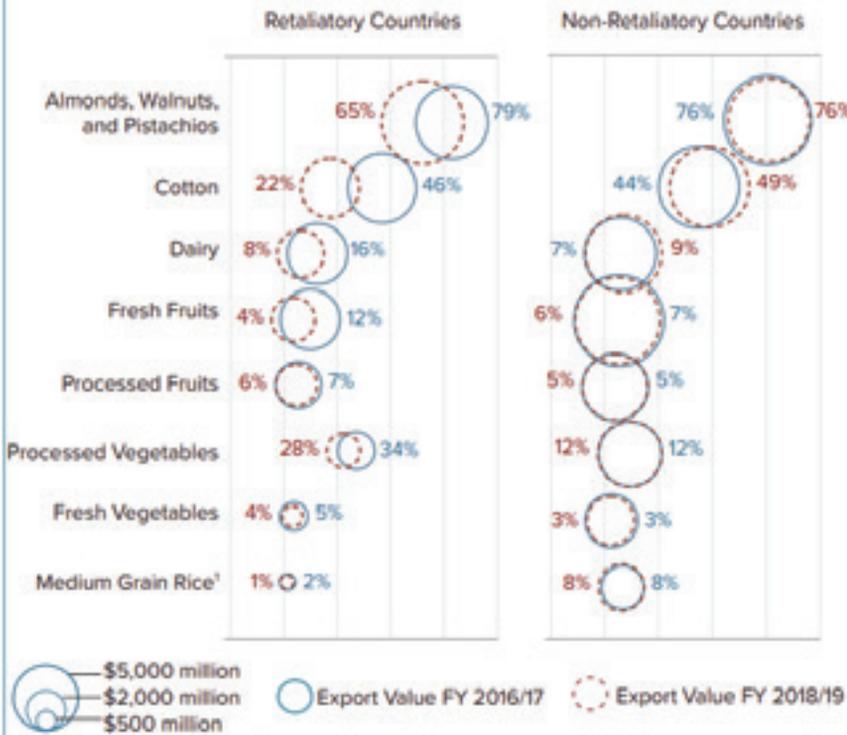
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Figure 1. Exports of U.S. Products Before and During the Trade War¹

Retaliated Products Relevant to California, Export Value in \$ Millions, and U.S. Market Share in Percent



Note: ¹Import data from the retaliatory and non-retaliatory countries used for all categories except medium grain rice. Retaliation (tariff change) identified at HS6 level. For medium grain rice, U.S. export data used for circle size and overall rice (including long grain rice) share used for vertical axis value.

Source: Global Trade Atlas by IHS Markit; authors' analysis.

bors. The U.S. and China reached a phase-one trade deal in January 2020 that's expected to ease tensions with China's commitment to significantly increase imports of American bulk products such as corn and soybeans.

But difficulties remain, the report's authors said.

"California's producers focus on high value-added products and have a significant stake in reducing trade barriers everywhere, and in particular in China," said Carter. "The MFP payments may have jeopardized international trade arrangements because the excessive payments violated U.S. farm subsidy commitments to the World Trade Organization.

"Several countries are considering a challenge at the WTO in opposition to these huge payments," he concluded. "This dispute could cause the effects of the trade war to drag on."

Read the full report at giannini.ucop.edu/publications/are-update/issues/2020/24/2/2018-trade-war-mitigation-payments-and-california/.

Continued on Page 8

Values of U.S. export products dropped significantly during the trade war, with cotton and tree nuts taking the biggest hits from retaliatory countries.

for retaliation, encompassing more than \$31.9 billion in U.S. exports. China imposed retaliatory tariffs on almost all U.S. agricultural and food products. Canada, Mexico and the E.U. also levied higher tariffs on a variety of American goods. Turkey also raised import duties on several products, including tree nuts.

"We calculated that the average foreign tariff on U.S. agricultural and food products increased from 8.3% to 28.6%," Carter said.

The biggest impact for the ag and food sector occurred with China. U.S. agricultural exports to China fell 53% between 2017 and 2018. That opened opportunities for other countries to capture market share.

"Before the trade war, California was the major exporter of walnuts to China, but with the retaliatory tariffs, China shifted to Chile and Argentina for imported walnuts," noted Carter.

Australian almonds and walnuts and Iranian pistachios also gained from the Chinese tariffs against the U.S.

Trade War Today

By May 2019, ongoing negotiations helped lighten several retaliatory tariffs. Canada and Mexico lifted their import duties to clear the way for the ratification of the United States-Mexico-Canada Agreement as the U.S. removed its tariffs on steel and aluminum imports from its two neigh-

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The Trade War Drags on for U.S. Pistachios, but Business is Looking Up



Tariffs continue to challenge the West Coast tree nut industry (photo courtesy Almond Board of California.)

FOR THE U.S. PISTACHIO INDUSTRY, the most significant tariff issue continues to involve China. “China was our No. 1 export destination but has dropped to No. 2 as a result of the tariffs,” said Richard Matoian, president of American Pistachio Growers. “We still have the same tariffs in place today as we’ve had for the last year:

50% on raw pistachios and 30% on roasted.”

In 2020, the higher tariffs plus COVID-19 restrictions disrupted the normal supply chain between the U.S. and China. Fewer containers were making their way to American shores.

“This caused a large increase in prices for containers, if you could

find them when you needed them,” Matoian noted.

Additionally, Iran’s improved crops between 2018 and 2020 allowed the Middle Eastern country to replace U.S. pistachios in China.

“While U.S. product may have certain quality and consistency advantages, it’s difficult to compete in any market when a tariff is imposed only on your product,” Matoian said.

President Biden had spoken with Chinese President Xi Jinping, added Matoian, but no tariff reductions have been announced by either side. In fact, President Biden was quoted as saying the tariffs will remain in place.

Even so, as of late February, U.S. pistachio business with China was picking up.

“Shipments to China for the current crop year, starting September 1, 2020, are up 16% year over year, so things are better than last year,” Matoian said. “Overall, exports to date are up 18.5% over the same time last year.”



U.S. pistachios continue to face significant tariff issues with China, a major market (photo by C. Merlo.)

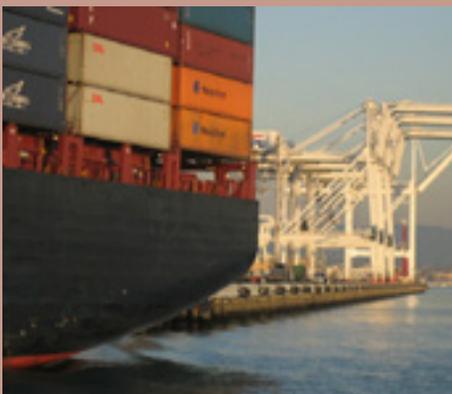
Retaliatory Tariffs on California Walnuts Remain in Place

THE GLOBAL MARKET IS CRITICAL TO California's walnut industry, which exports 60% of its crop. But growth in foreign markets slowed after key buyers like China, India and Turkey imposed retaliatory tariffs.

How has the walnut market fared this year? The California Walnut Commission's Pamela Graviat, senior marketing director, international, gave this update:

Have things improved with the trade war, retaliatory tariffs and the walnut industry?

Tariff rates and retaliatory tariffs that have been imposed on California walnuts and other commodities remain in place. Through other USDA programs designed to help mitigate the impacts of tariffs, including the Agricultural Trade Promotion Program, the CWC has expanded its marketing activities in both directly tariff-affected countries as well as other markets. This program has been instrumental in helping to both establish and maintain positive relationships in foreign markets despite tariff actions. The CWC will continue its advocacy with USTR, USDA, local representatives and other U.S. governmental agencies to keep them abreast as to how these high tariffs are having a continued negative impact



Tariff rates and retaliatory tariffs that have been imposed on California walnuts and other commodities remain in place (photo courtesy ABC.)

while advocating for fair trade for the industry.

Are California's walnuts regaining export markets lost during the trade war?

Tariffs are only one component facing the California walnut industry, and importers have responded accordingly. This crop season, we have seen shipments to some key tariff-affected markets, including India and China, rebound as overall market price is very low and consumer demand for nuts in general has increased globally. However, China is unlikely to be a significant market as it's the largest global producer of

walnuts and no longer needs imports to fulfill demand. In the past five years, China has become a significant exporter, adding additional price pressure to the walnut industry.

Are there continued impacts?

Yes, tariffs, along with increased world production, increased competition, lower prices and non-tariff barriers continue to challenge the California walnut industry. Even with increased shipments to China and India, the impacts remain with these very high tariff rates as California's walnut crop increases over the next few years.

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Increased Tariffs Shift Market Focus for California Almonds



Whether or not trade-war tariffs will ease by the time this year's almond crop heads to market is still an unanswered question (photo by C. Merlo.)

FIVE YEARS AGO, CHINA WAS THE second-largest export destination for California almonds. But the trade war's increased tariffs helped shrink the Chinese market to No. 4 for the Golden State's almond export shipments.

The decline stemmed from China's trade-war decision to raise tariffs on U.S. almonds, lifting them from 10% to 55% beginning in 2018. As a result, the California almond industry felt

its greatest trade-war impact with China.

But business with the Asian superpower has improved recently, said Julie Adams, vice president in Global Technical and Regulatory Affairs for the Almond Board of California.

"We've seen an increase in direct shipments to China, which is likely due to lower prices and more importers becoming familiar with the Chinese tariff

exclusion process," Adams said. "The exclusion brings the tariff down from 55% to 25%, which is still over double the previous 10% tariff in 2018. If you compare the volume and value of shipments to the region as a whole -- China, Hong Kong and Vietnam -- we are still behind former years."

Yet there has been good news elsewhere. India was able to absorb much of that volume -- and continues to be the leading export market for almonds.

"Almonds are shipped to more than 100 countries," added Adams. "So, more than anything, we saw a shift in market focus. This diversified marketing portfolio across a variety of countries worldwide helps the almond industry adjust when marketing challenges arise."

While the Biden Administration has been focused on COVID and a U.S. economic recovery, Adams expects trade to get more attention in the coming months. "We look forward to seeing increased progress on trade agreements with some of our key partners, particularly the E.U. and U.K.," she said.

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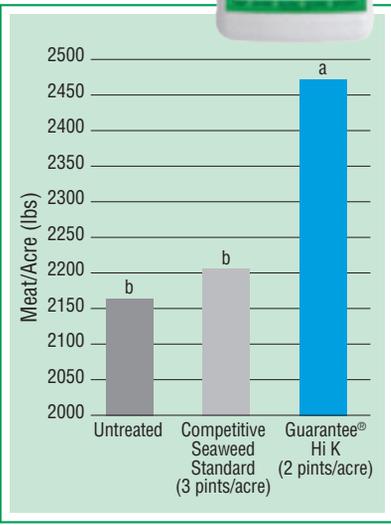
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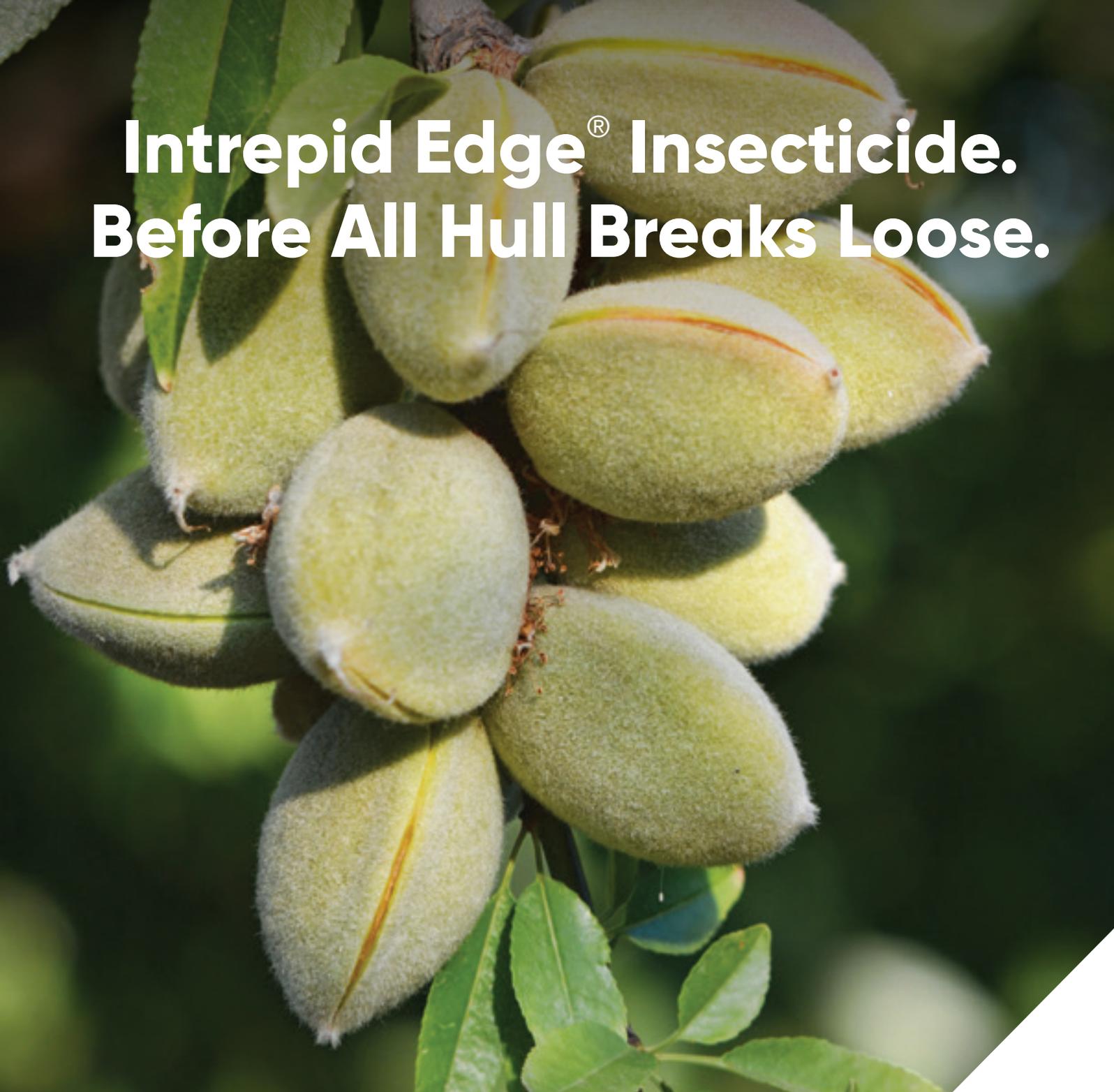


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New Fungal Species Fells Young Trees

Research hopes to shed light on almond *Ganoderma* butt rot and possible control regimes.

By VICKY BOYD | Contributing Writer

A *Ganoderma adspersum* conk foretells butt rot infection of an almond tree (all photos by Bob Johnson, UC Davis.)

UNTIL 2016, WHEN UC DAVIS PLANT PATHOLOGISTS DAVID Rizzo and Andrew “Bob” Johnson identified a species of the *Ganoderma* fungus previously unreported in the state, butt rot in almonds was considered a problem of older orchards.

Since then, the newcomer, *Ganoderma adspersum*, has been found infecting orchards as young as four years old and has been responsible for a number of growers removing younger orchards because of extensive tree loss.

So far, *G. adspersum* infections have been confirmed in almond orchards from Madera County south to Kern County. Reports also are limited to trees planted on Nemaguard rootstock.

More recently, what appears to be *G. adspersum* has been found infecting a rose bush in the Sacramento Valley and a walnut tree, said UC Davis doctoral student Daisy Hernandez, who works in the Rizzo Lab at UC Davis. Researchers currently are conducting pathogenicity tests and Koch’s postulates to confirm that the fungus is indeed responsible for the infections.

As part of her doctoral dissertation, Hernandez will begin a spore survey of orchards this spring that she hopes will shed light on how environmental conditions affect fungi sporulation and sporulation timing.

Her project involves surveying orchards once a month for an entire year. Two young orchards of about five years old will be compared to two older orchards of about 17 years old. They will be in different counties, so Hernandez can monitor how different environmental conditions, such as temperature, precipitation, timing of rainfall, dew point and other factors, affect *Ganoderma* sporulation.

More than two dozen orchard owners volunteered to participate in the spore survey after Hernandez sent out a request in late 2020. Accompanying it was a flier about *Ganoderma* infections that generated additional grower questions.

“Many growers didn’t realize they had *Ganoderma* until they saw the flier and the pictures and the description,” she said.

In a separate study, Hernandez plans to inoculate almond and walnut rootstock with *Ganoderma* and crown gall under controlled field conditions to gauge their susceptibility. She said she hoped the data gained from her studies will lead to eventual management strategies for growers.

“In order to get to the control strategy, or possibly “Z” in the alphabet, we have to pin down “A-B-C” first before we can get to Z,” Hernandez said.

Her research is being sponsored by the Almond Board of California.

Phoebe Gordon, a UC orchard systems advisor in Madera and Merced counties, said she hoped the results of Hernandez’s studies will help answer questions she receives from growers.

“We really don’t have many suggestions,” she said. “But if you removed your orchard due to *G. adspersum*, it might be wise to stay away from replanting with Nemaguard—that’s just a guess based on the tiny amount of information we know.”

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"I THINK IT'S SOMETHING THAT'S GOING TO MAKE PEOPLE PAY MORE ATTENTION TO WOOD ROT FUNGI"

— DAISY HERNANDEZ, UC DAVIS

The rootstock has been popular in the southern San Joaquin Valley because it is one of the least decayable, according to Johnson, who studied the pathogen as part of his doctoral thesis in plant pathology at UC Davis. But NemaGuard has thin bark, likely increasing its woundability and providing entryways for *G. adspersum*.

If an almond orchard is in its 20s and a few trees blow over, most growers don't think much of it, Gordon said. But when trees much younger begin to topple, it catches their attention.

"I think it's something that's going to make people pay more attention to wood rot fungi," she said. "We need to know more about it to be able to find out how to manage it. From the UC side, we don't really know how many orchards are affected by it and how widespread it is."

Root Rot, Heart Rot and Butt Rot

Native to Europe, *G. adspersum* appears more aggressive than *G. brownii*, a related fungus endemic to California that tends to infect older orchards on the downhill side, according to research by Rizzo and Johnson. In Europe, *G. adspersum* infects a wide range of both hardwood and coniferous hosts.

In California, *G. adspersum* appears to have displaced *G. brownii*, now accounting for more than 90% of all samples of butt rot in almonds.

Butt rot can be differentiated from root rot and heart rot by the part of the tree it infects.

Armillaria root rot, also known as oak root fungus, attacks the cambium and sapwood, eventually girdling the tree and leading to death. It is spread primarily by contact between healthy and diseased roots and doesn't require a wound entryway. Trees do not blow over and remain standing until they are cut down. Infections typically occur in specific patches within the orchard.

Heart rot, caused by *Phellinus tuberculosus*, infects the canopy and trunk, decaying heartwood and sapwood and reducing structural stability. It may result in trunk and limb breakage.

Heart rot is spread by airborne spores and needs a pruning wound to provide an infection entryway. Because of the trend toward reduced pruning in almonds, it is not as wide-



A tree infected with *Ganoderma* butt rot is toppled by a strong wind.

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Continued on Page 14



Rusty red spores cover a *Ganoderma* conk on an almond tree trunk.



Ganoderma conks. Notice the rust-colored spores around the conk in the lower-right picture.

Continued from Page 13

spread a problem as in prunes.

Unlike root rot and heart rot, butt rot affects the below-ground portion of the trunk from which the roots radiate. Butt rot fungi decay the tree by moving upward and moving from the inside out. Infections rarely extend more than 12 to 18 inches above the soil line and may go undetected without visual symptoms until the tree snaps off at the soil line during strong winds.

When trees are wounded, they erect high-lignin reaction wood around the entryway to try to contain potential invaders. But *G. adspersum* can eat through the reaction wood, overcoming the tree's defenses, according to Johnson's research. Tree structure is compromised through delignification.

The normally tan to brown lignin turns a whitish color, resembling brittle Styrofoam. With a weakened support system, trees are easily toppled by strong winds.

Young Orchards Affected

The belief that butt rot was only a problem of older orchards changed in 2016 when a 9- to 10-year old orchard in Kings County was diagnosed with it. During a two-year span, each block experienced between 8% and 13% tree loss. Subsequent sampling put the infection level of the remain-

ing trees at more than 50%, and the orchard was eventually removed.

The discovery marked the first time *G. adspersum* had been found in the state infecting young orchards, but it was not a lone incident. As of July 2020, 68 younger aged orchards, including one 4-year-old orchard, in Madera, Fresno, Kern and Tulare counties have been identified with *G. adspersum* butt rot infections. Many were eventually removed.

After prolonged infection, shelf-like conks, known scientifically as basidiocarps, may protrude from the trunk near the soil line. *G. adspersum* conks typically have a white border and may take on a rusty red color when sporulating.

Airborne spores are most likely the primary source of inoculum for *G. adspersum* infections, with a hand-sized conk capable of producing trillions of spores annually.

Sporulation is believed to occur year-round.

What Hernandez hopes to pin down with the spore survey is the time period in which most sporulation occurs. Having that information could help focus control measures during the most infectious periods.

"That way we won't be wasting our resources to control it throughout the year," she said. "Maybe we can pin it down to a few months or a few weeks when it's the highest infection."

Researchers hypothesize that harvesting and the associated blowing help disperse spores throughout orchards. As part of her spore survey, Hernandez will monitor spore traps in participating orchards during harvest to validate the belief.

"It seems to be the most probable situation, that's why we've said it with confidence," she said. "But with anything, it's always good to have data to back it up."

The spores need an entryway into the tree, and wounds caused by shakers, other machinery or pests appear the most likely. Infections do not appear to move through root-to-root contact between trees, although this has not been ruled out.



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ARE 'MAY SPRAYS' A LOW-HANGING FRUIT TO CUT ALMOND COSTS IN 2021?

By **DAVID HAVILAND** | UCCE Entomology Farm Advisor, Kern County
and **JHALENDRA RIJAL** | UCCE & Statewide IPM Program

Cost-wary growers who plan to make one spray for navel orangeworm should apply it at the beginning of hullsplit (all photos courtesy D. Haviland.)



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FOR ALMOND GROWERS LOOKING TO cut costs in 2021, 'May sprays' present an opportunity that may be hard to pass up. May sprays, which are typically applied in either April or May, can have many purposes related to the management of peach twig borer (PTB), navel orangeworm (NOW), leaffooted bug and spider mites. However, problems with PTB these days are minimal compared to what they used to be, insecticide sprays for NOW are more effective at hullsplit, the need to treat for leaffooted bug is the exception and not the rule, and recent advances in biocontrol have made the need for preventative miticide sprays obsolete. Most growers and PCAs who monitor for each of these pests and make decisions based on principles of integrated pest management will find that the May spray can be skipped altogether in most orchards.

Peach Twig Borer

The term 'May spray' was originally coined to control PTB if growers did not have the opportunity to do so during the dormant season and/or bloom. However, despite its historical

significance as an almond pest, damage by PTB has become almost irrelevant after trees start bearing fruit, unless perhaps the orchard is located next to commercial stone fruit production and the orchard has a history of damage. Most growers, including those who capture hundreds of PTB in traps, typically report very low to negligible levels of PTB damage in their official USDA kernel quality assessments. These assessments, of course, are what counts.

There are currently two main theories for why PTB is not the problem it used to be. The first is that modern-day precision irrigation practices allow for uniform shell expansion, leading to a good shell seal. When there is a good shell seal, PTB tends to feed outside the shell on the inside of the hull. This is in comparison to the historic use of flood irrigation, where wet-dry cycles during shell expansion caused cracks and splits in the shell that facilitated PTB access into the marketable kernel. The second theory relates to improved biological control. Historically, dormant and in-season applications of organophosphates reduced populations of all ant species. However, modern-day use of selective ant baits allows for control of pestiferous ant species, such as southern fire ant, while allowing the survival of the beneficial native gray ant. This species of ant feeds on PTB larvae, especially while they overwinter inside hibernacula on the trunk. Reductions in the use of organophosphates and pyrethroids have likely also benefited species of parasitoids that attack PTB.

Navel Orangeworm

May sprays for NOW have always been problematic. The most common insecticides for lepidopteran worms, including methoxyfenozide and chlorantraniliprole, do not kill overwintering larvae and pupae that are still in the mummy, do not kill adults that fly in the spring, and can only provide control from the time eggs are laid until the new larva passes below the mummy surface. Unfortunately, the first NOW

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Continued on Page 18

'After monitoring individually for peach twig borer, navel orangeworm, leaf-footed bug and spider mites, the verdict in most cases will be that no insecticide applications are needed in April or May.'

Continued from Page 17

flight occurs over a long period of time such that even a perfectly timed spray will only kill a small segment of the first-generation eggs and larvae. This also assumes that coverage is excellent, as eggs laid into cracks and crevices without insecticide residue have a good chance for survival. May sprays also do not directly protect kernels of the current year's crop, including from moths immigrating into the orchard from neighboring tree crops as hull split begins.

Cost-wary growers who plan to make one spray for NOW should apply it at the beginning of hullsplit. If a second spray is needed, it should be applied toward the end of July as residues from the first spray break down, pollinizers are splitting and the third flight is approaching. If the grower is dealing with a NOW nightmare where three sprays are needed, then spending extra money for a May spray may be warranted as the exception, not the rule.

Leaf-footed Bugs

Insecticide applications for leaf-footed bugs in the spring are only needed sporadically. Cases where treatments are warranted most commonly follow mild winters in orchards near excellent overwintering sites. Key examples include areas that contain plants with foliage, such as urban landscapes, Cyprus trees or citrus orchards, or lots of debris, such as riparian areas along streams or rivers. From March to May, monitor almond orchards for the presence of leaf-footed bugs, gummosis associated with a puncture mark on the almond hull and aborted nuts. If found at levels that are not acceptable, consider a treatment. Otherwise, save your money.

Spider Mites and Their Predators

May sprays for spider mites were invented in the early 2000s by almond growers in the lower San Joaquin Valley. At that time in Kern County, it was common for almond orchards to become defoliated by June in the absence of intervention, and it was quickly determined that newly registered abamectin was most effective through its translaminar activity if applied in May before leaves hardened. Ten years later, as generic abamectin products became available and active ingredient prices dropped, May sprays became adopted more widely throughout the entire San Joaquin Valley. Adoption eventually reached a point that 'preventative' mite sprays in May became the industry standard practice.

Fast-forward to 2020 and things have totally changed. It is nearly impossible to find mite-induced defoliation in a bearing almond orchard until after hullsplit, and biological control of spider mites is at an all-time high with thanks primarily to 'greener' production practices that promote sixspotted thrips. Recent research has shown that this natural enemy is present throughout the San Joaquin and Sacramento Valleys and that overwintering adult thrips become active in almond

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From now until May, monitor almond orchards for the presence of leaffooted bugs, gummosis associated with a puncture mark on the almond hull and aborted nuts.

Continued from Page 18

orchards in April and May. Miticides should only be applied in the spring if a treatment threshold of approximately 40% of leaves infested has been reached, and recently-published research has confirmed that if you find a total of

two sixspotted thrips in two Pherocon predator traps (Trécé, Inc) within a week, or a total of three sixspotted thrips in four traps, that there is sufficient biological control to confirm that a miticide is not needed. In most

orchards most years, sixspotted thrips density far exceeds this threshold at the typical timing of May sprays. The exceptions are typically cases where the grower has done something that disrupts biological control, such as a pyrethroid spray for leaffooted bugs. It is time for almond growers to make 'preventative' miticide sprays obsolete. Abandoning this practice will also help save on costs in a tight year.

Interactions

After monitoring individually for PTB, NOW, leaffooted bug and spider mites, the verdict in most cases will be that no insecticide applications are needed in April or May. However, when exceptions for one of these pests occur, growers should make sure they get the best bang for their buck. If spraying for PTB, choose a product that is also effective against NOW. If spraying for NOW, consider applying it at a timing that is optimal for PTB. If spraying for leaffooted bug, consider the relative merits of different options: pyrethroids are inexpensive and effective but kill natural enemies, abamectin has short-lived effectiveness but is safe on most natural enemies other than sixspotted thrips, and clothianidin is more expensive and has short effectiveness but preserves natural enemies. If applying a miticide, weigh your options between using abamectin (less expensive but toxic to sixspotted thrips) or a more expensive miticide not known to impact natural enemies that may help reduce the risk that another miticide treatment is needed later in the season.

When all things are considered, May sprays have great potential to serve as a low-hanging fruit for cost-wary almond growers in 2020. For more information about making 'May spray' decisions, consult the UC IPM Pest Management guidelines for almond (www2.ipm.ucanr.edu/agriculture/almond/) or contact your local Cooperative Extension office.

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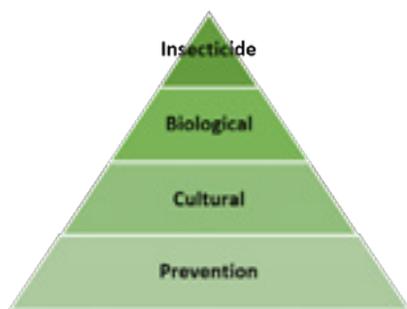
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Managing Hull Rot is No Easy Matter

Use Proper Treatment Timings and Manage Nitrogen and Water to Avoid Severe Consequences

By MITCH LIES | Contributing Writer



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WITH PROPER FUNGICIDE APPLICATIONS, REGULATED DEFICIT irrigation and adherence to a nitrogen management plan, a grower should be able to manage hull rot in almonds. But even then, it is no sure bet. And the consequences of letting this disease get away can be severe.

Left to its own devices, hull rot can inflict long- and short-term damage on almond orchards. It can reduce the bearing surface of trees by killing infected spurs and attached shoots and provide an overwintering host for navel orange-worm through infected sticktights that are not removed after harvest.

For years, researchers focused their efforts to control hull rot on targeting the two primary pathogens associated with the disease, *Rhizopus stolonifer* and *Monilinia spp.* In recent years, researchers have determined that a species of *Phomopsis* also could be causing hull rot, as well as the fungus *Aspergillus niger*, which for the past two years has been the focus of a research project.

Several facts have come to light thus far into the three-year Almond Board of California-backed project, including that fruit in the development stage is most susceptible to the disease, said Mohammad Yaghmour, UCCE farm advisor for Kern County. “And we know that it is in the soil and that it reaches the canopy on soil particles; so, pretty much dust contributes to the movement of the pathogen from the soil to the canopy.”

Some of the fungicides that are effective on *Rhizopus*- and *Monilinia*-caused hull rot, such as FRAC group three, seven



Symptoms of almonds infected with hull rot caused by *Aspergillus niger* include the appearance of flat, jet-black spores (all photos courtesy M. Nouri.)

and 11 fungicides, have been shown to also be effective on *Aspergillus*-caused hull rot, Yagmour said. And symptoms of *Aspergillus*-caused hull rot are similar to symptoms of hull rot caused by the other pathogens in that leaves shrivel and then fruiting spores die.

But there are differences that merit attention. Black fungal growth on the inside of a hull, for example, indicates infection by *Rhizopus*. A tan fungal growth in the brown area on the inside or outside of the hull indicates infection by *Monilinia*. Symptoms of hull rot caused by *Aspergillus niger*, meanwhile, include flat, jet-black spores in between the shell and the hull.

Treatment Timing

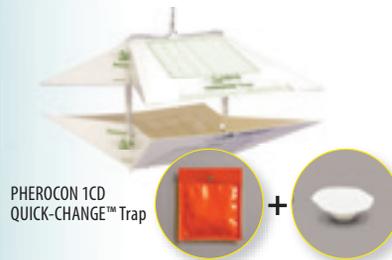
Identifying which pathogen is causing the rot is a key to determining when to treat for the disease, according to researchers. If targeting *Rhizopus* or *Aspergillus*, researchers recommend applying a fungicide at hullsplit. If targeting *Monilinia*, the recommendation is to apply a product three to four weeks

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Shriveled leaves are a common symptom of hull rot infection in almonds. The disease can also reduce the bearing surface of trees by killing infected spurs and attached shoots.

Continued from Page 23

before hullsplit.

In addition to proper timing, good coverage is also vital to the success of a treatment, Yaghmour said. “With the *Rhizopus*, for example, we know that the most susceptible stage is the very beginning of hull split. So, if you can protect the suture at that stage with good coverage, then most likely you will reduce the onset of disease incidence in your orchard.”

Because there is no predictive model for the disease, often the best indicator of whether to treat is whether an orchard has a history of developing hull rot. “In those cases, there might be a high spore load in the soil when we are considering hull rot caused by *Rhizopus stolonifer*,” Yaghmour said, “so that is an indication that the grower might

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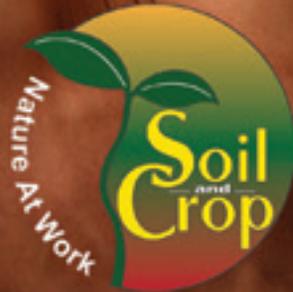
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Continued from Page 24

need to use a fungicide.”

Yaghmour cautioned growers, however, from relying on fungicides for their control strategy. “Fungicides will not provide 100% control of this disease. You will need an IPM approach, involving good nitrogen and water management,” he said.

“We know for sure, for example, that regulated deficit irrigation will significantly reduce the hull rot in the orchard,” Yaghmour said. “And we know that if we over-fertilize with nitrogen, then, for sure, we are going to get high incidence of hull rot.”

Modify N Based on Crop Load

Previous UC research has shown that nitrogen application rates above 250 pounds per acre resulted in trees most severely affected by hull rot, and hull rot strikes were higher in low crop years.

In order to reduce hull rot, nitrogen rates should be modified based upon crop load to keep the trees sufficient, the report noted. Further, the report recommended growers base nitrogen rates on analysis of leaf nitrogen content. “If properly sampled, the critical value for mid-summer leaf nitrogen percentage is 2.2% to 2.5%,” a recent UC report stated, and nitrogen should not be applied after kernel development is complete. Applications after that point will be directed to the hull, making the hull more susceptible to infection. Kernel development typically is completed in late spring, but can



Symptoms of hull rot caused by *Rhizopus stolonifer* include a fuzzy fungal growth on the inside of a hull.

extend into early summer in abnormal years.

Further, the report noted that UC research has shown that inducing a slight to moderate water stress at hullsplit can reduce hull rot. Irrigation should occur when the stem water potential is four bars below baseline, usually -14 and -16 bars, depending on the weather, the report stated. Deficit irrigation should be carried out for two weeks, then full irrigation should resume until harvest dry-down. Typically, the report noted, a 10% to 20% reduction in applied water will be needed, depending on the soil and irrigation system. It added that a properly timed deficit irrigation can reduce hull rot by 80% to 90% without affecting yield or kernel size.

Phoebe Gordon, UCCE orchard crops farm advisor in Madera County, cautioned growers from over-stressing trees, however. “If someone doesn’t monitor stem water potential and has issues with hull rot, I’d start at a 10% reduction in water during the critical period,” she said. “Cutting back on water without monitoring tree stress with

a pressure chamber is risky as it is. Your trees may already be stressed.”

Another consideration in any hull-rot management program is varietal susceptibility. Nonpareil, Sonora and Winters have a very high susceptibility to hull rot caused by *Rhizopus stolonifer*, Yaghmour said, while Monterey has a low susceptibility to the disease. According to the UC Statewide IPM website, hard-shelled varieties such as Mission, Davey and Drake may exhibit rotted hulls, but rarely exhibit shoot dieback.

With proper fungicide use, varietal selection considerations and good water and nitrogen management, Yaghmour said control of hull rot is within reach of an almond producer. But attention to all three approaches is needed.

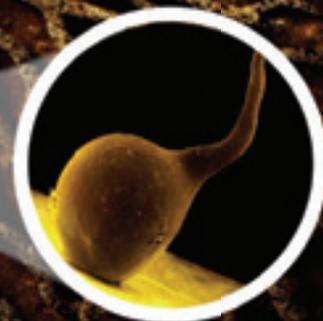
“If we use all three approaches, and use them appropriately, we can manage hull rot,” Yaghmour said.

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5 TOP

THINGS AN ALMOND GROWER WANTS TO SEE IN APRIL

By **CECILIA PARSONS** | Associate Editor



Leaks and clogs should be addressed so the irrigation system is functioning as the season gets underway (photo by Marni Katz.)

WARMER AND LONGER DAYS THIS month means orchard activity is picking up. Nut crops are developing and trees are growing. Water use by trees is increasing and tree roots are actively seeking nutrients. Insect pests and beneficial insects are reproducing. With all of these activities in mind, when you walk out into your orchard, what are five things you want to find?

1. A Functional Irrigation System Ready to be Put to Use

Early maintenance of your irrigation system, before it will be put to use, provides confidence in uniform distribution and efficient use of water. No one wants to deal with leaks, plugs and pressure problems when trees need water.

Maintenance starts at the irrigation pump. Clean filters and backwash to remove organic or particulate matter. Check the sand media filter to be sure sand is not caking. Drip and micro

systems should be inspected for leaks and plugs. Flush lines, beginning with mainlines.

Leaks in drip and micro systems should be repaired. Nozzles and drip emitters should be checked for clogs. Running emitters at pressure ranges listed will determine if pressure is uniform.

Make sure monitoring tools – pressure chambers and soil moisture sensor equipment – are ready for use.

UCCE's Sac Valley Orchards can provide specific operations to ensure the system is operating properly when you need to turn on the pumps (sacvalleyorchards.com/almonds/irrigation/irrigation-system-maintenance).

2. Healthy Trees

Leaf size is an indication of tree health, said CCA Rich Kreps. Trees bearing a full canopy of good-sized leaves in the spring have the potential to deliver a healthy crop of nuts. Those



Trees bearing a full canopy of good-sized leaves in the spring have the potential to deliver a healthy crop of nuts (photo by M. Katz.)



Beneficial insects, such as this six-spotted thrips, can provide free control of mites and other pests (photo courtesy UC ANR.)



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'FINDING BENEFICIAL OR 'PREDATOR' INSECTS IN AN ALMOND ORCHARD CAN HELP WITH CONTROL OF SPIDER MITES AND MAY ALLOW FOR REDUCED PESTICIDE USE IN THE ORCHARD.'

'solar panels', Kreps said, will show the trees received adequate nutrition prior to and after harvest. Tree health is achieved by meeting crop demand and not over applying nitrogen.

Soil and tissue analysis done last summer or fall would show a lack of or overabundance of critical crop nutrients. The tests are commonly done in April and July, Kreps said, and allow for replenishment of depleted nutrients. He said September analysis after harvest could be helpful in allowing growers to make adjustments in nutrition late in the season or early in the spring. There is a fine balance to be made with nitrogen applications, he stressed. Growers who apply most of their annual N budget at once and too early in the season risk blowing the buds off the trees. Instead of growing a crop, the tree will push more vegetative growth. Smaller applications over time will not only ensure tree health over the growing season, but it will direct healthy crop development.

Another nutrient that plays a part in tree health and is often deficient in orchards is phosphorous. Kreps said this important nutrient might be difficult to get into the tree when temperatures are cold and should be applied in the form of orthophosphate that can be taken up by the tree.

3. Beneficial insects

Finding beneficial or 'predator' insects in an almond orchard can help with control of spider mites and may allow for reduced pesticide use in the

orchard.

The most common natural enemies that can be found in the spring in almond orchards are sixspotted thrips and destroyer beetles that prey on spider mites.

"Don't kill them," stressed David Haviland, entomology and pest management farm advisor in Kern County. Predator populations can be preserved by avoiding applications of broad-spectrum insecticides early in the season.

The only way to know if these beneficials are present in the orchard is monitoring with the use of sticky yellow predator traps. Sixspotted thrips is a reliable mite predator and feeds on mites in both the nymph and adult stages.

If they are present in the orchard and monitoring shows they are keeping spider mite populations below the economic threshold, Haviland advises forgoing a timed insecticide application in May to preserve the beneficials and maximize biological control.

Broad-spectrum insecticides, including pyrethroids and spinosads, will kill off the beneficials along with the spider mites.

Predators will typically control webspinning mites if presence-absence sampling indicates equivalent numbers of leaves with predators and with webspinning mites.

4. Full Nut Set

A full net set in an almond orchard is achieved because of excellent bloom and pollination weather along with

Continued on Page 30



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Tree roots will actively seek soil moisture to sustain trees during the spring (photo courtesy Dave Wilson Nursery.)

Continued from Page 29

strong hives. Weather is beyond a grower's control, but as long as pollinators are active for at least two to three days during bloom, good nut set can be achieved.

Fresno-area almond grower Ryan Indart said bees need at least two full days during full bloom to pollinate the primary varieties and pollinator varieties.

Matching bloom, weather and bees can result in a 3,000 pound crop, Indart said, which is what growers need to make money in this lower price almond environment.

The Almond Board of California's best management practices for pollination point out the importance of avoiding insecticide applications during bloom. Fungicide applications may be safely applied in late afternoon or evening when bees and pollen are not present.

Communication between grower and beekeeper before, during and after bloom can foster a good understanding about expectations during this critical time in almond production.

Hives should be inspected as they arrive in the orchard to determine if the terms stated in the grower/beekeeper agreement are being met.

Colony strength evaluations not only help ensure growers get what they pay for, they also help ensure that beekeepers are compensated for additional expenses in providing quality hives.

Growers can further monitor colony strength by walking orchards daily during bee flight hours to observe activity levels. In addition, growers should record hives that appear weak (i.e. relatively few bees coming and going at the hive entrance) or inactive, and then report those hives to the beekeeper.

ABC has a complete list of best management practices for bees at almonds. com/almond-industry/orchard-management/pollination.

Continued on Page 32

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Strong pollination and good weather during bloom can provide a full nut set during the season (photo by M. Katz.)

Continued from Page 30

5. Optimal Soil Moisture

Almond tree roots are actively seeking moisture to sustain the trees as they leaf out and nuts develop. Growers need to verify that their trees are in a zone of adequate moisture to meet water needs, said Tom Devol, Almond Board of California's Senior Manager of Field Outreach and Education.

"You have to go physically check, dig in the dirt," Devol stressed.

The UC Drought Management website notes that almond water use begins when the leaves develop and shoot growth begins. By April, longer days, higher temperatures and lower humidity result in higher water use. Using the weekly ET values, growers can determine if rainfall is meeting water needs or if irrigation should begin to fill the gap.

Sources of water available to trees include: soil-stored moisture, in-season rainfall absorbed by the soil and applied irrigation water. These all com-

bine to determine the total seasonal water available to the orchard.

Mature, conventionally spaced almond trees in the southern Sacramento Valley can use about 41 to 44 inches of water in an average year of unrestricted water use. High-density orchards, long pruned orchards or those with a cover crop can have even higher use.

Soil moisture monitoring demonstrations in more than 40 almond orchards in Kern County indicate that seasonal water use in the southern San Joaquin Valley may be as high as 50 to 54 inches.

A USDA guide to estimating soil moisture by look and feel can be found at nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_051845.pdf.

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Building Demand for California Walnuts

A look into what the California Walnut Board and Commission is doing to drive consumer demand for California Walnuts across the United States.

By CALIFORNIA WALNUT BOARD AND COMMISSION | Contributing Writer



THROUGH STRATEGIC DIVERSIFICATION of sectors such as retail, industrial food manufacturing and food-service, the California Walnut Board (CWB) and California Walnut Commission's (CWC) domestic marketing activities are designed to expand California walnut use and consumption.

The work of the Board and Commission is focused on educating consumers on the versatility and health benefits of walnuts by reaching them in a variety of ways, from news articles, print advertising, social media, e-newsletters, partnerships and more. In fact, this approach saw year-over-year consumer U.S. media coverage increase by 53%, with walnut messaging seen more than 12 billion times, or 37 times per person. This article highlights some of the recent domestic marketing initiatives from the CWB and CWC aimed at continuing to grow the California walnut industry in the U.S.

Studies Examine Walnuts and Heart Health

Three peer-reviewed papers recently published, which were supported by the CWC, demonstrated the impact of walnuts on various aspects of heart health. The findings were so compelling that the publications were supported by each respective journal with a press release and editorial coverage, which stimulated broad media attention. Here are just a few of the highlights:

New findings published in the online journal *Heart*¹ analyzed the impact of a traditional Mediterranean diet, green Mediterranean diet and healthy

U.S. diet on LDL cholesterol, weight and insulin resistance. Both Mediterranean diets included a daily serving of walnuts.

A study published in the *Journal of the American College of Cardiology*² looked at regular consumption of foods rich in marine or plant-based omega-3s and risk of death among individuals who have suffered a heart attack. Walnuts are the only nut with an excellent source of plant-based omega-3 ALA (2.5 grams/ounce).

Another recent study published in the *Journal of the American College of Cardiology*³ explored regular consumption of walnuts and anti-inflammatory effects. Chronic inflammation, caused by factors such as poor diet, obesity, stress and high blood pressure, is damaging and a factor associated with heart disease risk.

The outcomes from the publications have been seen more than 753 million times by U.S. consumers to date in popular media outlets such as TODAY, Health Digest, Yahoo!, Consumer Reports and Eat This, Not That! The CWC continues to prioritize and support health research projects that address important research questions, sharing findings to educate consumers and health professionals about the health benefits of walnuts. In this case, consumers are seeing how including walnuts in their diet can have a beneficial impact on heart health, and ultimately, they are keeping walnuts top-of-mind when shopping. This news also informs health professionals such as registered dietitians and nurse practitioners, who

Consumers are seeing how including walnuts in their diet can have a beneficial impact on heart health, and ultimately, they are keeping walnuts top-of-mind when shopping (all photos courtesy Walnut Board and Commission.)

can then recommend walnuts to their patients as a food to include in healthy dietary patterns.

"I've found that the health research provided by the California Walnut Commission is not only helpful to me and my business, but the wider grower and handler community," said Todd Ramos, Market Development Committee Chair at the CWC. "These insights help shape our marketing initiatives around increasing California walnut consumption and driving market demand among consumers."

American Heart Month

Promoting the benefits and many ways walnuts can play a role in the overall health of consumers is a key focus for the California Walnut Board and Commission. Communicating to consumers that walnuts are a heart-smart food choice was at the forefront of the fourth annual retail marketing program, centered around American Heart Month in February. This year's campaign incorporated walnut displays and promotions in more than 10,000 stores across the nation, surpassing the 2020 campaign that reached 7,300 stores. The CWB has worked to change the retail mindset to show value to retailers and give walnuts additional placements throughout stores for better visibility and greater opportunity for consumer purchases.

Golden Walnut Sweepstakes

Another recent and exciting initiative was the Golden Walnut Sweepstakes, which was a marketing effort aimed to push California walnuts within and outside the baking aisle during the holiday season, especially with consumers spending more time cooking and eating at home due to the COVID-19 pandemic.

This year's sweepstakes garnered positive engagement across digital and social channels and resulted in over 8 million media impressions and over 25,000 entries from consumers across the United States. Additionally, in December alone, Golden Walnut Sweepstakes ads generated 500,000 impressions, meaning they were seen half a million times.

Walnuts at Work

Walnuts offer a unique value proposition that meets consumer and food manufacturing needs for plant-based ingredients with high nutritional value. The CWC actively works to encour-



The CWC actively works to encourage walnut usage in menu items and consumer packaged foods by educating and informing food professionals about the many uses of walnuts as well as showcasing new recipe and formulation ideas.

age walnut usage in menu items and consumer packaged foods by educating and informing food professionals about the many uses of walnuts as well as showcasing new recipe and formulation ideas. To further reach food professionals, in August of 2020, the Commission

launched its @CAWalnutsatwork food-service social channels on Facebook and Instagram. These social channels have helped drive initiatives such as 'Walnuts at Work Live' promotions

Continued on Page 36



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The work of the Walnut Board and Commission is focused on educating consumers on the versatility and health benefits of walnuts by reaching them in a variety of ways.

Continued from Page 35

with guest chefs and a partnership with Plate Magazine.

In total, the new social channels have delivered more than 500,000 impressions to date. Since its launch, the @CaWalnutsatwork social channels have seen a steady growth with over 1,890 Facebook page likes and over 195 Instagram followers.

Lastly, the Plate Magazine partnership, a plant-forward project, has included multiple outreach and engagement touchpoints, including signature e-blasts, advertorials, newsletters, full video production, recipe development from top domestic chefs, photography

and more. Since the start of this program, California walnuts have received more than 2,100 viable foodservice operator leads from the digital campaign that has sparked interest and inspiration for food professionals with the goal of getting walnuts on the menu.

The CWB and CWC continue to build demand for California walnuts through integrated marketing programs that increase awareness and drive retail purchase. The California walnut industry has a long tradition of producing a healthy, safe, quality food product for global consumers.

To learn more about what the

California Walnut Board and Commission is doing to support and grow the walnut industry, visit walnuts.org and follow the CWB's new grower-focused social media channels on Facebook and Twitter at @GrowCAWalnuts.

Sources

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Implementing Best Management Practices for Nitrogen Fertilization in Almonds

Nitrogen Management is Critical from Full Leaf-Out Until Early Postharvest

By **DOUGLAS AMARAL** | UCCE Farm Advisor, Kings and Tulare Counties and **PATRICK BROWN** | UC Davis

WITH GROWING SEASON UPON US, an understanding of the seasonal uptake of nitrogen is essential to time fertilizer applications. Nitrogen fertilizers are the most important chemical input in modern agriculture. Among all essential nutrients for higher plants, N is required in the largest quantity. It is

estimated that over 100 million tons of N fertilizers are applied globally. However, this number could be much lower if our farming systems used N more efficiently. Typically, less than half of the applied N is utilized by the crops while the rest is lost to air and water by run-off, leaching, denitrification and volatilization.

Due to excessive use of N in California, the Irrigated Lands Regulatory Program (ILRP) implemented new regulations to prevent agricultural runoff from impairing surface waters, requiring every grower to implement a N management plan. As a result, there is a growing pressure for all of ag to 'tighten' the efficiency of N use, and it requires an improved understanding of N demand to grow almond.

Nitrogen in Plants

Nitrogen is essential for a wide range of processes in plant production. It is

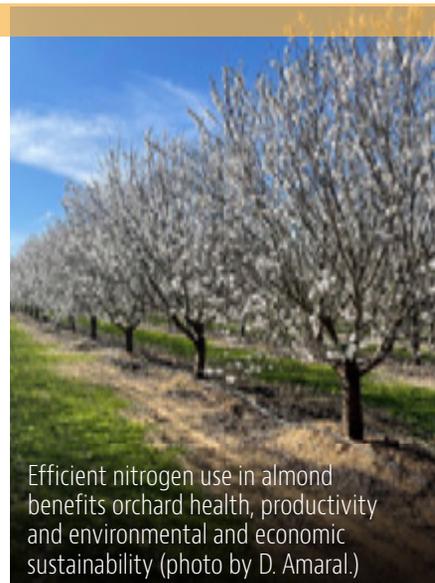
the major element found in chlorophyll, which is needed for photosynthesis, the most important of all the plant processes, converting the sun's energy into carbohydrates. It is also needed for the formation of amino acids (the building blocks of proteins, major component of the almond kernel) as well as DNA and RNA, which are the genetic materials that allow cells (and eventually plants) to regulate growth, development and reproduction.

Matching Supply with Tree Demand

Managing N in almond orchards is a balancing act of supply versus tree demand. When making fertilization decisions, growers need to consider the different supplies of N as well as the demand for N due to tree growth and kernel production requirements. An understanding of all different N (re) sources (fertilizer, compost, cover crop, manure, irrigation water) and how N can be "lost" (volatilization, leaching) in the orchard will help growers better make management decisions.

Understanding Tree Demand

As previously stated, N is essential for a wide range of processes in tree production such as growth of all annual (flowers, leaves and kernel) and perennial organs (branches, trunk and roots). However, the primary factor impacting N demand in trees four years and older is kernel yield. Based on a study developed by UC Davis professor Dr. Patrick Brown and team, it is estimated that with every 1,000 pounds of almond



Efficient nitrogen use in almond benefits orchard health, productivity and environmental and economic sustainability (photo by D. Amaral.)

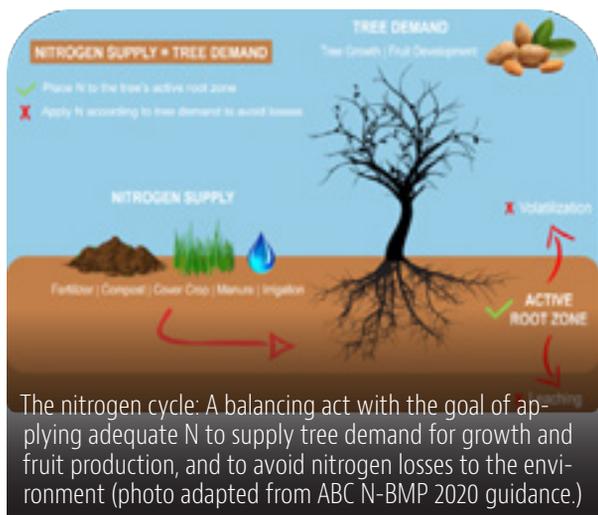
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Timeline of N Uptake in Almonds

Proper rates and timing of N fertilizers are important for managing the delicate balance between vegetative and reproductive growth while avoiding losses to the environment. Therefore, using small and frequent fertilizer applications during the season will have a significant impact on tree production and reduction of N losses by adjusting application according to the trees' needs.

It is important to note that N

reserves that are built up in the previous season are used to support early growth the following spring. It means that perennial organs are an important additional sink of N during winter. The remobilization of internal N reserves is therefore crucial for optimal shoot growth, flowering and fruit set since bud break occurs when conditions (end of winter) are not optimal for root N uptake. Thus, maintaining your trees' health throughout the season is essential.

As described in the provided table, N uptake from the soil closely follows the development of fruits and shoots, increasing in March after stored tree nitrogen is depleted (70% leaf out) and slowing dramatically after hull split.

Excessive Use of N

While it is always important to ensure sufficient N supply for optimum growth and yield, it is equally important that we do not assume that more is better. Nitrogen is the nutrient most often abused in terms of a 'more-on' approach. Excess N can cause several problems.

When nitrogen is overapplied, it negatively affects the uptake of other nutrients. Overapplication of nitrogen is associated with higher incidence and severity of hull rot, which may affect nut quality and food safety. Excess N can also cause excessive vegetative growth in the current season, thus compromising the production of next year's flower buds and subsequent production of next year's crop.

kernels produced, 68 pounds N are exported from the field and an additional amount of N is required to satisfy the trees' annual growth demand. Thus, potential yield estimation early in the season can have a significant impact on N management decisions. Growers can normally make these estimations based on their orchard productivity over the past years combined with the expected productivity of similar orchards in their growing region, environmental conditions of the prior year, winter chill and spring flowering conditions.

Approaches to Improve N Management

In order to achieve maximum productivity and to reduce N losses to the environment, close attention to the 4R's— Right Amount, Right Time, Right Place and Right (re)Sources—is needed in all orchard fertility programs. Remember, you need to TRAP the N in the soil:

TIME nitrogen application according to tree uptake patterns,

Identify and understand available nitrogen **RESOURCES** (fertilizers, composts, manure, cover crops, irrigation water),

Apply the **AMOUNT** needed according to tree demand, and;

PLACE nitrogen to the tree's active root zone.

Following the 4R's principle can be viewed as a balancing act with the goal of applying adequate N to supply tree demand for growth and fruit production.

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Continued on Page 40

Table 1. N uptake from the soil closely follows the development of fruits and shoots, increasing in March after stored tree nitrogen is depleted (70% leaf out) and slowing dramatically after hull split (data courtesy ABC N-BMP 2020 guidance.)

Tree Phenology (Tree Growth Stage)	Key Nitrogen Dynamics
Dormancy	Nitrogen remains stored in the perennial wood
Bloom Time	Nitrogen demand is supported by remobilization of stored nitrogen
70% Leaf Out	Nitrogen uptake from the soil begins and stored nitrogen is depleted
100% Hull Growth	30% nitrogen uptake from soil has taken place by 100% hull growth
Kernel Fill	55% nitrogen uptake from soil has taken place by the end of kernel filling
Kernel Weight Accumulation Complete	85% nitrogen uptake from soil has taken place by the end of kernel weight accumulation
Beginning of Hull Split to 3 Weeks Post-Shake	100% nitrogen uptake from the soil has taken place*
Early Leaf Senescence to Leaf Fall	No nitrogen uptake from the soil

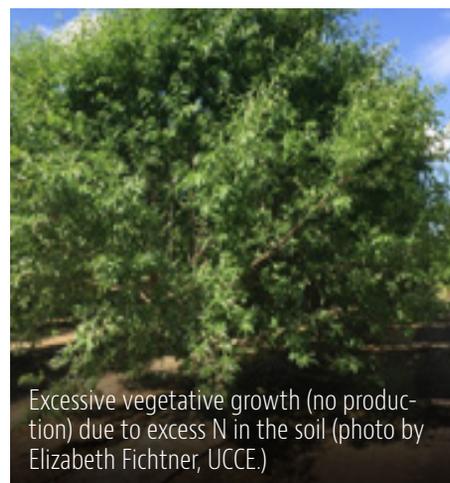
*For late-harvest cultivars, cold temperatures or harvest stress can limit post-shaking nitrogen uptake.

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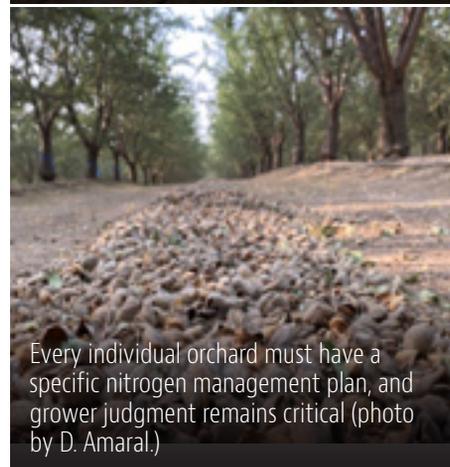
Additionally, plants cannot absorb all the excess nitrogen in the soil and extra N levels will leach out of the soil. As a result, groundwater and drinking water become contaminated from the nitrate levels.

Improving Nitrogen Use Efficiency

Nitrogen management plays an important role in determining your bottom line, so ensure you manage this nutrient well in order to keep tree performance, production and nut quality up as well as costs down. Some approaches that can be adopted to minimize risks and optimize N use include applying



Excessive vegetative growth (no production) due to excess N in the soil (photo by Elizabeth Fichtner, UCCE.)



Every individual orchard must have a specific nitrogen management plan, and grower judgment remains critical (photo by D. Amaral.)

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N to meet tree demand and according to tree uptake patterns. For this, an efficient irrigation system is essential. Fertilizers must be present in the root system where they are most likely to be used by the tree.

In summary, adopting the 4R's principle will help growers to improve N management, sometimes achieving over 80% efficiency under optimal conditions. However, every individual orchard must have a specific N management plan (there is no “one-size-fits-all” approach), and grower judgment remains critical. A complete N management guide for Almonds (ABC N-BMP 2020 guidance) has been recently developed by the Almond Board of California (see related story in this issue of *West Coast Nut* magazine) in cooperation with UC researchers and can be accessed at almonds.com/almond-industry/orchard-management/soil-health-and-nutrients/nutrient-management.

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Once nut set is complete and petal fall and rapid leaf expansion is occurring growers need to focus on two key components affecting yield – 1) maximizing leaf size and chlorophyll development during rapid leaf-out and 2) continuing to push nut cell division and calcium into nut cell walls before the division window closes. These two steps are critical to achieving top yields at harvest.

Demands for zinc, magnesium, and other micronutrients reach peak demand timing during rapid leaf and root development. Soils are often cold and wet during this time which limits nutrient availability and uptake hindering root and leaf growth and chlorophyll development. Satisfying peak nutrient demands are critical to maximizing yield potential. Zinc is the cornerstone for leaf, root and vascular system development. Manganese and molybdenum play a key roles in nitrogen metabolism. Iron, magnesium, copper and manganese are backbones of chlorophyll development and structure. Shortages of one or more of these nutrients will limit yield potential. Applying Micro SeaMix and System Leaf Max with fungicide or insecticide sprays at rapid leaf-out is an ideal way to meet early season almond nutrient needs while simultaneously reducing plant stress. Maximizing

leaf surface area ensures the photosynthetic factory is capable of supporting and sizing a large nut crop.

At petal fall, nut cell division is not yet finished and it is important to support the final stages of this process with foliar phosphorus and calcium. Foliar applications are important as cold and/or wet soils combined with limited root activity at this time limit uptake of these important nutrients. Vigor SeaCal supports uptake of phosphate for increased cell division leading to increased nut size. Tank mixing 100% ortho-phosphate based AgroBest 9-24-3 and Vigor SeaCal with fungicide sprays delivers the nutrients needed, in the right form and at the right time to maximize nut cell division and ultimately increase nut size. Nut size and weight directly impact yield. Proper nutrient management at rapid leaf-out also reduces May/June nut drop another major factor to increased yields.

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Nitrogen BMP Guide Helps Summarize, Simplify Key Research

By ALMOND BOARD OF CALIFORNIA | *Contributing Writer*

NITROGEN MANAGEMENT HAS MAJOR IMPACTS ON THE productivity of almond orchards, the profitability of growers throughout the Central Valley and the effect of nitrogen on the environment. With the implementation of the Irrigated Lands Regulatory Program (ILRP), every grower is required to implement a management plan that allows for the efficient use of nitrogen fertilizer and reduces nitrogen leaching into groundwater.

To support growers in both their formation of nitrogen management plans as well as their broader understanding of nitrogen management, the Almond Board of California (ABC) developed the Nitrogen Best Management Practices. These practices provide almond growers with an understanding of nitrogen's role in almond production and guidance on how to achieve efficient, profitable nitrogen management.

"This resource is an excellent example of how years of research, all the way from basic research to applied science, and long-term strategic planning can be combined and communicated to growers in a way that is most helpful to them," said Sebastian Saa, associate director for Agricultural Research at the Almond Board.

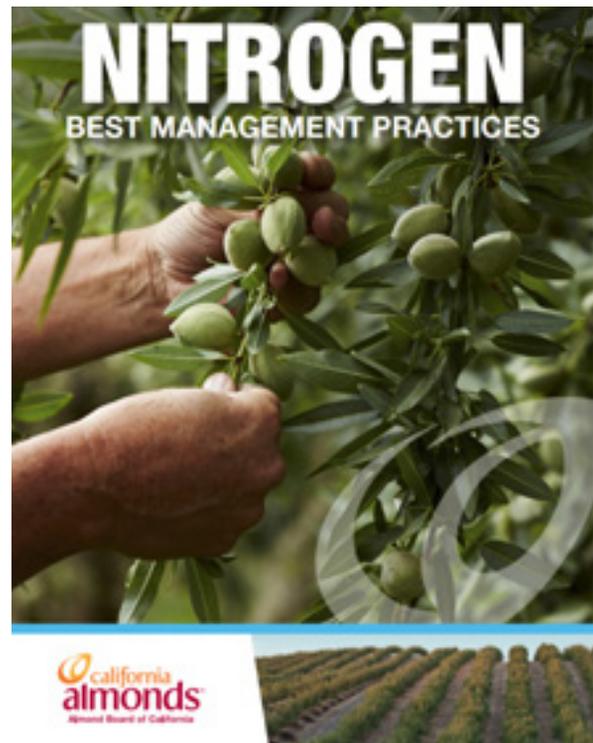
Saa made it clear that these best management practices should serve as a guide to growers; individual management plans should be devised in conjunction with PCAs and other field experts to adequately meet individual orchard's needs.

Saa and Patrick H. Brown, Ph.D., UC Davis, authored this resource, in addition to Saiful Muhammad and Sat Darshan Khalsa, also of UC Davis.

Excess Nitrogen Affects Productivity

On page two of the guide, its authors elevate the most vital principle surrounding nitrogen management – while you cannot enhance orchard productivity by providing more nitrogen than is needed by the trees, you can harm productivity by applying too much nitrogen.

Efficient, environmentally-sound and profitable nitrogen fertilization can be achieved when growers abide by the 4 Rs of Nutrient Management. These 4 Rs are as follows: nitrogen must be applied at the Right Rate and at the Right Time, in the Right Place, using the Right Source of nutrients. These guidelines help growers succeed in reaching the ulti-



The Nitrogen Best Management Practices provide almond growers with an understanding of nitrogen's role in almond production and guidance on how to achieve efficient, profitable nitrogen management (all photos courtesy Almond Board of California.)

mate goal of effective nitrogen management, which is to apply adequate – but not excessive – amounts of nitrogen so that productivity is optimized and loss to the environment (and wasted input) is minimized. If nitrogen supply is not well managed, nitrogen will be lost from the orchard system, nitrogen use efficiency will be reduced, money will be wasted and tree productivity will be compromised.

In fact, the single most significant case of nitrogen loss can occur when nitrogen moves below the active root zone via leaching. What's more, a small amount of nitrogen can be lost via gaseous losses and surface runoff, which may occur if excess irrigation or rainfall washes fertilizer and sediment from the orchard surface. Growers are encouraged



The Nitrogen Best Management Practices provide insight and instruction on how to conduct leaf sampling and analysis, which is helpful to growers as sampling allows them to determine the effectiveness of their current practices and identify current issues.

A small amount of nitrogen can be lost via gaseous losses and surface runoff, which may occur if excess irrigation or rainfall washes fertilizer and sediment from the orchard surface.

to read page 4 of the Nitrogen Best Management Practices to learn more about how nitrogen can be lost from the orchard system.

Monitoring Tree Nutrient Status

Beyond information on nitrogen supply, loss and the 4 Rs of Nutrient Management, the Nitrogen Best Management Practices also provide insight and instruction on how to conduct leaf sampling and analysis. This practice is extremely helpful to growers as sampling allows them to determine the effectiveness of their current practices and identify current issues.

Sampling in conjunction with yield estimation can be conducted in April to help predict seasonal nitrogen demand. Then, in July, sampling can be used to monitor nitrogen status and make end-of-year adjustments.

Growers generally collect one combined leaf sample per orchard. However, if the orchard has substantial variability, then the sampling protocol should be repeated in each zone and nitrogen should be managed independently in each zone, accordingly.

For each orchard block or sub-block requiring individual information, growers should conduct the following in April and July (or August):

Collect leaves from 18 to 28 trees per orchard. Each sampled tree must be at least 30 yards apart. A minimum of 100 leaves per sample bag is required. Repeat this process for all orchards or orchard regions differing in productivity, age or soil type. Identify areas with low-yield performance and collect samples from those areas independently.

Combine all the leaves in a single bag. Label all samples with the collection date, field name, cultivar and location within the orchard, when possible. Also, note if foliar fertilizers have been applied.

Submit the leaves to a leaf nutrient analysis laboratory. Retain records for year-to-year comparison.

Growers interested to receive a physical copy of ABC's Nitrogen Best Management Practices are encouraged to email the Almond Board at industry@almondboard.com with their name and mailing address. Industry members are also invited to visit Almonds.com/NutrientManagement to print

or download a digital version of these practices and to access the accompanying Nitrogen Best Management Practices Quick Guide.

Note: Nitrogen application recommendations differ for orchards where Whole Orchard Recycling has taken place. For more information on these recommendations, view pages 7 and 8 of the Nitrogen Best Management Practices.

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A Non-Glyphosate System for Walnut Weed Management Programs Work, But are More Expensive and Timing is Critical



UC Davis researchers were able to dramatically improve junglerice control through use of sequential applications of a preemergence herbicide, as depicted in the photo on the left that was taken in August. The photo on the right shows junglerice treated with one shot of a postemergence material (all photos courtesy B. Hanson)

By **MITCH LIES** | Contributing Writer

WITH A GOOD ARSENAL OF HERBICIDES on-hand, walnut growers should be able to control weeds in a non-glyphosate system, but, according to Brad Hanson, UCCE weed specialist at UC Davis, it will take better management and be more expensive.

Speaking at the 2021 Walnut Conference, a virtual event sponsored by *West Coast Nut* magazine, Hanson said growers will face several challenges if they elect not to use glyphosate in their herbicide program.

“The biggest challenges will be related to timing,” Hanson said. “Glyphosate is forgiving of weed size for the ones that it works on, [while] large weeds can be difficult to control with contact herbicides like paraquat or glufosinate. And you are going to have a little bit more of a challenge with contact herbicides on grasses.”

Weed types that will be most challenging in a non-glyphosate system include perennials, such as bindweed, Hanson said. “Once established, those types of weeds are going to be really difficult to control with preemergence or

contact herbicides,” he said. “In grasses, we can do okay with the ACCase herbicides. We are much more limited in terms of translocated activity with broadleaves, [and] timing is going to be a challenge.”

In a question-and-answer session after his presentation, Hanson said he doesn’t believe that EPA will ban glyphosate, the active ingredient in Roundup, anytime soon. “So far, there has been no indication that EPA thinks that it is carcinogenic, and there haven’t been any changes to the label at the federal level,” Hanson said. “In fact, in a 2020 registration review, EPA clearly stated that glyphosate is not carcinogenic.”

Market forces, however, could be another story.

The market factors seem more likely to drive changes in specialty crops like walnuts, he said. “So, if buyers or food companies demand something gets done, that is probably more likely to have a faster impact than a regulatory change on that particular herbicide.”

According to herbicide use data that Hanson displayed, glyphosate was used on 354,789 acres of California walnuts in 2017, or about 93% of the state’s 380,000 bearing and nonbearing walnut acres. Oxyfluorfen, or Goal, was applied on 197,471 acres that year, accounting for the second-most widely used herbicide in walnuts, followed by

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glufosinate, which was used on 118,698 acres.

More Preemergence Usage

Notably, Hanson said, the data showed significant increased use of preemergence materials, such as indaziflam (Alion) and rimsulfuron (Matrix) over previous years. Use of penoxsulam (a component of Pindar GT) also was up dramatically.

"I definitely see a trend of increase in preemergence use over the last few years," he said.

In general, Hanson said, compared to other specialty crop producers, walnut growers have access to a good supply of herbicides. "We have quite a few herbicides registered in walnuts," he said, "both preemergent herbicides and postemergence materials."

In terms of modes of action, however, the options are limited, he said, and no new modes of action have been added for the past several years.

Fortunately, he said, with some ex-

ceptions, herbicide resistance in walnut orchards is primarily isolated to glyphosate-resistance in broadleaves, like horseweed and fleabane, and winter grasses. "Winter grasses, and specifically ryegrass, are still far and wide the greatest problem in orchards from a resistance standpoint," Hanson said.

Hanson noted that there have been reports of annual bluegrass, or *Poa annua*, showing resistance in both the Sacramento and San Joaquin valleys, but it is not believed to be as problematic as the ryegrass. There have also been reports of Palmer amaranth resistance in California, but he noted there has been little evidence of that in tree crops to date.

Stacked Resistance

Researchers also in recent years have seen evidence of multiple resistance, or stacked resistance, in isolated weeds. In most cases, that involves resistance to a second herbicide in addition to glyphosate, Hanson said.

"We have reports of small acreages with paraquat resistance in annual bluegrass, or *Poa*," he said. "And then, if you start looking at ryegrass populations, you can find lots of different combinations of paraquat resistance, ACCase resistance and some resistant to glufosinate, in addition to resistance to glyphosate.

"So far, those haven't been hugely problematic to my knowledge," he continued, "but they are out there, and a species like ryegrass is certainly prone to develop resistance rapidly."

In terms of summer grasses, Hanson said junglerice has shown resistance to glyphosate in recent years, and he has fielded reports of glyphosate resistance in sprangletop and witchgrass, although those reports have not been confirmed.

Threespike goosegrass is another weed worth keeping an eye on, Hanson said. A short-statured and short-lived perennial, the weed is a very prolific

Continued on Page 46



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Glyphosate-resistant hairy fleabane in almonds will flourish without integrated herbicide programs.

Continued from Page 45

seed producer and very tolerant to glyphosate.

“It has a tendency to persist mostly in orchards that are glyphosate-only programs or in the orchard middles, where herbicide use is less intense,” Hanson said. “It seems like most of our preemergence herbicides can work very well on the seedling stage of this grass, so if you have a good preemergence program, you can keep it out of the strips. But once it is established, it can be fairly difficult to control because of its tolerance to glyphosate. This is one to be aware of if you see it in your orchards.

“Definitely keep an eye out on all these summer grasses because they emerge in May, June and July when our preemergent wintertime programs are starting to run out of steam,” he said.

Sequential Treatments

Hanson noted that he and a post-doctoral student recently launched a project where they are looking at sequential preemergent herbicide treatments for extended summer grass weed control. “The whole approach was in regard to how best to use preemergence herbicides,” he said.

Typically, he said, when looking for longer control, the common practice was to increase the rates applied in the winter. “That always seemed like an inefficient way to solve that problem. So, what we looked at was a second

preemergent herbicide application, targeting the timing just ahead of summer grass control. So, this was basically a one-two punch – a winter program, and then a March or April preemergence application specifically targeting grasses.”

The researchers applied several combinations in the trial at two sites, such as Alion in the winter followed by Prowl in the spring; or Tuscany followed by Prowl; or Pindar GT followed by Prowl.

“Essentially, in each case, we got very good summer grass control where there was one of the followed-by treatments,” he said, “which makes sense. If you put the preemergence herbicide on shortly before the problem emerges, you are going to have much better control than if you put it on six months before that weed starts to emerge.”

Hanson added that he found it encouraging that, in most cases, whether the spring treatment was at a two-quart or four-quart rate, it usually resulted in control that was better or at least as good as the four-quart rate applied in the winter.

“So, just by using the herbicide more appropriately, based on the target weed’s biology, we actually save money, reduce the pesticide load in the environment and get better weed control,” he said.

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New Research on Whole-Orchard Recycling in Walnuts

By KATHY COATNEY | Contributing Writer

After chip spreading (91 dry tons to the acre), but before incorporation (all photos courtesy L. Milliron.)

WHOLE-ORCHARD RECYCLING (WOR) IS THE ON-SITE grinding or chipping of whole trees during orchard removal, then the chips are incorporated into the soil prior to replanting. This technique is currently being used in almond and now, Luke Milliron, UCCE orchard systems advisor for Butte, Glenn and Tehama counties, has started research in the Sacramento Valley for WOR in walnuts.

“We’re a long way behind the almonds, where Brent Holtz (UCCE farm advisor, San Joaquin County) had the original trial at the Kearney Agricultural Research and Extension Center,” Milliron said, and since then, almond growers started trying WOR on their own.

“One or two walnut growers have done it, but we still haven’t seen it in a randomized, replicated, scientific way that it works or what management techniques we would need to adjust around it,” Milliron said. “There is a lot of research that needs to be done before growers start using it.”

“We’re very much in the initial research phases now, so I wouldn’t encourage growers necessarily to do this because we haven’t evaluated all of the risks,” Milliron said.

Tree Removal

Milliron’s first trial was in 2018, and he calls it the “chipocalypse” because everything that could go wrong, went wrong in that trial. He’s currently started a new, replicated trial and just finished planting trees in the southern Sacramento Valley.

Milliron’s tree removal for the new research is the same practice that they’re currently using in almond.

Research has found that it’s actually not efficient to use the single large rototiller type machine that pushes the tree over and grinds and incorporates it in place, Milliron said. “It’s much more efficient to remove the trees and chip them up with several different machines.”

The trees are chipped in a single location, a manure spreader is used to then spread out the chips and incorporate them through tillage, Milliron said.

The closure of biomass power plants has resulted in a lower value for the woodchips, which used to cover the cost of orchard removal. In the Sacramento Valley, burning remains the standard method of tree removal. When it costs just a few dollars an acre for a burn permit in the Sacramento Valley, push and burn is the economic approach. This isn’t the case in the San Joaquin Valley, where it costs \$400 to \$500 an acre for permitted burning and most of that practice is being phased out due to regulation.

Milliron believes it’s only a matter of time before the Sacramento Valley sees similar regulations. “We’re going to end up with the same situation that the San Joaquin Valley is in where it’s going to be potentially much more expensive to burn,” he said, and growers will have to determine what method is more affordable.

“Right now, it may not make financial sense to do whole-orchard recycling in the Sacramento Valley either for almonds or walnuts, but with our wildfire problems and our need to have burn permits for forestry, I think that will be changing in the coming years,” Milliron said.

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After chip incorporation with tillage and planting of bareroot trees (planted that day.)

The California Air Resources Board on Feb. 25, announced action to phase-down agricultural burning in the San Joaquin Valley by Jan. 1, 2025.

Disease Concerns

There has been concern that incorporating the chips in the almond orchards could increase disease. To date, there hasn't been an increase in disease in almonds with this method, Milliron said, and he's hoping for the same result in walnuts.

At Milliron's current research site, there were massive old root systems that were chipped and incorporated before planting the second generation walnut orchard. These root systems had crown gall, oak root fungus and root lesion nematode.

"We'll see whether there's increased disease or not," Milliron said, adding currently it's way too soon to know.

Milliron's first research with WOR found root lesion nematodes, and the field was fumigated with Telone® II. Two years later, the lesion nematode levels have remained almost nonexistent in both the chipped and non-chipped areas.

The new research site is unfumigated because of its small size (four acres), a problem that many growers with small replant sites face, he said. Vermicompost was applied in the planting hole and around the tree at planting. The lab of

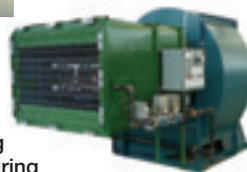
Dan Kluepfel, a USDA pathologist based at UC Davis, has data supporting the idea that the microorganisms contained in some vermicompost may be able to outcompete soilborne pathogens.

"Ideally, we would like to do some of the more sophisticated studies, like researchers have done in almonds, where

Continued on Page 50

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Continued from Page 49

you have whole-orchard recycling vs. complete tree removal and you have fumigation vs. non-fumigation,” Milliron said, adding he would also like to eventually have a future study that is layered with anaerobic soil disinfestation.

Tree Nutrition

Milliron didn’t apply nitrogen in the planting hole. Past walnut research has shown under normal circumstances there was no advantage to putting nitrogen in the planting hole, or other nutrients for that matter.

“There will be mineral nutrients applied around the tree, and then watered in, that I’ll carefully document in this first year,” Milliron said, adding the new research site will be receiving nitrogen in the first year, and early leaf analysis will be done to ensure the trees are receiving sufficient nutrition.

Soil Types

Milliron’s first “chipocalypse” demonstration site and the new research site were both planted on very sandy ground.

“It just happened to be that way. They’re both right next to rivers, and that is just not representative of large portions of Central Valley walnut ground,” Milliron said.

He intends to test on clay and loam soils, too, to determine the breakdown rate of the woodchips. It’s important to research in different soil types, but it will take a number of years and more trials, he said.

Milliron’s new site was planted and replanted in walnuts, but he thinks researching different combinations of WOR, whether it be almond to walnut or walnut to pistachio or prune, is important, too.

“I would always be most concerned and most interested with the same crop followed by the same crop because that is where you’re going to have the highest potential disease pressure, the highest potential nematode pressure,” Milliron said.

Just like in almond, the lifespan of walnut orchards isn’t what it used to be. Old cost studies for almond and

walnut in the 1950s and 60s projected much longer lifespans for both orchard systems. It’s unknown whether the reduced longevity is due to more intensive farming or, Milliron suspects, increased disease pressure that is reducing the longevity.

Potential Benefits

Milliron hopes to find several benefits of WOR through his research and says he’s a believer—a Brent Holtz woodchip believer. “We hope that woodchips will solve all the world’s problems,” he joked, but more seriously he said, “I am hoping to document a lot of the great things that Brent’s been able to document.”

Some of these benefits include:

- Increased growth or at least the same growth without stunting the trees.
- Increased nutrients in the leaves.
- Increased organic matter in the soil.
- Reduced water stress from increased organic matter and water holding capacity in the soil.
- Increased yield.

Milliron has been intrigued by some of the results that Holtz and others have found using a pressure chamber to show that trees with whole-orchard recycling are less water stressed, which would hopefully increase yield, he said.

Milliron has seen a lot of interest in WOR from walnut growers, but he’s also urging caution because WOR in walnuts is still largely unresearched. Still, he’s hopeful that with the new research site, he will start getting solid data to report on very soon.

Currently, Milliron has his WOR on walnuts research in the Sacramento Valley, and Mohamed T. Nouri, a UCCE orchard systems advisor in San Joaquin County, will be initiating a walnut WOR project in 2021 in the Central Valley.

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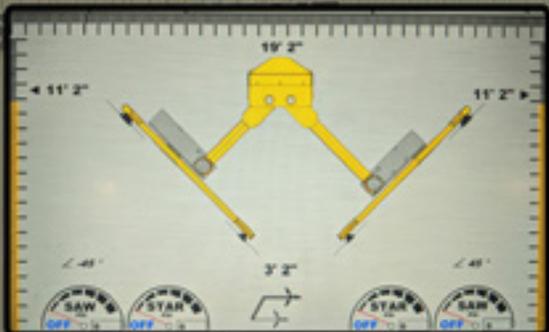
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Here We Go Again— State Proposes to Increase Tax on Pesticides

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



Tiered mill assessments will be phased in for pesticides with different signal words (photo courtesy WAPA.)

AS WE ROLL INTO 2021, ATTEMPTING TO come out of an economically devastating pandemic, the State of California is proposing to increase taxes, this time specifically on pesticides. In the proposed budget, the Department of Pesticide Regulation (DPR) is requesting \$16.75 million (\$8.25 million General Fund and \$8.5 million DPR Fund) and 44 positions in 2021-22, and the California Department of Food and Agriculture (CDFA) is requesting \$11.75 million General Fund in 2021-22, as part of a comprehensive proposal to support the state's transition to safer, sustainable pest management.

Figure 1: Proposed Tiered Mill Assessment by Signal Word Implementation Schedule

Signal Word	FY 21/22	FY 22/23	FY 23/24	FY 24/25
Tier 1 - None or Caution	21 mills	25 mills	25 mills	26 mills
Tier 2 - Warning	30 mills	30 mills	35 mills	40 mills
Tier 3 - Danger or Poison	35 mills	35 mills	40 mills	45 mills

Risk-based Mill Assessment

Additionally, DPR proposes to replace the current flat-fee mill assess-

ment on pesticide sales with a risk-based tiered mill assessment, where higher toxicity pesticides are assessed a higher

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fee. Once fully phased in by 2024-25, the tiered mill assessment is anticipated to generate approximately \$45 million in additional revenue annually to the DPR Fund. According to DPR, “The additional revenue will fund various DPR and CDFA programs and will increase support to the County Agricultural Commissioners (CACs) for local pesticide use enforcement activities to accelerate the state’s transition away from harmful pesticides.”

The tiered mill assessment will be based on a product’s “signal word” as determined by the United States Environmental Protection Agency (U.S. EPA) and will be phased in over four years, using phased down General Fund to support during this transition. When the tiered mill is fully implemented, products without any signal word or a “Caution” signal word will be assessed 26 mills; products with a “Warning” signal word will be assessed 40 mills; and products with “Danger” and “Poison/Danger” signal words will be assessed at 45 mills. The additional revenues will fund the following efforts:

Enhanced implementation of integrated pest management (IPM) practices, including:

DPR’s IPM Program (\$8.25 million and 15.0 positions). In 2021-22, the General Fund will fully cover these costs; in 2022-23 \$5.75 million will be funded from the General Fund and \$2.5million will be funded from the DPR Fund; and the DPR Fund will fully fund these ongoing costs beginning in 2023-24.

CDFA IPM Research, Education and Extension Grant Programs (\$3.75 million ongoing). This includes \$2 million for Biologically Integrated Farming Systems and \$1.75 million for Proactive IPM and IR-4 research. These programs will be funded from the General Fund in 2021-22, 2022-23, and 2023-24, and will fully shift to the DPR Fund beginning in 2024-25.

CDFA, through cooperative agreements with the California State University Agricultural Research Institute (CSU ARI) and University of California Agriculture and Natural Resources (UC ANR), to expand research, education and extension capacity for IPM (\$8 million ongoing). In 2021-22 this will be funded from the General Fund; in 2022-23 \$7 million will be funded from the General Fund and \$1 million will be funded from the DPR Fund; in 2023-24 \$6 million will be funded from the General Fund and \$2 million will be funded from the DPR Fund; and the DPR Fund will fully fund these ongoing costs beginning in 2024-25.

Strengthened DPR enforcement activities (\$3 million DPR Fund and 18 positions in 2021-22 and ongoing).

Increased support to the County Agricultural Commissioners for local pesticide use enforcement activities from 7.6 mills to 10 mills (estimated to be an approximately \$9.5 million increase).

Enhanced Pesticide Air Monitoring Network (AMN) (\$4 million DPR Fund and 7 positions in 2021-22 and ongoing).

Increased community engagement by DPR, including with communities identified by the Community Air Protection Program (as authorized by Chapter 136, Statutes of 2017, AB 617)(\$1.5 million DPR Fund and 4 positions beginning in 2021-22 and \$1.5 million DPR Fund and 7 positions in 2022-23 and ongoing thereafter.)

Sufficient revenues to repair the DPR Fund’s structural fund imbalance and provide a prudent reserve.

Adoption Schedule

If adopted, the tiered increase would be instituted as per the schedule in **Figure 1, see page 52.**

This proposal causes many concerns especially for the tree nut industry, among others. While anyone in agricultural understands the need to transition away from pesticides, some activities, such as fumigation, are absolute necessities. Some countries require fumigation for products being imported regardless of need, like walnuts going to Korea. With the increased assessment on products with the “Danger” signal word, it will definitely, and unfairly, impact fumigants and commodities that are forced to use them.

Other areas in the proposal that do warrant some consideration include IPM research from state universities like Cal State University, Fresno and CSU Chico, and assistance from UC Cooperative Extension. But additional enforcement or ongoing monitoring when nothing has been found after years of monitoring is not justification to increase costs on growers already suffering from dropping commodity prices, especially following the pandemic. Agriculture cannot support the entire proposal, or even the majority of it for that matter. DPR should have considered discussing this with the agricultural community before slapping us in the face with it.

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INSECTICIDES AND MAXIMUM RESIDUE LIMITS FOR GILL'S MEALYBUG IN PISTACHIO

By **DAVID HAVILAND** | *UCCE Entomology Farm
Advisor, Kern County*



Gill's mealybug continues to spread and become more entrenched within the California pistachio industry, and is becoming more difficult to control (all photos courtesy D. Haviland.)

OVER THE PAST TWO DECADES, GILL'S mealybug has become entrenched within pistachio orchards in California. Each year, new orchards become infested as the distribution of mealybugs in infested orchards becomes ubiquitous. Unfortunately, insecticide programs that used to be highly effective against the Gill's mealybug are becoming less and less effective, and growers have been exploring new and creative ways to try to achieve control.

In some cases, this has led to the rejection of fruit in export markets due to pesticide residues. Most notable in 2020 were rejections in the European Union for fruit that exceeded the 0.05 ppm tolerance for imidacloprid (Admire Pro and more than 25 other labeled products.) This concern is likely to increase due to plans in the E.U. in 2022 to decrease this imidacloprid tolerance to the default maximum residue limit (MRL) of 0.01 ppm. This means that 2021 crop sold in the E.U. in 2022 will have to meet the new standard. This issue is similar to the one facing buprofezin (Centaur) that also has a default MRL in the E.U. of 0.01 ppm. Default MRLs can be difficult to satisfy because they are based on minimum detection levels of residues instead of the levels at which residues are known to pose no health or environmental concerns.

One-Spray Programs in May

Traditional insecticide programs

for Gill's mealybugs were developed in the early 2000s based on research on mealybug biology that was conducted in commercial pistachio orchards in Tulare County. Data showed that during the last week of May, a very high percentage of Gill's mealybugs were synchronized in the first instar developmental stage, often referred to as a crawler. These tiny nymphs crawl over plant tissues where they are easily exposed to pesticides. Because they were just born and have not fed, they have minimal carbohydrate reserves and have not developed the thick waxy cuticle that makes larger mealybug nymphs and adults relatively immune from most insecticide applications. Research from 2005 to 2007 showed that one well-timed application of an effective insecticide in the last week of May would easily provide season-long mealybug control.

The most common options for one-spray programs include Movento, Centaur, Assail, Admire and the newcomer Sequoia. Profiles for each of these products, including concerns regarding tolerances for residues in exported fruit, are described below.

Centaur (buprofezin) is an insect growth regulator that affects the ability of mealybugs to produce chitin. Most susceptible are first-instar nymphs (crawlers) that pick up residues as they walk over the surface of plant tissues and become unable to molt. Maximum efficacy from this product is tied to the

ability to apply it at the time crawlers and other small nymphs are present. The primary concern with the use of buprofezin relates to the destination of the crop. The E.U. has imposed a default MRL of 0.01 ppm, which has a high risk of being exceeded when foliar applications are made in May. For this reason, growers should consult with their processor regarding whether or not the E.U. is a potential destination of their crop. If the answer is yes, do not apply Centaur in May.

Movento (spirotetramat) is a lipid biosynthesis inhibitor that prevents mealybugs from producing fat bodies that are used to store energy. Most susceptible are small nymphs that have no fat reserves and are unable to produce new ones. Over a few days to weeks, these mealybugs run out of energy and die. One unique property of Movento is that it is systemic in both the phloem and xylem. After an application is made to the leaves, ideally with a good penetrating surfactant to assist its movement into the leaf, the active ingredient moves within the plant to locations where mealybugs are feeding. Because of the time it takes for the active ingredient to penetrate the leaf, become systemic, be ingested, inhibit fat production and eventually cause mealybug death, pest managers are advised to wait two to three weeks after application to evaluate full efficacy. The best application timing for Movento is at the front end of the

main crawler emergence in the second or third week of May. This application timing is about a week earlier than the ideal application timing for other products to give time for the active ingredient to penetrate the leaf and become systemic within the phloem liquids that are ingested by the mealybugs.

Assail (acetamiprid) is a foliar-applied neonicotinoid that affects the nervous system of mealybugs. Like other products previously mentioned, it is most effective against the crawler stage that is not protected by the thick waxy cuticle typical of larger nymphs and adults. Applications of this product can be made at the May timing; however, most growers avoid using this product in May to keep it in their insecticide toolbox in case a second insecticide treatment is needed during the second half of July when crawlers of the second generation of mealybugs begin. Assail is widely accepted as the most effective insecticide that can be used in July, and its use does not raise concerns about pre-harvest intervals and tolerances for residues at harvest.

Admire (imidacloprid) is also a neonicotinoid that affects the nervous system of mealybugs. Over the past decade, it has historically been used at the maximum label rate as a soil-applied product. In relation to the products previously mentioned, it is not as effective on mealybugs, but when considering that the product is relatively inexpensive and can be applied through the drip system without the costs of a foliar application, it becomes a viable option for orchards with low mealybug populations, or as a supplementary treatment to foliar applications of other products made in May.

However, it is extremely important to recognize that recently there were a considerable number of fruit rejections in the E.U. for 2020 crop that exceeded the tolerance when sold in 2021, and that the tolerance will be decreasing for crop sold in 2022. To proactively address this issue, on Feb. 26, the Administrative Committee for Pistachios (ACP) sent out a directive to all growers and processors that fruit shipped to the E.U. should satisfy three requirements:

No foliar applications of imidacloprid should be made in 2021.

If imidacloprid was applied as a soil injection in 2020, then no imidacloprid applications should be made in 2021.

If imidacloprid is applied to the soil in 2021, applications should be made prior to May 15.

Adherence to these guidelines will be crucial in efforts of the industry to ensure the acceptability of fruit in E.U. markets. For growers with advance knowledge that their fruit will not be

going to E.U., the ACP did not recognize any concerns regarding residues when imidacloprid is used at the traditional timing in May when the product is most effective.

Sequoia (sulfoxaflor) is a new foliar insecticide within the pistachio industry. It is a nerve toxin that is classified as new mode of action (IRAC 4C) known

Continued on Page 56

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as sulfoximines. In UC trials, it has shown sufficient efficacy against Gill's mealybug to begin including it into rotations with other products. This has potential benefits for mealybug control, but also as a new mode of action in the spray rotation to help prevent resistance to all products. Unlike other mealybug products, Sequoia also has activity against small bugs like lygus and can provide some suppression of stink and leaf-footed bugs. Maximum residue limits and import tolerances for sulfoxaflor have been established in many export markets; however, as is true with any new product, growers should consult with their processor regarding potential export markets and confirm the latest information on MRLs before using Sequoia. If used, the best application timing would be at peak crawler emergence in May.

Multi-Spray Programs

Over the past few years, pistachio growers throughout the San Joaquin Valley have reported that they are no longer achieving season-long control with one application of traditional insecticide products. Nobody knows the exact cause for the reduced efficacy, but one leading candidate is resistance following more than a decade of use of buprofezin, spirotetramat, imidacloprid and acetamiprid. Another theory is that changes in weather over the past 15 years have caused mealybugs to be less synchronized than in the past. More specifically, some people have theorized that what used to be a rather synchronized start to mealybug activity in March has become more spread out and asynchronous during abnormally warm winters and springs, or due to significant reductions in the amount of winter fog compared to 15 years ago. During 2021, Kent Daane will be conducting research to investigate this theory.

For cases where one spray is not adequate, growers have several options. For the past decade, the most common two-spray program has been Movento or Centaur (assuming the fruit is not going to the E.U.) at the traditional May timing followed by Assail in the second half of July when the next generation of crawlers is present. This program has also historically been supplemented by a soil application of a product



When developing mealybug control programs for 2021, be sure and ask how much mealybug pressure is in the orchard, will it likely require one or two-spray program, and where is the fruit going?

containing imidacloprid, though this practice is now in question for fruit with the possibility of being destined to the European Union. Another option is to make a foliar application of an insecticide previously mentioned (not pyrethroids—they are not effective on mealybugs) immediately after harvest in September or early October when crawlers of the overwintering mealybug generation are present, or in March as overwintering mealybugs (still small nymphs) move up to and begin feeding on the swelling buds and new plant tissues.

The March timing is being promoted heavily by the manufacturers of Centaur as a way to maintain use of the product at a timing that avoids the issues of default tolerances in the E.U. that were previously described when the product is used in May. Thus far, my personal opinion regarding these trials (mostly done as observational trials by pistachio growers or by chemical manufacturers) is that neither of these alternate timings are as good as the May timing, but both are viable options to provide supplemental mealybug control when a two-spray program is needed. For the 2021 and 2022 growing seasons, the California Pistachio Research Board has funded research that will further investigate the efficacy of these alternate spray timings.

Ask Questions, Be Prepared

Gill's mealybug continues to spread and become more entrenched within the California pistachio industry, and is becoming more difficult to control. When developing programs for 2021, the first questions to ask are: 1) How much mealybug pressure do I have in the orchard; 2) Will I likely need a one or two-spray program; and 3) Where is the fruit going? It is highly advised that pistachio growers talk to their processor regarding these issues as each processor is well aware of issues associated with residue tolerances, knows the export markets in which sales are anticipated, and most have developed guidelines for what their growers should (and should not) do regarding insecticide treatments to maximize marketability. In some cases, individual processors have developed guidelines that are more restrictive than the ones presented herein as general guidance for the entire pistachio industry.

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Wolfskill trees produce a harvestable crop by year 4 and ramp up to full production by year 9 or 10 (photo by Janine Hasey, UCCE Emeritus.)

TRACING DEVELOPMENT OF UC WOLFSKILL

New adaptable variety should perform well under range of conditions and locations.

By **CECILIA PARSONS** | Associate Editor

UC DAVIS' NEWLY RELEASED WALNUT VARIETY UC WOLFSKILL came about due to a slightly different crossing technique than is traditionally used.

“The first step in breeding a new variety is to bag female flowers before they open and apply pollen from another selected variety with a syringe,” said Walnut Improvement Program Specialist Chuck Leslie, describing the process used to generate new walnut varieties.

In the case of UC Wolfskill, the plant breeding team, under Gale McGranahan at the time, went to a young Chandler orchard in an isolated location, removed catkins and applied a mixture of pollen in the air along the row of trees. Once the nuts were formed, they were collected and grown out to start the evaluation process.

Since a mixture of pollen was used to fertilize the flowers, the exact parentage could not be known until UC Davis Walnut Breeder Patrick J. Brown, using computing tools to look at differences in the DNA sequences of walnut varieties, was able to finger the early harvesting Solano variety as the provider of half of UC Wolfskill’s genes.

Hundreds of seedling trees from crosses are grown each year in the UC Davis Walnut Improvement Program, funded by the California Walnut Board (CWB), but very few will have the combined traits and production required to make it all the way to release for commercial use. The UC Wolfskill variety results from a cross made in 2003. It was named after John R. Wolfskill, an early pioneer and horticulturist in the Sacramento Valley.

Walnut Selection Process

Leslie explained that once the seedling trees begin to grow, the evaluation, and elimination, process begins. Trees with undesirable leafing traits, poor yield or dark kernels are culled while young. The most promising of the crosses remain and keep growing, and evaluation continues. Some are grafted to rootstocks to produce multiple copies in the University trial orchards.

If they continue to show favorable traits on campus, they are tested further in small commercial orchard trials where growers provide additional evaluation under their own conditions and in different areas of the state. Depending on their interest, tolerance for risk, and orchard design, they may plant only a few or whole rows of prospective new varieties to see how they perform. Leslie said that trying potential varieties in a commercial production system is a critical part of the evaluation process. It gives growers a chance to observe tree growth habit and production for them-

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Wolfskill nuts (left) and kernels (right). Kernels are a consistent light color and a fairly large nut with a shelling percentage well over 50% (photos by Chuck Leslie, UC Davis.)

selves and gives real-world information before deciding on release.

“Growers will share their observations and give feedback to the Walnut Improvement Program about the trees. Are they upright? What is the yield? Kernel quality? When do they leaf out? All of these are important traits for commercial walnut production,” Leslie said. “Through the Walnut Board, growers fund the program, and we want to give them value in return.”

In addition to annual infusions of support for the breeding program, funding also comes to the program from the proceeds of a \$2 million CWB endowment set up years ago as a stable source of long-term supplemental support.

Leslie said while yield and kernel color are the most important traits in walnut production, the additional focus of the program in recent years has been on introducing varieties that harvest earlier than Chandler, another UC variety

that was released in 1979. Since that time, Chandler has become the most widely planted walnut variety in the state, commanding half of the walnut acreage and producing nearly 60% of the state’s crop. Harvesting, hulling and drying that huge Chandler crop in a timely manner is a challenge for the walnut industry, and the reason why new productive and high-quality varieties that harvest earlier

Continued on Page 60

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than Chandler are needed.

It is hoped that as UC Wolfskill orchards are planted and mature, they will help fill the roughly two-week harvest window between earlier varieties and Chandler. Pollinizers for UC Wolfskill are Chandler, Howard and Tulare.

Phenology varies a bit depending on the location of the orchard, but Leslie said that leaf-out of UC Wolfskill is about the last week of March and harvest is in the September 23 to 25 range, 12 to 14 days before the Chandler harvest begins.

Goals of the Breeding Program

UC Davis walnut breeder Patrick J. Brown said increasing grower profitability, industry sustainability and staying power, and driving consumer demand are three goals of the Walnut Improvement Program.

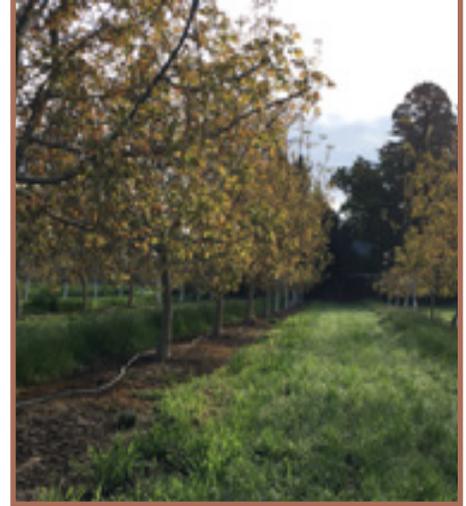
In his presentation for the virtual UCCE Statewide Walnut Series, Brown said that challenges for the program

include developing walnut varieties that have lower chill requirements and blight resistance. Improving walnut shelf life while retaining the health benefits of walnuts is another area where the program is directing research.

Earlier leafing genotypes, including UC Wolfskill, are expected to require less winter chill, Brown explained. Later varieties, including Chandler, have higher chill requirements, which can result in staggered bloom and harvest. In the other direction, late-leafing varieties are better for blight avoidance.

Joe Grant, research director for CWB, said no big surprises are expected with UC Wolfskill moving into commercial production as it is a very 'adaptable' variety and will perform well under a range of environmental conditions and locations in the state's walnut growing regions. Most have been grafted on Paradox rootstocks, but nurseries propagating UC Wolfskill can decide on rootstocks depending on specific growing conditions.

The oldest UC Wolfskill trees are now



Mature trees look similar to Chandler and are upright with open stature (photo by David Norene, Big Time Farming, LLC.)

10 to 12 years old and at the peak of production. The mature trees look similar to Chandler and are upright with open stature. They adapt well to the minimal pruning techniques used in many new orchards, Grant said.

UC Wolfskill is also a high-producing and precocious variety, producing a harvestable crop by year 4 and ramping up to full production by year 9 or 10.

Kernel quality is impressive, Grant said. They are a consistent light color and a fairly large nut with a shelling percentage well over 50%.

"This variety will fill an important window in California walnut production," Grant said. "There are not a lot of good varieties that mature in that time slot.

"Our goal is to be a valued supporter to our grower and handler community by providing funding for research that improves orchard health, yields, and sustainability," he said of the CWB.

Grant said there has been a lot of interest in UC Wolfskill from walnut growers and nurseries. Given the recent soft markets for walnuts, he said it is good to see an uptick in interest in planting new varieties.

UC Wolfskill is now available to California nurseries for propagation in California and sales to growers throughout the state. Nurseries interested in propagating and selling this cultivar may obtain a license from UC Davis InnovationAccess.

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

New, recently pollinated trees were sizing so significantly in the first week of their development that they were already 30% the size of last year's smaller nuts (photo by R. Kreps.)

THE PERFECT STORM SEEMS TO BE rolling into the agricultural mainland. Walnut and almond prices are down, inputs are going up with the petroleum and shipping debacles, water is off the charts (if you can get it) in many districts, and last year's bumper

crops will most likely lead to smaller yields this year. Farmers don't back away from challenges. In most cases, we pull our hats down a little tighter and get ready for the ride ahead. Well, saddle up buckaroos, this ride is going to get wild! Many of my growers' original

concerns with me, specifically as a crop advisor that sells a particular brand of nutrients, revolves around how I am going to help them save money. That concern gets more intense with those of us that peddle less salty and more efficacious nutrients as they tend to cost more. The first conversations this year typically focused on cutting the budget by a specific percentage at each event and planning the season that way. It would most likely make sense by giving the plants a little something at each fertigation or spray and attempting to mitigate the reductions in nutrients and deficit while holding on to profit. Those conversations then turned to a different perspective as I pleaded with my clients to ride that horse on a different saddle.

Growing nut crops has its specific growth and agronomic stages. Shorting them specific nutrients at those stages can be detrimental to optimizing yields. My argument is for not reducing most of your nutrient budget up front.

I recently produced a few short videos showing the significant development of almonds in a very short time (seven to 10 days.) I pulled many of last year's smaller nuts (stick tights) off branches of some fields I just started consulting for this spring. The new, recently pollinated trees were sizing so significantly in the first week of their development that they were already 30% the size of last year's smaller nuts.

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The warm and extended bloom produced an abundance of ‘pollinated nuts’ in most varieties of almonds and, hopefully, will do the same for pistachios and walnuts. If the crop is decent again upfront, those trees are going to need adequate yet specific nutrients to size, develop and avoid being shed.

Cut N but Not P and Ca

Of all the necessary nutrients to cut, if you’re going to do that, it is my recommendation to only reduce your nitrogen budget early. Focus on energy, cell division, cell elongation and nutrient movement with the other big boys, P and Ca. I don’t have many growers that ever skimp on nitrogen. It’s the cheapest nutrient and at the top of the list for crop need. Most, if not all of them, are above adequate levels every July. However, much of that early need is satisfied by what was stored in the roots last fall. Many growers start applying too early and too heavy.

In speaking with other consultants, it is becoming more and more apparent that heavy early N applications may be adding to the early nut shed. It’s not a June drop anymore, but more of a late April/early May drop. Nitrogen pushes a tree to promote more vegetative growth as opposed to a tree making babies. Rank vegetative growth can also increase pest pressure and disease. Nitrate is like a fuel additive early compared to ammoniacal or urea forms of N. It works well with Ca as a synergistic nutrient for cell division and can probably be applied in smaller, more frequent doses. Couple that with alternating shots of P (ortho of course) and micro-nutrients; you not only add proper nutrition but deliver the energy needed to fuel enzymatic reactions as well. As you know, P is critical to creating ATP (energy), and calcium builds cell walls and plant strength. However, they can’t go together in adequate amounts without creating plaster. When you read this article, it will be time to pull your leaves to sample for early levels of N. If you are above adequate (most will be), reduce that N budget and save a few bucks!

Let’s take this a step further. Ca will wedge the ground open and allow for soil flocculation and water penetration. That is why gypsum works well getting water down. The reason it keeps on working is that wall board is very stable and resists breaking down. That is not feeding a plant Ca. Do that with soluble Ca in addition to your gypsum applications. As you open that ground, you create the ability to leach soluble nutrients below the root zone. K, B and Na will do just that: go down like a young cowboy on a rank bull. Especially with long irrigation sets. And the point? Fertigate like it’s an 8-second ride. This isn’t a pack trip; it needs to be quick. If you typically irrigate for 24 hours in a week, break that into three eight-hour sets. Fertigate for 8 hours in the middle set and keep more of that nutrition in the root zone.

This will do four things in-season to save you money: With more nutrition effectively getting into your trees, you can probably cut back a bit on total inputs in season. Wetting and drying the root zone quicker will create more functional aerobic conditions quicker and keep the roots from sitting in water for too long. It also typically keeps deep moisture from subbing up on those longer dry intervals. If you can fertigate from 7 p.m. to 7 a.m., you’ll save a significant amount

Of all the necessary nutrients to cut, if you’re going to do that, it is my recommendation to only reduce your nitrogen budget early.

of money on utility costs as well. Running water at night is much more effective at getting all that precious gold into the earth and not the air. We lose a significant amount of water during the day with our 100-degree F temps. Keep it where it needs to be.

As you take the reins this season, give your trees what they need upfront in short, focused amounts. Start the season with all the adequate nutrition you need through April to divide cells and develop those strong solar panels. Think about cutting back after your April 15 tissue tests are analyzed. The structured, strong leaf expansion without rank growth should also save you money on crop protection products. Weak trees attract bugs. Over-applying one or two nutrients can do that. We have to be lean and mean in years like this and change the way we have typically done things. When the day is done, we may find we have a new favorite horse to ride.

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Soil Microbiome Benefits for Tree Nuts

By **DR. KARL A. WYANT** | Vice President of Ag Science, Heliae Agriculture

WITHOUT A DOUBT, WEST COAST growers are exceptional at producing a wide variety of nuts, including almonds, walnuts and pistachios, that are enjoyed across the globe. Furthermore, progress in advancing best practices in nut crop production, plant breeding programs, nutrient and pest management, and using the latest in agricultural technologies are widely recognized. The next frontier for tree nut growers and their crop advisor partners is to promote new practices that encourage the long-term sustainability of farms for future generations.

Two important components of on-farm sustainability programs are

soil health and soil quality. Soil health refers to the biological integrity of a field and includes practices that optimize the living, biological components of a soil⁶. Soil quality refers to how well an agricultural soil does its “job”, and we often use measurements of soil structure and water storage along with typical measurements of crop yield and quality to keep track of this.

Researchers recognize a strong link between soil health and quality and crop performance. A recent article demonstrates this connection quite clearly and shows the power of committing to a program that builds soil health and quality on the farm³. For

Although soil microbes, including bacteria and fungi, are microscopically small, they can have an enormous impact on the performance of your nut crop and are critical indicators of overall soil health and quality.

example, when California almond growers adapted soil health management practices into their operation, nut yields increased by 10% to 20% over time. These practices include upgrading the irrigation system to double line drip, laying down mulch made from pruned branches, using compost and building out a custom fertilizer program that includes products that help optimize the biological components of a soil. Another important research study shows that practices that help improve soil health and quality, such as reducing tillage, are critical for the long term sustainability of tree nut production².

The remainder of this article will focus on the key connection between soil microbes and tree nuts and how a grower can optimize the living component of their soil by incorporating several practices into their operation (Table 1, see page 67) to help drive soil health and soil quality improvement



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- Influence on soil structure (hyphae)
- Improvement in plant tolerance to stress

BACTERIA

- Improvement in plant available nutrient supply
- Increase in plant access to micronutrients
- Direct influence on soil structure (EPS)
- Improvement in plant stress regulation



Figure 1: How soil microbes (fungi and bacteria) improve tree nut soils and crop performance⁴ (courtesy K. Wyant.)

Continued from Page 64

programs. But first, some agronomy basics on soil microbes and how they positively impact your trees.



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Importance of Soil Microbial Activity

Although soil microbes, including bacteria and fungi, are microscopically small, they can have an enormous impact on the performance of your nut crop and are critical indicators of overall soil health and quality. According to a recent study, soil microbial communities associated with tree crops are critical for their long-term growth and development, particularly under challenging soil conditions^{1,4} (**Fig. 1**). Healthy soil microbial communities are known to help optimize above ground plant productivity, improve the availability of nutrients and water, and mitigate the negative impacts of abiotic stressors (e.g. heat/cold, low/high soil moisture, excess salinity, etc.) and toxic compounds for the associated crop^{4,5}. With this agronomic underpinning, I will outline several key practices a grower

can use to improve the soil microbiome.

Feed the Soil Biology

There are billions of bacteria and fungi in your soil that are waiting to be put to work. All they need is a food source to help jumpstart their activity, particularly in the cooler months when root exudate supply from trees is at a minimum. Root exudates act as a food source but are most available during the warmer months when plant growth rates peak (e.g. June to August). Microbes, on the other hand, can be put to work year-round if given the right food source. Microbial food choices include products derived from microalgae, molasses, grocery store waste, worms and compost teas, among others. Focus on providing the soil microbiome a balanced food source (carbohydrate %, protein %, lipids %, ash %) to help optimize both below ground abundance and species diversity.

Cover Cropping

This practice helps keep living roots in the soil, which can have a positive impact on microbial populations and other measures of soil health and quality. As mentioned above, living roots provide a food source for microbes via carbon 'leaked' from the roots (exudates), and will help maintain the biological component of your soil in the off-season. Keeping the soil covered can also help reduce wind and water erosion and can also reverse the impacts of soil compaction.

Reduce Tillage

Tillage is a critical tool for growers, but it can slice and dice soil microorganisms and their soil habitat, thereby reducing the biological component of your soil over time. No-till or reduced tillage practices helps to keep soil structure and microbial communities intact. By reducing the physical disturbance to the soil habitat, you can promote more biological activity over the long term.

Incorporate Mulches and Compost

These materials provide a bulk carbon and nutrient source to the soil. If your soil samples tend to come back with a Soil Organic Matter (SOM) reading of less than 3%, consider adding more bulk carbon to the soil to help boost this number over time. Soils with a higher SOM% tend to have better aggregate structure, improved water holding capacity and optimized cation exchange holding capacity. This soil carbon building practice takes commitment as increasing the SOM% is a slow process, especially in the warm, dry areas we produce nut crops in. The mulch and compost will not only improve your soil habitat and provide nutrients to the plants, it will also provide a slower release food source for the microbes.

Irrigation Management

This point may seem out of place, but hear me out. Like human beings, microbes have a certain comfort zone for soil moisture. Too dry, they dehydrate and go dormant. Too wet and they

Component

Practice

Feed the soil biology (bacteria and fungi)

Provides the soil microbiome a balanced food source to help optimize abundance and diversity.

Cover Cropping

This practice helps keep living roots in the soil which can have a positive impact on microbial populations and other measures of soil health and quality. Keeping the soil covered can also help reduce wind and water erosion.

Reduce tillage

No-till or reduced tillage helps keep soil structure and microbial communities intact.

Incorporate mulches and compost

These materials provide a bulk carbon and nutrient source to the soil.

Focus on irrigation management and reducing runoff and leaching

Best practices in irrigation and nutrient management help keep microbes alive and keep materials out of local waterways and the groundwater.

Table 1: A brief listing of soil health and quality practices that can be deployed in the field⁵ (courtesy K. Wyant.)

will drown. If you want to optimize your soil microbial community and their potential impact on crop growth, then good irrigation management is crucial. By correcting issues with distribution uniformity and matching irrigation run

times to plant demand and soil type, your microbes will benefit along with your trees. Best practices in irrigation and nutrient management also help

Continued on Page 68

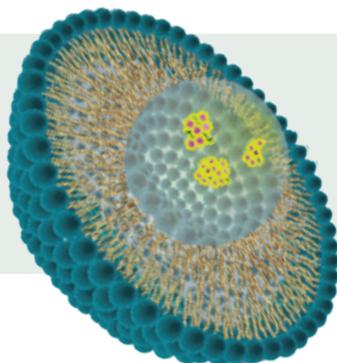
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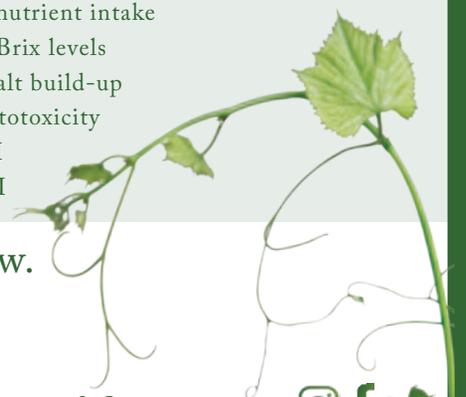


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keep materials on the field and out of local waterways and the groundwater, which is a win/win for everybody.

Closing

Tree nut crops have a clear connection to important soil health and soil quality metrics, including a robust and healthy soil microbiome (bacteria and fungi), good soil structure and the soil's ability to store moisture for crop use during periods of stress (e.g. peak summer irrigation and harvest dry down). Practices that help improve belowground microbial abundance and diversity (**Table 1, see page 67**) should be considered for optimizing the biological components of a soil and their known positive impact on crop growth and production. Furthermore, an improved soil microbiome can influence soil moisture characteristics, which can help push the crop through periods of abiotic stress. Please take a look at the reference

section for some key resources on the connection between tree nut crops and the soil microbiome if you would like to read more.

Dr. Karl Wyant currently oversees the internal and external PhycoTerra® trials, assists with building regenerative agriculture implementation and oversees agronomy training at Heliae Agriculture. To learn more about the future of soil health and regenerative agriculture, you can follow his webinar and blog series at PhycoTerra.com.

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When collecting sample branches, cut the base of the twig at the base of the most current year's growth with at least four inches length using a pair of pruning shears. A total of three shoots, each from three different but similar trees, should be selected for sampling (photos courtesy P. Guzmán Delgado.)

NUT YIELDS LINKED TO TREE CARBOHYDRATE LEVELS

MODEL MAY HELP PREDICT YIELD AND BLOOM DATES IN ALMONDS

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

THE CITIZEN SCIENCE APPROACH AT UC Davis' Carbohydrate Observatory is yielding valuable information for tree nut growers.

Founded by UC Davis plant physiologist Maciej Zwieniecki, the Carbohy-

drate Observatory, part of the 'Z Lab', has received samples from about 600 almond, walnut and pistachio orchards across the state. The samples, sent throughout the year, are being used to track seasonal trends of non-structural

carbohydrate levels over multiple years and gain deeper knowledge of the biological processes within trees. Funding for this research has come from Almond Board of California, California Pistachio Research Board and California Walnut Board.

One of the most important discoveries made thus far is a strong correlation between tree carbohydrate levels and crop yield. Paula Guzmán Delgado, director of the Carbohydrate Observatory, said the information gathered from the samples would also help with development of specific management guidelines for growers, helping them improve production and predict yields.

The purpose of the carbohydrate research is to build a stronger biological understanding of the role carbohydrates play in tree nut production and to use data generated by the twig samples as a yield and bloom prediction tool. Coupled with the effect environmental stresses have on tree health and yield, researchers hope to arm growers with knowledge to improve production.

Presently, results from sample testing are available through a website that participating growers and the public can access. Growers are able to track the carbohydrate levels of their nut trees throughout the year and pair the levels with climate, management or phenological events such as dormancy, pollination, bud break, flowering, fruiting, harvest and leaf drop.

Continued on Page 72

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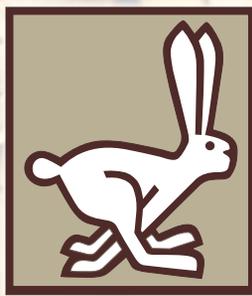
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How Carbohydrates Work

During photosynthesis, carbohydrates are formed as plants convert CO₂ from the atmosphere. A UC Davis report on carbohydrate dynamics in almond trees explains that cellulose, a structural carbohydrate, builds cell walls. Non-structural carbohydrates, or NCSs, support trees as sugars or starches. Sugars are the product of photosynthesis and starch is the storage form of carbohydrates and can be broken down later to provide sugars. NCSs circulate through trees throughout the year, but levels fluctuate with the stage of production. For example, NCSs are depleted during bloom, then build up to assist with new growth and nut fill, then decline until postharvest. Carbohydrate levels in the tree peak in the fall, and the supply is there for the next bloom. Fluctuations of NSC content occur throughout the season and significantly varies between years

due to inherent climatic effects on trees' energy reserves.

UCCE Orchard Systems Farm Advisor Katherine Jarvis-Shean, explained in Sac Valley Orchard News that the carbohydrate level research also helps explain how trees may be counting winter chill and spring heat. By following the amounts of NSC in a plant over time, a better understanding can be reached of how trees are using carbohydrates for vegetative and fruit growth or future challenges including dormancy, defense against pathogens and other stressors.

Bloom Prediction

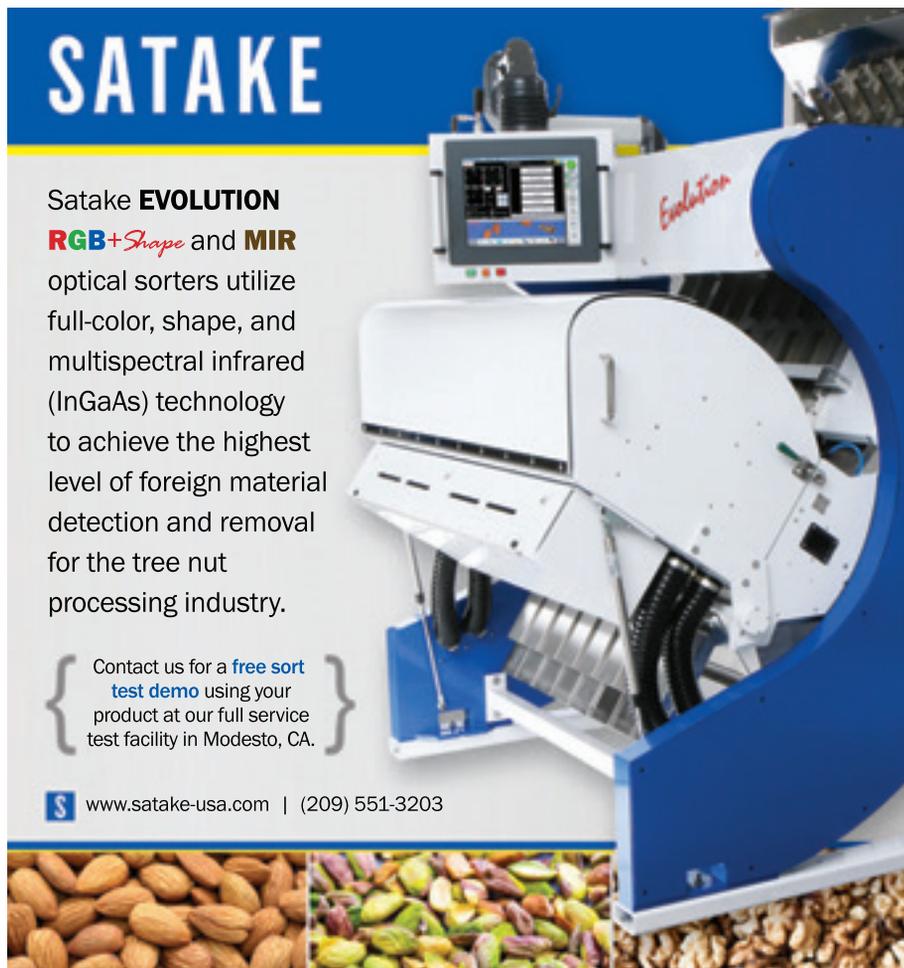
The Carbohydrate Observatory team used 40 years of bloom data to develop a model which uses fall NSC and winter hourly temperatures as inputs. The model provides a physiological framework for bloom forecasts in almond, integrating contrasting notions of chill and heat, and explains why abnormal



Cut portion of the twig of three to four inches with wood and bark separated to be sent for carbohydrate analyses. Growers can put the samples in an envelope in this way and send to the Carbohydrate Observatory.



'The purpose of the carbohydrate research is to build a stronger biological understanding of the role carbohydrates play in tree nut production and to use data generated by the twig samples as a yield and bloom prediction tool.'



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winter temperatures may compromise bloom.

The observatory team quantified NSC throughout the winter in almond, peach and pistachio trees in California and Israel and characterized winter metabolism. The model constructed projects changes in starch and sugar soluble carbohydrate concentrations by temperature-mediated kinetics. The model was tested against 20 years of temperature and phenology records from California.

The model projects a surge in starch synthesis at the end of winter and critically low concentrations of soluble carbohydrates that trigger bloom.

Jarvis-Shean wrote that the Carbohydrate Observatory found that in almonds, walnuts and pistachios, shortly before bud break, there is a surge in starch and lower sugar concentration. She explained that plants regulate sugar concentrations to maintain desirable metabolism and osmotic dynamics within their tissue. The lab used this information along with specific values and thresholds assembled from sampling to create their model for almond bloom timing.

The negative correlation between twig NSC content in the late summer and early fall and yield the following summer implies need for development of postharvest management practices that will assist with improving NSC content prior to natural defoliation.

Fall orchard practices that interrupt NSC accumulation, environmental impacts on NSC accumulation, or disruption of phloem activity during dormancy can lead to significant delay in bud break. Early leaf drop in the fall can delay bud break in the spring.

In a research update provided by Almond Board of California, Zwieniecki noted that high seasonal variation of NSC and starch reserves determined that mid-summer was an important period for reversal in the NSC trend from supply to accumulation of storage. This suggests, he said, that management practices during and postharvest might influence the future performance of an orchard.

Other Conclusions in Pistachio

Alternate bearing can be linked to the accumulation-exhaustion pattern of NSC. This suggests that management practices that reduce the exhaustion of NSC or rapidly restore reserves can lead to a reduction in alternate bearing.

Natural senescence and spring thermal conditions promote NSC redistribution across the tree crown and result in synchronous early bloom.

All conditions that reduce fall NSC content or affect spring redistribution of carbohydrates result in bloom delay and asynchronous bud break.

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EARLY SEASON WATER MANAGEMENT IN WALNUT

PRESSURE CHAMBERS CONTINUE TO BE A GOOD OPTION FOR DETERMINING IRRIGATION TIMING

By **TAYLOR CHALSTROM** | Assistant Editor

WHEN SHOULD GROWERS START irrigating?

“Short answer: wait for the tree to tell you when it needs water,” according to Ken Shackel, professor of irrigation in the UC Davis Department of Plant Sciences. There’s also the questions of how much to irrigate and how to know that it’s working.

Measuring Stem Water Potential

One of the best ways to know when

to irrigate in walnut orchards and other crops is to take a tree’s stem water potential (SWP) through the use of a pressure chamber, according to Kari Arnold, UCCE farm advisor in Stanislaus County.

In a 2021 Virtual Walnut Series presentation, Arnold said that pressure chambers measure tree stress through readings taken during the hot hours of the day. The values collected from the readings are then compared with base-

line values that are specific to a given crop, which are dependent on temperature and relative humidity.

To use a pressure chamber, find the terminal leaflet of the inside branch closest to the tree root between 1 p.m. and 3 p.m., according to Arnold. Next, close off the selected leaf with a foil-formulate bag and leave it on for ten minutes. With the leaf still in the bag, place it inside the pressure chamber

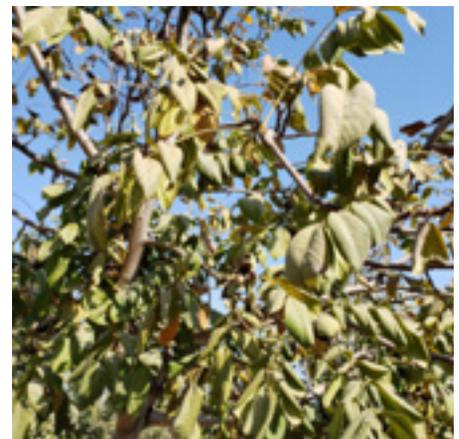
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In walnut trees and other orchard crops, too much water can be the cause of a variety of plant disorders (photos courtesy K. Arnold.)

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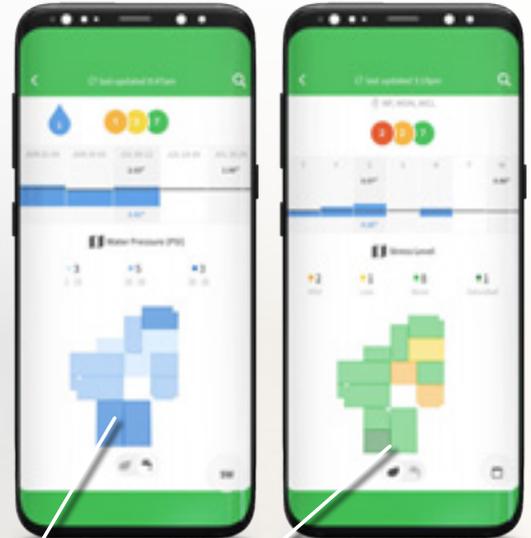
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accordingly and start pumping the chamber to apply pressure to the leaf.

“What happens is that you start to get this bubbling [on the cut stem edge],” Arnold said. “That’s your point where you read the pressure on the leaflet.”

This pressure value shows how much water tension the leaf is experiencing. Once the value on the leaflet is read, it is compared with baseline numbers on a chart (contact your local farm advisor for a baseline chart specific to your crop.) A walnut chart, for example, contains a range of temperature (60 degrees F to 120 degrees F) and humidity (10% to 85%) values plotted against each other to give values of midday SWP measured in bars tension to expect for fully irrigated walnut trees (See Table 1).

“When we start irrigating, we want walnut trees to be between 1 and 2 bars below baseline,” Arnold said. “This is based on previous research that showed that walnut trees behave better and look better when below baseline, and yields are not affected.”

Temp (°F)	Air Relative Humidity															
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
60	3.8	3.7	3.7	3.6	3.6	3.5	3.5	3.4	3.3	3.3	3.2	3.2	3.1	3.1	3.0	2.9
62	3.9	3.8	3.8	3.7	3.7	3.6	3.6	3.5	3.4	3.4	3.3	3.2	3.1	3.1	3.0	2.9
64	4.0	3.9	3.9	3.8	3.7	3.7	3.6	3.5	3.4	3.4	3.3	3.2	3.1	3.1	3.0	2.9
66	4.0	4.0	3.9	3.8	3.8	3.7	3.6	3.5	3.4	3.4	3.3	3.2	3.1	3.1	3.0	2.9
68	4.1	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.4	3.3	3.2	3.1	3.1	3.0	2.9
70	4.2	4.1	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.1	3.1	3.0	2.9
72	4.3	4.2	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.1	3.1	3.0
74	4.4	4.3	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.1	3.1
76	4.5	4.4	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.1
78	4.6	4.5	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2
80	4.7	4.6	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3
82	4.8	4.7	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.4
84	4.9	4.8	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5
86	5.0	4.9	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.6
88	5.1	5.0	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7
90	5.2	5.1	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.8
92	5.3	5.2	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9
94	5.4	5.3	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.0
96	5.5	5.4	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1
98	5.6	5.5	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2
100	5.7	5.6	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3
102	5.8	5.7	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4
104	5.9	5.8	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5
106	6.0	5.9	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6
108	6.1	6.0	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7
110	6.2	6.1	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8
112	6.3	6.2	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9
114	6.4	6.3	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0
116	6.5	6.4	6.4	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1
118	6.6	6.5	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2
120	6.7	6.6	6.6	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3

Table 1: Values of midday stem water potential (SWP in bars tension) to expect for fully irrigated walnut trees under different conditions of air temperature and relative humidity (courtesy K. Shackel.)

When to Irrigate and How Much

Calculating bars from baseline that the leaf is experiencing is simple, and the calculated value tells the grower when the tree is ready for water. First, take the value on the baseline chart for that day’s temperature and humidity and

subtract it from the value on the pressure chamber gauge. If the resulting number is between 1 and 2 bars below baseline (negative number), it is time to “open the flood gates,” according to Arnold.

Determining how much water to apply to an orchard requires some different resources. Arnold noted that UCCE sends out weekly emails that provide evapotranspiration (ET) estimates calculated by the Department of Water Regulations using CIMIS weather station data. These estimates should be used only as a guide for how much water to put down at a given time, according to Arnold, and followed up with SWP measurements.

Follow-up SWP measurements will ensure the effectiveness of a given irrigation in the orchard. “You can take that funky contraction [pressure chamber] back out to the orchard, do the same measurement and see where it sits,” Arnold said.

If a measurement for a walnut tree reads 2 bars above baseline, for example, the trees are well irrigated and do not need to be measured again or irrigated for one to two weeks, according to Arnold. Arnold noted that growers do not need to regularly irrigate to two bars above baseline, however.

“Most times, trees rebound to baseline and don’t go much further,” she said. “UCCE advisors are happy to help further with questions and values.”

Soil Moisture Depletion

In a previous article from the October 2020 edition of *West Coast Nut*, Allan Fulton, UCCE farm advisor emeritus in Tehama County, said that pressure chambers aren’t a standalone solution for irrigation; rather, they complement other tools like soil moisture sensor readings as well as aforementioned ET estimates.

Soil sensors don’t provide the “when” and “how much” like pressure chambers and ET estimates do, but they do provide indications of where water is being taken up by the root

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Pressure chambers are an excellent tool to measure the stem water potential of tree leaves and determine when a tree needs to be irrigated (photo courtesy K. Arnold.)



When pumping the leaf inside the pressure chamber, bubbling will occur on the cut stem edge. This means the gauge value is ready to be measured (video screenshot courtesy Cameron Zuber, UCCE.)

system and where in the soil profile it is being depleted, which dictates the effectiveness of an irrigation set.

In a 2019 study done in a Central Valley walnut orchard, Arnold and other researchers placed a soil sensor at depths of 18 inches and 36 inches to measure where moisture was being

depleted. Between March and December of that season, according to Arnold, they found that more moisture was depleted over time with each irrigation set at the 3-foot depth.

“A number of researchers have actually seen that walnuts do better in situations where moisture is being depleted at about three to four feet below the soil line,” Arnold said.

Pressure Chamber Adoption

Although use of pressure chambers has been proven through research to be a beneficial irrigation management practice, Shackel, who has been promoting the device for almost three decades, said in a previous *West Coast Nut* article that the industry has been slow to catch on.

“I’ve been saying, ‘This is a really good tool,’ but it’s really taken a lot of time to catch on,” he said. “The main resistance to it is people regard it as a scientific instrument and say it’s too detailed. There tends to be a little bit of bias against a monitoring tool that requires hand labor.”

According to the same article, a recent survey by the California Department of Food and Agriculture’s Fertilizer Research and Education Program noted about 16% pressure chamber use in perennial crops.

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OPTIMISM AND CALL FOR UNITY AT RECENT WALNUT INDUSTRY CONFERENCE

By MARNI KATZ | Editor

SPEAKERS AT THE CALIFORNIA WALNUT Board's virtual industry conference expressed optimism despite the challenge of low prices, buoyed by a positive marketing outlook once trade and COVID disruptions normalize and the supply demand curve begins to stabilize.

Over the last decade, walnut production has grown in California to a record this year of 784,000 tons—a 19% increase over the previous year's production. New plantings mean an additional 54,000 tons will come into production over the next four years, bringing a projected California crop of 835,000 tons on 435,000 acres, said Michelle Connelly, CEO of the California Marketing Board and Commission.

Add to that increased competition from other walnut producing countries, such as Chile and China, and the industry will have more nuts to move in increasingly competitive international markets. Connelly said the Board and Commission are strategically targeting their research, regulatory and marketing programs with this future production and competition in mind.

In addition to developing a five-year goal of moving an additional 196,000 tons, the Walnut Board is funding production research to protect the profitability of growing walnuts and postharvest research to protect the marketability and selling walnuts.

"As you know, it's been a very difficult year, and it's going to take all of us working together to move us forward," Connelly said.

Handler Optimism

"We have an optimistic outlook in the long term, even though we are facing near-term hurdles right now" said Jack Mariani of Mariani Nut Company in Winters, Calif.

California walnut growers recently approved an amendment to the federal marketing order that provides walnut

handlers a credit back for their own targeted marketing and promotions of 70 cents for every dollar spent.

Mariani said the new credit back provision will have multiple benefits to the industry and allow processors to target their investments into new products and new areas.

"We expect credit back to make a significant contribution in expanding walnut sales and consumption," Mariani said, following his presentation. "A handler can now focus specifically on an individual product or more in what they feel is worth investing their own marketing dollars.

"This is especially important in new product development like flavored walnuts, walnut butter and walnut milk," he continued. "These are all areas where walnuts are underrepresented in the market and where substantial sales growth is possible with targeted marketing."

Chuck Crain, a grower and processor with Crain Orchards Inc. and Crain Walnut Shelling in Los Molinas, Calif., said recent home baking trends have boosted regional business and that the industry should be able to maintain those higher levels of retail consumption even as foodservice channels normalize once restaurants open and trade barriers are reduced.

"Obviously these are difficult times with grower prices at a level below the cost of production. We need to remedy it as fast as we can using all the tools in our toolbox," Crain said. "And we do much better working together as we can working independently."

Laurie Demeritt of the Hartman Group discussed some of the changes in the retail sector that could help position California walnuts well.

She noted that 84% of respondents in a recent study on food sourcing had changed the way they shop in the last year. Shoppers are price conscious and also focused on supporting local

businesses and workers. They are also revisiting "center store" food categories in the search for shelf-stable ingredients. Demeritt said the walnut industry needs to ensure its packaging ensures products stay fresh, healthy and safe.

Darci Vetter, a leading expert on agricultural trade issues with Edelman, discussed trade policy and the outlook for easing trade tensions given the new administration's worker-centric and "America first" trade policy. Those policies are likely to bolster domestic production, she said. In the short term, she said tariffs and retaliatory tariffs with China are likely to remain in place as new trade policies are developed with those priorities and the environment and human rights issues in mind. It is likely the U.S. will be more engaged in multilateral trade agreements moving forward, however.

Chuck Conner with the National Council of Farmer Cooperatives said climate change is also likely to play a large part in the new Biden administration, and agricultural groups should not hesitate to find a seat at the table.

Conner is part of the Food and Agriculture Climate Alliance, which includes ag, forestry, food and environmental groups all working together to help guide policy. Ideally, he said, being part of the solution will help develop climate policies that can actually enhance farm income, such as technical assistance and cost-share programs to implement new climate-friendly technologies.

"I actually welcome the climate debate in the Congress," Conner said.

"If we're not at the table, we're on the menu," added Bill Carriere, a fourth-generation farmer from Glenn, Calif.

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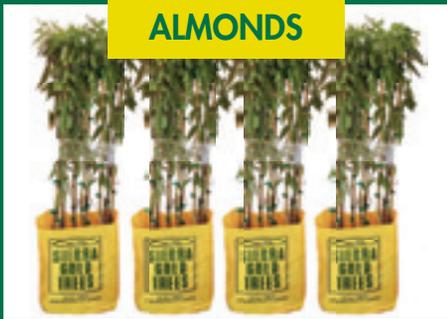
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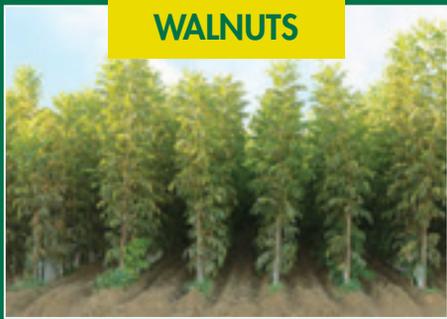
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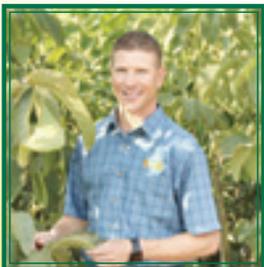
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DON'T UNDERESTIMATE FORM I-9

PRACTICAL GUIDANCE FOR EMPLOYERS

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

AS YOU BEGIN TO PREPARE FOR SEASONAL HIRES, INITIATE A new best practice this year and review your new hire check list and required employee forms. In your new hire packet, there is one form in particular that gives countless employers issues, and the fines for administrative errors can cost companies thousands of dollars. The Form I-9 on the surface does not look complicated to complete, however there are a number of common mistakes employers make on a regular basis. In this article we will review the essential elements of the Form I-9, the most common mistakes and best practices to ensure your compliance.

The red circles on the Form I-9 depict some of the areas in which employers commonly have errors. Ensure you have the correct version of the form, the employee inputs the date correctly (mm/dd/yyyy) and provides their signature in Section 1 (courtesy AgSafe.)

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Background

The U.S. Citizen and Immigration Service (USCIS) utilizes the Form I-9 to verify the identity and employment authorization of individuals hired for employment in the U.S. All U.S. employers must ensure proper completion of the form for each individual hired for employment in the U.S., including citizens and noncitizens. All employers must complete and retain the I-9 for every person they hire for employment after November 6, 1986 in the U.S. as long as the person works for pay or another type of payment. Form I-9 is required to be completed for part time, full time, regular, seasonal and temporary employees.

Essential Form Elements

First and foremost, before you begin filling out Form I-9, it is important to confirm you have the correct version. The date edition of the current form is 10/21/2019 and the form's expiration date, which is 10/31/2022, can be found on the upper right-hand corner of the document. The form is divided into three sections: the first section is for your employee to complete, the second section is for the employer and the third section is reserved for rehires or reverification. The employee should fill out Section 1 at the time of hire, which should be no later than the first day that their pay begins. If the employee has literacy or language issues, an employer representative can help, but remember that anyone who assists with the preparation/translation of this form is required to fill out the "Preparer and/or Translator Certification" located below the employee signature.

In Section 2, the employer is responsible for ensuring this portion is completed no later than three business days after the employee's first day. Additionally, as an employer, you should provide clear instruction on documentation options employees can use to comply with employment verification requirements. It is important that employees understand the Form I-9 directions and they present a document from List A or a document from List B and List C to satisfy USCIS requirements. Employers are strictly prohibited from directing

employees on what type of document to present to demonstrate employment eligibility.

Common Mistakes

There are more than a dozen common mistakes employers make when completing the Form I-9. While these mistakes may seem minor, they could result in fines if USCIS were to conduct an audit.

- Failure to fill out Form I-9 for current employees.
- Missing digits on dates. All dates on the form must be documented in the following format: mm/dd/yyyy.
- Providing P.O. Box information rather than a physical address.

Continued on Page 82

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- Missing employee or employer signature.
- Failure to complete Section 2 within the three business days from the date of hire.
- Improperly completing Section 2 documents (incomplete information or too much information, not examining acceptable documents or listing expired documents.)
- Failure to audit Form I-9s for administrative errors on an annual basis.
- Inability to write information requested legibly on form.
- Failure to provide Form I-9 to ICE when requested for audit (usually

within 72 hours.)

- Illegible forms because of use of pencils or gel pens to complete. Black or blue pen colors are recommended when filling out the form. A PDF-fillable form is available for easier completion.
- Utilizing a highlighter or white out on the form.

Another critical element of the Form I-9 involves the correct storage of these documents. Forms must be on file for all current employees and stored securely in a way that meets your business needs. Because these forms contain personal information, only authorized employees should have access to these documents. Additionally, as mentioned previously, these documents must be made available within three days of an official request for inspection by ICE.

Another frequently asked question involves how long the Form I-9 must be kept after an individual is no longer employed. If an employee worked for less than two years, then you must retain the form for three years after the date entered in as the first day of employment. However, if you have an employee who has worked for more than two years, you must retain their form for one year after the date they stopped working for you.

For additional details on the Form I-9, please visit USCIS at uscis.gov/i-9central. If you should have specific questions regarding your Form I-9 or your hiring best practices, please contact the AgSafe team at 209-526-4400 or email safeinfo@agsafe.org.

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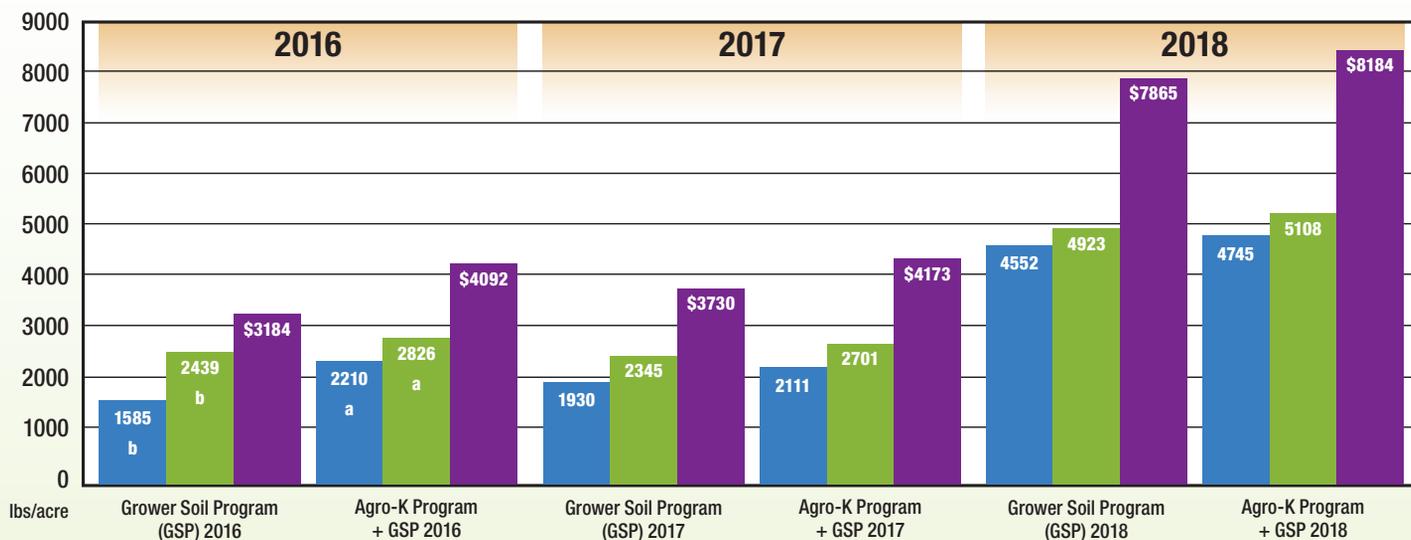


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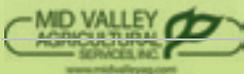
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DON CAMERON MARKING 40 YEARS OF TRYING SOMETHING NEW

By **SABRINA HALVORSON** | Contributing Writer



PRESIDENT OF THE CALIFORNIA STATE Board of Food and Agriculture, 2017 Agriculturist of the Year, Chairman for the California Cotton Alliance, Director and past chairman for the California Tomato Growers Association, director for Western Growers Association, Raisin City Water District, and the list goes on. Don Cameron has held so many distinctive positions within the agriculture community, it's almost hard to believe he didn't originally intend to become a farmer.

"I had always wanted to work outdoors and originally wanted to go into wildlife management," he said over the phone as he traveled from one commitment to another. "The story is pretty simple. I actually worked after college for six months out of Mendota Wildlife Refuge as a seasonal aide. I took the state test to become a full-time employee and got a little card back that said 'Congratulations, you passed the test. However, you weren't randomly drawn by our computer for an interview.'"

That was the end of Cameron's wildlife management career. Still in need of a job, he tried something new and applied where a friend worked. He was hired to work with the farm advisors at the Fresno County UC extension office. That was in the 1970's, and it was the start of a long and expansive career in agriculture.

Meaningful Contributions

This month, Cameron is celebrating 40 years at Terranova Ranch Inc. in the central San Joaquin Valley. When he

was hired in April 1981, the farm was much different from the 6,000 acres of diversified crops it is today.

"It was much smaller when it opened in 1979. I had actually been doing work for the previous owner there," he said. "I was really familiar with the area here. It was a natural fit, but I had a lot to learn. As you know, farming is very complex, but I thought I had a really good background."

With his degree in Biology from California State University, Fresno and his experience at the extension office, Cameron already had a wide knowledge of soil, water and plant tissue. That knowledge was the initial foundation on which he built innovative conservation practices used at Terranova.

"I think having a fresh look at what we were doing was really important. We became very innovative. We try different things," Cameron explained. "I wasn't afraid to try different things that maybe other people would be a little hesitant to try. Maybe it was because of my lack of experience that I was freshly looking at the way things are being done."

When Cameron came on board in the 1980s, Terranova primarily grew cotton and wine grapes. In the early 2000s, the farm started adding in a wider variety of crops, with a focus on crops that were not widely grown by other farms. Today, there are more than 25 different crops produced at Terranova, including organic, conventional and biotech products.

"We looked for different crops that



would be more profitable. Crops that a lot of other people didn't want to grow or found too difficult to grow, we tried it," said Cameron, Terranova's vice president and general manager. "A lot of them were successful and some of them weren't, but we did try a lot of different crops over the years."

He said one of the biggest changes came in 2009 when the farm invested in subsurface drip irrigation. He explained the irrigation was more uniform and led to better production for the crops they were growing. The farm also removed some of the wine grape acreage because of the highly variable market and started planting tree crops including almonds, walnuts and pistachios.

"We found that being diverse stabilized our income," he said. That wasn't the only benefit Cameron found. He believes the farm's crop rotation is also helping with disease and pest control.

That rotation includes dozens of crops spread over the 6,000-acre farm. The top crop by acreage is processing

tomatoes, but you will also find carrots, onions, peppers and seed crops to name a few. The farm also has about 900 acres in organic production with crops including tomatoes, garlic, peppers, wheat, alfalfa, corn for rotation and several organic crops for seed.

“There’s more risk in organic production, but we feel like we do pretty good with it. We have a good program in place. Some of the things we learn with organic we use in the conventional crops and vice versa,” he said. “Different farming techniques. If it works well in one, we’ll transfer it to the other.”

Water: A Constant Need

With all the changes and transformations the farm has seen, one thing stays constant: the need for water.

“The primary source of water for growers in our areas is groundwater. But prior to GSA formation, prior to the groundwater sustainability law going into effect in 2014, we realized we couldn’t pump the groundwater forever,” Cameron said. “We were seeing declining levels. We’ve seen at least a foot of decline in elevation every year. I figured out that if we didn’t do something about it, we wouldn’t be farming long-term. And so, over the years, we’ve been capturing floodwater and using it instead of pumping the water from underground. If floodwater was available, we’d use that in place of groundwater.”

That started Cameron’s groundwater recharging project. In 2010, officials from the Natural Resources Conservation Service (NRCS) heard about the project and suggested Cameron apply for a Conservation Innovation grant. He applied and received a grant, which he said started the farm down the path of actively using floodwater to grow crops such as almonds, walnuts, wine grapes, pistachios, olives and open ground.

“From that, we documented the inflows and the water levels below these fields and saw that we could actually flood actively growing fields and increase the water table below them,” he said.

They then worked with grant writer Phil Bachand and the Kings River

Continued on Page 86

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Conservation District to submit a grant to the Department of Water Resources and received a floodwater corridor grant. Cameron said the intent is to take water off of the river during flood periods and divert it to the farm. There is a dual benefit to the plan. While providing needed water to the farm, it also prevents flood damage to areas downstream of the project.

“It took until last year to complete

the whole phase one of this grant with the Department of Water Resources. As you can expect, the costs went way up during the lengthy planning and construction of the project. We thought it was important and would benefit not only our farm, but additional acres and farms within our region. So, we built it large enough for other projects to be attached to it and really take advantage of the floodwater that came down and flooded the Kings River,” Cameron explained.

Phase One is complete. Phase Two is receiving funding from a grant through the Raisin City Water District from NRCS. Cameron said the project is ongoing with plans for completion in a couple of years. With the project moving forward, the only thing missing is the water. California continues to be drier than average, and there has not been much opportunity for floodwater capture in recent months. Still, Cameron is a farmer and farming requires optimism.

“We know that it will flood. We know it’ll flood again. We know we’re going to have continual drought throughout California, and with climate change, we’re probably going to see more extremes going down the road,” Cameron said.

With more than 40 years of farming under his belt, Cameron has seen floods and droughts come and go, along with many other aspects of working the land. When asked what wisdom he would give to a farmer who is considering trying something new, he said he would encourage them to take a risk.

“We all take risks in everything we do as farmers,” he said. “You have to weigh the benefit against the risk and balance it. Try it on a small scale, and if it works, you can expand it.”

Cameron has had the opportunity to try many new things during his career and has seen at least one of his experiments become something that has the potential to benefit farmers around the state well into the future.

“What’s really been interesting is, working with UC Davis, working with Stanford, working with Department of Water Resources and Department of Pesticide Regulation, our project has been the example of what can be done in stormwater and floodwater capture throughout the state,” he said.

And it all started with trying something new.

Sabrina Halvorson is the host of the MyAgLife Daily News Report. Hear the full interview with Don Cameron in the April 1st MyAgLife Daily News Report at myaglife.com or on the MyAgLife app.

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