

WEST COAST NUT

MARCH 2019 ISSUE

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Plant Uses and Field
Application**

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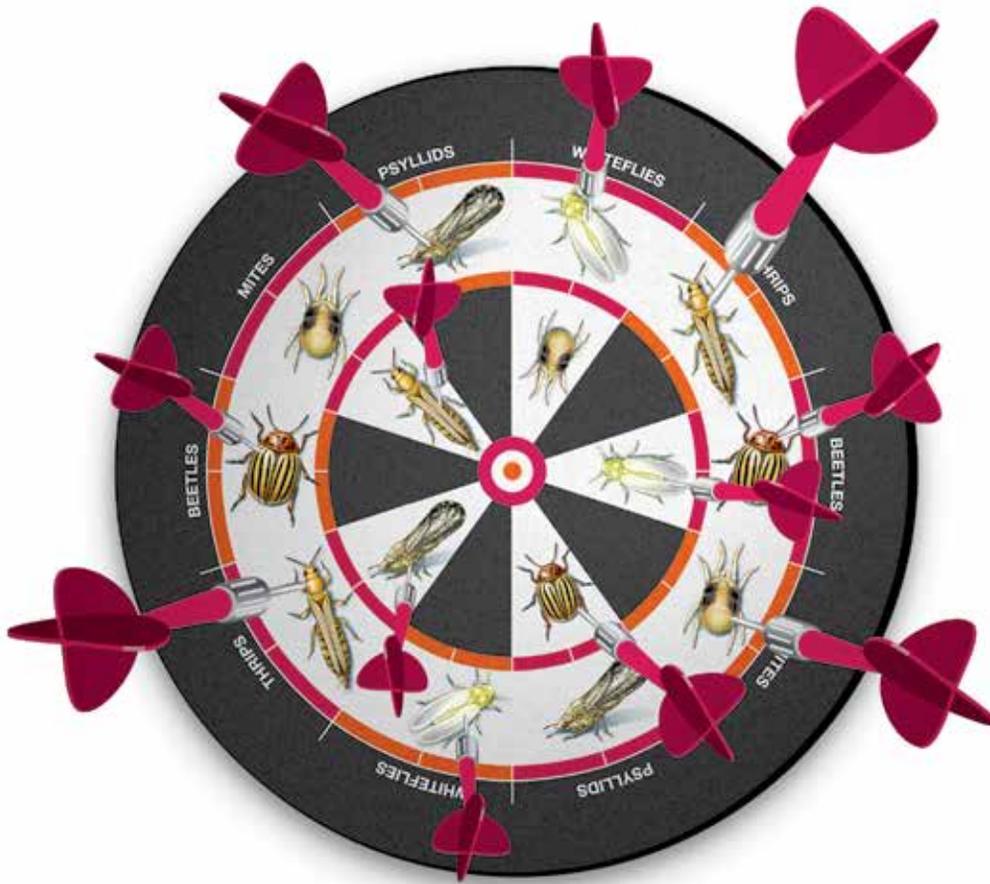
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Potassium in Nut Crops: Plant Uses and Field Application

All tree crops need potassium (K), however its high cost, difficulty in management in some soils, and a sometimes apparent lack of a response to added K has resulted in incomplete adoption of potassium fertilization programs in orchard crops. It is an unusual nutrient in that it is not incorporated into plant tissues. Its role in the plant is primarily relegated to maintaining cellular ion balances, particularly in the stomata, and is an activator of many enzymes.

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Update on Sterile Insect Program for Control of Navel Orangeworm

By HOUSTON WILSON | Asst. Coop. Extension Specialist, Kearney Ag. Center, Dept. Entomology, UC Riverside
and By CHUCK BURKS | Research Entomologist, USDA-ARS, San Joaquin Valley Agricultural Sciences Center

STERILE INSECT TECHNIQUE (SIT) makes use of large numbers of sterile insects which are released into wild populations as part of an area-wide integrated pest management (IPM) control strategy. Insects are typically mass-reared in a controlled environment and then ionizing radiation (e.g. x-rays, gamma rays) is used to induce genetic mutations that lead to sterility. The basic idea is that introduction of sterilized individuals into the wild population will limit the successful reproduction of wild individuals and lead to an overall reduction or even eradication of the target pest population (Knipling 1955). Mating with sterile individuals can reduce populations by either directly blocking reproduction or through inherited sterility in which offspring are actually produced but are themselves sterile (North 1975). Releases can include both males and females, although some programs utilize just one sex, and this is typically due to specific biological or ecological requirements.

The concept of using sterilized

insects to control wild pest populations was first conceived in the 1930s and 1940s. Implementation took place in the 1950s, when the first area-wide SIT program was successfully carried out to control the New World screwworm (*Cochliomyia hominivorax*), a pest of livestock in the southeastern United States and Caribbean. Since then, SIT has been used to control a number of endemic and invasive agricultural pests. This includes a lot of programs for various Tephritid flies such as the Mexican fruit fly (*Anastrepha ludens*) in southern California, melon fly (*Bactrocera cucurbitae*) in Japan, and Mediterranean fruit fly (*Ceratitis capitata*) in various locations across the globe. As for lepidopterans specifically, successful programs have been developed for the pink bollworm (*Pectinophora gossypiella*) and codling moth (*Cydia pomonella*) in the southwest United States and British Columbia, respectively (Klassen and Curtis 2005).

SIT programs can either be for pest suppression or total eradication,



Irradiated and unirradiated females were paired together to evaluate attractiveness to wild males. Photos Courtesy of Houston Wilson.



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depending on context and needs. Furthermore, in most cases release of sterile moths is typically complimented by a range of additional IPM (integrated pest management) strategies. For instance, the pink bollworm program was an eradication effort that included mating disruption, coordinated plow down and *Bt* cotton in addition to release of sterile moths. Alternatively, the codling moth program in British Columbia is a suppression effort that also includes mating disruption and sanitation.

The basis for any successful SIT program hinges on the ability to rear, irradiate/sterilize and release large quantities of the target pest without impacting their viability and

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SIT programs can either be for pest suppression or total eradication, depending on context and needs.

Plane dropping moths over a pistachio orchard. Photo Courtesy of Houston Wilson.

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performance in the field relative to the wild population (Simmons et al. 2010). Other important factors include the development of accurate monitoring tools (i.e. both traps and some form of marking the sterile moths) and determination of the appropriate overflooding ratio (i.e. the per acre ratio of sterile to wild moths needed to successfully reduce pest populations and crop damage).

Opportunity to Use SIT for NOW Control

In 1968, the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service Plant Protection and Quarantine program (APHIS-PPQ) developed a mass-rearing and irradiation facility near Phoenix, Arizona.

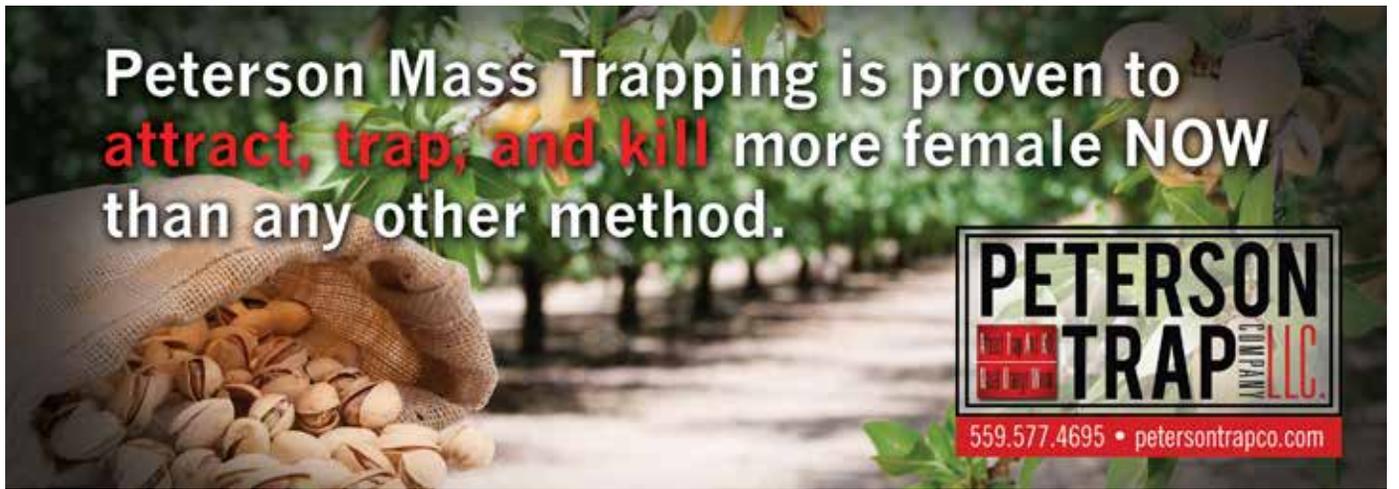
The Phoenix Pink Bollworm Rearing Facility (PPBR Facility) supported the pink bollworm eradication effort across the southwest U.S., northern Mexico and California's San Joaquin Valley (Henneberry and Naranjo 1998, Walters et al. 2000). As mentioned, this was an area-wide program that involved multiple IPM strategies including release of sterile pink bollworm. After more than 40 years of effort, the pink bollworm has been eradicated and the PPBR Facility is now available to be used for mass rearing and irradiation of another lepidopteran species, such as the navel orangeworm (*Amyelois transitella*). As such, the California pistachio industry recently partnered with USDA-APHIS to explore the use of SIT for control of navel orangeworm (NOW) and, since 2016, efforts have been underway to adapt the PPBR Facility for production and irradiation of NOW. The first

trial shipments of irradiated NOW to California were made in 2017 and production is now sufficient to support field-based evaluations of irradiated/sterilized NOW.

Field Trials in California

The PPBR Facility can currently produce and irradiate approximately 750,000 adult moths/day (50:50 male:female). These moths are shipped in specialized "cartridges" that can be loaded into a modified California Department of Food and Agriculture (CDFA) airplane for aerial release 500 feet above an orchard. The NOW larvae are raised on a diet that contains a fat-soluble dye that carries over to the adult stage. The sterile adult moths are therefore dyed internally and NOW captured in the field can be dissected

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to determine whether they are wild or sterile released moths.

In 2018 aerial release of irradiated/sterile moths initially took place over 1,900 acres of mostly contiguous pistachio and some almond orchards located in Kern County, all of which were conventionally managed and included mating disruption. Between April and October, cartridges of NOW were shipped daily (Mon-Sat) from the PPBR Facility to a CDEA facility in Shafter, California. There, moth cartridges were loaded into the modified plane and released at sunrise over the orchards. Male NOW were monitored with pheromone traps across the release area and in an adjacent no-release area. This aspect of the 2018 NOW-SIT program was mostly a logistical exercise to refine the production, shipping and release process as well as explore how to integrate SIT with a standard IPM program that included mating disruption.

In June 2018, weekly shipments of approximately 6,000 moths were sent to the University of California (UC) Kearney Agricultural Research and Extension Center (Parlier, California) for ground release into a two-acre pistachio block that was practically unmanaged (i.e. no sprays, sanitation or mating disruption). This effort was an attempt to monitor recovery and mating success of the sterile moths. NOW were monitored with both pheromone and phenyl-propionate traps (PPO). Additionally, mating success of the sterile moths was monitored using mating tables, in which a single virgin female NOW was placed out in the orchard overnight and checked the following day to determine whether or not she mated with a wild or sterile male NOW. These sentinel moths included both irradiated and non-irradiated females. Finally, at one point the virgin female moths were observed 1x/hour over a 72-hour period in order to determine if the irradiated female NOW

mated at the same time as non-irradiated females.

Starting in July 2018, the regular Monday aerial release planned for the 1,900 acres in Kern County was redirected to a commercial field site close to Kettleman City that was conventionally managed but did not include mating disruption. This site consisted of a 640-acre section of land with 160-acre blocks of pistachios in the northwest, northeast and southeast. The southwest section was a 160-acre block of almonds. Sterile moths were released into the northeast block of pistachios and then moth dispersal monitored with a grid of pheromone traps spread evenly over the entire 640 acres. These releases were conducted every Monday for a four-week period, then paused for two weeks, then reinitiated for another four weeks. This on-off cycle was repeated three times through October 15.

Results

Overall, in 2018 the pilot releases
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of sterilized NOW had mixed success. Very few moths were recovered in pheromone or PPO traps at any of the research sites (0.24 – 0.35 percent of all captured moths were sterile), although the few sterile moths recovered in the 640-acre block did appear to be dispersing outside of the release area. There was also evidence of dispersal over distances of up to a mile by a few NOW of both sexes in the pilot releases in Kern County. The sterile females did appear to effectively attract wild males and seemed to call and mate at approximately the same time as non-irradiated NOW females, but no sterile males were ever recovered in the mating tables.

As a whole, data from 2018 indicate that sterile males did not respond normally to synthetic pheromone or PPO lures placed in traps, or to natural pheromone emitted by the virgin females in the mating tables. In contrast, the sterile females did seem to behave relatively similar to non-irradiated females and successfully attracted wild males. Finally, the pilot program demonstrated that large quantities of moths could be successfully reared, shipped and released over a broad area in Kern County, although recovery was complicated by the presence of mating disruption.



Plane dropping moths over a pistachio orchard. Photo Courtesy of Houston Wilson.

Future Directions

There are multiple factors that could potentially explain the performance of the sterile NOW in 2018, such as the radiation dose, mass-rearing process, shipping conditions

and/or release methodology. These are all very common problems in SIT programs that must be refined specifically for each unique target organism. Exposure to greater radiation levels maximizes the sterilization effect, but also increases the probability of negative impacts on moth performance. It may be that a lower dose of radiation is needed that presents an acceptable tradeoff between moth performance and sterility levels. At the same time, mass-rearing processes create a very artificial environment that, in some cases, can select for moths better suited to the rearing environment than to the field. For example, mass-rearing of some tephritid flies has sometimes led to loss of wing-development and flight ability. In such cases these problems require modification to the rearing process itself. Shipping conditions could interfere with NOW behavior by altering the photoperiod, temperature and/or pressure over time, which can impact moth health and behavior. Finally, moth release from the modified plane takes place at dawn, with the plane flying at about 500 ft altitude and 100 mph. Release of the moths at this speed could potentially lead to wing damage (or other damage) and the dawn release is just at the end of their activity period (NOW are nocturnal, active between midnight and sunrise, with

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most mating taking place about two to three hours before dawn). These and other potential factors effecting sterile moth performance are not necessarily mutually exclusive; one or several of these factors may be relevant.

In 2019, research efforts will focus on modifications to the radiation dose, mass-rearing conditions and shipping protocols in order to see if it is possible to develop a rearing, irradiation and shipping process that produces a competitive sterile moth. High-throughput laboratory assays will be used to rapidly screen moths subjected to changes in these various aspects of production and transport. If improved moth performance is observed in the laboratory, moths will then be brought to the field for small-plot releases to evaluate dispersal and mating success.

Developing the use of SIT for any given insect species is an incremental and time-consuming process. Both the pink bollworm and codling moth programs required multiple decades of work to refine the production and release methodologies and, as such, we should expect no less for this current NOW SIT program. Furthermore, these other moth SIT

programs also included various additional IPM components such as sanitation, mating disruption and *Bt* crops—all of which was carried out as part of an area-wide IPM program that required coordination and cooperation between growers, researchers and program personnel.

Can SIT be effectively developed as a control strategy for NOW? We don't know yet, but the availability of the PPBR Facility has presented a unique opportunity to explore a novel control strategy that could possibly complement current

Developing the use of SIT for any given insect species is an incremental and time-consuming process.

IPM strategies. Make no mistake, sanitation remains the foundation of NOW control, along with monitoring, well-

timed sprays, early/timely harvest and, more recently, mating disruption. With more than 1.5 million acres of almonds, pistachios and walnuts in California, plus many additional acres of alternate crop and non-crop hosts, the ability to produce enough sterile NOW to blanket the entire state presents a significant challenge. In this way, the sterile NOW program will not be a stand-alone technology. If a competitive moth can be produced and research can then determine the adequate overflooding ratio as well as timing and method of release, the next step would be to then develop decision models to identify priority release areas for the sterile moths. While the development of an effective SIT program clearly requires the successful completion of many incremental steps, this is an exciting opportunity that merits further evaluation, as it could potentially lead to significant reductions in NOW populations and crop damage.

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Potassium in Nut Crops: Plant Uses and Field Application

By PHOEBE GORDON and FRANZ NIEDERHOLZER | Contributing Writer



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Potassium in Plants and Soils

ALL TREE CROPS NEED POTASSIUM (K), however its high cost, difficulty in management in some soils, and a sometimes apparent lack of a response to added K has resulted in incomplete adoption of potassium fertilization programs in orchard crops. It is an unusual nutrient in that it is not incorporated into plant tissues. Its role in the plant is primarily relegated to maintaining cellular ion balances, particularly in the stomata, and is an activator of many enzymes.

Symptoms of potassium deficiency differ by species, but many symptoms are similar or the same: deficiency symptoms appear in the summer as the growing crop demands more potassium, which may

be supplied from surrounding leaves and branches. Leaves will curl up, their color may become pale, leaves may become smaller, yield may decrease, and leaf margins may become necrotic. There may be more specific symptoms for each crop plant, but we won't spend time going over each one in detail here.

Crop	Critical Value (percentage)	Adequate (percentage)
Almonds	1.0	> 1.4
Pistachios	1.6	1.8 – 2.0
Walnuts	<0.9	> 1.2

Potassium is held in three different pools in the soil: most is found as a part of the primary minerals in soil and not plant available when considering an annual K fertility program. A smaller pool is bound to the cation exchange capacity (CEC), and an even smaller amount is found in the soil solution. The last two can be quantified by soil fertility tests, typically an ammonium acetate test.

Potassium is immobile in soils, as it binds to the cation exchange capacity or can be fixed by soil minerals, both processes of which are described below. However, in coarse textured soils with low CECs, or in soils in which you apply other cations on top of a potassium application, (a gypsum application on top of a potassium application, for instance), potassium can move deeper into the soil. This can be beneficial in heavy-textured soils if you want potassium to move into the root zone, but in a low CEC sandy soil, fertilizer K can be leached out of the root zone.

The CEC is a measure of the soil's ability to hold onto positively charged ions. It is generated by weathering of soil particles, where negatively charged surfaces are exposed, among other factors. Because it is dependent on surface area, the only soil solids that meaningfully contribute to the CEC are clays and organic matter, both of which have large surface areas.

Cations, which are positively charged molecules that are released into solution when salts dissolve, are not permanently bound to the CEC. They are in flux with the soil solution, so large inputs of one type of cation (sodium, for instance) can result in the CEC being dominated by that cation. Similarly, intensive crop production without applications of fertilizer can result in the CEC being depleted of nutrients.

Potassium Fixing Soils

Potassium fixation is an issue on the eastern side of the Central Valley, primarily the Southern San Joaquin Valley. It occurs in soils derived from granitic parent material from the

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Sierra Nevada, which contains vermiculite. Soils on the west side of the valley are more likely to be derived from the coastal range, and they do not fix potassium as much as east-side soils. Potassium ions can become trapped between sheets of vermiculite, and once it is fixed it is unavailable for uptake by the plant.

This potassium will eventually be released, however, and become available for uptake but the rate of release is soil dependent. For our purposes, we'll consider it unavailable for uptake in a growing season. This release makes the ammonium acetate soil test less reliable

in potassium fixing soils, as the test does not reflect the potential for the release of fixed K. In potassium fixing soils, you either need to band potassium to overwhelm the fixing abilities of the soil, or apply potassium throughout the season, targeting when the trees need the nutrient the most. For example, in pistachios, this would be approximately between April and August, which is during fruit development and nut fill, when over 90 percent of the potassium needed by the trees is taken up. If potassium is applied outside of tree demand, it should be banded to overcome potassium fixation in the soil.

Research Done Showing Positive Responses to K

In the past, research looked at applying extremely high rates, such as 1500 lbs of KCl/acre, to remediate deficient orchards. However, results from the 80s in walnuts done by Olsen, Uriu, and Pearson

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indicated that it was better to maintain sufficiency levels than to wait until orchards showed deficiency symptoms to add potassium.

Other research has looked at comparing different sources of potassium. Two trials, one in almonds and one in pistachios, conducted during the 90s found that in general, the source of potassium did not matter, however mono potassium phosphate applied to almonds had better yields under micro jet sprinklers in one of the three years of the trial. It is possible that the phosphorus contributed to increased yield, however soil levels for phosphorus in that study were adequate. The researchers did not report leaf values of phosphorus, so the authors of this article cannot confirm or deny the phosphorus response. More importantly, the researchers found a poor response to banded potassium under single line drip irrigation, as the potassium was banded outside of the wetted zone, which only

Source	Formula	% K ₂ O	Solubility@ 20 C° (grams/liter)	% K ₂ O in a saturated solution
Potassium Chloride	KCl	63	255	16.1
Potassium Sulfate	K ₂ SO ₄	54	111	5.4
Potassium Nitrate	KNO ₃	47	209	11.2
Potassium Thiosulfate	K ₂ S ₂ O ₃	25	155	25
Potassium Carbonate	K ₂ CO ₃	30	112	

Adapted from the Western Fertilizer Handbook, 9th Edition.

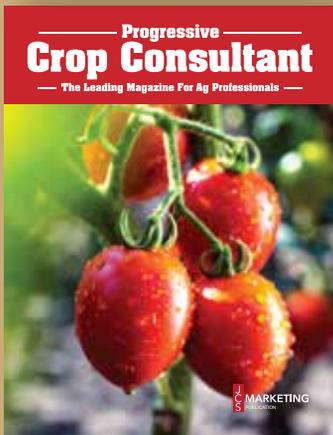
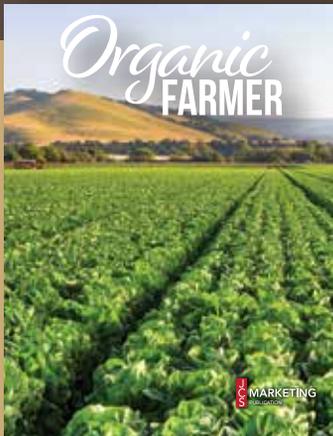
allows uptake when soils are wet from winter rains, either very late in the fall or early in the spring.

In the pistachio trial, yield was greatest at 200 lbs K/acre. A higher rate, 300 lbs K/acre, resulted in cation antagonism between the potassium, calcium, and magnesium. The soil type was a sandy loam, which has a more limited cation exchange capacity, and is more

easily 'flooded' by a heavy application of potassium, so this rate may not cause antagonism in a heavier textured soil.

Potassium Fertilizers and Solubility

Before we get into fertilizing your trees, it's helpful to talk about solubility in potassium fertilizers, which can be an issue during fertigation. The solubility of a fertilizer determines how much



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potassium you can deliver over a certain period of time; fertilizers with high solubility require less water to dissolve. If, for some reason, you have a limited time frame for potash delivery, or you want to minimize the volume of fertilizer you need to dissolve, fertilizers with higher solubility may be for you. Just keep in mind that there's no physiological reason why you can't spread potassium applications throughout the growing season, especially if your orchard does not fix potassium. You can also combine fertigation with banding or micro-broadcasting.

The major reasons to choose a particular source of potassium fertilizer are price per pound of K, the presence of additional needed nutrients, whether you can leach with rain or high-quality irrigation water, and whether your orchard's soil is suitable for leaching. Orchards in which leaching may be difficult are those with heavy textures, clay pans or hard pans, or soils that already have reduced infiltration rates due to sodium. In deciduous tree crops, pistachios have the highest tolerance to soil and water salinity, however they too will eventually lose yield at soil salinity levels above 9 dS/m. The Sacramento Valley typically gets more rain than the San Joaquin Valley, and buildup of soil chlorides may not be as much a concern in normal rainfall years.

The method of application, source of potassium, or solubility of a fertilizer do not change potassium's fate in the soil. In most soils, potassium will end up in the CEC, and in a potassium fixing soil, potassium will eventually be fixed.

Fertilizing Your Trees

The best fertilization practices are to treat potassium like nitrogen and do yearly applications to replace what was lost through yield. The amount of potash removed per unit yield for common nut crops is shown on **Figure 1**.

Micro-broadcast

In orchards irrigated with micro sprinklers, some growers and Certified Crop Advisors (CCAs) have moved to directed or micro-broadcast potassium fertilization that delivers dry potassium (usually potassium sulfate) in the tree row onto the soil wetted by the sprinklers. No fertilizer is spread on the soil

Crop	Critical Value (percentage)	lbs of K ₂ O Removed
Almonds	85-95	1,000 lbs kernel weight
Pistachios	29	1,000 lbs marketable yield
Walnuts	40-50	1 ton nuts

Figure 1

in the drive row. Application timing is commonly in the fall.

Band

Banding potassium has been the standard in the industry for many years to overcome potassium fixation, and it works just as well in non-fixing soils. It works by saturating the fixation capacity of a small zone in the soil, ensuring there is potassium available for uptake. It is an appropriate application method as long as the band is in the wetted zone.

Fertigation

Fertigation has become more common, especially as irrigation technology has

improved. Fertigation is appropriate for potassium fixing as well as non-fixing soils, provided you apply the potassium when the trees need it (during fruit development). You can avoid fixation of potassium through in-season fertigation.

Foliar sprays

Foliar potassium fertilization through an airblast sprayer can be an effective way to quickly deliver a limited amount of potassium into trees. However, given the large annual K budget for a mature orchard carrying a good crop, foliar potassium is best considered a supplemental program to soil applied K. For example, foliar applications in almonds

Continued on Page 18

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Continued from Page 17

and prunes using 20-30 lbs potassium nitrate (fertilizer material, not actual K₂O)/per acre in 100 gallons per acre has been shown to increase leaf potassium levels over untreated trees. However, with spray application efficiency in the range of 75 percent, at best, the amount of K from a single application that reaches leaves is roughly 10 lbs K₂O/acre/spray. This amount is only three percent of total crop K need assuming 100 lbs K₂O per 1000 lbs of kernel crop removed in a 3000 lb almond crop. In prunes, a crop with a smaller annual K budget than almonds, research showed that foliar potassium application (100 lbs KNO₃/acre/year applied in four applications from April through July) could keep leaf K levels and yield at a par with a banded soil application of 360 lbs K₂O/acre as KCl (600 lbs/acre MOP) applied the previous fall. The authors of this work cautioned that this work was done in a single orchard for only three years and so should be tested under other locations/crops before considered for wider application. In addition, the foliar K delivery rate in that trial was less than crop removal, suggesting that a “foliar K, only” program is not a long-term strategy.

Foliar potassium fertilizers come in many forms. There are bulk, dry materials such as potassium nitrate—alone or blended with other dry nutrients—and specialty liquid materials formulated from sources including potassium acetate, potassium carbonate, potassium nitrate or others.

Rates for potassium nitrate, alone, or in a tank mix with

Foliar K fertilizer supplements soil applied K, but is not a sustainable, long term stand-alone K fertility program.

pesticides, run from 10-30 lbs fertilizer/acre. Growers should be aware of the risk of phytotoxicity from higher rates and test application rates and practices in a particular orchard. An experienced pest control advisor (PCA)/CCA in the Yuba City area never recommended a potassium nitrate rate per acre above 20lbs material/acre in prunes to eliminate the risk of phyto.

The specialty foliar K fertilizers often range in K₂O content from 25-30 percent with max labeled rates of 4-6 quarts/acre. While these rates are most probably developed to minimize phyto, they also limit the potential K₂O rate on the leaves to around 2.5-3 lbs K₂O per acre per spray.

Foliar K fertilizer supplements soil applied K, but is not a sustainable, long term stand-alone K fertility program. Growers and PCA/CCAs should consider the level of K nutrition in the orchard and recognize the limited impact of foliar K application when deciding whether to spray K or not.

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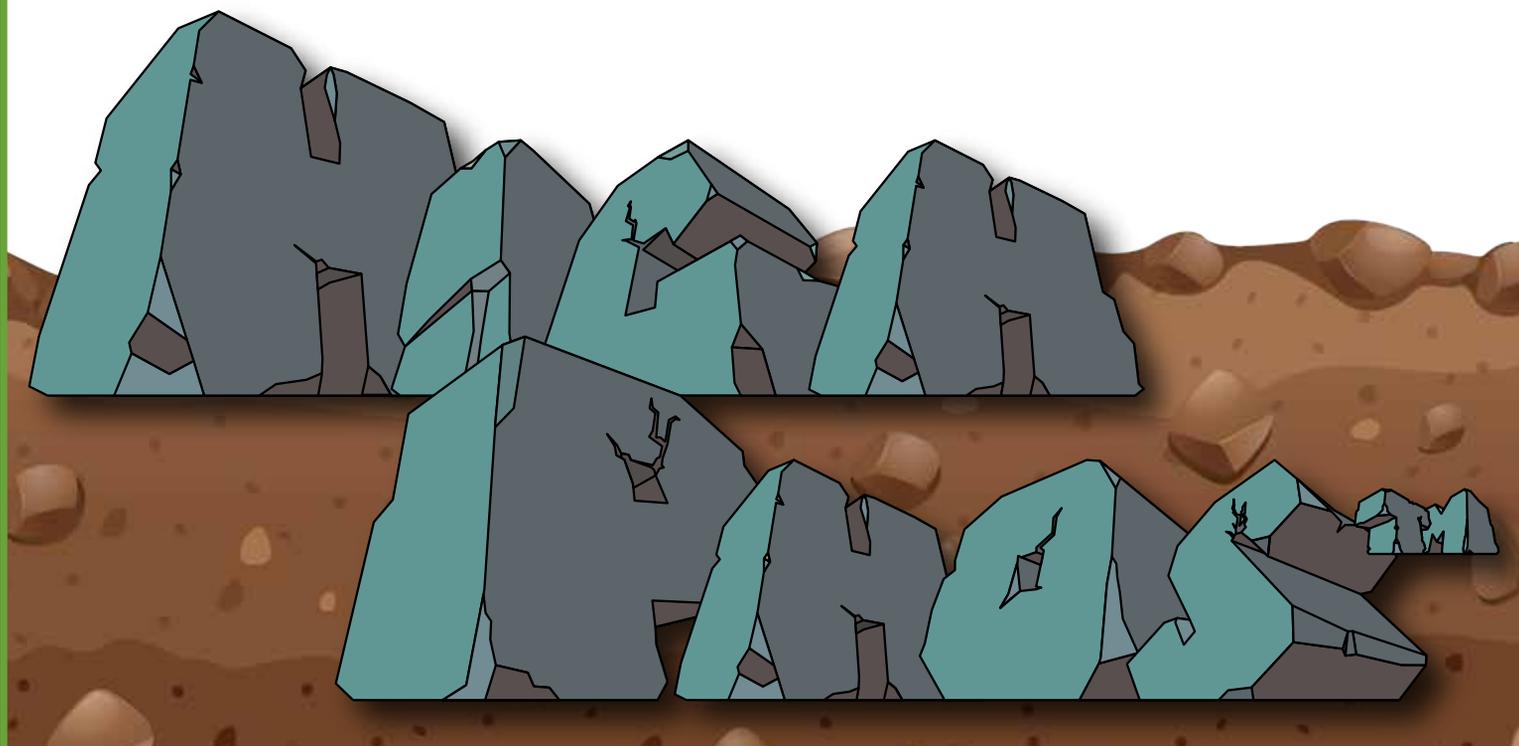
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THE LATEST ON BOT CONTROL IN WALNUTS

In her Walnut Trade Show presentation on The Latest on Bot Control in Walnuts, Janine Hasey got right to the root of things in fighting Botryosphaeria and the damage it can cause in orchards and crops.

By JULIE R. JOHNSON
Contributing Writer

Janine Hasey, University of California Cooperative Extension tree crops and environmental horticulture advisor in Sutter/Yuba counties, shared what researchers know about Botryosphaeria (Bot) and Phomopsis canker and blight, and the most cost effective management strategies based on the level of Bot infection.

Hasey also explained the symptoms of both Bot and Phomopsis, disease progress, species, spread, pruning, management, and more.

Botryosphaeria (Bot) and Phomopsis canker and blight can significantly reduce walnut yields by killing small fruit wood and large branches and directly infecting nuts, Hasey said.

“Bot can be responsible for large economical losses in walnuts if not managed correctly,” Hasey said. “

There are 10 species of Bot and at least two of Phomopsis,



Janine Hasey, University of California Cooperative Extension tree crops and environmental horticulture advisor in Sutter/Yuba counties, presents her discussion on The Latest on Bot Control in Walnuts during the January 4, 2019 West Coast Nut hosted Walnut Trade Show at the Yuba-Sutter Fairgrounds. All photos courtesy of Julie R. Johnson.

Hasey said.

All 10 species of Bot can infect fruit and then indirectly infect spurs and shoots; with six species directly infecting spurs and shoots. As for Phomopsis, both species infect fruit and indirectly

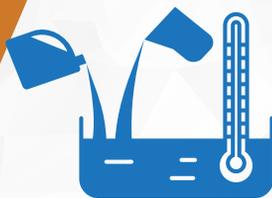
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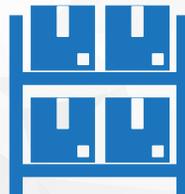
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Bot main symptom types



In her Walnut Trade Show presentation, Janine Hasey, University of California Cooperative Extension tree crops and environmental horticulture advisor in Sutter/ Yuba counties, shared the main symptoms types of Botryosphaeria. Photo courtesy of Janine Hasey.

Continued from Page 20

spurs and shoots.

In wet springs, Bot can be more prevalent. Bot infection can occur in as little as a quarter inch of water on susceptible tissue with a temperature of 50 degrees F or higher with the presence of susceptible tissues. In California, those conditions are common.

Bot Symptoms

Hasey said there are a number of Bot symptoms to look for—the main symptom types include branch canker and dieback, blighted shoots, twig blight, fruit and shoot blight and infected nuts.

In Phomopsis, symptoms are leaf spots early in the spring, fruit blight, cankers, and pycnidia. Among other symptoms seen in the orchard are blighted and moldy nuts through late August, September and October, blighted spurs, dead buds, and trunk cankers in young trees.

Spread/Infection

Both pathogens, Bot and Phomopsis, need water to trigger infection, and produce abundant pycnidiospores that spread through water splashing and dripping, or wind-borne

ascospores that spread by blowing around the orchard.

“How Bot moves into the tree is through waterborne spores which drip down through the canopy or are splashed up into the tree, or airborne spores which blow up through the tree,” Hasey said.

She explained Bot spores infect the fruit husk and grow through tissues quickly. The infection then moves into the peduncle/nut stem, and onto killing the spur/shoot. The infection also moves up into the trees branches. Infected spurs and branches will darken and die, resulting in thinned canopies and death of next year's buds.

The infection can also move from fruit to fruit, however, walnut leaves are not infected by Bot, according to Hasey.

In addition to direct fruit infection, infection can occur through:

During the season

- Wounds from hail, freeze, sunburn, and woodpeckers
- Pruning wounds
- Scale wounds
- Walnut blight lesions, downy spot and branch wilt

At harvest

- Scars from peduncles
- Fruit scars
- Leaf scars
- Mechanical wounds

Postharvest

- Peduncle scars
- Leaf scars
- Husks (remaining on tree)
- Pruning wounds
- Wounds from freeze damage
- Injuries from woodpeckers
- Other types of injuries

One of the reason walnuts are so susceptible to Bot, according to Hasey, is the very makeup of the spur/ shoot tissue.



Continued on Page 24

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“What we have learned is that three- and four-year-old shoots are more susceptible to Bot than 1- or 2-year-old shoots, although they are susceptible as well,” she added.

In addition, research has determined untreated wounds can be susceptible to infection from Bot for extended periods of time.

“For instance, pruning wounds can be susceptible for at least four months,” Hasey stated.

Frost damage can also present an extended threat.

“What we found was about 50 percent of frost damaged shoots/spurs developed pycnidia in a year,” Hasey added.

She said researchers have found 60 to 75 percent more walnut shoots infected with Bot when scale is present.

“As for latent infection, what that means is that we have immature fruit that can be infected in the springtime when the conditions are ripe. They become infected but are symptomless,



Tighter spacing in orchards, like hedgerow, may influence spread of *Botryosphaeria* through shading, less light and poorer air circulation, compared to traditional spacing, said Janine Hasey, University of California Cooperative Extension tree crops and environmental horticulture advisor in Sutter/Yuba counties. Photo courtesy of Janine Hasey.

and then what happens is that we move into August and September and the infected fruit infects the spur causing the cankers and killing the buds,” Hasey added.

Management Strategies

“Based on the level of Bot, obviously

with the price of walnuts, we care a lot about the cost of management,” Hasey said.

She said growers need to examine spurs and blighted shoots to determine the level of Bot. Bot infection levels will greatly determine spray management.

“Management of Bot is a two-pronged process of integrating cultural and chemical control,” Hasey added.

Cultural control involves reducing inoculum in the orchard by pruning dead branches and blighted shoots.”

Sanitation by pruning of deadwood in the summer is necessary to remove disease and decrease future infection, according to Hasey.

Chipping of prunings is dependent on inoculum level, however, Hasey said chipping brush reduces inoculum by 66 percent.

Chemical control is the second prong in the fight against Bot. This is done by applying effective fungicides.

“Resistance in these fungi has not been a problem,” Hasey added.

Fungicides shown to have excellent and consistent efficacy include:

- Quash—metaconazole (3)
- Merivon—fluxopyroxad+pyraclostrobin (7/11)
- Pristine—boscalid+pyraclostrobin (7/11)
- K-Phite—polyphosphite (33)
- Luna Experience—fluopyram_tebuconazole (7/3)
- Luna Sensation—fluopyram+trifloxystrobin (7/11)

Hasey shared three timing options

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for sprays:

Option 1 was a one-time spray in late June to early July, which provides cost savings.

Option 2 was the standard calendar of three sprays—mid-May, mid-June, mid-July (post harvest still inconclusive)

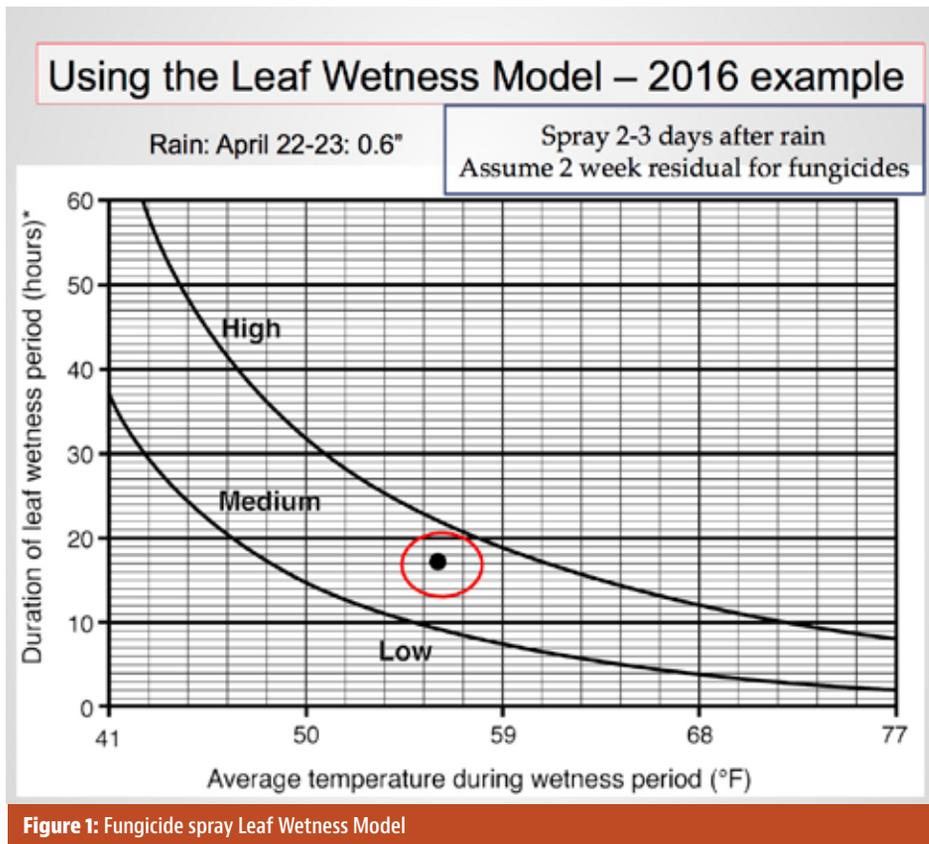
Option 3 was the Leaf Wetness Model (weather dependent) See Figure 1.

With the Leaf Wetness Model, sprays are only applied when there are environmental conditions conducive to disease. A fungicide is applied within two to three days of a rain event and estimated two week residual.

“If your orchard has no Bot yet,” Hasey said, “chip prunings and leave in the orchard and don't spray.”

For light infection (1-20 percent), she advised pruning or hedging these orchards first, then move into more infected orchards. Remove prunings from the orchard, but don't chip. Provide one spray timing (option 1).

When an orchard has moderate



Continued on Page 26

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Continued from Page 25

infection (20-50 percent), prune or hedge first, then move into more infected orchards, remove prunings from orchard, and don't chip.

Hasey said for moderate infection orchards, one time spray or leaf wetness model option is advised.

Orchards with heavy infection, (more than 50 percent), chip prunings and leave in the orchard. Treat with a full fungicide program (May, June, July, and possibly postharvest) or the leaf wetness model option.

"It is important to remove dead and infected wood in the summer or fall when it is not raining," Hasey said.

In addition, disinfecting pruning equipment is critical. "The Bot spores are sticky and they can be transmitted from both hand and mechanical pruning equipment," she added.

"Always be sure and disinfect equipment before moving into a new field, especially when moving from an infected orchard."

In her summary, Hasey reiterated Bot management requires both sanitation (pruning) and fungicide sprays.

Avoiding Bot Infection

One way to avoid Bot infection, Hasey said, is to not wet the canopy with high-angle sprinklers. She advised pruning in fall when things are dry instead of February when there is more risk to wetness.

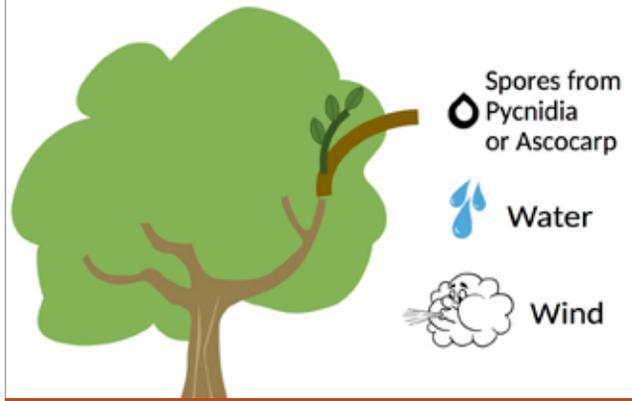
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How Bot spores can move in the tree



Bot moves into the tree through waterborne spores which drip down through the canopy or are splashed up into the tree, or airborne spores which blow up into and through the tree.

Fruit → Peduncle → Shoot



Bot infection spreads from the fruit to the peduncle/nut stem and then into the spur/shoot. Photo courtesy of Janine Hasey.

Symptoms in the orchard...



Moldy, infected nuts is one of the main symptoms of Bot seen in the orchard. Photo courtesy of Janine Hasey.

Controlling scale is another avenue, Hasey shares, by using IGR (Insect Growth Regulators) insecticides, such as Seize or Centaur. Also, monitor "crawlers."

"Tighter spacing in orchards may, emphasis on 'may,' influence spread of Botryosphaeria through shading, less light and poorer air circulation, compared to traditional spacing," she said.

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What Impact did 2018's Wildfires Have on Orchards?



by KAT JARVIS-SHEAN | UCCE Orchard Systems Advisor, Sacramento, Solano & Yolo Counties
LUKE MILLIRON | UCCE Farm Advisor for Butte, Tehama, and Glenn Counties
RICK BUCHNER | UCCE Farm Advisor Emeritus, Tehama County

UC | University of California
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As has widely been reported, 2018 was the most destructive wildfire season on record in California. Quite rightly, primary attention has been paid to the direct loss of lives, homes and livelihoods that resulted from these fires. Less discussed are the potential impact downwind of these fires. Many growers, managers and

advisors have been asking what impact weeks of wildfire smoke may have had to their fruit and nut orchards.

We've gone in circles recently trying to get a good answer to that question. We can't point to a solid number or a conclusive experiment that will answer the question of how wildfire smoke impacts orchard production. Most of

the research on impacts of smoke has focused on human health. Research into air pollution effects on trees has largely focused on urban air pollution (which is a slightly different mix of contaminants). Additional research reports describe air quality impacts to forest productivity, and a few studies have been done on impacts to wine grape berries and wine quality.

The best we can do is piece together what we know from other systems to estimate, theorize and speculate at what might be happening to fruit and nut orchards when they experience prolonged periods of smoke. So what do we know?

How Wildfire Smoke can Hurt Plants

Ozone (O₃) is a common pollutant in wildfire smoke. Surface level ("tropospheric") ozone enters tree leaves through the same stomata that let in carbon dioxide for photosynthesis and let out water. Ozone inside the leaf is toxic. It splits into oxygen and peroxide, oxidizing proteins and lipids of cell membranes (chemically combining with them), interfering with enzyme processes. This is bad news for trees. Trees need carbon dioxide to make sugars during photosynthesis, but they don't want ozone coming in and throwing a wrench in the works.

Research with peach trees in China has found elevated ozone decreases photosynthetic rate and the content of pigments (like green, photosynthesizing

Continued on Page 30

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chlorophyll), while increasing antioxidant enzyme activity (Dai et al, 2017). In other words, the plant is dedicating resources to fighting and repairing the oxidizing effects of ozone, while also having its sugar production decreased by ozone damage. Illinois forestry researchers have found that increasing ozone from ambient levels of 40 parts per billion (ppb) to 64 ppb decreased tree biomass by 11 percent (Wittig et al, 2009). Elevating it to 97 ppb decreased biomass by 17 percent.

Examining the ozone records kept by the California Air Resources Board (<https://www.arb.ca.gov/aqmis2/aqd-select.php>), there were days in early August 2018, in the midst of the Carr Fire, when daily average ozone in

Tehama County was higher than 70 ppb. This is squarely in the range of ozone that decreased biomass in deciduous trees in the Illinois study. University of California Cooperative Extension (UCCE) advisors Allan Fulton and Rick Buchner shared photos from Tehama County in October that are consistent with cellular leaf damage caused by high ozone exposure.

On the other hand, one can find ozone levels recorded that high for the same period in 2016, when corresponding symptoms were not recorded. Additionally, symptoms of leaf damage caused by high ozone exposure can be difficult to differentiate from other causes, such as over-irrigation. The story gets more complex when we take into account that chronic exposure to

On the whole, smoke and its byproducts can have positive and negative impacts to plant health and production.



Unusual, late season leaf discoloration in an otherwise healthy walnut orchard in Tehama County. Photo courtesy of Allan Fulton

elevated ozone decreases stomatal conductance. The Illinois forestry study, for example, found reduced transpiration rates in trees exposed to smoke. It may be that smoke-exposed orchards were being over-irrigated because there were not transpiring as much as they usually would mid-summer. Given this variety of factors that can cause the same symptoms, controlled studies and purposeful measurements are needed to better grapple with what effects smoke has on tree functions.

Sulfur dioxide (SO₂) and nitrogen dioxide (NO₂) are two other components of wildfire smoke. Both can interfere with important steps in the energy-making process of photosynthesis. However, neither are as widely researched as the impacts of ozone.

How Wildfire Smoke can Help Plants

In orchard production, one of the potential benefits of smoke exposure is the increase in aerosols. Fine mode aerosols (particulate matter less than 2.5 µm in diameter, also known as PM_{2.5}) diffuse solar radiation. We've heard anecdotally from many walnut growers and processors that smoky years are the best years for nut quality, possibly because there are fewer sunburned nuts and less discoloration-producing heat stress. We don't know of any experiments that have tested this, but the logic makes some sense if the smoke exposure is not so prolonged as to lead to other problems.

Another impact of increased aerosols can be increased photosynthesis. You might think plants want all the solar radiation they can get for photosynthesis, but actually, on a clear day in the height of a Central Valley summer, that solar radiation is often more than the plant can utilize. Aerosols promote photosynthesis by enhancing diffuse irradiation. In essence, these aerosols can soften the intense radiation of peak summer. But there's a balance, since too much particulate matter interferes with photosynthesis. A recent study on how aerosols impact plant activity cites maximum plant photosynthesis as occurring when the diffuse fraction is between 0.4 to 0.6, whether that diffusion results from cloud or aerosols

(Yue and Unger 2018). Modeling work in this same paper found that photosynthesis enhancement by aerosols in smoke can partially offset the decrease in photosynthesis that results from increased ozone in smoke. However, aerosols only weakened the ozone-caused photosynthesis decrease by about 8-30 percent. In other words, the ozone in the smoke decreases photosynthesis much more than aerosol light diffusion increases it, resulting in a significant net decrease in photosynthesis from smoke exposure.

So Where does That Leave us?

On the whole, smoke and its byproducts can have positive and negative impacts to plant health and production. Acute (short but severe) and chronic (steady, prolonged) exposure can have different impacts. This summer's fires may have benefited walnut quality but decreased energy production, which may have impacted tree growth or carbohydrate reserves for the spring. There

are still more questions than answers. Whether we like it or not, we're likely to have plenty more opportunities in the future to collect data and observations on what smoke does to our trees and their production.

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Hazelnut Varieties Have Allowed *Expansion in the Industry*

By CECILIA PARSONS | Associate Editor



New varieties developed at the Oregon State hazelnut breeding program have not only contributed to the hazelnut industry with their resistance to eastern filbert blight (EFB), they are also helping growers deliver a product desired by buyers.

EFB Resistant Varieties

Resistant varieties allowed the industry to continue after EFB decimated many orchards in the 1970s. The fungal disease infected hazelnut orchards throughout the Pacific Northwest and threatened expansion of hazelnut acres along with crop production. The disease has a

two-year life cycle and an incubation period of 13-16 months before cankers grow and spread on scaffold limbs and tree trunks, affecting tree health and productivity.

After the onset of the disease in the Pacific Northwest, total hazelnut acreage remained static at about 29,000 acres from 1990 to 2009. Acreage began to rapidly grow with the release of Jefferson, a highly EFB resistant variety that was developed at Oregon State University (OSU) and released in 2009. This variety targeted the in-shell market as an EFB resistant replacement for Barcelona, a widely planted variety that lacked EFB

resistance, but is the standard for the kernel market. Most of the world crop is sold at kernels.

The Jefferson variety sparked resurgence in Oregon hazelnut planting as new and existing acres now total near 72,000.

Nearly all new acres of hazelnuts and replant acres are being planted with EFB resistant varieties, said Shawn Mehlenbacher, OSU hazelnut breeding program leader. A few growers are using EFB susceptible varieties like Ennis in low pressure areas, but Mehlenbacher said in 2009 and for the next six or so years, Jefferson was the most widely planted. Now, new orchards are planted mostly to kernel varieties including Yamhill, Wepster, and McDonald. PollyO is also a kernel type, but few trees are available for purchase.

Variety Qualities

Namesake of the PollyO, Polly Owen at the Hazelnut industry office that includes the Oregon Hazelnut Commission and Nut Growers Society, said in addition to EFB, growers are looking for qualities in a variety that will increase their value.

“They are looking for precociousness, varieties that produce more nuts,” Owen said. Growers are also looking for a higher shell out to improve their bottom line. A higher shell out, Owen said means thin shells, a trait important in the kernel market. Another sought after quality is ease of blanching. A lot of hazelnut buyers are looking for this trait, Owen confirmed.

Breeding Objectives

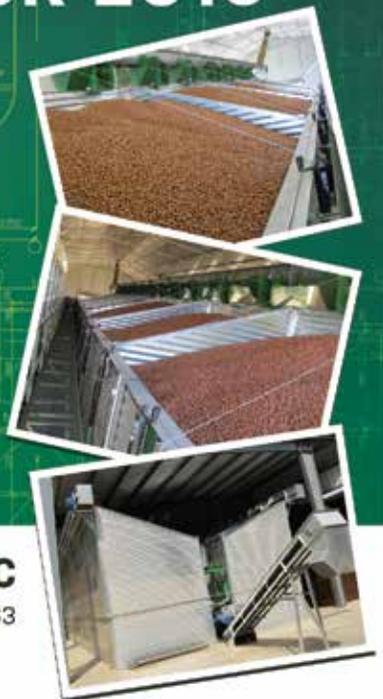
Mehlenbacher listed the breeding objectives of the OSU program and explained the process from selection of the parent material for the cross, to the

Continued on Page 34

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final release to nurseries for propagation. There are two stages of testing: seedling and replicated trial (with check cultivars.) Five thousand seedlings are planted each year. The best 20 or so are selected, propagated and planted in the replicated trial.

If we are lucky, out of those 20 or so selections, one gives us a new cultivar, Mehlenbacher said. It can take 17 years to determine if the selections are suitable for commercial production.

The steps in the breeding program begin with setting standards for the new hazelnut varieties to achieve and defining objectives for the OSU breeding program.

Objectives for the blanched kernel market are bud mite resistance, round nut shape, high percent kernel, precocity, high yield, ease of pellicle removal, few defects after cracking a sample, early maturity and free falling nuts. Defects include blanks, brown stain, shriveled kernels, poorly filled nuts, moldy kernels, twins (two kernels in one shell) and black tips due to weak suture. For EFB resistance the program uses dominant alleles that confer a high level of resistance as well as quantitative resistance that is expressed as fewer and smaller cankers.

The OSU breeding program also looks at pollen-stigma incompatibility and qualitative and quantitative traits in hazelnuts.

Collecting Parent Material

Mehlenbacher has traveled to Turkey, historically the world's



Oregon State University (OSU) hazelnut varieties helping growers succeed. Photo courtesy of Shawn Mehlenbacher and OSU hazelnut breeding program.

largest producer of hazelnuts, to collect parent material. He brought back seeds, selected the best seedlings and made crosses. The country had been restricting the movement of hazelnut genetic material, but Mehlenbacher said in 2004 he had the opportunity to travel to Turkey with an official permit to collect. That trip yielded 70 selections and Mehlenbacher said he is finding some interesting traits among those selections. Eight to ten of the selections have remained free of EFB after several years of field exposure.

EFB Disease Remains a Challenge

Mehlenbacher said that even with the development of EFB resistant varieties, the disease would remain a challenge to the hazelnut industry. Releases of new varieties have relied on a dominant allele from 'Gasaway,' which is highly resistant to EFB. Mehlenbacher said these are no longer resistant to isolates of the EFB fungus in New Jersey. Fortunately, he added, the breeding program has more than 100 accessions with high resistance to EFB in the collection. Single gene resistances have mapped to linkage groups 6,2 and 7. The program also has quantitative resistance as in fewer cankers and smaller cankers as in Sacajawea and Tonda di Giffoni.

New Kernel Cultivars

An important goal of the program is to release a new kernel cultivar whose nuts mature three weeks earlier than Barcelona. Currently, 'McDonald' and 'PollyO' are two weeks earlier and Jefferson is one to three days later. Mehlenbacher said the program now has the parent material that should contribute to the early maturity trait. In addition, Mehlenbacher said he would like to release an in-shell cultivar that produces large, attractive nuts that matures at least one week earlier than Barcelona.

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The other important disease in hazelnuts is bacterial blight. This disease can be controlled with copper sprays. A method to quantify susceptibility to this disease has not been developed. Recent releases also have strong to moderate resistance to bud mite.

Current Emphasis

Mehlenbacher said the breeding program's current emphasis is one using diverse germplasm in their collection. The base of the OSU breeding population is Barcelona, Negret and Casina from Spain; Tonda Gentile delle Langhe, Tonda Romana, Tonda di Giffoni and Montebello from Italy; Extra Ghiaghli, Tombul Ghiaghli from Turkey and Daviana from England. Germplasm importations are from 18 countries.

This winter's crosses will include many Turkish parents. The program is working with several sources of EFB resistance and trying to move them all forward to combine resistance with other desirable



Photos courtesy of Shawn Mehlenbacher and OSU hazelnut breeding program.

hazelnut traits. Mehlenbacher said the OSU program in cooperation with Rutgers University, has identified more than 100 sources of resistance to EFB. While that trait is important, it must be combined with yield, quality and other desirable traits.

The OSU breeding program's flow chart begins with choosing parents and making crosses. After a year growing in the greenhouse, the seedlings are planted in the field and evaluated for years three to five. Replicated trials of the best-performing crosses are made in year 10 and evaluation of traits continue through year 16.

Mehlenbacher said the breeding program does use DNA markers to



determine if the seedlings carry the Gasaway gene for EFB resistance. Now that the hazelnut genome has been sequenced he can look for genes in the target regions and more quickly develop markers for other EFB resistance genes.

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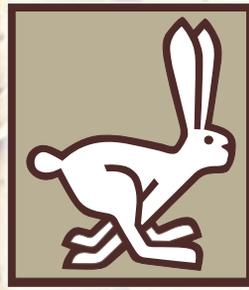
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Having a shipment of almonds rejected by an overseas port for excessive aflatoxin can be expensive, and it's especially frustrating when pre-export testing appeared to show that the lot in question was fine.

At The Almond Conference last December, a world-renowned authority on testing commodities for mycotoxins explained how rejections can happen—and strategies for avoiding them—during his presentation titled, “Addressing the Aflatoxin Menace Head On.”

“We often hear from handlers that, ‘We tested it here and it passed, but then when we send it over, they say it didn’t pass,’” said Dr. Thomas B. Whitaker. “[In my presentation] I was trying to show the handlers why, and that we

can predict the chances of these things happening.”

A professor emeritus at North Carolina State University and retired from the United States Department of Agriculture (USDA) Agricultural Research Service (ARS), Whitaker has authored or co-authored more than 150 scientific articles on the subject.

Testing Methods Leave Some Uncertainty

No testing protocol is perfect. Some good lots will be rejected by the testing protocol (exporter's risk) and some bad lots will be accepted by the testing protocol (buyer's risk). These two risks exist with any testing protocol. Though improvements have been made in how countries reduce these risks when testing for aflatoxin, there is always some uncertainty associated with sampling, sample preparation and quantification steps of the protocol. The largest reason for this is that only a small percentage of almonds in each lot (about one-tenth of a percent by weight) are tested and then used to characterize the whole lot.

To complicate matters, even among almonds with higher levels of aflatoxin (most often associated with insect damage) the percentage of contaminated kernels is extremely small (an estimated one kernel per 1,000) and the kernels are not evenly spread throughout the lot. While efforts are made to collect representative samples from throughout the consignment, there can still be significant variability in sampling results, especially when aflatoxin levels are high, Whitaker said.

During his presentation, Whitaker gave one example (see Figure 1 below) where samples were taken from a bulk commercial lot of almonds with a relatively high amount of aflatoxin (about 22 parts per billion (PPB)) and tested 16 separate times (16 10-kilogram samples). Nine of the sample test results were below 10 ppb—which meets the European Union's (EU) limits—while seven other sample test results from the same lot were above 10 ppb, which would lead to rejection.

With extremely low tolerance levels for aflatoxin—as little as 10 parts per billion for shipments headed to the

European Union—even a small amount of variability can make the difference between whether a shipment is accepted or rejected by both the almond industry export sampling plan and the European Union sampling plan.

“This shows how a shipment can pass here, but then be rejected over there,” Whitaker said.

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Image of Aflatoxin—all photos courtesy of the Almond Board of California.

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Rejections Increase in Bad Years

When aflatoxin levels increase in “bad” years—that is, when environmental conditions make almonds more susceptible to insect damage, such as during droughts—rejected shipments can increase even though the same testing methods are used. That’s because even though the U.S. testing protocol catches many of the highly contaminated lots, a certain percentage gets through. In years with low aflatoxin levels, rejected shipments overseas can drop to less than half a percent. But as aflatoxin levels rise, rejects can spike significantly higher, even though far more shipments are caught before export.

“In a sense, these higher levels of aflatoxin can overwhelm the testing protocol,” Whitaker said. “There is nothing wrong with your testing protocol; what is happening is more aflatoxin-contaminated lots are in the system and more contaminated lots are accepted for export.” These conditions all lead to greater risks for exporters and importers.

The solution for exporters, Whitaker advises, is to be prepared in bad years and not wait for more shipments to be rejected in the European Union. Rather, if warning signs (such as higher levels of insect damage or poor quality) begin to show up, or climate conditions have predicted a tough year for quality, then the percentage of lots rejected by the almond

“WHEN WE ARE MET WITH CONDITIONS SUCH AS HIGHER INSECT DAMAGE, IT’S A CHALLENGE WE MUST MANAGE.”

industry export sampling protocol can be used by handlers to adjust their criteria for passing consignments in the U.S. to reduce lots rejected in the European Union.

A key potential strategy during these years is to test shipments at a lower tolerance; for example, at 5 ppb instead of the standard 10 ppb. This greatly reduces the chances that shipments will be rejected overseas and gives the handler the option to manage the quality on this side of the ocean through additional processing or to seek alternate markets where tolerances are higher than the European Union. This is precisely what the industry decided to do for last year’s crop, as the Almond Board of California (ABC) Board of Directors approved the change that went into effect in April 2018. And this strategy is paying off: since lowering the acceptable criteria in the U.S., we have seen a decrease in rejections in the EU.

The strategy for modifying the almond industry export sampling plan is based upon a scientific study conducted by Whitaker and Almond Board staff to show the effect of high levels of aflatoxin contamination in almonds on the percentage of U.S. lots rejected at their destination by the European Union.

A general discussion about random variability associated with sampling, sample preparation and quantification associated with a mycotoxin testing protocol can be found at this YouTube video: youtu.be/BgQ5bJCQX0s

Success Key to Maintaining Confidence in Almonds

“Though aflatoxin is a natural occurrence when growing almonds, and some variability in test results is expected, managing the issue carefully is an important priority for the Almond Board of California,” said Julie Adams, ABC vice president of Global Technical and Regulatory Affairs.

“While countries do accept that there is a certain degree of variability in the crop,” Adams said, “the priority is always going to be compliance with that country’s food safety standards and regulatory requirements. When we are met with conditions such as higher insect damage, it’s a challenge we must manage, because it can potentially undermine an importing country’s confidence in our food safety system.”

Minimizing rejections of shipments helps maintain confidence among importers, customers and government authorities, while also avoiding adverse outcomes for exporters.

“We understand this can be a really frustrating and economically challenging situation,” Adams said. “That’s why it is important for us to not only work closely with our industry here in California, but to also keep the authorities in export markets aware of the steps we are taking to manage the situation and minimize the opportunity for rejections.”

Handlers wanting to learn more about aflatoxin can find resources on the Almond Board website or contact Tim Birmingham at tbirmingham@almondboard.com.

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Gill's Mealybug Remains a Damaging Pest in Pistachio

By CECILIA PARSONS | Associate Editor

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That's not snow on your pistachio trees, that's a mealybug infestation.

As trees enter dormancy and shed their leaves, infestations of *Ferrisia gilli*, more commonly known as Gill's mealybug, can easily be seen as white tufts of the aggregating adults cling to tree trunks and undersides of major scaffolds.

Mealybug Relatively New Pest

This relatively new insect pest in pistachios has spread from Tulare County where it was first found in commercial production in the late 1990s. It has been found in nine pistachio producing counties, though Justin Nay, pest control advisor (PCA) with Integral Ag, said he has not found any Gill's mealybug infesting pistachio orchards north of Modesto.

Pressure from this pest varies from year to year in pistachios. Nay said once an infestation is found in an orchard, a management program should be initiated to keep mealybug levels low.

Determining Infestation Level

Determining the level of infestation is not easy during the growing season. As thresholds for economic damage are low, monitoring is advised.

That isn't simple, said University of California IPM (Integrated Pest Management) specialist Kent Daane. Although some pheromones have been synthesized for mealybugs, there is no specific pheromone to lure mealybugs into traps to detect their presence. Gill's mealybug infestations are easy to spot after the growing season, but a small population will be difficult to spot at the beginning when the first instar crawlers emerge to look for food.

David Haviland, University of California Cooperative Extension (UCCE) entomology advisor in Kern County reports that in orchards not known to have Gill's mealybug or blocks where the pest is spreading, the best time to survey is after harvest when the white tufts are easily seen on trunks and scaffolds.

Nay said those trees should be marked and surveyed the next spring. In infested orchards, mealybugs can be found at the base of new buds on trees previously marked as infested.

Daane said not many mealybugs may survive over winter and, therefore, searching for crawlers can be difficult at the time. By mid-May, weekly monitoring is advised to check numbers of adult females on the rachis and for the presence of crawlers. Treatment decisions should be made based on the number or adult female mealybugs per cluster.

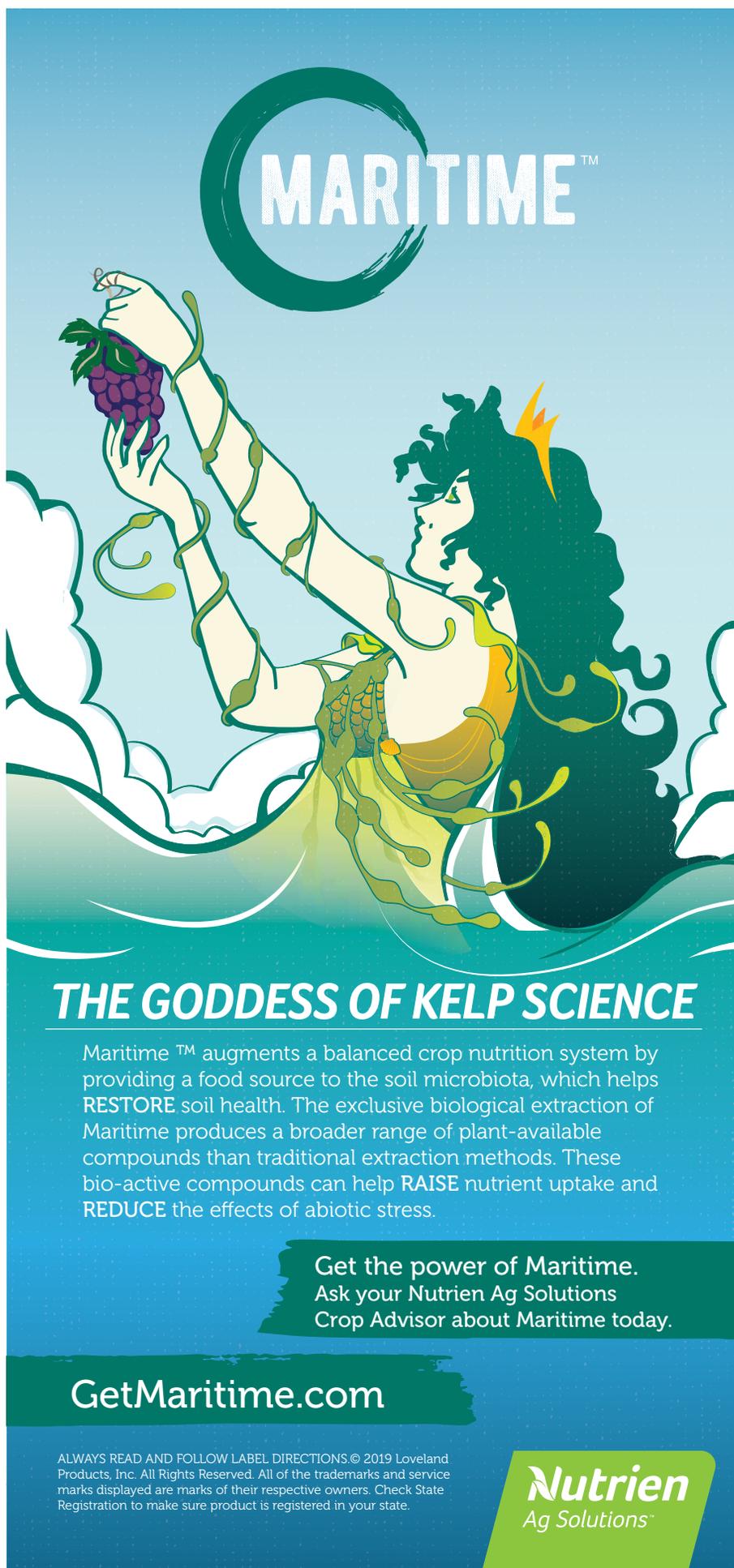
The UC Statewide IPM guidelines use the level of one mealybug per six to ten clusters in May to justify a control treatment. Research showed for each mealybug per cluster in May there was a 4.73 percent reduction in crop value associated with quality and a 0.866 kg reduction in yield per tree.

Control Options

The most effective time for treatment is when mealybugs are in the crawler stage of the first generation. Later in the season success with chemical control can vary.

Encouraging populations of predators

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and parasitoids also helps to keep mealybug populations low. Daane noted that use of pyrethroids for control of bugs in pistachios also kills mealybug predators and parasitoids and allows mealybug populations to build up. Mealybugs parasitized by parasitoid wasps will have a slightly yellowed, bloated appearance and the adult wasps will emerge in the spring by chewing a round hole in one end of the mealybug.

Ant associations can also help by predation. However, they can also disrupt biological control by picking up and spreading mealybugs. Post harvest insecticide treatments for mealybug are discouraged in the IPM guidelines as this is the time is when predators are most active. Post harvest, there is no longer a threat to the crop and mealybug winter mortality is naturally high.

Common predators of mealybug in pistachios are brown lacewings and a lady beetle whose larva resembles a mealybug. The beetle species population can build up when mealybugs are present in the orchard, Daane said. Parasitoid wasps that attack Gill's mealybug include an *Acerophagus* sp. and a *Chysoplastycerus* sp.

Cultural Practices

Cultural practices can keep mealybugs from spreading to nearby orchards. Cleaning harvest equipment and other

machinery or equipment used in the orchard before moving can decrease the rate of spread. Mealybug populations are at their highest during harvest and infested nuts and foliage can be caught in shakers, catch frames and bins. When equipment is moved to another orchard, the mealybugs are moved to a new location and start new infestations.

Crows and other birds that frequent pistachio orchards can also spread mealybugs. Crows can pick up and carry infested nuts to other orchards. Crawler stages of mealybugs can attach to feet and legs of crows and be moved to another orchard or the alternate host mulberry trees.

Mealybug Damage

Infested orchards can lose both yield and nut quality due to Gill's mealybug.

When it feeds on hulls within nut clusters, it intercepts carbohydrates and other nutrients intended for kernel development. The feeding reduces both kernel size and overall yields. The smaller kernels add to the percentage of unsplit shells. Feeding also causes hull deterioration and staining as infested hulls are covered in honeydew and sooty mold due to mealybug feeding.

Mealybugs feed by using their straw-like proboscis to extract plant juices. Some of those juices are eliminated as honeydew which can cover the surface of tree limbs, leaves and nut clusters. When sooty mold forms on the honeydew, it stains the shells and causes the nuts to shrivel. They can become "sticktight" and remain on the tree after harvest.

Identification

Identification of the type of mealybug found in an orchard is important. According to Haviland and Daane, the grape mealybug can also be found in pistachio orchards, but it does not harm the crop. The two types of mealybugs can be distinguished by several characteristics. Adult female Gills mealybug possess two white wax tails and when they remain in one location for a period of time, they produce long, glassy, white filaments that extend over the top of their body. The female grape mealybug has four slender white tails and also has short, white lateral projections extending from the sides of their bodies. It will also extrude a bright red liquid when poked. Grape mealybugs hatch from egg sacs while Gill's mealybug are born live. During immature stages the crawlers aggregate near the adult female.

In the absence of effective bio-control, mealybug control programs require insecticides. Timing for applications, reported by Haviland, Bob Beede (UCCE farm advisor, emeritus) and Daane is late May to early June when crawlers are present. Later timing would be mid July at the beginning of the second generation. Early season mealybug infestations by the overwintering generation do not cause economic injury and there is no need to treat until the May crawler stage. Studies were conducted in Tulare County and actual dates may be later in cooler climates.

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DOES PLANTING PECANS MAKE SENSE FOR YOUR OPERATION?

That depends, says California pecan grower Ben King.

By CECILIA PARSONS | Associate Editor

Pecans can complement a permanent crop portfolio, King said, and are less sensitive to growing conditions than other tree nut crops. Water availability and soil quality can be limiting factors to production.

Pecan trees have a long life span, but the time between planting and profitable harvest is longer than for other tree nut

crops. U.S pecan production comes from 15 states, more than any other tree nut, but the industry has only had a federal marketing order for promotion and standards since 2016.

Pros and Cons

The pros and cons of pecan production aside, potential growers need to

assess sites and choose the right variety for their growing conditions.

King, who farms more pecan acreage in California than any other grower, said the pecan industry is in the same place the pistachio industry was 25 years ago. There is room for more acres and with a new marketing push from the American Pecan Council, demand will grow, he said. Domestic consumption of pecans has increased even without the marketing order and only 40 percent of the crop is exported compared to 80 percent of the walnut crop and 70 percent of the almond crops.

“With marketing, pecans have a lot of room to grow. It’s moving from a bakery-confection ingredient to a source of plant-based protein,” King said.

He also noted that currently there is no good price structure and the market continues to be dominated by supplies

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from Mexico.

“There is a lot more volatility in pecan pricing,” King said. He also expects that when the American Pecan Council sets standards market conditions will stabilize. When those standards are in place, giving buyers more confidence, King said the pecan market would be poised to go in the direction of the pistachio market. He also believes that California, which currently has only 6,000 to 7,000 acres of pecans, can be a leader in pecan production, due to the state’s successful track record in tree nut production.

Pecan Production

Mature California pecan trees can produce an average of 2400-2600 pounds per acre, King said and return \$2.20 to \$2.50 back to the grower. Production costs can vary due to water.

Georgia has historically produced the bulk of the U.S. pecan crop, but has been hit by crop losses due to hurricanes. New Mexico is a strong contender for the top producing spot, harvesting 92 million pounds in 2017,



Pecan production is on the rise in California, Arizona and New Mexico. Growers expect the federal marketing order, approved for pecans in 2016, will help open new markets for “The Original Supernut.” All photos courtesy of Cecilia Parsons.

but in some growing areas of that state, water availability is an issue. Arizona and California pecan acres are increasing as growers are strategically planting orchards where the conditions are favorable.

Two types of pecans are produced in the U.S. Native or seedling pecans are

produced from seed and not budded. Texas and Oklahoma are two states where the native pecans are harvested on a semi-regular basis. The trees are not farmed in the traditional sense, but a harvest is warranted when there is a

Continued on Page 48

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Continued from Page 47

good size crop. Improved varieties make up the rest of the U.S. Pecan production and are more intensely farmed.

Not having a good estimate on crop size has been noted as a marketing issue.

Establishing Pecans

Bruce Caris of Green Valley Pecans in Arizona, said costs to establish a pecan grove depend on availability of water. In the West, he said all pecans are sprinkler irrigated compared to southeastern planting which may be dry farmed.

Green Valley is located in the Santa Cruz Valley south of Tucson, an area that has experienced significant growth in pecan planting, some, Caris said, by California growers.

Pecans are not for those who need to see early returns on their investment. Caris said that a crop that pays for itself wouldn't be harvested for seven to eight years after trees are planted. However, pecan trees can be productive for well over 50 years.

Federal Marketing Order

In contrast, the pecan industry's federal marketing order (FMO) has been in place for only two years and executive director Alex Ott took the helm in 2018.

"For the first time ever, we have an organization that unites pecan growers and shellers all working toward the advancement of the pecan industry," Ott said. It was important when the American Pecan Council (APC) was formed that both growers and handlers/processors were represented, Ott said. Growers, handlers and processors are now serving on the council.

A milestone for the marketing order occurred last April with introduction of the first-ever national consumer brand for pecans: American Pecans—The Original Supernut. Ott said that through APC marketing efforts there has been a significant increase in media and consumer conversation about pecans. Consumer surveys are also showing an increased awareness of pecans—a significant step for the industry.

The marketing agreement and order for pecans covers 15 states: Alabama, Arizona, California, Florida, Georgia, Kansas, Louisiana, Missouri, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina and Texas. The order provides authority to collect industry data and to conduct research and promotion.

Crop reporting is another major benefit of the FMO, Ott said. Monthly crop information is now being reported for the first time. This year another milestone will be reached with the initiation of nutrition research. The council is working to communicate to consumers that pecans are more than a bakery or pie ingredient. Ott said the council's consumer research found that pecans aren't listed as a snack nut or a nutritious part of a diet.

Ott said growers see the potential of the pecan industry because all forecasts point to continued tree nut demand globally. They also believe in the potential of the American Pecan FMO, and how marketing orders have benefitted other tree nut growers with industry funded marketing programs.



Pecan production is on the rise in California, Arizona and New Mexico. Growers expect the federal marketing order, approved for pecans in 2016, will help open new markets for "The Original Supernut." All photos courtesy of Cecilia Parsons.

"At the American Pecan Council, our marketing priority is to first raise awareness of pecans. This is an important step toward pecan preference and increased demand," Ott said.

Ott said pecans are consumed all over the world, but APC sees significant opportunity to increase awareness and demand for pecans overseas. The council won't let up on pursuit of the domestic market, but there will also be pursuit of strategic international markets.

The forecast for increased nut consumption is a global trend and APC has a high quality product to offer, Ott said.

"As we increase awareness of the nutrition, taste and versatility of pecans overseas, our expectation is that American pecans will become increasingly competitive with other tree nuts. Most of the other competing tree nuts have had federal marketing orders in place for decades, and their growth reflects this. We are a new program; we know there is much work to be done, but we see tremendous opportunity for growth."

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Maximizing profitability in your almond orchard starts with maximizing nut set every year. Achieving consistency in set and minimizing alternate bearing cycles is the key to consistent high yields and higher profitability. The secret is ensuring your trees have the right nutrients, at the right time, in the right form and right mix.

Nut set is influenced by boron which stimulates pollination. Boron is synergistic with calcium and enhances its affect. Molybdenum plays a direct role in nut set and retention by increasing pollen production. Moly also synergizes boron. Agro-K's Top Set DL is the right tool to apply from pink bud through bloom. Top Set DL supplies a balanced nutrient mix that significantly improves nut set. It is soft on blooms, bees and other beneficial insects. It penetrates tissues rapidly and thoroughly to drive increased nut set.

Once set, nuts need more size and weight to maximize yield. Size is driven by cell division and phosphate is a key energy source that drives this process. Calcium is a critical factor in nut weight. Getting it into the nut during cell division is the key to heavier nut meats. More calcium uptake during the cell division in the leaves creates thicker cell walls that are more tolerant of diseases like rust and scab, allowing your fungicide program to be more effective. Getting calcium where it is needed at this peak demand timing is therefore very important. Applying Vigor SeaCal provides this key calcium along with an effective seaweed nutrient that reduces the stress that

accompanies the ethylene the tree produces during bloom. It also supports the benefits of phosphate for increased cell division leading to increased nut size. When tank mixed with AgroBest 9-24-3 a high phosphate/low potassium fertilizer blend more P is available to drive improved nut cell division and leaf cell division for larger leaves to support increased photosynthesis, nut size and nut retention. Agro Best 9-24-3 is the most cost effective liquid phosphate available. It is specifically designed with minimal potassium content for early season foliar applications to give you more P per dollar and less K at a time when the tree requires very little K. Foliar applications of potassium applied during cell division will antagonize calcium uptake and negatively impact leaf cell wall integrity and nut weight.

The energy requirements to maximize nut fill and bulking is significant and requires large healthy and efficiently functioning leaves. Micro Mix DL contains zinc and a complete mix of micronutrients. Zinc is essential for maximum leaf size, vascular function, pollination, and root growth. The micronutrients are essential for the complete development of chlorophyll in the leaves. As bloom ends the leaves are beginning to form and this is the start of increased demand for all these nutrients. At this timing the leaves are still small and a minimal rate of Micro Mix is all that is needed. After this point very rapid leaf out occurs and increased rates of these nutrients are required and an application of System Leaf Max should be discussed with your PCA.



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FMO-101

By ALEX OTT | Executive Director, American Pecan Council (APC)

In a Nutshell

Since coming on board as the Executive Director of the American Pecan Council (APC), I have received numerous questions as to the abilities of the Federal Marketing Order (FMO). Simply put, what can the FMO do? What is the function? Are we really a government body or an industry body? Can FMOs really do research, domestic promotion, international marketing or standards? Can FMOs set prices? Why are there growers and handlers (shellers) on the APC? Who gets to vote? In an effort to address these questions, the APC has put together a little FMO-101.

The pecan growers have approved a fantastic tool for the industry. It is one of many tools that the industry may use. If one pictures a toolbox, a FMO is one of those many tools in the pecan toolbox.

To begin, the Federal Marketing Order is the purest form of a local government the industry has at its disposal. The APC is only one of 29 FMOs in the U.S. FMOs are voted in by the growers, and council-members are elected by the industry. The Council votes for its assessments, policies, standards, marketing, research and budget. After five years, the growers, and only the growers, have the ability to vote to continue the FMO. Other government bodies do not have this type of local government aspect. The APC provides direct grower and industry input for the industry.

Conversely, the APC is also an extension of the United States Department of Agriculture (USDA). Meaning, that we have a level of oversight that USDA provides in order to ensure certain aspects of the industry do not take advantage of other members of the industry. It also allows USDA to provide oversight, to ensure that the industry is following all necessary “government speech” rules and regulations. Additionally, by allowing shellers to sit on the board, the APC can collect assessments from the handlers, making less paperwork on the grower while providing an oversight mechanism to ensure that shellers are properly reporting the industry information correctly, and accurately. Failure to report correctly may result in penalties. This system of having growers, shellers, and accumulators, makes the American Pecan Council the largest and broadest pecan body in the U.S. Additionally, with USDA oversight, it makes the APC government and provides the industry with a powerful tool.

The Job Duties of an FMO

There are specific items that FMOs may do. For the APC we are allowed to do the following activities:

- Domestic and international promotion and marketing
- Research
- Grades and standards
- Compliance
- Data and statistics

These activities are permissible and required under the Federal Marketing Order. However, it should be noted that all activities, including promotion and messaging must follow all USDA rules and regulations and must be approved by the USDA. The Council sets priorities for each of these five areas and then establishes a budget for each section. All activities, once approved by the Council, move to USDA review and approval to ensure that a specific group does not directly benefit solely on the activities approved or funded and that

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Shelled pecans. Photos courtesy of the American Pecan Council.

the activities meet both the FMO requirements and USDA rules and regulations. This oversight, as mentioned earlier, is the extra check and balance for the industry in order to ensure that the Council does not overstep its authority.

Activities That The Apc Cannot Do

There are specific activities that the industry may not conduct. These include:

- Setting prices
- Lobby
- Buy or sell product
- Promote one company over another

These activities are not permissible under the FMO and will not be approved by USDA. However, other entities, associations or “tools” have this ability and should be handled by other pecan organizations.

As mentioned earlier, FMOs are one critical tool in the toolbox. Without an FMO, standards, marketing and promotion, research, and data would go away. These activities that are now being conducted are establishing, for the first time, an opportunity for the industry to have transparency and ultimately have data to make critical marketing decisions. The FMO provides an opportunity for everyone to play by one set of rules for standards. Furthermore, the FMO provides an opportunity to unite the industry under one organization and one message, paving the way for everyone to work together for one goal, increase demand for pecans. And that’s FMO—101, in a nutshell.

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Close up of pecan leaves.



Pecans being processed.



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THE AGRICULTURE IMPROVEMENT ACT of 2018

By JENNY HOLTERMANN | Contributing Writer

Bipartisan support and a relatively fast Presidential signing helped make the 2018 Farm Bill a reality just before the government shutdown for one of the longest stretches in history. There were already trade tariffs, regulatory burdens and decreasing commodity prices putting pressure on the agriculture community. It was reassuring to have the Farm Bill pass with such support. The Agriculture Improvement Act of 2018 passed the House by a vote of 386-47 and the Senate voted 87-13 the following week. President Trump soon after signed it into law.

In a statement issued by Sonny Perdue, the Secretary of Agriculture, “the Farm Bill is good news because it provides a strong safety net for farmers and ranchers, who need dependability and certainty this legislation affords. The Farm Bill will help producers make decisions about their future, while also investing in important agricultural research and supporting trade programs to bolster exports.”

The Agriculture Improvement Act of 2018 defines its purpose as to “provide for reform and continuation of agricultural and other programs of the Department of Agriculture through fiscal year 2023.” This time around there was plenty of pressure from American farmers from the already stressful trade wars that may have played a part in the bipartisan support. The \$867 billion farm bill approved subsidies for farmers, continued to support conservation programs, set new farm policies and rejected stricter work requirements for nutrition assistance programs.

SNAP

What the average consumer does not realize, is the largest percentage of spending outlined in the Farm Bill is nutrition funding. The nutrition section of the Farm Bill is the longest of the 12 sections covered. The Supplemental Nutrition Assistance Program better known as SNAP, takes up 95 percent of all the funding covered by the Farm Bill, 80 percent of which is directly tied to nutrition and not farmers. A failed attempt was made to make stronger work requirements for those receiving SNAP benefits. The House version of the Farm Bill tried to enforce work requirements on those aged 49-59 and those with children aged 6-12. This would have resulted in cuts for over 1 million households who currently take part in SNAP. Though this version was not included, there is discussion as to whether the President will later cut food stamp funding and incorporate some of these changes on his own. The SNAP program did eliminate recipients being able to receive funding in multiple states at one time. Now, those who qualify for assistance are only eligible in one state at one time. There was also a program that rewarded states with federal funding for payment accuracy and accessibility that was taken out of the Farm Bill.

Subsidies

Subsidies are how the Farm Bill is most commonly known. Many believe the majority of the Farm Bill funding is being given to farmers in the form of government subsidies. If you understand the SNAP funding, you know that is not the case. This Farm Bill did however, make provisions for who is eligible for agriculture subsidies. The agriculture subsidies have now been expanded to nieces, nephews and first cousins, even if those relatives do not work directly on the farm. How this will play out is unsure.

Trade/Commodities

In a time where trade barriers and tariffs seem to be hindering the sales of many agriculture commodities, there was a level of importance put on the trade portion of the Farm Bill. Increased funding for the Market Access Program, better



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“The Farm Bill is good news because it provides a strong safety net for farmers and ranchers, who need dependability and certainty this legislation affords.”

— **SONNY PERDUE** | *The Secretary of Agriculture*



referred to as MAP, of at least \$200 million annually was made possible through the Farm Bill. This will also help to fund the Technical Assistance for Specialty Crops program for \$9 million.

One noteworthy addition to the commodity protection article of the MAP program is the now mandatory funding for the promotions of U.S. agriculture exports through private companies or labels. This increased foreign market access funding will increase to \$200 million annually. The MAP programs and funding dollars help to increase accessibility and ease to foreign markets while boosting our agriculture economy as well. Export and foreign trade help to support

jobs in our rural and agriculture communities and therefore help to enhance our local economy.

The Farm Bill also made improvements to the Price Loss Coverage and the Agriculture Risk Coverage programs. Disaster relief programs maintained their support for livestock and tree losses through the Tree Assistance Program, Livestock Indemnity Program, Livestock Forage Program, and the Emergency Assistance for Livestock, Honeybees and Farm Raised Fish Programs. These programs help to elevate some stress associated with crops demanding long term investments.

Specialty Crops

The Specialty Crop and Research sections of Farm Bill is of big importance to California. The Specialty Crop Research Initiative or SCRI was enhanced by allocating \$80 million yearly for the program which specifically conducts research

Continued on Page 54



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on specialty crops, provides grants for specialty crop projects regionally and statewide, which are producer based for improving sustainability and profitability. Within this program now there is an increased focus on mechanization. With the regulation climate and labor shortages in California, mechanization is key to future success of the agriculture industry.

Within the SCRI, there is \$25 million specifically earmarked for battling citrus greening. There was increased support for protecting against invasive pests and diseases. The National Clean Plant Network has increased funds for the next five years to further fight such pests and diseases impacting specialty crops.

The Specialty Crop Block Grant program will continue with support of \$85 million a year. The Block Grant program has proved itself to be useful and helpful in developing and encouraging innovation in specialty crop promotion and initiatives.

Organic is another sector of the agriculture industry that maintains its strong support and funds through multiple programs within the Farm Bill. The Farm Bill shows continued support and importance set into backing local agriculture growers who specialize in direct markets and local sales. The Local Agricultural Market program will house \$500 million over the next 10 years to further support farmers markets and local food promotions programs.

In an ever-growing segment of agriculture, there will be a creation of an Urban Agriculture office within United States Department of Agriculture (USDA). This new department will fund \$10 million of research and promotion for the urban and indoor agriculture production segments.

The Farm Bill legalized the protection of hemp as an agriculture commodity. Hemp will no longer be a controlled substance. Hemp will now be commercially grown, monitored and production recorded as an agriculture commodity.

Conservation

With the destructive and terrible California wildfires that seem to be tearing down our state, I know there was hope that there would be increased

funding for forest management and conservation. With the President coming to fire destroyed areas back in November of 2018, there seemed to be a level of help on the way. Unfortunately, the provisions brought forward for wildfire prevention and forest management were not included in the Farm Bill.

The current Good Neighbor Authority plan was reauthorized to allow U.S. Forest Service to create agreements and contracts with states and counties for forest management and removal of timber on federal forests. There was also language formulated to create a pilot project to help reduce hazardous areas near utility right of ways. This program is aimed at fuel treatment and fire risk territories within federal lands.

The Environmental Quality Incentives Program, or EQIP, was provided \$2 billion a year for its various projects. There was additional funding through the Conservation Innovation Grant Program that is for air quality within EQIP. Previously held within EQIP, the Regional Conservation Partnership Program, which is what provides many of our counties with the Natural Resources Conservation Service (NRCS) programs, is now a standalone program with \$300 million funds annually.

There are many more programs and details covered under the Farm Bill to include the vast sectors and commodities across our nation. This single Farm Bill aims to cover and protect one industry with such a diverse climate. It is a big task and therefore will continue to be amended and altered through the years. The history and enduring support for the Farm Bill over the decades is what helps the agriculture industry thrive. With the help of the Farm Bill and affiliated legislation, the legislators are given more insight into the struggles and hardships of the American farmer. It is not on our own that the American farmer is able to prosper and strive to keep our farms going into the next generation. It takes a country of support regardless of political parties, geographical locations, or faith bases to make an industry as strong as American agriculture.

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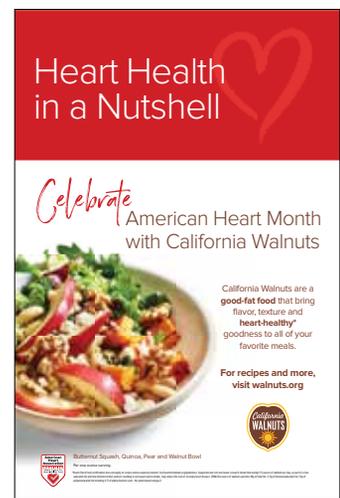
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The California Walnut Commission's Foodservice and Manufacturer program is also growing. National print and digital ads are running in high profile industry publications, along with advertising, PR efforts, and trade relations. We're educating food manufacturers and foodservice operators on walnuts' health benefits and versatility. A number of new products with walnuts were recently launched and you can find walnuts featured on the menu of several chain restaurants, including Sizzler, Velvet Taco and others.

¹Source: IRI, February 2018 vs. February 2017

*Heart-Check food certification does not apply to recipes unless expressly stated. See heartcheckmark.org/guidelines. Supportive but not conclusive research shows that eating 1.5 ounces of walnuts per day, as part of a low saturated fat and low cholesterol diet and not resulting in increased calorie intake, may reduce the risk of coronary heart disease. (FDA) One ounce of walnuts provides 18g of total fat, 2.5g of monounsaturated fat, 13g of polyunsaturated fat including 2.5g of alpha-linolenic acid - the plant-based omega-3.

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SUPPLY vs DEMAND

MATCHING NUTRIENT APPLICATION TO CURRENT TREE NEEDS

By RICHARD KREPS, CCA | Contributing Writer

You're hungry.

You just woke up from a long winter's nap. The fat you stored over winter is used up. You're lean and mean and looking for a good meal. A nice, juicy, medium-rare ribeye would be great right now. Then you find it; a whole frozen side of beef... and you have no way of lighting a fire. With cold temps and rain there's no way that meat is going to even thaw anytime soon, let alone get cooked. Good luck. Now think about your trees. A couple good cold snaps, some winter rains filling the soil profile, mostly anaerobic conditions for three months and then BAM!... Spring hits. The roots flush and search for nutrition for energy production. The buds swell pulling the dwindling nutrients to the spurs. Roots use up any available calcium, building structure for themselves. Whatever phosphorous that may have become available was depleted in the root ball over winter. The nutrition and carbohydrates they stored in their roots is mostly used up. This is particularly true if you skimped on post-harvest nutrition. They step on the gas only to find the tank is just fumes. There's just not enough energy and nutrition to fulfill maximum production.

Critical Nutrients

Three of the critical nutrients we need for proper plant nutrition are in high demand early; nitrogen (N), phosphorous and calcium. Calcium builds structure in plants, both in the roots and above ground. It is non-mobile in plants once it is assimilated and put in place. Towards the end of the year, our tissue tests show calcium levels often outweigh our nitrogen levels. Plants need a constant supply

of calcium throughout the growing season. Nitrogen is stored very well in the roots. N is one nutrient a plant tries to keep a high level of over winter. We are getting better at spoon feeding nitrogen throughout the season to assimilate more of the applied amount. Phosphorous is the element in the Krebs cycle that drives the energy production circle and makes ATP: adenosine triphosphate. It is needed in higher levels early in the season, when everything explodes and growth is maximized. However, phosphorous doesn't move to the roots by mass flow or diffusion. It has to be intercepted by the roots to be assimilated. And when those roots intercept it, it has to be in a form the plant can use, orthophosphate. We often find our first tissue tests are deficient in phosphorous and it is my opinion that our springtime standards are too low for this nutrient.

Calcium and Phosphorous

I now picture your eyes rolling back in your head as you think the words, "Thanks for the remedial agronomy lesson Rich, what does that have to do with a frozen side of beef?" Here's the deal: in Ag, it's often said calcium (Ca) and phosphorous (P) don't like each other much. That thought is actually specific to blending or injecting fertilizer to avoid tie up. They actually love

each other. In fact, they love each other so much, they'll actually spend 1000's of years together once locked up in their original form: calcium phosphate. We mine that rock, heat it, cook it, drown it, pour acid on it, and chemically alter it to separate the two. We put them in bags and liquid solutions so we can put them back on our fields to feed our trees. Then as farmers, with all the other things we have to deal with to produce a crop, it is easier to apply an overabundance of both nutrients to ensure our trees have an adequate supply. Add a little water, let them sit for a while, and the match made in Heaven is returned to its original form, calcium phosphate. Geologic bliss.

While dry calcium sources are excellent soil conditioners, we typically apply a big slug, often a couple tons, in the fall. Mother nature will hopefully provide clean rainwater to help solubilize some of that calcium to a plant ready form. However, here in the West, we don't get the acre feet we need to make that happen. And if your calcium source is less than one percent soluble, those tons only yield a few pounds of its elemental percentage when totally solubilized (by acre feet of water!). Unless you perfectly timed that fall application to maximize assimilation during the root flush, most if it is going to sit there....and wait.

We often find our first tissue tests are deficient in phosphorous and it is my opinion that our springtime standards are too low for this nutrient.

—RICHARD KREPS



Chemically induced hardpan.



Over applied dry calcium product and unincorporated, after 6 inches of rain. All photos courtesy of Rich Kreps.

Spring

Spring hits. We start applying the phosphorous. Most products are 20-30 percent orthophosphate (plant ready) and 70-80 percent polyphosphate. When it's cold and wet, polyphosphate can take 100 days to for active biology and weathering to turn it into ortho. Hopefully, the plant will drink the available ortho as soon as it hits the roots, but all the P that doesn't get quickly taken up, sits there as well. Low and behold that match made in Heaven is reunited! All that excess calcium that was applied found its mate

in a P form that couldn't be absorbed. The meal you were feeding the trees (the ribeye) just became a frozen side of beef again. Money wasted, as two nutrients are now no longer available.

So how do we avoid this? Although it takes more logistical planning, apply your P and calcium 10 days to two weeks apart in multiple, smaller applications. Alternate those applications. In spring, you can adjust a good amount of your P and Ca tissue levels in a few, separate foliar sprays. Back up your results with multiple tissue tests to verify

more of the nutrition is getting into the trees. Hit them from the top (foliar) and the bottom (fertigation). It will cost you more time and effort to "spoon feed" your orchards, but that should come back to you two-fold: potentially less on your nutrition costs, and higher yields on your crops. Good nutrition isn't cheap. It's important to assure you get as much of it as possible into your crop.

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Life Without Pyrethroids—What Now?



California almond growers use pyrethroid insecticides to control navel orangeworm populations in their orchards and prevent crop damage and aflatoxin contamination. There is evidence of developing resistance to this class of pesticide and growers are looking at new strategies to ensure a quality harvest. Photo courtesy of Cecilia Parsons.

By CECILIA PARSONS | Associate Editor

Is there life after pyrethroids? Nut growers, especially those in the southern San Joaquin Valley, may need to think about changing up their pest control strategies down the road in the face of increasing pyrethroid resistance and the potential for use restrictions.

Synthetic Chemical Insecticides

Pyrethroids are synthetic chemical insecticides whose chemical structures are adapted from the chemical structures of the pyrethrins, and act in a similar manner to pyrethrins. Pyrethroids are modified to increase their stability in sunlight. Their lower cost, compared to more targeted insecticides, has made pyrethroids the 'go to' control material for navel orangeworm (NOW).

In addition to use in agriculture, pyrethroids are contained in numerous household pest control products, used for flea control in pets and mosquito control. Pyrethroid insecticides have been widely used to control navel orangeworm and large plant-bug/stink bugs in nut crops. Their lower cost and effectiveness made them a favorite insecticide alternative to organophosphates when their use became more restricted.

Pyrethroid Applications

Pyrethroid applications in agriculture do present a lower health risk to workers and applicators than organophosphate products. They also present less of a risk to mammals and birds than organophosphates. The downsides for pyrethroids, as a broad spectrum insecticide, are association with outbreaks of secondary pests such as spider mites, incompatibility with biological control programs, offsite movement in surface water and toxicity to aquatic organisms and fish species. Pyrethroids also tend to persist for longer periods in the environment.

Pyrethroids are known for being effective in knocking down adult navel orangeworm and killing larvae by contact. They are also effective in controlling large bugs including leaf-footed bug. And, pyrethroids are the only control product with a four-week residual action.

Pyrethroids and NOW

Pyrethroids have played an important role in control of navel orangeworm helping the almond and pistachio industries maintain high quality nuts. Damage to kernels and introduction of aflatoxin-producing *Aspergillus* molds by NOW has cut into the growers' bottom line and adversely affected export markets.

Christine Abbott-Hearn with Pacific Bio Control said there is evidence that pyrethroids are becoming less effective in southern San Joaquin Valley almond and pistachio

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orchards than they were several years ago, making the chemical less effective against navel orangeworm.

Growers need to understand there are no new insecticide chemistries coming within the next five to six years, Abbott-Hearn said. Cost of development and registration for use on crops can easily top \$300 million and chemical companies are less willing to invest. Companies have also backed off investing in new products due to push back by environmental groups.

IPM Control Strategies

University of California entomologists and private companies have developed integrated pest management (IPM) control strategies for navel orangeworm that include orchard sanitation, mating disruption with the use of pheromones, and when needed insecticide treatments, such as Intrepid or Altacor.

Historically, wide scale adoption of mating disruption is often preceded by catastrophic insect control failures. This was seen with organophosphate resistance in codling moth in pome fruit in California and the Pacific Northwest and also with organophosphate resistance in oriental fruit moth in fresh market stone fruit in California. Since that time, mating disruption has become a conventional pest control strategy in both these markets with approximately 90 percent of all pome fruit growers and fresh market stone fruit growers in the western U.S. using mating disruption every year. Mating disruption is proven to be efficacious in controlling navel orangeworm in nut crops said Abbott-Hearn. Pheromones work by reducing insect populations in orchards. Orchard sanitation is also extremely important because that is where the overwintering navel orangeworm live and grow. It is on mummy nuts that NOW continue to survive until the new nut crop is available. Research shows that a grower can reduce their NOW reject percentage by 50 percent in the first year with the use of mating disruption, sanitation and efficacious insecticides.

Mating disruption is gaining in almond and pistachio production as with multiple suppliers in the market

and the proof that it can work even on smaller acreages. Extension IPM specialists David Haviland, Jhalendra Rijal and Emily Symmes with the help of a Department of Pest Regulation (DPR) Pest Management Alliance Grant have recently demonstrated the effectiveness and cost effectiveness of pheromone mating disruption.

Large Bugs

Where large bugs in pistachio and almond crops are concerned, there may

not be immediate resistance issues, but the lack of effective control poses an uncertain situation for growers.

Neonicotinoid products are more expensive and do not have the residual effects needed to control large bugs. Abbott-Hearn said stink bugs and leaffooted bugs don't emit a sex pheromone to attract mates and therefore mating disruption can not be used as a means to control these pests. Stink bugs

Continued on Page 60

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During bloom to pre-bloom, growers and orchard managers are urged to monitor for insect pests and use pheromone traps where appropriate.

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and leaffooted bugs emit an aggregation pheromone which draw them to a central point. It is their aggregation pheromone that is used in lures in traps to monitor these bugs. The Almond Board of California (ABC) is funding research to understand leaffooted plant bug pheromones.

Kris Tollerup, an IPM advisor at the UC Kearney Research Center said the residual effect of pyrethroids makes them valuable for control of large bugs in pistachio and almond orchards. The neonicotinoid product Belay will also provide some control, but it has to make contact.

Resistance Management

In an Integrated Pest Management presentation for Almond Board of California, Kern County University of California Cooperative Extension (UCCE) entomologist David Haviland noted that resistance management was necessary to retain efficacy of

pyrethroid products. In addition to judicious use, rotation of chemistries was advised. Insect growth regulator (IGR) products and the Diamide product Altacor have similar efficacy against NOW and rotating use of these products with pyrethroids can help with resistance.

A study at Wonderful Orchards showed that between 2009 and 2016, resistance factor for bifenthrin in both low and high use situations had increased. With high use, resistance factor went from 0.7 in 2009 to 15.7 in 2016 in low or no use of bifenthrin, resistance factor went from 1.05 in 2009 to 11.4 in 2016.

According to Charlotte Fadipe at California Department of Pesticide Regulation (CDPR), pyrethroid use in California agriculture has been increasing over the last few years. This is partly because Environmental Protection Agency (EPA) and DPR have been actively encouraging a transition away

from organophosphates to the less harmful alternative.

Almond use of pyrethroids fluctuates from year to year, depending on pest pressure. Total pounds for 2016 were 113,627, down from 127,969 even as total productive almond acres increased. The Almond Board of California reports that over the past 25 years, pesticide use per acre in almonds has decreased 13 percent.

Reducing Pesticide Use

Gabriele Ludwig, Almond Board of California's director for Sustainability and Environmental Affairs, said tactics and tools have been developed for growers to reduce overall pesticide use. Pest management is one of the four 2025 goals announced in 2018 by ABC at their annual conference. The tactics and tools developed thus far to achieve the goal include monitoring, use of beneficial insects, habitat removal and mating disruption. Additional



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practices for pest control in nut crops may come from research funded by a CDPF Pest Management Alliance grant. The grants are aimed at projects that increase implementation and adoption of proven and effective integrated pest management practices that reduce pesticide risks to human health and the environment.

To meet the 2025 goal of a 25 percent increase in adoption of environmentally friendly pest control tools, ABC lists IPM practices for each growth stage of an almond crop. During bloom to pre-bloom, growers and orchard managers are urged to monitor for insect pests and use pheromone traps where appropriate. Pesticide applications should be timed according to Pest Management Guidelines for fungal and bacterial diseases.

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



THE ABCs OF H2A

By ANNA GENASCI, QAL | Assistant Director of Education at AgSafe

When speaking to growers throughout California, and frankly, throughout the United States one issue transcends commodities and geography—labor. The food and farming industries seem to be constantly seeking a reliable labor force and some have taken advantage of the foreign guest worker visa program, H2A. While H2A can provide our industry with temporary labor relief, ensure you have done your homework to fully understand the stringent requirements that come along with utilizing this program. Let's delve into a few of the requirements.

H2A Requirements

First, you must prove that there is a need for an H2A workforce due to the lack of domestic workers, the work that is being offered must be temporary or seasonal in nature, and you must demonstrate that employing H2A guest workers will not adversely affect the wages and working conditions for domestic workers that are performing similar tasks.

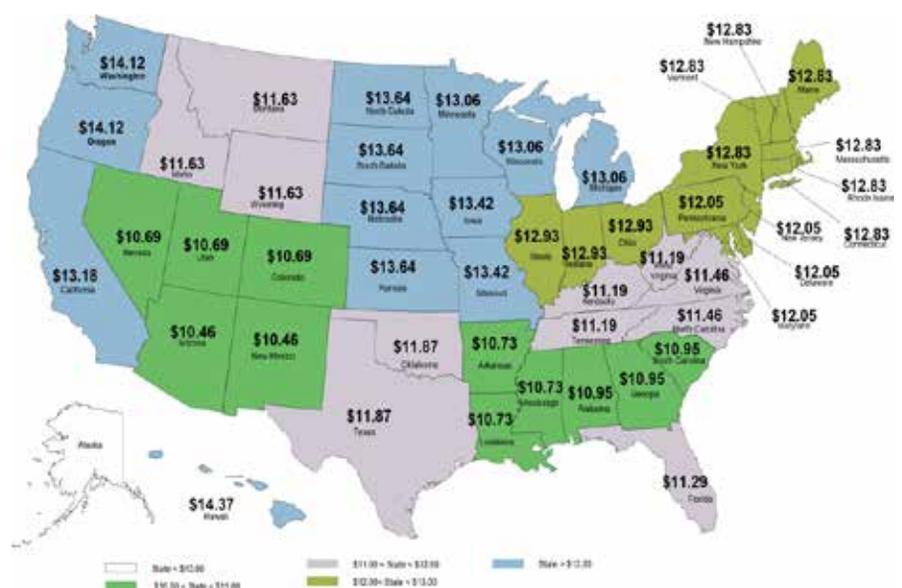
Employers must then submit a temporary labor certification application to the United States Department of Labor (USDOL). This application includes evidence of having actively advertised positions and placed jobs with the state workforce development agency to better demonstrate the lack of domestic workers. Finally, Form I-129 must be submitted to United States Citizenship and Immigration Services (USCIS).

Paying H2A employees is more detailed than just paying the state's minimum wage. If you choose to pay your H2A employees an hourly rate it needs to be at least the Adverse Effect Wage Rate (AEWR), minimum wage or the contracted rate, whichever is the highest. If piece rate is a better fit for your operation, it cannot be less than the AEWR, minimum wage or contracted rate. Regardless of if you pay hourly, piece rate or a combination of the two, you must pay whichever is highest in your area—minimum wage, the AEWR or the agreed upon contracted rate negotiated with the workers.

Rate of Pay

Mentioned previously was the rate of pay. This contracted rate is captured in the disclosure of terms. In addition to the rate of pay, the disclosure must also include the following information:

- Beginning and ending dates of the seasonal work
- Condition of employment
- Hours per day and days per week
- Crops and job(s) to be performed
- Tools required (at no charge to the worker)
- Any authorized deductions, like meals
- Guarantee of 75 percent of the work



Paying H2A employees is more detailed than just paying the state's minimum wage. If you pay your H2A employees an hourly rate it needs to be at least the Adverse Effect Wage Rate (AEWR), minimum wage or contracted rate, whichever is the highest. All photos courtesy of AgSafe.

Transportation Expenses

When utilizing labor through the H2A program, the employer is responsible for transportation expenses. This includes paying in advance or reimbursing for the cost of transportation to get to your operation, the cost for that worker to return home once the contract is complete, the cost associated with obtaining the visa, and daily transportation to and from the worksite.

The employer is also responsible for providing:

- Housing at no expense to the worker
- Laundry facilities at no expense to the worker
- Free, hygienic and convenient cooking facility OR
- Three nutritional meals each day
 - The employer may deduct from pay a stipend for meals when providing them and that must be disclosed in the employment conditions, as well as be noted on each wage statement. The daily deduction is limited to \$12.07.

Treatment of Workers

It is important to note the treatment of domestic workers who are performing similar tasks to the work being completed by their H2A counterparts. Employers are required to treat existing domestic workers the same as their H2A workforce, including paying employees the same rate if they are doing similar work. Additionally, employers must continue to recruit domestic workers through the first 50 percent of the contracted period.

In evaluating the use of the program, it is worth reviewing the areas where current users of the H2A program find themselves in violation by the USDOL:

- Rejection of U.S. workers
 - Not hiring a domestic worker who is able, willing and qualified to work in a position offered to an H2A guest worker.
- Preferential treatment of foreign workers
 - Providing higher wages, more hours, and better working conditions to the foreign workers than U.S. workers in corresponding employment.

- Wages
 - Not paying the highest applicable wage rate.
 - Misclassification of a corresponding worker (US worker doing the same job).
 - Not paying for all hours worked.
- Housing
 - Housing not maintained in a safe and sanitary condition.
 - Not providing an adequate cooking facility.
- Not providing 3 nutritious meals when there are no cooking facilities.
- Transportation
 - Using unsafe vehicles.
 - Unlicensed drivers transporting workers.
 - Not reimbursing the H2A worker the correct amount of inbound and subsistence costs.

Continued on Page 64

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Continued from Page 63

- Not reimbursing the H2A workers the correct amount of outbound and subsistence costs.

It is interesting to look at what states are currently utilizing the H2A program, and the commodities that tend to utilize this option for securing a workforce.

Currently Florida, Georgia, North Carolina, Washington, and California rank in the top 5 states using H2A labor. Berries, apples, tobacco, fruits and vegetables make up the top commodities utilizing this labor option.

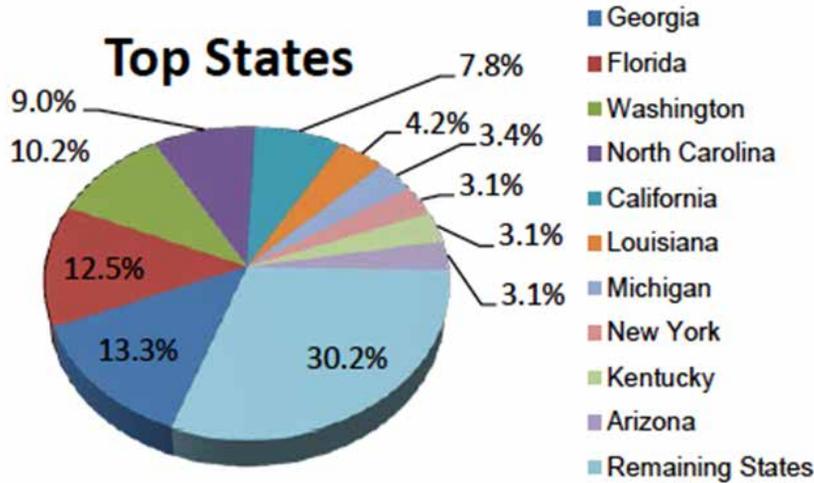
As we continue to navigate the labor shortage issues present in our industry it is easy to assume H2A use will continue to grow, and perhaps we will

see a new worker program come to light. Regardless of the labor source you choose to hire, ensure you do your homework first to ensure you fully understand the impact to your business.

For more information about the requirements of the H2A guest worker visa program, or any worker safety, human resources, labor relations, pesticide safety, occupational safety, or food safety issues, please visit www.agsafe.org, call (209) 526-4400 or email safeinfo@agsafe.org.

AgSafe is a 501c3 nonprofit providing training, education, outreach and tools in the areas of worker safety, human resources, labor relations, pesticide safety, or food safety for the food and farming industries. Since 1991, AgSafe has educated nearly 75,000 employers, supervisors, and workers about these critical issues.

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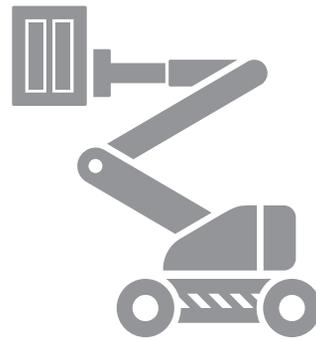
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Working with Aerial Lifts



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

By ELDA BRUEGGEMANN | Director of Environmental & Safety Services
Western Agricultural Processors Association



All photos courtesy of WAPA.

Every tree nut grower, huller and processor has some type of aerial lift to elevate workers to perform certain activities on the worksite. From orchard pruning towers to scissor lifts or telescopic/articulating boom lifts to homemade “man baskets” used with forklifts, they are common place throughout the industry. An average of 26 workers die each year from accidents related to aerial lifts. As a result, the industry must be proactive when it comes to working safely with aerial lifts. The most common aerial lift accidents occur as follows:

Electrocutions

When the worker or the lift come into contact with overhead power lines. This accounts for more than 25 percent of the deaths.

Falls

When the worker extends his/her body beyond the confines of the lift or gets out of the lift.

Collapse or tip-over

Workers must maintain the lift on stable ground, stay within load limits and not move in an elevated position

Caught in or between—workers involved with this type of accident were caught between the edge of the bucket and another object, like a roof joist or beam, when they were repositioning the aerial lift bucket.

Being struck by the aerial lift or object

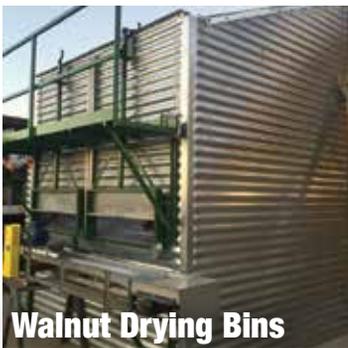
This accident occurs when the operator isn't aware of their surroundings and comes into contact with objects that come loose.

It is important to note that more than 70 percent of the accidents involving aerial lifts occur with boom lifts. Half of the falls from boom lifts involved being ejected from the bucket after being struck by vehicles, cranes, or crane loads, or by falling objects, or when a lift is suddenly jerked. Two-thirds of the deaths from collapses/tip-overs of boom lifts occurred when the bucket cable or boom broke or the bucket fell, and almost one-third were due to tip-overs. Half of the boom lift electrocutions involved body contact with overhead power lines.

When working with aerial lifts, employers must consider the safety

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in operating the lift, and the safety of the worker in protecting against falls. Employers must ensure only trained and certified operators may use the aerial lifts. Each authorized operator must go through classroom and hands-on training which consist of operation (review of emergency controls, emergency escape techniques), aerial platform hazards and basic lift operation demonstration.

The operator of aerial lift must follow all of the key points when operating aerial lift:

- Be trained in the safe and proper operation of a manlift.
- Be familiar with the specific lift and its operator's manual.
- Know the maximum load capacity (weight of personnel, tools, etc.)
- Conduct a pre-start inspection of the equipment by conducting a visual inspection of the equipment and checking things like tires, wheels, battery, leaks, controls, etc.
- Conduct an inspection of the environment where the work will take place looking for such things as overhead clearance, traffic patterns (forklifts, pedestrians, etc.), wind hazards (if outside), and location of other workers.
- Protect against fall hazards by inspecting guardrails on the lift and having the necessary fall protection gear on (i.e. harness, fall restraint).
- Employees shall not sit, stand or climb on guardrails or use planks, ladders to gain additional height.
- Never operate the lift when in the elevated position.
- Maintain safe clearance from power lines and apparatus.

This article is not meant to be a training tool, but rather to highlight safety concerns when operating manlifts in the workplace. To carry this out further, the Western Agricultural Processors Association (WAPA) is conducting a series of training sessions throughout the state to assist the tree nut industry with this important safety issue. For details, please visit www.agprocessors.org.

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APPLYING NITROGEN: GUIDELINES FOR GROWER SUCCESS

By THE ALMOND BOARD OF CALIFORNIA



When almond irrigation and nitrogen applications are managed carefully, optimal yields can be achieved while still realizing 70 percent nitrogen use efficiency. Image courtesy of the Almond Board of California.

When it comes to applying nitrogen (N) fertilizer, the decisions almond growers make really matter—to the environment and their bottom line.

That's the message top experts in fertilizer applications are emphasizing as growers enter the season where the most important nitrogen management decisions are made.

"Nitrogen use efficiency is very important for growers," said Patrick Brown, professor of Plant Sciences at the University of California, Davis. "You want that nitrogen you paid for to go into your crop, not be wasted, or lost to the groundwater."

Fortunately, decades of research and collaboration between the University of California (UC) and the Almond Board of California (ABC) have produced practical guidelines and tools to assist growers, increasing their chances for a successful crop while minimizing impacts to the environment.

"With the last decade or so of getting the foundation in place, we're in a very good position," Brown said. "We've learned that you can get optimal productivity, while minimizing the losses of nitrogen."

Growers Increasingly in Spotlight

While growers are always focused on efficient crop production, they should be also be aware of increasing regulatory attention to groundwater quality and pressure on all farmers to improve performance in the area of nitrogen use efficiency, said Gabriele Ludwig, director of Sustainability and Environmental Affairs for the Almond Board.

In the Central Valley, growers are regulated under the Irrigated Lands Regulatory Program, which is beginning to set limits on the amount of nitrogen that can be applied to a certain area based on townships. While those limits are still being developed, now is a good time for growers to keep close track of their nitrogen applications and strive for greater efficiency to stay ahead, Ludwig said.

"The spotlight on nitrogen management is not going to go away," she said.

A Few Simple Rules

According to several top experts, nitrogen use efficiency can be achieved if growers follow a few key guidelines and pay careful attention during the peak nitrogen uptake season,

from March through May. Among the most important of these guidelines:

- Determine your orchard's expected demand using available tools (see below), then apply frequently and incrementally, adjusting during the season based on plant tissue testing to assure the right rate of nitrogen is applied at each key growth stage.
- Check your irrigation system to make sure everything is always working properly—nitrogen use efficiency requires irrigation uniformity.
- Fertilizer nitrogen (in the urea or nitrate form) moves readily with irrigation or rain water. When fertigating, add the nitrogen toward the end of the irrigation set to keep more of the nitrogen from being moved deep in the rootzone, too far away from most of the active roots. Mid to -later in the irrigation set fertigation injections allow the fertilizer nitrogen to stay higher in the soil profile where the roots can get to it.
- Avoid early or late applications (before bloom or after harvest) because trees aren't taking up nitrogen at those times.
- Check the weather to avoid applying nitrogen right before a significant rain, which would likely flush some or all of the nitrogen below the root zone before the tree can use it.

With more and more growers using fertigation, properly managed irrigation is more vital than ever for efficient water and nitrogen use. That means checking to make sure the system is evenly applying water throughout the block, and that lines, pumps, and sprinklers are all working properly.

"I encourage growers to check for irrigation uniformity and apply nitrogen toward the end of the irrigation cycle to promote high efficiency," said Sebastian Saa, the Almond Board's senior manager for Agricultural Research.

And, especially earlier in the season, growers should keep an eye on the weather, Saa said.

"Especially in sandy soils, if you know it's going to rain the next day, that is not the best time to apply," Saa said. "You want to try to avoid leaching; you want the nitrogen to go into the tree instead of wasting your money and losing it."

Continued on Page 70

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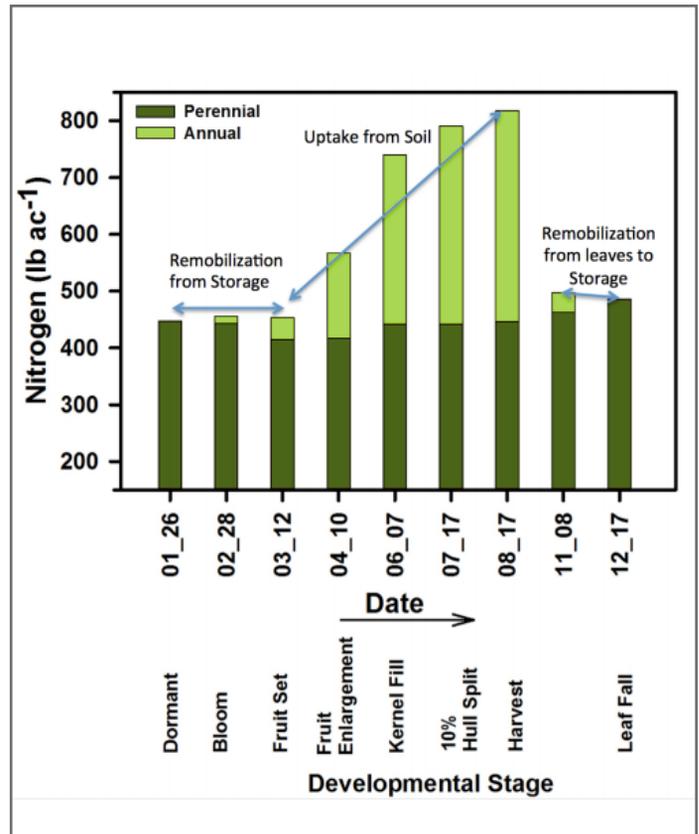
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Not Too Early, Not Too Late

Experts say growers should be estimating their crop's nitrogen demand as early as January, based on a five-year average of previous yields and fruit set. The California Almond Sustainability Program (CASP), which provides helpful tips and opportunities for growers to improve on-farm practices, includes a Nitrogen Calculator that allows growers to input orchard specific data and then provides a total nitrogen fertilizer recommendation, along with recommended amounts by crop growth stage (see the Almond Board's Nitrogen Calculator and Nitrogen Budgeting pages for help; links at the end of this article). Using the Almond Board's nitrogen calculating tools also provides the grower with the necessary paperwork for submitting nitrogen budgets to their Irrigated Lands Regulatory Program coalition.

While planning ahead is helpful, growers must ensure they do not apply too much nitrogen—it is wasteful and unnecessary. "Before bloom is definitely too early for nitrogen applications," said Franz Niederholzer, a University of California Cooperative Extension farm advisor specializing in orchard systems. "You want to wait until the bees are moved out of the orchard and you are into petal fall."

Research has shown that prior to that time, mature trees provide their own nitrogen from inner storage to get growth started—and couldn't use nitrogen even if it were available in the soil.



Avoid early or late applications (before bloom or after harvest) as trees aren't taking up nitrogen during those times. Image courtesy of the Almond Board of California.

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"Trees do not access nitrogen from the soil until flowering has finished and the leaves are 50 percent expanded," UC Davis' Brown said.

Research has also shown that late applications of nitrogen, especially well after harvest, do not help the trees, are wasteful and likely will no longer be available in the soil by spring.

"We have learned that the uptake of nitrogen after harvest is limited to the first few weeks after harvest, diminishing thereafter," Brown said.

"Limited trials suggest there is no yield benefit the following year from late nitrogen applications," Niederholzer said.

Adjustments Needed, but Timing Important

While nitrogen applications pre-bloom or post-harvest don't help the crop, a lot can be done during the season to adjust applications to meet crop demand.

Following the pre-bloom estimate, growers can use tissue sampling in April to assess N levels in the tree, and they can input a revised yield estimate to adjust remaining nitrogen applications, as needed.

Niederholzer said additional leaf samples in July can help a grower determine whether they are running short on nitrogen in an orchard and therefore determine whether additional applications are needed.

"Too much [nitrogen] isn't going to help, and too little leaves money on the table," he said.

Further Progress on the Horizon

When almond irrigation and nitrogen applications are managed carefully, optimal yields can be achieved while still realizing 70 percent nitrogen use efficiency—higher than many other crops, according to Brown.

Still, researchers expect further improvements to be made in the future, with innovative strategies that allow growers to customize nitrogen rates to individual rows of trees or by soil type within individual orchards.

Brown points to continued collaboration with the Almond Board as vital to the progress that has happened so far and is expected into the future.

“We’ve certainly had a wonderful experience over the last three decades working with the Almond Board and in coordination with the California Department of Food and Agriculture and United States Department of Agriculture,” said Brown.

“The Almond Board has been very supportive, even before they were aware of the challenges with nitrogen in the environment.”

Tools for Growers

Tools, calculators and important information is available for free to growers at the Almond Board’s website—Almonds.com/Growers—and a few key webpages dedicated to nutrients are listed below. Almond growers are also encouraged to contact Saa at the Almond Board with questions regarding nitrogen management (ssaa@almondboard.com).

- “Almond Early-Season Sampling and In-Season Nitrogen



All almond growers can use the Nitrogen Budgeting Calculator to create budgets for their nitrogen applications, but growers must be participants in the California Almond Sustainability Program to access the data storage feature, which saves the need to reenter all the data when revising budgets during the growing season.

Application Maximizes Productivity, Minimizes Loss”: bit.ly/2GhbjAz

- ABC’s Nitrogen Budgeting Page: Almonds.com/nutrients/Budgeting
- ABC’s Nitrogen Calculator Page: Almonds.com/Nutrients/Calculator
- Patrick Brown’s 2016 TAC Presentation, “Managing Nitrogen Efficiently”: bit.ly/2Rv0i3F

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New Interim Restrictions for the Agricultural use of Chlorpyrifos

Davis, California—New interim restrictions for the agricultural use of chlorpyrifos are in effect since January, as the state moves forward in listing the insecticide as a toxic air contaminant this April.

by ANNA KATRINA HUNTER and LISA BLECKER

The California Department of Pesticide Regulation, or CDPR, is responsible for enforcing the current interim measures that update conditions for obtaining a permit for chlorpyrifos use in production agriculture. But its imminent listing as a toxic air contaminant is a joint effort coordinated between state regulatory agencies that include the Office of Environmental Health Hazard Assessment and monitoring by the Air Resources Board.

According to a health risk assessment performed by an independent scientific review panel on July 30, 2018 for CDPR, a necessary step in the regulatory process for listing chlorpyrifos as a toxic air contaminant, its use contributes to unacceptable exposure to bystanders. From 2004 to 2014, about 246 pesticide illness injury reports from exposure to chlorpyrifos were made, the majority of incidents due to drift. Chlorpyrifos exposure comes from air, food, water and through incidental ingestion from residues that settle on surfaces outdoors.

Despite that it is not a fumigant, chlorpyrifos has semi-volatile properties. It is an organophosphate insecticide and miticide that controls a number of insect and mite pests on 60 different crops in California. Around 70 percent of its use in the state are in five crops: orange, almond, walnut, cotton and alfalfa, although its overall use is in decline after peaking in the 1990's.

As with all organophosphates, it binds with and inhibits acetylcholinesterase in the human nervous system, an enzyme that is an essential buffer for communication between nerve cells. Symptoms at low doses of immediate

exposure are headache, nausea and other side effects, respiratory paralysis and even death at higher doses.

Areas in the state where chlorpyrifos has the greatest use and therefore the highest risk of exposure to the public are in the Central and San Joaquin Valley in Tulare and Kern counties and Imperial County and on the Central Coast near cole crop production (see Figure 1). Its use around the state is year-round, but peaks in the summer months.

New Interim Permit Conditions for Chlorpyrifos

Critical use exemptions effective



Adult leaffooted bug, *Leptoglossus occidentalis*. Photo by Larry L. Strand.

January 1, 2019 permit allowances for 18 crop and pest combinations where few or no alternative control measures are available to growers. These identified combinations are from a joint effort between the UC Statewide IPM Program and CDPR.

Specific commodity and pest critical uses:

- Alfalfa for weevils, blue alfalfa aphids, cowpea aphids
- Almonds for leaffooted bug, stink bugs
- Asparagus for garden symphylans, asparagus aphid
- Citrus for ants
- Leafy vegetables, radish, rutabaga,

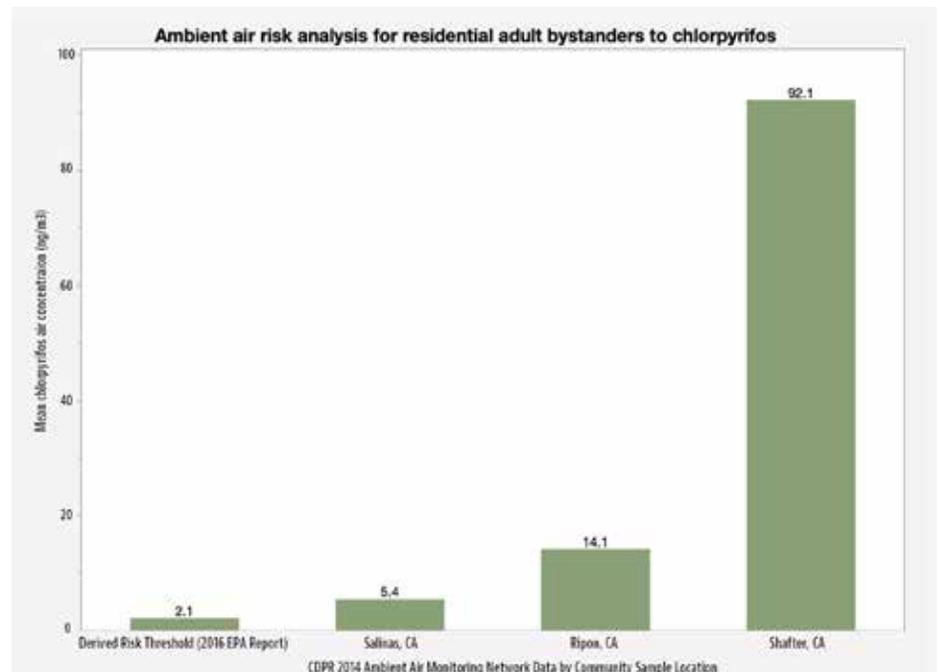


Figure 1 – Graph shows the derived risk threshold for chlorpyrifos concentrations in air, for chronic exposure to adults, compared to the average air concentrations measured in Salinas, Ripon, and Shafter by the CA Department of Pesticide Regulation in 2014. Risk levels found at all three locations were of concern. Source: US EPA 2016 Chlorpyrifos Revised Human Health Risk Assessment for Registration Review, Table 9.1. Adapted from NRDC.org.

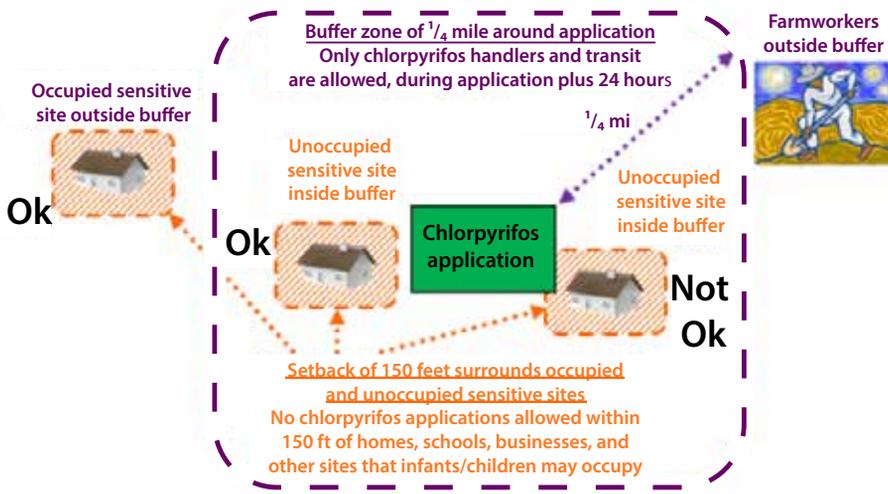


Figure 2: Buffer zone and setback requirements for chlorpyrifos ground applications Source: CDPR

or turnip for root maggots

- For cotton aphid, sweet potato whitefly
- For root maggots
- Grapes for ants, vine mealy bugs
- For root maggots
- Peppermint for garden symphylans, mint root borers
- Walnuts for borers

Granular or chemigation and precision sprayer applications of chlorpyrifos, however, are permitted for use on any crop up to a limit of 40 acres within a 24-hour period. Granular and chemigation applications are exempt from buffer zone and setback requirements that are explained in more detail below.

Before any application of any kind is made, growers must work with a pest control adviser (PCA) to identify a need for the application through a field assessment in order to receive a written recommendation (please see Table 1, page 74).

If any application of chlorpyrifos is identified as necessary, a 48-hour notice to the local county agricultural commissioner is required with certain additional steps. With the exception of granular or drip applications, maps that mark a quarter mile or 1320-foot buffer from the perimeter of the treated application site are required. Written permissions from neighbors are required if the buffer zone extends into other properties (Figure 2). The quarter mile buffer zone remains in effect for 24 hours after the application is made with only handlers permitted

and vehicle transit if public roads fall within the buffer zone to prevent exposure. Neighbors that fall within the buffer zone that provide written permission must vacate all persons. Sensitive sites such as schools or homes that fall within the buffer zone are subject to a 150-foot setback or supplemental buffer

even if unoccupied because of potential for residues (Figure 2). A 40-acre limit also applies to the allowed crop pest combinations.

Any chemigation application must be made by someone who is trained in pesticide handler safety and knowledgeable of the on-farm irrigation system. Aerial applications are prohibited due to a high potential for drift as demonstrated through computer modeling. For airblast applications, the three outside rows of a treatment site must be sprayed inward and the nozzles away from the treatment area closed. Top nozzles that fall above the crop canopy must be closed and all nozzles must be shut off when passing between gaps in the canopy.

Please visit the California DPR webpage Appendix O: Chlorpyrifos Interim Recommended Permit Conditions to read through a full list of the interim measures. This article does not itemize an exhaustive list of all of the permit conditions for chlorpyrifos.

Continued on Page 74

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Notice of Intent requirements that apply	All requirements	All requirements	All requirements	All requirements
PCA requirements that apply	All requirements	All requirements	All requirements	All requirements
Buffer zone requirements that apply	All requirements	All requirements	No requirements	All requirements
Setback requirements that apply	All requirements	All requirements	No requirements	All requirements

Table 1- Summary of recommended interim permit conditions for chlorpyrifos. Source: CDPR

History of Federal Ban and State Listing

A federal ban on chlorpyrifos began in 2007 when the Natural Resources Defense Council and Pesticide Action Network North America petitioned the U.S. Environmental Protection Agency (U.S. EPA) and filed a lawsuit to cancel chlorpyrifos registrations. In July of 2015, the California Department of Pesticide Regulation (CDPR) listed chlorpyrifos as a restricted material requiring permits for use from local agricultural county commissioners because of identified health and environmental issues.

In June 2015, the U.S. EPA proposed to revoke all food residue tolerances for chlorpyrifos which effectively would remove its registration with a final decision scheduled to be made by March 2017. Instead, the Ninth Circuit Court of Appeals ordered the U.S. EPA by October 31, 2015 to either deny the petition, issue a proposed revocation or a final rule. By November 2016, the U.S. EPA revised a health risk assessment that supported the 2015 proposal demonstrating risks from dietary exposure through food residues and drinking water for non-food use, and neurodevelopmental effects.

According to the U.S. EPA, chlorpyrifos will remain registered until 2022, while undergoing registration review of the science that addresses neurodevelopmental effects.

But, in August 2018, a panel of three federal judges in the Ninth Circuit Court of Appeals ordered that the U.S. EPA cancel all chlorpyrifos registrations within 60 days; stating that the U.S. EPA is not justified in maintaining the insecticide’s registration “in the face of scientific evidence that its residue on food causes neurodevelopmental damage to children” and criticized that for “over the past decade or more, the U.S. EPA has stalled on banning chlorpyrifos.”

The U.S. EPA requested a full panel rehearing of the trial and also expressed plans to appeal if denied. Until recently, the federal ban was on hold, but on February 6, 2019 the Ninth Circuit Court of Appeals in San Francisco granted the U.S. EPA an en banc rehearing for March 25. U.S. Department of Justice attorneys argue the Ninth Circuit does not have authority to rule in the case and the court should have overturned the U.S. EPA’s decision and sent it back for reconsideration, as the order nullifies the FIFRA process.

In California, outside of the U.S. EPA and the federal court of appeals ruling, the state interim measures will provide CDPR an opportunity to assess their efficacy. The listing of chlorpyrifos as a toxic air contaminant by the state will go into full effect this April. Starting this summer through the participation of multiple agencies such as the Office of Environmental Health Hazards Assessment, local air districts, county agricultural commissioners, and the California Department of Food and Agriculture, CDPR will determine whether more data is needed before developing permanent mitigation measures in the fall that will be available for public comment by 2020 and in full effect by spring of 2021.

According to Special Advisor for the Pesticide Programs Division at CDPR, Randy Segawa, who is involved in leading the toxic air contaminant listing effort for chlorpyrifos “it is very likely that further measures will be needed.”

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UPDATE ON SALINITY MANAGEMENT *In Pistachios*

By CECILIA PARSONS | Associate Editor

Helping California's pistachio growers with orchards adversely affected by high levels of soil salinity and sodicity is a group of University of California (UC) researchers and Cooperative Extension specialists and advisors.

Salinity Research

Several multi-year studies have been or continue to be conducted in salt affected areas to more precisely determine water needs, i.e. evapotranspiration rates and crop coefficients, of mature micro-irrigated pistachio orchards grown on saline or sodic soils. Daniele Zaccaria, agricultural water management specialist at the UC Davis Department of Land, Air, and Water Resources (LAWR), is one of the scientists focused on the challenges posed to the pistachio industry by salty water and soil. Another contributor to the research is Giulia Marino, post-doctoral scholar in the Agricultural Water Management Lab at LAWR Department of UC Davis.

With looming groundwater pumping restrictions in many pistachio production areas, due to the Sustainable Groundwater Management Act (SGMA), knowing more precise water needs and evapotranspiration (ET) rates for mature pistachio trees grown with micro-irrigation on saline soils will be important water allocation and scheduling information for growers.

"We need to know actual water use of well-watered, non-stressed and high-yielding orchards" Zaccaria said. Farm managers will have to document water usage, so the current research will help them with baseline information, predict water (and energy) needs and

eventually design viable, yet profitable, deficit irrigation strategies. California's highest concentration of pistachio production areas, Zaccaria noted, are over critically overdrafted groundwater basins.

Pistachio Acreage

Pistachio acreage in California is near the 300,000 acre mark and Zaccaria and the California Pistachio Research Board estimate that 20-25 percent of those acres are affected by high salt concentrations. As this industry expands further and increases in value, Zaccaria said the prediction is that more salt-affected acres would be planted. This crop, he noted has the fourth highest valuation among California permanent crops. Although pistachio trees are known to tolerate much higher salinity levels than other permanent crops, irrigation management and monitoring and salt leaching practices where possible will be critical, he said, to maintaining economic production.

Most of the increase in pistachio production is coming from former cotton ground on the San Joaquin Valley's central and west side. Origins of the salts in that area are geologic (result from ancient marine deposits), Zaccaria said. Other than salt effects, the area is a prime pistachio growing region that is more likely to have adequate chill hours compared to the valley's warmer east side.

Measuring Evapotranspiration Rates

Due to the large number of acres affected by high soil salinity or sodicity, researchers have been measuring evapotranspiration rates and determining crop

coefficients in well-watered, non-stressed orchards grown in both non-saline and saline-sodic affected soils to compare information. Both salinity and sodicity are caused by too much salt in the soil, but sodic and saline soils require different management to maintain crop productivity. Saline soils possess salts that are soluble and move in soil water. The salts reduce the soil osmotic potential, and make water less available for plant's uptake. Soils become sodic when the concentration of sodium in the soil reach levels that can affect soil structure, and water infiltration. Clay particles get dispersed, clog pores, reduce infiltration and drainage, eventually leading to soil hypoxia or asphyxia.

This salinity research, said University of California Cooperative Extension (UCCE) Kern County irrigation advisor emeritus Blake Sanden, is aimed at giving growers and farm managers a better understanding of pistachio water use in salt-affected soils, and on the mechanisms by which salinity and sodicity may reduce tree performance and nut yield.

Long Term Exposure to Salinity and Sodidity

Zaccaria's 2015-18 study of mature pistachio trees in Kings County was directed at the long-term effects of exposure to salinity and sodicity. Although long-lived pistachio trees have a high capacity to adjust to challenges posed by salinity and sodicity, his study consisted of mature Kerman on PG1 rootstock grown on soils ranging from non-saline to increasingly saline and saline-sodic.

At a pistachio evapotranspiration workshop held at the UC Kearney agricultural research and extension center in January, Zaccaria said research is showing that lower osmotic potential of saline soils reduces tree canopy growth, light interception by the canopy, ability of trees to extract and take up water, evapotranspiration and crop yield.

By measuring light interception in tree canopies, actual evapotranspiration and crop yield over the 2016-18 crop years, Zaccaria said the information gathered showed sodicity to be more detrimental to tree health than salinity.

The 2015-2018 study showed that the non-saline control orchard in Hanford with a light interception fPAR of about 76 percent had a maximum actual

"We need to know actual water use of well-watered, non-stressed and high-yielding orchards"

—DANIELE ZACCARIA



Dodging welcome winter rain events, pruning crews are busy in February shaping young trees and preparing them to bear a crop. Photos courtesy of Cecilia Parsons.

ET (evapotranspiration) of about 0.31 inches per day and a maximum crop coefficient (Kc) value of about 0.9 in the peak water-demand months (June-July). This new information resulted in Kc values about 20 percent lower than those published for sprinkler-irrigated orchards in 2005 and 2012. In the salt-affected orchards Zaccaria said there was a 10-30 percent lower ET relative to non-saline orchards due to the combined effect of the smaller tree canopy size and lower soil osmotic potential. The 2015-2017 data showed significant influence due to weather variations, orchard specific soils, and management practices on ET and Kc values.

Zaccaria said that the study continued over the course of the 2018 crop season to account for the pistachio's alternate-bearing behavior, and with an eye on the potential water supply limitations that will come from regulation of groundwater pumping. In 2018 the UC research team instrumented an additional mature, well-watered non-saline orchards located in the Coalinga area and measured ET, Kc, light interception, nut yield, as well as soil and plant water status over the entire crop season. The non-saline orchard in Coalinga has a 15-20 percent higher ET and Kc than the non-saline orchard in Hanford. The two orchards have a very similar light interception by the tree canopy (~ 76 percent) as a result of similar canopy size and density.

At both the non-saline orchards in Coalinga and Hanford, measurements of the midday stem water potential and of soil moisture showed that no water stress occurred over the course of 2018.

Zaccaria said the difference in the orchards was most likely due to the presence of a winter cover crop in the Coalinga orchard. The observation suggested by measurements of net radiation at both orchards during the entire crop season 2018 that the higher values of net radiation could be possibly due to the bright vegetation of the dead cover crop and its residues reflecting and scattering around in multiple directions part of the incoming solar radiation. Capture by the tree canopy of the reflected and scattered radiation could trigger the higher water transpiration in the orchard, which may lead to higher water productivity (more yield per water evapotranspired).

2019 Research

The proposed research plan for 2019 is to continue collection of field data over the crop season at the five orchards with an expectation of averaging out the influence of alternate bearing, season specific and orchard specific growing conditions and variations on ET, Kc and nut yield. The information will help determine water use and water productivity of micro irrigated

pistachio orchards.

A second objective will concentrate on the two non-saline orchards to collect information comparing effects of a clean orchard floor versus a cover cropped ground.

This research is expected to provide more reliable water use information for mature pistachio orchards on non-salt affected and increasing saline crop conditions in the San Joaquin Valley. It will also seek a better understanding of how orchard floor management affects water use, soil structure, root health and water uptake function.

In addition, it will also determine the amount of water necessary to establish and maintain a winter cover crop in pistachio orchards.

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LOOKING AHEAD TO 2019

By EMILY ROONEY | Contributing Writer

It's a new day in Sacramento with Governor Gavin Newsom at the helm of the state. He is pursuing what he calls a bold and audacious public policy agenda for California. The ambitious governor is particularly prioritizing education, health care and housing, and Ag Council is seeing alignment between his policy ideas and many Democrat legislators. We are pleased the governor has also expressed support and is taking action to resolve the safe drinking water crisis.

With Democrats holding mega-super-majorities in both the Assembly and State Senate, we see collaboration between the Legislature and the new governor occurring in pursuit of the policies outlined below, among others.

Education

Universal preschool, a priority for the new governor, is phased in over three years in his budget proposal for all four-year-old children who are eligible based upon income. The budget also includes funding to increase the number of children who can access full day kindergarten.

Further, the governor's budget freezes tuition at California State University (CSU) and University of California (UC) schools and proposes funding for two tuition-free years of community college for first-time, full-time students, which is an expansion of the current policy of one-year.

Emergency Readiness

Legislators and the governor are working to support regions devastated by wildfires in 2018. Plans include backfilling wildfire-related property tax losses and waiving the local cost share for debris removal, among additional efforts.

Greenhouse Gas Reduction Fund

As part of the January budget proposal, Governor Newsom announced his blueprint for the Cap and Trade Expenditure Plan, which is funded by the entities that

pay into the state cap and trade program, including some Ag Council members, and other food processors. The approximately \$1 billion in cap and trade funds in the Expenditure Plan are intended to support efforts to reduce or sequester greenhouse gases.

This is an important funding mechanism and agricultural advocates, including Ag Council, have secured and utilized Expenditure Plan monies over the past two years in order to lower both mobile and stationary emissions.

The governor's budget proposal released this month unfortunately allocates fewer dollars in the Expenditure Plan toward certain agricultural categories. However, it is important to note with new priorities on the wildfire situation in California, some of these funds were redirected toward those efforts. Ag Council will continue to work to improve the funding amounts for our agricultural programs. In the meantime, the following funding allocations are provided in the governor's current plan:

2019-2020 Cap and Trade Expenditure Plan (Ag programs)

- Methane reduction (dairy digesters & alternative manure methane reductions)—\$25 million
- Ag diesel engine replacement & upgrades—\$25 million
- Healthy Soils Program—\$18 million
- Food Production Investment Program—no funding in the current proposal for 2019-2020

Health care

Governor Newsom's proposed 2019-2020 state budget expands Medi-Cal coverage to undocumented 19-25 year olds in California. Currently, the state limits Medi-Cal coverage to children 18 and under regardless of immigration status. In the legislative branch, a measure has been introduced to extend Medi-Cal benefits to all individuals age 19 and over regardless of a person's immigration status.

Housing

Housing affordability and homelessness continue to be a priority for the governor and legislators. Bills on this topic include a measure to increase the low-income housing tax credit program and boost the credits permissible for farmworker housing projects. The governor supports such tax credits to develop more low- and moderate-income housing. Additional measures submitted in the new legislative session would encourage housing production through the streamlining of approval processes and penalize local planning that restricts housing construction.

Labor

California will continue to be one of the most progressive states in the nation on labor issues. On the docket for the new governor is an expansion of paid family leave to six months. He is coordinating a task force on this issue to determine the next steps. On another labor issue, some members of the Legislature are gearing up to move legislation to codify a court case that makes it much more difficult for employers to define workers as independent contractors.

Water

The governor's budget plan includes a commitment of \$4.9 million in one-time General Fund dollars to take the initial steps to implement the Safe and Affordable Drinking Water Fund. This is an important action as we seek a permanent solution to the safe drinking water crisis, which is a cornerstone legislative issue for Ag Council.

The budget language demonstrates Governor Newsom's commitment to address the safe drinking water crisis in California. Further, in his January budget speech, the governor specifically cited Senator Monning's (D-Carmel) drinking water bill and stated that we "have to get this done." He said, "it's a disgrace" that one million people are without safe drinking water in California.

We thank the governor for making this issue a high priority. With Governor Newsom's backing, Ag Council continues to remain committed to this issue in 2019.

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



SHRED IT!

DS SERIES STATIONARY DEBRIS SHREDDER

The **DS Series Stationary Debris Shredder** is an inline waste shredder for precleaning and mummy densification. This shredder is made compact to easily install in any hulling/precleaning line. Available in 24", 30", 36", and 40" widths.



Key Features

- Reduce waste volume quickly and efficiently while creating compostable mulch.
- 20 horsepower electric motor allows for easy intergration into almost any processing line.
- 7-pounds of knives at each station result in optimum debris destruction.

Performance

Great for reducing waste volume while creating compostable mulch. The Vrisimo DS Series Stationary Debris Shredder has a bolt on flange. Features and electronically balanced cutter drum for vibration free operation. Includes electric drive motor allowing easy intergration into your processing line.

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Risk conditions are in full bloom this year.

It's not just the rain, it's the risk. Spring almond diseases can occur under a variety of conditions, and the humid, warm weather this year will bring them out whether it rains or not.

Find out your risk factors at LunaScalaCombo.com.

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THIS YEAR COULD BE A BAD YEAR FOR SPRING DISEASE RISK...

Weather forecasts¹ are suggesting that this year could be wetter and warmer. Almond spring diseases can occur under a variety of conditions, such as:



18 HRS
LEAF WETNESS
@ 50°F

OR



8 HRS
LEAF WETNESS
@ 68°F

OR



HIGH
HUMIDITY
≥ 60%

...MEANING SPRING DISEASES COULD BE ON THE RISE?²



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¹WARM WEATHER FORECASTS ARE BASED ON THE 2019 PREDICTION CENTER OUTLOOK. WET WEATHER FORECASTS ARE BASED ON 2019 ACCUWEATHER OUTLOOK.
²Disease images are photo credits of University of California IPM.

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