WEST COAST NUT

JANUARY 2019 ISSUE

SPOTLIGHT:

Mating Disruption:

A Crucial Tool for Nut Growers

SEE PAGE 4

IN THIS ISSUE:

JCS MARKETING PUBLICATION

CONSUMERS AROUND THE GLOBE ARE BUYING CALIFORNIA WALNUTS

Over 30 billion California walnuts have made their way into export markets for snacking, commercial and home baking, trail mixes, savory sauces, restaurant menus, ready-to-eat meals and more this past crop season.

Marketing programs are the key to building consumer demand to expand distribution and raise consumption.

Top 10 Export Markets:

Germany	Japan	Turkey	Spain	Korea
Italy	Greater China	Canada	UAE	Netherlands

Currently, the California Walnut Commission (CWC) conducts targeted marketing programs in eight countries throughout Europe and Asia, including an EU regional industrial program, positioning California walnuts distinctive quality, taste, versatility and nutritional benefits. Industry growers, handlers, and the CWC have made great strides by working together and will continue building demand in an ever-expanding global market.

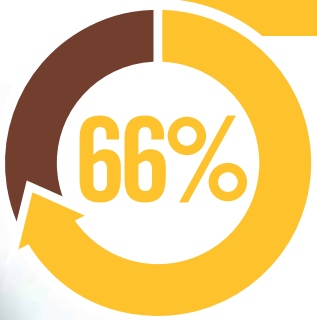
Here are the numbers:

Walnuts were the 4th leading export commodity from California.[1]

Every $1 spent in California walnut export promotion returned over $26 in export revenue to the industry.[2]

Each $1 in FAS-taxpayer support for California walnuts export promotion generated over $15 in tax revenue creation.[2]

Spending on export promotion in 2017 created 2,682 jobs.[2]



66% of the California walnut crop was **exported in the 2017/18 crop year.**

California WALNUTS

walnuts.org

[1] California Agricultural Statistics Review 2016/2017 by CDFA
[2] Economic Evaluation of the California Walnut Commission's Export Promotion Programs: An Analysis of the Direct and Indirect Impacts, January 2018, Harry M. Kaiser, Cornell University

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WEST COAST NUT

By the Industry, For the Industry

IN THIS ISSUE

Mating disruption—A Crucial Tool for Nut Growers

Mating disruption for navel orangeworm (NOW) has been widely tested throughout California with numerous research studies, and peer reviewed research has demonstrated it's efficacy.
Mating disruption is a very simple process. Females emit pheromones, males use those pheromones to find the female. If an orchard is flooded with artificially produced pheromone the entire orchard smells like a female and the males struggle to find the real females. If they don't find each other, they don't mate, and if they don't mate there are no eggs, no larvae, and less overall nut damage.

See full article on page 4

MATING DISRUPTION

A Crucial Tool for Nut Growers

By KATHY COATNEY | Editor

MATING DISRUPTION FOR navel orangeworm (NOW) has been widely tested throughout California with numerous research studies, and peer reviewed research has demonstrated it's efficacy.

Mating disruption is a very simple process. Females emit pheromones, males use those pheromones to find the female. If an orchard is flooded with artificially produced pheromone the entire orchard smells like a female and the males struggle to find the real females. If they don't find each other, they don't mate, and if they don't mate there are no eggs, no larvae, and less overall nut damage.

Mating Disruption in Almonds and Pistachios

Navel orangeworm is a major and costly pest of almonds and pistachios for growers and processors.

Currently growers use winter sanitation and chemical sprays for control, but mating disruption is another important tool at their disposal.

How mating disruption works is dispensers contain an artificial pheromone. They are placed in the orchard and inundate the orchard with the female pheromone so that the males either can't find or are delayed in finding the females.

There are two types of dispensers for NOW. "Three companies have dispensers that use pheromone in aerosol cans," according to David Haviland, University of California Cooperative Extension (UCCE) entomology and pest management farm advisor in Kern County.

"Those dispensers are displaced at a rate of one to two per acre depending on the product, and the dispensers spray pheromone at preplanned intervals when the moths are active," Haviland said.

With the fourth product, the pheromone is impregnated into a plastic strip. They are hung at a rate of approximately 20 per acre, Haviland said, adding this is the only dispenser that is approved for organic use, and it offers organic growers an option for mating disruption.

The other products are not organically approved due to the solvents involved in their production, Haviland continued.

"The solvents that are used to put the pheromone in those aerosol cans are not currently approved for organic use. The pheromone itself is organic, but the solvents are not," Haviland said, adding efforts are underway to find organically-approved solvents that would allow for organic approval for a

Two moths mating—photo courtesy of David Haviland.

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pressurized pheromone dispenser.

Placement

"All four products contain the same pheromone and contain approximately very close to the same amount of pheromone on a per acre basis over the season," Haviland said.

Dispensers are typically placed in the orchard prior to the first NOW flight—typically by the end of March.

"For the three aerosol based products, the dispensers are installed towards the end of March-beginning of April and are removed at the end of the season and new ones are put in the next season," Haviland said, adding all products last one season.

Installation of the passive dispensers is a very simple process that is also done around the end of March. Passive dispensers do not need to be removed at the end of the season.

Research

Haviland has done evaluations of all the dispensers in almonds and pistachios.

"We used 40 acre replicated trials to evaluate all four of these products. Data showed that all four can be effective. On average, they reduced damage by approximately 50 percent," Haviland said.

That was followed with a larger scale, two-year trial with six side-by-side demonstration projects in the San Joaquin Valley that also showed a 50-70 percent reduction in damage using mating disruption for navel orangeworm.

All of the trials except for one were done using mating disruption in conjunction with existing sanitation and spray programs. In the final trial, mating disruption was used instead of insecticides.

"We're not typically using mating disruption to replace sanitation or insecticides at this point. It's another tool in the toolbox being used in addition to other tools," Haviland said, noting that replacing insecticides is a possibility for orchards that have excellent sanitation and historically low levels of damage.

"One concern is that some growers want to pay for mating disruption by saving money on sanitation. Unfortunately, growers who don't sanitize and expect that mating disruption by itself is going to solve the problem are setting themselves up for problems. However, research has shown that using mating disruption in addition to existing management programs, including sanitation and insecticides, is effective and can reduce damage by another 50 percent," Haviland said.

Chemical Options

With the almond industry's drive towards increased sustainability and no

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new insecticides coming down the pike for navel orangeworm, mating disruption is the choice, Haviland said.

"So it's not just a matter of looking to see if mating disruption can work. It's an active, progressive, research program to try and figure out how to make mating disruption work, and how to make it work as good as it possibly can," Haviland said.

There is also the potential that mating disruption can result in less chemical applications between hull split and harvest, Haviland said.

"At this point, as a general recommendation across the state, unless you're in that category of naturally low pressure, we don't recommend backing off on your existing program when using mating disruption," Haviland said, noting that finding ways to use mating disruption to reduce insecticide sprays is an area of active research for the future.

Future Research

Two of the three phases to Haviland's research have been completed.

- Phase one—show mating disruption works.
- Phase two—does mating disruption consistently work and work well enough to justify it's use.
- Phase three—is mating disruption working well enough that it can start replace existing programs including pesticides.

Phase one and two are proven. Phase three, we're just not quite there yet, Haviland said.

> "All four products contain the same pheromone and contain approximately very close to the same amount of pheromone on a per acre basis over the season"

Haviland will continue conducting mating disruption research to further refine ways to use mating disruption as well as additional methods for application.

Most of the research at this point has been in almonds, but there was scaled down research done in pistachios.

"We did get the same level of trap shutdown in pistachios that we do in almonds on navel orangeworm, however, this year there was no damage in pistachios by navel orangeworm," Haviland said.

Because there was such a low damage in pistachios in 2018 good harvest data wasn't available in those trials, Haviland said.

Haviland plans to do significant mating disruption research on almonds in the future.

"It's not just that we're going to do research on mating disruption in the future, it's that mating disruption is becoming a significant part of the future," Haviland said.

Walnuts and Mating Disruption

Walnut growers have a more complex challenge when it comes to mating disruption. They face not only NOW but also codling moth (CM), and their harvest nut grade is based on the "worm damage" combined of these two pests.

NOW attacks the new nut crop primarily in the preharvest period at husk-split. CM larvae penetrate the walnut shell and eat the nutmeat throughout the growing season. NOW finds these nuts attacked by CM and enters the damaged nut through the exit hole provided by the CM larvae.

A single CM larvae will feed on the walnut consuming only a portion of the nutmeat. Once a NOW female finds a CM-penetrated nut it will lay multiple eggs, resulting in as many as a dozen worms that enter the shell and devour the remaining nutmeat.

NOW populations will rapidly build up in the mid-season period, then emerge in August and attack walnuts at their most vulnerable—husk-split stage. This makes management of both moth pests extremely important.

Doug Light, United States Department of Agriculture (USDA)/ Agricultural Research Service (ARS) Western Regional Research Center in Albany, California, has been conducting

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research on mating disruption since the early 2000s.

"Twenty years ago I discovered a potent host plant odor or kairomone attractant from pears and it is called the 'pear ester'," Light said.

Pear ester attracts both male and female CM. Moreover, when a trap is baited with pear ester combined with the CM pheromone, males are attracted in much higher numbers.

Research has shown this is due to a synergistic enhancement and greater stimulation of male brains when pear ester accompanies pheromone, Light explained.

Fifteen years ago this combination of pear ester and pheromone was developed as a "combo lure", that allows for effective accurate monitoring of CM in both conventional and most importantly in mating disruption treated orchards, that had no effective lure.

Blooming almond blossoms in February, 2018.

This combo lure is the standard lure for monitoring CM worldwide, Light said.

Light and Joe Grant, emeritus UCCE farm advisor in San Joaquin County, demonstrated that pear ester and pheromone combined in a dispenser significantly reduces mating and nut damage.

For the last nine years Light has been conducting cooperative research with Grant and two other UCCE tree nut specialists, Emily Symmes, University of California (UC) Area Integrated Pest Management Advisor (IPM) for the Sacramento Valley region, and Jhalendra Rijal, also an IPM Advisor with the UC Statewide IPM Program in the San Joaquin Valley.

This team has been experimenting with passive dispensers for mating disruption that is simultaneously effective for both codling moth and NOW.

Two dispensers, one for each moth, are co-hung together using a pole. They are placed at 20 per acre at mid-canopy. They are easy to hang and labor efficient, Light said.

Using passive dispensers, researchers have seen a reduction in mating and nut damage by both pests.

"Hanging them together, we get very high results—over 95 percent disruption and reduction in male moth capture in pheromone traps of both codling moth and naval orangeworm," Light said.

All of the past and ongoing research efforts will allow mating disruption to become a practical and useful tool for growers to use in their IPM programs for tree nut production.

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COMPOST

CROWN GALL ON WALNUTS

Assessing Origin of Infection, Disease Management and Prevention

By ELIZABETH J. FICHTNER | UCCE Farm Advisor, Tulare County

CROWN GALL IS ONE OF THE MOST common diseases observed in commercial walnut orchards in California. The disease, caused by a plant pathogenic bacterium, is easy to identify based on symptomology alone. *Agrobacterium tumefaciens* causes crown gall **(Figure 1)**, but the disease name is a misnomer because the pathogen also induces galls on roots **(Figure 1B)** and stems **(Figure 2)**. Another related bacterium, *Agrobacterium rhizogenes*, causes hairy root **(Figure 1B)** a disease that can easily be identified based on symptomology (root proliferation) alone. Crown gall is more prevalent in commercial walnut orchards than hairy root; however, hairy root incidence may be under-estimated simply because symptoms are below ground. Both pathogens may be established in the same orchard, and occasionally may be observed on the same tree **(Figure 1B)**.

The Infection Process

Agrobacterium tumefaciens is a soilborne pathogen that requires a wound to infect plants. The bacterium survives in soil and is a somewhat ubiquitous soil inhabitant. Although the bacterium may be prevalent in orchard soil, only a fraction of the population is pathogenic. Pathogenic isolates contain a circular piece of extra-chromosomal DNA called a plasmid. The plasmid inserts into plant DNA, thus genetically transforming plant cells to proliferate and form a tumor.

Location of Symptoms Assists in Assessing Origin of Infection

The most commonly asked question about crown gall is "where did it come from?" Unfortunately, it is often difficult to pinpoint the original source of inoculum in an orchard, particularly if tumors are present on roots or at the crown. The pathogen may be present in nursery or orchard soil and it may take months for symptom development after introduction of the pathogen to a wound. As a consequence, it is difficult to determine the timing of initial infection and whether the pathogen was introduced in the nursery or the field, or perhaps even both.

The location of aboveground (aerial) galls may offer some indication of inoculum source and provide lessons to prevent disease spread. When aerial galls form

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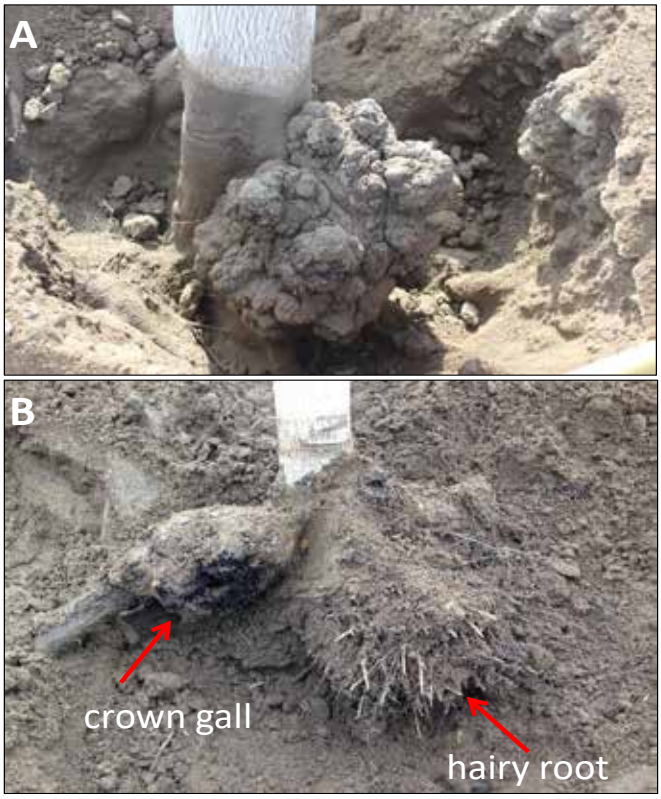

Figure 1. (A) Crown gall at the crown of a 'Paradox' walnut rootstock; **(B)** Tree affected by both crown gall and hairy root.

Figure 2. Crown gall above the graft union **(A)** and at the graft union **(B)** Red arrows indicate location of graft union.

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above or below the graft union, the most probable method of pathogen introduction is on infested tools utilized for pruning or removal of suckers **(Figure 2A, see page 12)**. Tools may become contaminated with the pathogen upon contact with infested soil or by cutting through infested plant material. The removal of rootstock suckers close to the crown may bring loppers or other pruning tools in contact with infested soil or crown gall tumors. The wounds caused by removal of suckers at the base of the tree may also serve as infection courts for inoculum residing in adjacent soil. Infested soil near the base of the tree may be splashed by rain or micro sprinklers to the cut surfaces, resulting in infection and future symptom development.

When galls are observed at the graft union **(Figure 2B, see page 12)**, the most common thought is that the pathogen was transmitted on a dirty grafting knife. There are other potential sources of inoculum, however, that may be responsible for galls formed at the graft union. Budwood may become contaminated with the pathogen upon collection. If the budwood shoot falls on contaminated soil after cutting from the mother tree, the cut surface may become infested. As a result, an infection may form at the graft union. When walnut rootstocks are field grafted at an older age (i.e. two-year old), suckering may be more prevalent at or near the graft union **(Figure 3A).** The removal of these suckers provides opportunities for infection near the graft union and gall formation long after the graft was made **(Figure 3B)**. Last, asymptomatic seedlings have been found (experimentally) to contain endophytic populations of *A. tumefaciens*. These endophytic populations have the potential to lead to gall formation at secondary stem wound sites (Yakabe, et al. 2012).

Figure 3. These clonal 'Paradox' rootstocks were planted in an orchard formerly containing crown gall-infected cherry. The trees were field grafted in the second leaf and exhibited excess suckering **(A)** on the rootstock. As these suckers were cut, loppers occasionally touched infested soil, suggesting that inoculum causing galls at the graft union **(B)** may have originated within the orchard.

Rootstock Selection

Another common question is whether the use of a clonal 'Paradox' selection offers some protection from crown gall. 'Paradox' rootstock is susceptible to crown gall, regardless of whether the rootstock was produced from a seed or via micropropagation (clonal). Plants produced by micropropagation are less likely to become infested with the pathogen in the nursery than seedlings, simply because the clones are produced in axenic (sterile) culture and plantlets are grown up in pots containing sterilized potting medium. The potted clonal plants could still become infected in the nursery if the pathogen is introduced via contaminated tools/boots, etc. or from the splashing of water from contaminated soil. Additionally, clonally propagated plants that are sold bare-root may become infected if grown out in contaminated soil. 'Paradox' seedlings may become infested with the pathogen if the seed contacts contaminated soil upon collection, or if the nursery block is planted in contaminated soil. To mitigate potential for contamination of seedling trees, nurseries tend to shake rootstock seed source trees onto tarps, disinfest the seed, and plant seed in ground with no prior history of infestation. Regardless of rootstock source (seed vs. clone), a low level of crown gall incidence may be anticipated in new plantings simply due to the endemic nature of the pathogen and ease of transmission, despite the vigilance in sanitation at the nursery level.

Clonal selections of 'Paradox' are available in the nursery trade. These include 'Vlach,' 'VX211,' and 'RX1,' which are regarded as vigorous, highly vigorous, and moderately vigorous, respectively. All are susceptible to crown gall, but 'RX1' may have low to moderate resistance, making it a potential choice rootstock for replant holes contaminated with *A. tumefaciens.*

For information on rootstock terminology utilized in the walnut nursery trade, please visit the following article posted on the UC Frit and Nut Information Center website: https://ucanr.edu/datastoreFiles/391-536.pdf

Influence of Crown Gall on Tree Health and Productivity

Many walnut trees live to maturity even with crown gall infection; however, infections that girdle the tree may cause early mortality. Crown gall is associated with reduction in tree size and yield; the higher the severity of the disease (i.e. percent of circumference of the tree affected), the smaller the tree diameter and yield (Yaghmour, et al. 2016; Olson and Buchner, 2001). Crown gall may also predispose trees to future damage by pests and diseases (Fichtner, 2011; Yaghmour, et al. 2016).

Treatment of Crown Gall in the Field

Removal of galls from infected trees is time-consuming and expensive. A decision on whether to remove infected trees and replant or remove the tumors is determined

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by the extent of galling and age of the tree. The decision can be aided by exposing the gall with compressed air to better judge the extent of galling **(Figure 4A)**. If a decision is made to remove the gall it can be surgically removed **(Figure 4B)**, and surrounding tissue can be disinfected. On trees with galls colonizing three-fourths the perimeter of the tree, heat treatment has been found to provide better control than surgery followed by chemical treatment (Olson and Buchner, 2001). Unfortunately, the exact amount of heat required to kill the pathogen while preserving cambium tissue is not known. Excess heat may damage the tree and inhibit recovery **(Figure 4C)**. Guidelines for assessing the value of replanting vs. treating affected trees, as well as the efficacy of various methodologies implemented for gall removal, can be found in the following article: http://ceglenn.ucanr.edu/files/185675.pdf.

Chemical and Biological Treatments for Managing Crown Gall

First and foremost, tools (i.e. pruning tools, grafting knives, etc.) should be sanitized between trees to prevent transmission of the pathogen. Sodium hypochlorite solution (bleach) is an inexpensive disinfectant with an LD100 of 0.5 ppm (parts per million) for *A. tumefaciens*; however, it is corrosive to tools, may be phytotoxic, and exhibits reduced efficacy in the presence of dissolved and suspended solids.

Figure 4. An air spade can be used to expose the crown of the tree prior to gall excision **(A)**. The gall can be cut off **(B)** and the resulting wound may be cauterized by flaming with a propane torch. Excessive heat may be both unsightly, leaving charred tissue and resulting in damage to the cambium **(C)**.

Always check with certifier to determine which products are organically acceptable.

In order to maintain the efficacy of sodium hypochlorite solution for tool sanitization, fresh solution would have to be continually replenished in the container to prevent the buildup of solids. Cationic surfactants, such as quaternary ammonium compounds, disrupt cell membranes of the pathogen. In a United States Department of Agriculture (USDA)/Agricultural Research Service (ARS) research study, a commercially available cationic surfactant, Physan 20® (Maril Products Incorporated, Tustin, California), exhibited an LD100 of 2 ppm. In this study, the presence of solids in solution had less impact on the efficacy of the cationic surfactants than on sodium hypochlorite, another benefit that these products have over bleach.

Strains of *A. tumefaciens* (Strain K84) (i.e. Galltrol A®, AgBioChem, Los Molinos, California) are sold as biological control agents for protection of plants from pathogenic strains of *A. tumefaciens*. The product is sprayed on the roots prior to planting to ensure colonization of wounds by the biocontrol agent prior to exposure to the pathogen. Research studies have demonstrated the efficacy of Strain K84 for preventing crown gall; however, efficacy of the product may vary based on pathogen population dynamics and environmental conditions.

Another registered product, composed of a mixture of two phenols (i.e. Gallex®, AgBioChem, Los Molinos, California), can be utilized as a post-plant treatment of galls. The product may be applied directly to small galls, or as a disinfectant on exposed areas after gall excision.

For more information on historic research conducted on crown gall, visit the Walnut Research Reports, which can be searched by topic, author, or year on the UC Fruit and Nut Research and Information Center website: https://ucanr.edu/sites/cawalnut/. Always read the label of the product being used, and note that all registered pesticides are not necessarily listed on the UC IPM Online website (http://www.ipm.ucdavis.edu) or in this newsletter. Always check with certifier to determine which products are organically acceptable.

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Peach Root-Knot Nematode

Found in Merced and Kern Almond Orchards in California

Source: UC IPM

IN BRIEF

Peach root-knot nematode is newly discovered in California, but its current distribution is unknown.

Peach root-knot nematode is capable of infecting most Prunus rootstocks currently used in almond and stone fruit production. Rootstocks resistant to previously detected root-knot nematodes may not be resistant to peach root-knot nematode.

The California Department of Food and Agriculture rated this nematode as an A quarantine-actionable pest. Contact your local county agricultural commissioner's office if you suspect you have peach root-knot nematode (uneven and poor tree growth, stunting, and root galls on resistant rootstocks).

Roots of rootstock Hansen 536 infected with peach root-knot nematode; note the knotting and deformation on the roots. Credit: John Chitambar, California Department of Food and Agriculture.

View of an infected tree adjacent to a healthy tree in a 2-year-old almond orchard. Credit: Andreas Westphal, UC Cooperative Extension.

THE PEACH ROOT-KNOT NEMATODE *(Meloidogyne floridensis)* was recently discovered in California and has the potential to infect many of California's economically important crops. At the time of this writing, it is not clear how wide-spread this nematode is in California. The California Department of Food and Agriculture (CDFA) rated this nematode as an A quarantine-actionable pest.

Since the early 1960s, the rootstock Nemaguard and others such as Marianna 2624 and Myrobalan 29C, have protected Prunus crops (almond and stone fruits) from attack by southern root-knot nematodes (M. arenaria, M. incognita, and M. javanica), which are common in California. In contrast, peach root-knot nematode is capable of infecting Nemaguard and peach-almond hybrids. Research in Florida has identified some differences in response among Prunus rootstocks, but peach root-knot nematode itself has variability that allows some populations

of it to infect peach and peach-almond hybrid rootstocks that are currently used in California.

A consortium of University of California (UC) Cooperative Extension, UC Riverside and CDFA is working with the county agricultural commissioners of the affected counties, the growers, respective crop consultants, and the Almond Board of California to mitigate the potential impacts of peach root-knot nematode. Emphasis will be on containing and treating the currently known infestations and assessing the distribution within California. Contact your local county agricultural commissioner's office if you suspect you have peach root-knot nematode.

An almond orchard with peach root-knot nematode was first detected by UC Cooperative Extension Advisor David Doll in Merced County. He was called to the field because of observed uneven, unthrifty (poor) growth and stunting of 2-year-old plants. Doll involved UC Cooperative Extension Specialist Andreas Westphal to identify the cause of the problem in this orchard. Westphal took diagnostic samples to confirm root-knot nematodes on Hansen 536, a rootstock that carries resistance to many known root-knot nematodes in California. On all stunted plants, severe galling typical for root-knot nematode infection on the Hansen 536 rootstock warranted continued identification of the nematode. Westphal involved taxonomists Sergei Subbotin and John Chitambar from the CDFA Nematology Lab to confirm the identification morphologically and molecularly by established protocols. They identified the nematode to be *Meloidogyne floridensis*, the peach root-knot nematode. About one month later, a second detection was made in a limited area in Kern County facilitated by Advisor Mohammad Yaghmour (UC Cooperative Extension Kern County).

The peach root-knot nematode was first described in Florida where it is a widespread pest in *Prunus* orchards, primarily in peach plantings. In general, root-knot nematodes are especially troublesome because they can infect many different host species. These microscopic soil-dwelling nematodes live in soil from where they infect their plant hosts. In susceptible host plants, they undergo an intricate interaction with the physiology of the plant, and ultimately induce the plant to generate the name-giving knots and deformations in the root system. These knots and deformations impair the uptake of nutrients and water by the plant and may increase infection by plant pathogens.

Resources:

California Department of Food and Agriculture Pest Ratings Proposals and Final Ratings: *Meloidogyne floridensis* Handoo et al., 2004. Accessed November 07, 2018.

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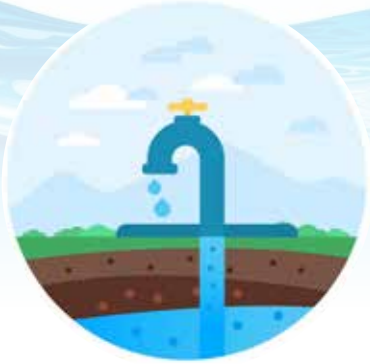
Challenges to Groundwater Recharge



By CECILIA PARSONS | Associate Editor

As the irrigated agriculture industry moves foward to meet goals of the Sustainable Groundwater Management Act (SGMA), there are potential conflicts related to groundwater recharge efforts.

Groundwater recharge, defined by California State Water Resources Control Board, is the augmentation of groundwater, by natural or artificial means, with surface water or recycled water. Some groundwater recharge projects may use short-term water surpluses that occur only infrequently.

Leaching Nitrates

Sarge Green, water management specialist at the Center for Irrigation Technology at Fresno State, and a speaker at Kern Ag Day, said there is concern that efforts to recharge underground aquifers could also leach nitrates from chemical fertilizer into groundwater.

Photo courtesy of Cecilia Parsons.

In his Ag Day presentation. Green noted there are two pathways for nitrate contamination of groundwater supplies to occur. The first is sandy soil combined with permeable deeper geological materials. The second is inadequate attention to backflow prevention in pressurized irrigation systems when fertilizer is injected. He addressed the first pathway in his presentation.

Green, who formerly worked for the California Regional Water Quality Control Board Central Valley region, is familiar with the soil landscape of the valley and sees the looming conflict between groundwater recharge projects and the possibility that recharging in certain areas may push nitrates and other soluble materials into the groundwater supplies.

Goals of SGMA

Goals of SGMA include restoration of groundwater levels and achieving water quality standards. Green said the competing regulatory process needs to be integrated with SGMA goals. It will take a clear understanding of material management, irrigation methods and strategic monitoring to meet the goals and also comply with water quality regulations, he said.

State and regional water quality boards are moving more aggressively to get groundwater quality improvements, he said. The state board has stiffened reporting of information under the irrigated lands program. The Central Valley region is advancing their regulatory process known as CVSALTS to address certain areas of the state with high groundwater nitrate levels more quickly. They are targeting the Hilmar area and eastern Tulare County.

Green said dairies are the main source of groundwater nitrate levels in the Hilmar area, but almond growers do have responsibility for

ongoing best management practices. Those practices and tools to implement them are offered by the The California Almond Sustainability Program. Those include a nitrogen calculator that generates a management plan report required by the Irrigated Lands Regulatory Program.

Green said a nitrogen budget takes into account the contents of the water used for irrigation.

Plans for Future

Much of the San Joaquin Valley lies above groundwater basins that were identified as critically overdrafted in 2016. Future water management systems, Green said, will include support for areas deemed good for recharging groundwater basins. The support could include returning to a flood irrigation system. Cost of installing a flood irrigation system that was removed may be a 'project' financed by a groundwater sustainability agency. Future combinations of irrigation systems could be drip systems for maximum crop production and flood irrigation in a specific area where chances of nitrate contamination could be minimized.

An important management tool to determine suitability is knowledge of soils. Soil types can be found using the California Soils Resources Lab app: https://casoilresource.lawr.ucdavis.edu/soil-web-apps and Google Earth. To determine the likelihood for recharge go to the same site and see the groundwater suitability index for your area.

The next steps are to learn the vertical and horizontal water movement patterns and to understand the flow patterns from the water application system in use. Water application rates should be determined to know when the vertical water movement will pass the root zone or when the horizontal movement could enter an area that may be flushed for recharge.

There are tests to manage recharge and materials management together. Using drip systems for the crop area requires using the vertical water movement to determine a deep percolation cut-off. Use the horizontal water movement to define the limits of flood in between the permanent crop area that could potentially be used for recharge. Soil testing may be needed for any annual crops to reveal the most conservative and highest concentration of mobile materials before using an area for flood or recharge.

Much of the San Joaquin Valley lies above groundwater basins that were identified as critically overdrafted in 2016.

Green acknowledged that managing for materials and recharge at the same time on sandy soils would be difficult. Recharge should dominate the thinking because even if some materials do escape below the root zone, consistent high volumes of water will be valuable to reduce the concentrations. Finally, working with groundwater sustainability agencies and regulatory agencies during the early implementation of material management and groundwater recharge will be crucial.

Nut growers who are in the East San Joaquin Water Quality Coalition can attend a workshop in February to learn how groundwater can be protected from nitrogen fertilizer impacts. The meetings will count toward the one meeting per year requirement for each member. Workshops will be set up for the major acreage crops grown in the coalition region and will focus on agronomy and irrigation.

A revised order for the region that was adopted earlier this year includes a requirement to sample for nitrates in all domestic wells on member parcels, replacement of the Nitrogen Management Plan with the Irrigation and Nitrogen Management plan and a requirement for all growers in low vulnerability areas to submit a Nitrogen Summary Report starting with the 2018 crop year.

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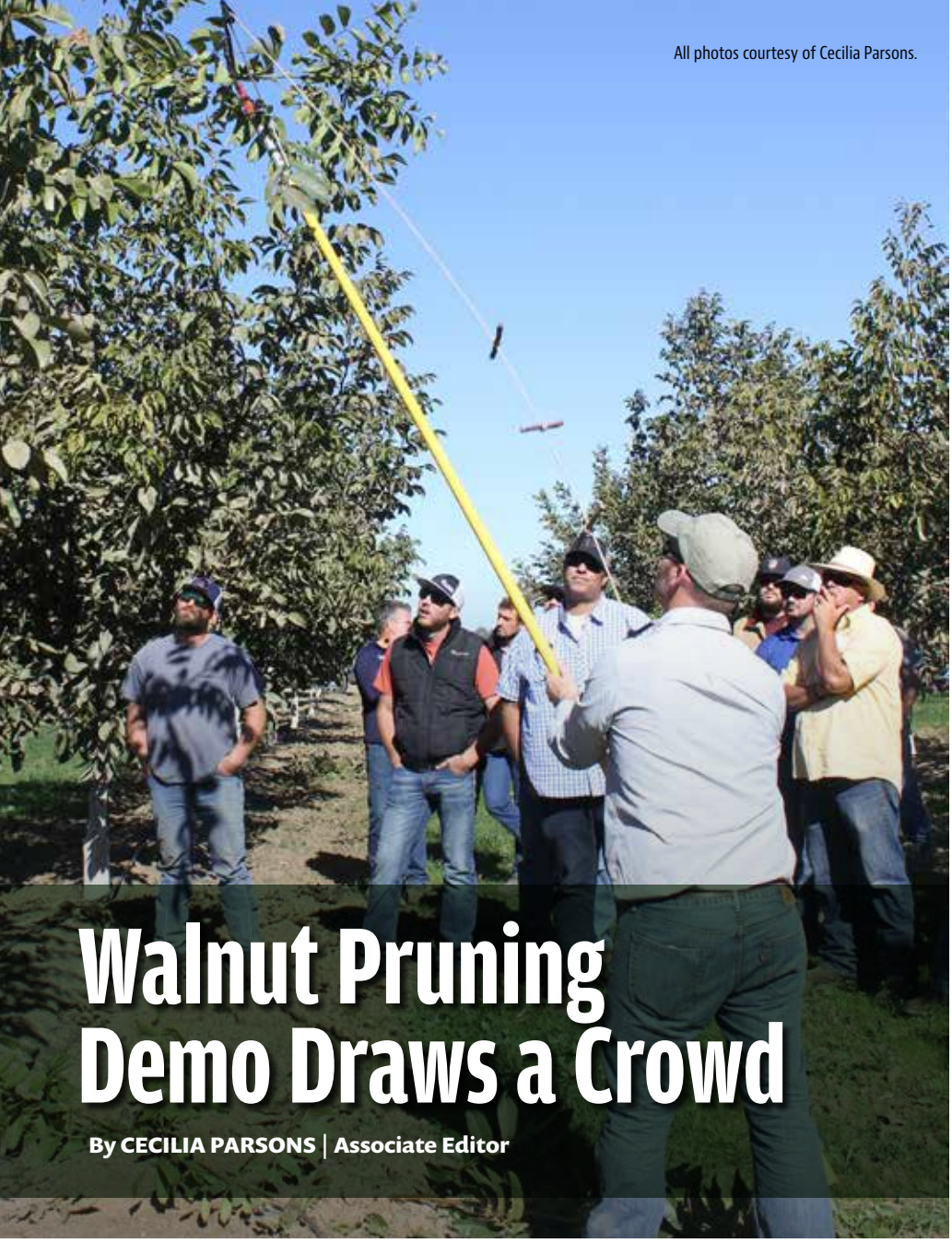

All photos courtesy of Cecilia Parsons.

Walnut Pruning Demo Draws a Crowd

By CECILIA PARSONS | Associate Editor

Walnuts are one of the oldest cultivated tree nut crops in California and over the years, many opinions and strategies have been formed in regard to proper pruning techniques.

In the 1920s, walnut trees were not pruned and were planted in much wider spacing. Later, pruning was advocated to induce more vigor. Tighter spacing in the 1970s reintroduced more pruning cuts. More recently, minimal pruning was recommended and leaving trees unheaded was advocated.

Give Trees Some Guidance

On his last day of work as a University of California Cooperative Extension (UCCE) advisor, David Doll of Merced County, gave walnut growers some parting advice: "give the trees a little guidance. Don't tell them what to do."

Doll acknowledged there are different philosophies on walnut pruning among UCCE farm advisors, and he encouraged growers to first understand walnut tree growth patterns when making pruning decisions in their orchards. Pruning terminology can also be confusing at first. Minimal pruning is not a 'no' system. Without some guidance, trees can have steep limbs angles or other structural problems that will need to be corrected later, Doll said.

"Train the tree to chase the light and build canopy that lets light filter through," he advised growers.

Walnut Growers Need Pruning Options

Mark Crow of Orestimba Nursery in Crows Landing, host of the pruning demonstration, said he valued Doll's vision in pruning choices.

"Walnut growers need options when it comes to pruning. David's directions can save them time and money," Crow said.

Doll's demonstration and explanation of walnut pruning techniques was given to a multi generational set of growers and he was able to bridge those gaps and provide something of value to all who participated, Crow added.

"Ag is a never ending learning experience. We have so many walnut varieties and with all the different classes and characteristics it is impossible to apply just one type of prune or minimal prune."

Research

Doll's pruning demonstration at two orchard sites in western Merced County was less of a tutorial and more of an explanation of the growing habits of young walnut trees. He said there are three kinds of pruning cuts for walnut trees: heading cuts where the central leader or limb is topped, 'headed back' thinning cuts to remove unwanted limbs and 'bad' cuts that will lead to poor tree structure down the road. It is recommended that any pruning activity be done after or well before the threat of frost as young trees are sensitive to freezing temperatures that can kill or damage wood. Walnuts are typically pruned in late winter or early spring.

Research done since 2004 has challenged the traditional thinking that if most walnut varieties were not pruned, their growth would stall out from early cropping. Trials on Howard, Chandler, Tulare, Forde, Solano and Livermore have shown pruning is not required to encourage growth.

With traditional pruning the trees look better, but at a cost to the grower. Unheaded is a cheaper route, Doll said and there is more crop in the

> **"give the trees a little guidance. Don't tell them what to do."**
> *—David Doll*

third to fourth year.

More Thinning Less Heading

Walnut growers are moving toward more thinning cuts and less heading, Doll said. When young trees are headed, and the apical buds are lost, the trees respond with rapid extension as the tree chases the light. Doll compared the loss of buds to feeding only four children instead of ten. Studies have shown that unheaded trees have the same rate of growth as headed trees, only in short increments.

In the unheaded system the central leader is left intact, other leaders are thinned and limbs lower than four to five feet from the ground are removed. This system looks awkward in the second year, Doll said, as the tree has more of a Christmas tree shape. Over time, he said, the tree would fill in and take a more traditional walnut tree shape.

With traditional pruning or a heading cut the tree has a better appearance early on, but pruning costs are incurred. Unheaded systems have lower costs and more of a crop in the third and fourth year. There is a labor-yield trade-off in the early years, Doll said, but by the fifth year there is no difference in production. What a grower is doing with the unheaded system is increasing the age of the wood at first harvest.

Nearly all walnut varieties are adaptable to unheaded pruning systems, but each can be a little different, Doll said. The vigorous Tulare may look like 'giant poodle tails' the second year with out a heading cut. If growers choose, he said they could wait to see how the buds initially break out before making the heading cut. If lower buds aren't pushing, the trees should be headed back a little higher than the traditional heading cut. His experience has found

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that if trees are headed back by the middle of May, there is minimal impact on growth.

Cultural Practices

He noted the cultural practices that affect tree growth. Doll said he is not advocating heavy doses of nitrogen the first year after planting. Trees are more in need of adequate water than nitrogen. Vigor can be controlled with rootstock choices and variety, water and nitrogen.

With a central leader system of training, he advised not stressing the tree in the spring, but at 10-12 feet of growth cutting water back to slow growth and limit the number of buds that will need feeding.

Tree spacing is another consideration in pruning choices. Orchard spacing should be site specific, Doll said, matching soil quality, rootstock and variety. Costs per acre go up, Doll noted with tighter spacing. Growers choosing tight tree spacing and hedging to control growth will have to stick with that choice and may have some canopy issues later on. Crop returns could offset that, he said.

Growers who are planting new orchards and considering pruning choices should take the conservative approach and try a few pruning options to see if they work for them as each type of cut changes the way a tree grows.

Doll, who has been a UCCE advisor in Merced County for the past ten years and is known for his blog, "The Almond Doctor," let growers know this was his last day on the job.

His plans include a new position in the south, central region of Portugal, developing almond ranches.

Crow expressed the feelings of many attending the demonstration. "We a losing an youthful asset and caring individual. I hope in the future we have more advisors like him in Extension."

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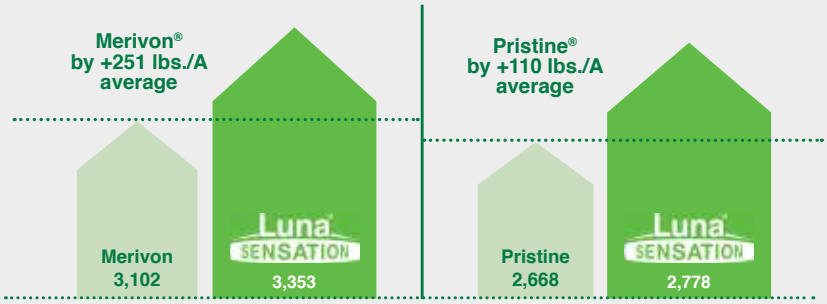

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*Source: Average yield gain in dollars per pound based on *California Agricultural Statistics Review, 2014–2015*, California Department of Food and Agriculture, page 81.

BYPRODUCT AND BIOMASS RESEARCH: WHERE ARE WE NOW?

By KATHY COATNEY | Editor

With over a million bearing acres of almonds planted in California there is an abundance of byproduct produced. In the past, almond shells were used as bedding for dairy cattle and hulls for supplemental feed.

With the decrease in the number of dairy farms in California, and an increase in almond acreage, prices for the hulls are dropping. But new markets may be emerging for almond hulls and shells from research coming out of the United States Department of Agriculture (USDA).

Bill Orts, research leader for Bioproducts at USDA/Western Regional Research Center, said he's doing research that is close to being ready to market. He's also working on research that is 'way out there' and might never make it to market.

Torrefaction Research

Torrefaction is a process where almond shells are roasted to remove moisture. This process creates a new product that is denser, easier to handle and it can be added to plastic.

Almond shells that have been torrefied can be made into things like:

- Pellets
- Flower pots
- Slip sheets—sheets that can be used to replace wood pallets for shipping
- Rubber

There are advantages to plastic made with torrefied almond shells—it's stiffer and more stable at high temperatures—a big advantage for a flower pot so that it doesn't melt in the sun.

"If you want to make it harder and stiffer and more heat stable, then torrefied shells are a good thing," Orts said.

Scaling Up

The process has been proven at a half ton a day quantity, and it's very close to commercializing, Orts said. There are many interested parties—industry just needs to make the investment, he added.

"Big and small plastic companies believe us. They're like, 'Okay we've done enough science. It's working,'" Orts said, adding now the process just needs to scale up.

But scaling up may be easier said than done, Orts continued.

There are definitely issues that arise when scaling up, and one of the big challenges is the torrefaction unit itself. Should it be made 10 times larger, or invest in 10 small units and have them in all in a row?

"We don't know that answer. It's an engineering/financial question," Orts said.

Other questions are: how are shells supplied to the unit, will it be every day and stockpile the shells year round or will it only be seasonal? Will plastic manufactures or almond huller/shellers create the product?

These are important questions to investors, Orts said.

"So now it's really just how do we build an industry that's not quite there yet, and where's it going to be located. Those are huge questions," Orts said, and this is where the industry needs to makes those calls.

Orts has a company that is interested if they could get 10 tons a day. Presently we only make a bucket at a time, he said. And the other glitch is, they only want to try it for a few of months.

"Do you want to tell some almond huller it's going to cost hundreds of thousands of dollars to get started on this, and we found somebody that would buy stuff for three months? So that's exactly the spot where we are. It's close to commercial," Orts said, but someone's going to have to make a commitment to process it.

Extracting Sugar from Almond Hulls

One of the 'out there' ideas is extracting sugar from almond hulls. Almond hulls are very rich in sugar. In fact, they are the fruit of the almond, and it doesn't take much to squeeze sugar out

Torrefaction is a process where almond shells are roasted to remove moisture. This process creates a new product that is denser, easier to handle and it can be added to plastic.

All photos courtesy of Kathy Coatney.

of a hull, Orts said.

When almond hulls sell for less than a $100 a ton, the sugars that are extracted become inexpensive on the world market, Orts said.

"The more they're under a $100 a ton, the more that that sugar can compete straight up with high fructose corn syrup," Orts said.

By extracting the sugars, a sugar juice is created, and that juice can be sent to a fermenter to be used in different foods, Orts said.

"We've been spending time extracting sugar and making different drinks out of them and foods," Orts said, but another idea that has everyone buzzing is squeezing the sugar to feed the bees in the wintering months.

Overwintering bees are fed a synthetic diet with corn sugars, Orts said.

"Bees don't love corn sugars, but they'll eat it," Orts said, "but bees love almond sugars."

Squeezing the sugar from the almond hulls and feeding it to the bees has real potential, and one advantage to feeding

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it to bees rather putting it into food or drinks is it wouldn't need approval from the Food and Drug Administration (FDA), Orts said.

"You just feed it to bees," Orts said, adding the extracted sugar juice is being sent to the USDA bee lab in Arizona and fed to the bees.

Spent Hulls

Removing the sugar from the hulls creates a sugar juice, but what happens to the spent hull, the hull without the sugar?

"You can take that hull and you can feed it to cows with less sugar," Orts said.

Another, potentially viable option is to use it as ground cover for mushrooms, Orts said.

Mushrooms grow in the dark on a nutrient rich cover, and a fairly expensive peat moss is currently used as ground cover called Sphagnum, Orts said.

On the West Coast Sphagnum is sourced from Canada, and on the East Coast it comes from places like Ireland and Russia.

Rather than create such a large carbon footprint by shipping the ground cover from outside the U.S., researchers have been looking for local Ag products as ground cover for mushrooms and almond hulls 'work' in the lab, Orts said.

"We've been working with some one of the bigger suppliers of mushrooms in northern California, and again they're ready to go," Orts said.

It's been proven that it works on a small lab scale and mushrooms were successfully produced, Orts said.

"So if there's a use for the sugars, if the bee diet one works out, then you'd have a bunch of spent hulls, and we'd have a home for the hulls as well," Orts said.

If ground cover for the mushrooms doesn't work, the hulls could still be sold as cattle feed, Orts said.

Biomass

Glenda Humiston, vice president, Agriculture and Natural Resources, University of California (UC) said, all kinds of biomass research is underway. The school of engineering at UC Merced, for instance, has a Material Science Department that has been looking at a lot of new innovative ways to use biomass, not just with almond shells, but all kinds of biomass.

> "YOU CAN TAKE THAT HULL AND YOU CAN FEED IT TO COWS WITH LESS SUGAR"

Infrastructure

Humiston has been focused on getting the supply chain and the manufacturing built so that there is an infrastructure to utilize the biomass.

"It's one thing to have the science, but in some ways the bigger challenge is to actually build the entire supply chain from biomass through processing, manufacturing, and actually getting that product into use somewhere," Humiston said.

High Value Uses for Biomass

"We're also looking at some of the new very high tech wood products for building. In fact, one of the presentations I've given recently to University of California system is to get them to take a wood first building policy for all the new building that has to go on, which is something Europe and Canada have been doing for quite some time," Humiston said, as well as Washington state, and Oregon is also jumping on board.

This is in the works in California, too, Humiston said.

Governor Brown's Executive Order B-52-18 requires the Board of Forestry and Fire Protection, working with UC and California State University (CSU), to establish a Joint Institute for Wood Products Innovation (JIWPI) to perform and accelerate research, development, testing, and adoption of advanced forest management and wood products manufacturing, Humiston said.

Humiston feels this is important to entities like almond shells. There is currently a lot interest with the wildfires and searching for new uses for small biomass, especially the undergrowth in the forest and small board trees that need to be thinned out. This could also include some of the burned wood from wildfires and dead trees.

Using small biomass will help bring up the economy of scale needed to get facilities online, which in turn would allow agriculture to take advantage of that infrastructure, Humiston said.

More good news is that more partners are coming on board, Humiston said.

"We've had a couple of meetings with diverse players looking at how do we build this entire supply chain from the raw material into the processing," Humiston said.

Corn growers have focused research dollars on utilizing corn for clothing, for oils, for a wide array of products, Humiston said.

The Corn Refiners Association is looking for opportunities with other California Agriculture to develop waste products into things like:

- Bio-based chemicals and materials
- Diversify existing feedstocks
- Reduce net carbon emissions

The bottom line, the research has reached the point where industry has to move forward with it, Orts said.

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Orchard Success and Why It Pays to Focus on Root Health

Below the surface of the soil, where plant roots are meant to thrive and provide a healthy support system, is the place to start your orchard health program.

Root health is a basic necessity impacting orchard health for many years. Sustainability, production and growth are all compromised by poor root health.

Sampling and Monitoring

With permanent crops like almonds, the biggest threats to tree root systems are destructive nematode species that feed on them, leaving trees struggling to take up sufficient nutrients and water. Whether the orchard is a new re-plant or mature, growers should consider soil sampling for nematode levels and continue to monitor for diseases that can also erode soil health.

According to the California Department of Food and Agriculture, nematodes reduce vigor and yield in tree nuts, causing 15 to 20 percent yield loss on average but sometimes as much as 50 percent.[1]

Fumigation

Restrictions on soil fumigant use due to air quality concerns make pre-plant soil fumigation less likely to be a permanent nematode management solution. In addition, nematode populations in soil can rebuild over two or three years, threatening the health of maturing trees, and additional applications to suppress nematodes after fumigations are necessary.

Nematicides and insecticides are reliable post-plant protection against nematodes. "Research shows annual applications, as trees establish root systems, can add to crop yields," says Rob Kiss, Bayer Customer Business Advisor in central California.

Nematicide and Insecticide Solutions

Velum® One is a new nematicide that can be easily applied via drip and microjet chemigation.

It suppresses a wide range of nematodes and has been shown to protect root health and help establish the crop. Trials conducted in California showed that ***young almond orchards treated with Velum One saw improved canopy diameter by more than half (58%) as well as improvement in yield***.

Movento® insecticide can be applied as an in-season foliar spray. It moves through the leaves, down to the roots, protecting the roots from the effects of nematode feeding.

Nematode populations can ***rebuild over two or three years,*** *threatening the health of maturing trees.*

Nematodes reduce vigor and yield in tree nuts, causing ***15 to 20 percent*** *yield loss on average but sometimes as much as* ***50 percent****.*[1]

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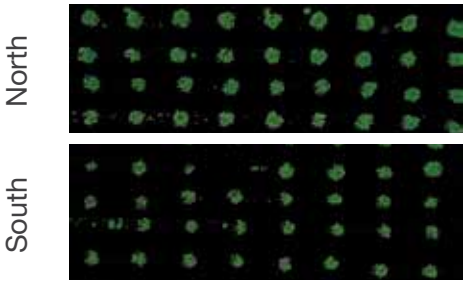

Velum One applied at 6.5 oz. per acre, spring 2017, via drip irrigation. Trees planted in January 2017.

Fungicide Solutions

Serenade® ASO applied through chemigation colonizes the roots, helping to protect them from damage caused by soil-borne diseases. Healthier roots improve soil health and plant nutrient and water uptake.

Summary

Growers looking for an optimal start for their newly planted orchards and maturing trees should continue to be vigilant in managing soil pests and diseases in order to extract the maximum production and value from their orchards.

Making sure the root systems are protected from soil diseases and pests will give trees every chance to produce up to their full potential and ensure the long-term vigor and health of your orchard.

Learn more at: www.CropScience.Bayer.us

[1]California Department of Food and Agriculture 2015 Specialty Crop Block Grant Program Project Abstracts.

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Identification Before Diagnosis

The key in dealing with both disease and weed problems in tree nut crops is correct identification.

By CECILIA PARSONS | Associate Editor

Mohammad Yaghmour, University of California Cooperative Extension orchard systems advisor in Kern and Kings counties, and a speaker at the Kern Ag Day event in Bakersfield, said growers who spot disease symptoms in their orchards should take samples to a laboratory to confirm a diagnosis.

"You have to know 100 percent what pathogen is causing the problem," he emphasized.

Different diseases may have similar symptoms and without a confirmed diagnosis, time and effort can be wasted. He advised the samples to include both healthy and diseased tissue, as the fungus is active at the interface.

Yaghmour, who is involved in research in fungal disease in orchard crops, said Phytophthora and crown rot are found in the southern San Joaquin Valley and can kill young trees. Water management, resistant rootstocks and scaffold selection in young trees are effective methods for controlling fungal diseases in nut orchards.

Careful soil water management is the best route for control of Phytophthora root and crown rot. Cultural practices that avoid wetting near tree root crowns can help minimize disease losses. Berms can help keep those areas dry, Yaghmour said.

Resistant rootstocks are another tool. Those with plum background are less severely affected by Phytophthora. Prevention of infection includes selection of scaffolds to avoid pockets where spores carried on harvest dust can collect. When the pockets are wet due to irrigation or rain events, infection can occur.

Knowing the site history and the level of inoculum in the soil is important. Yaghmour said fumigation or solarization can reduce the level of inoculum, but will not eliminate it.

Weed management specialist Kurt Hembree also encouraged knowing the weed species when choosing an herbicide program or cultural practices for control. Choosing and mixing modes of action of herbicides should be a part of the control program to mitigate resistance. He advised mixing modes of action and rotating combinations specific for pre or post emergent weeds to prevent resistance.

Modes of action and group numbers can be found on the herbicide labels.

Other advice for weed control included applications prior to applying compost materials to orchards. Compost can tie up herbicides, which need to make contact with the soil to be effective. Leaf cover can also deter herbicide action.

Paying attention to the physical applications is also important to achieve effective coverage. Applicators need to pay attention to where spray is hitting. Volume and speed must also match targeted weeds. Hembree also advised replacing worn nozzles when they are three to four percent off their delivery range.

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Walnut trees with crown rot. All photos courtesy of Kathy Coatney.

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Almond Board Debuts Updates to Honey Bee Best Management Practices

By **ALMOND BOARD OF CALIFORNIA** | CONTRIBUTING WRITER

IT'S OFTEN SAID THAT change is the only constant, and for the almond industry continual change is what keeps us moving forward in important areas like pollinator protection. With input from the almond community, beekeepers, University of California (UC) Davis, state and federal regulators, pest control advisors (PCAs), applicators and many others, the Almond Board of California (ABC) recently published an update to its popular "Honey Bee Best Management Practices for California Almonds," otherwise known as the "Honey Bee BMPs."

Bob Curtis, retired director of Agricultural Affairs at the Almond Board, oversaw the development of the original best management practices in 2014.

Hives should be placed near forage that is flowering before, during and after almond bloom, if possible, as an alternative source of food.

Although he's retired, Curtis has remained on as a consultant for ABC, and he once again proved instrumental in revising the three pieces that comprise the Honey Bee BMP materials: the "Honey Bee Best Management Practices for California Almonds," "Honey Bee BMP Quick Guide" and "Honey Bee BMP Quick Guide for Applicators" (available in English and Spanish). All three can be accessed online at Almonds.com/BeeBMPs.

The Almond Board sat down with Curtis to learn more about the important changes made to the Honey Bee BMPs.

Q: WHY DID THE ALMOND BOARD DECIDE TO UPDATE ITS HONEY BEE BMPS?

Curtis: Things are different now than when we first released the Honey Bee BMPs in 2014. We and many others are constantly researching ways to better protect pollinators and develop new programs, and we have learned new things. One of the most exciting changes is the introduction of the Bee Where program, an improved registration and reporting system that keeps beekeepers, growers, PCAs and applicators better connected. With funding from ABC and the California State Beekeepers Association, this new paradigm developed under the leadership of the California Agricultural Commissioners, Sealers Association and the California Association of Pest Control Advisors will greatly improve hive registration and, most importantly for PCAs and applicators, will provide the locations of those hives.

Q: HOW DOES THE BEE WHERE PROGRAM WORK?

Curtis: Using the Bee Where mobile app, beekeepers can register hives electronically with the county agricultural commissioner and provide the real-time location(s) of their hives. Registration is mandatory, and the location information entered by beekeepers is completely under the purview and control of the county agricultural commissioner. In addition, when PCAs and applicators use the electronic crop management programs Agrian or Crop Data Management Systems (CDMS), the location information of hives within one mile of the planned spray site will immediately become available to them in the form of pop-up screens. The message will say something like, "Here are the hives that are adjacent to the orchard where you want to make the application and here's how you get a hold of the beekeepers to notify them." This is a huge improvement over the corkboard-and-pins approach used by ag commissioners from before.

Key changes to the Honey Bee BMPs include updated recommendations regarding bee health, the impact of pesticides and overall management practices.

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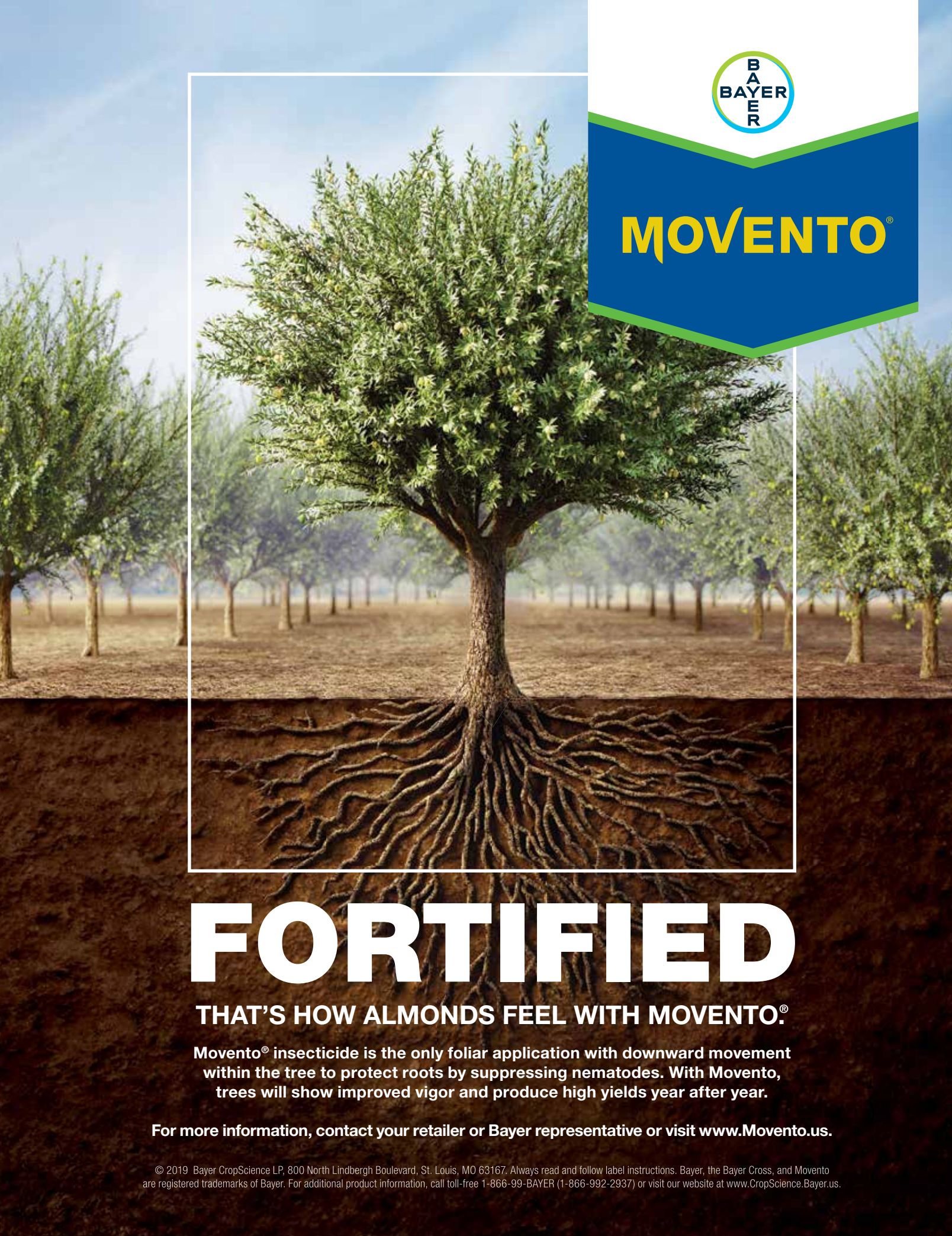
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Q: WHAT OTHER CHANGES MERITED AN UPDATED HONEY BEE BMPS?

Curtis: We have been very focused on bloom spray applications of both insecticides and fungicides. Our recommendation is to avoid applying insecticides during bloom, as they can impact adult bees and brood (young developing bees) in the hive. A new aspect to this there is one exception and that is Bacillus *thruingiensis* (Bt), which is documented as safe to both bee adults and immatures. We also included the recommendation that fungicides should only be applied during the afternoon and evening when the bees are done foraging for the day and there's no exposed pollen on the flowers. And, we added a note about adjuvants. Most fungicides are already formulated with adjuvants, and the University of California states that the only time you'd want to add an adjuvant is when the label explicitly states to do so.

The Bee Where program will allow beekeepers to register hives electronically with the county agricultural commissioner and provide real-time locations of hives for growers, PCAs and applicators.
(Image courtesy of the Almond Board of California.)

Q: WITH THE RELEASE OF THE UPDATED HONEY BEE BMPS, WHAT ARE THE MOST IMPORTANT PRECAUTIONS THAT ABC RECOMMENDS FOR HONEY BEE PROTECTION?

Curtis: The updated Honey Bee BMPs continue to emphasize the importance of communication among all parties involved in honey bee pollination of California almonds, so the Almond Board recommends the following precautions:

1. Communication about pest control decisions should occur between all pollination stakeholders.
2. Agreements made ahead of bloom should include a pesticide plan that outlines which pest control materials may be used.
3. Contact beekeepers 48 hours before pesticide application, if deemed necessary. Beekeepers should register their hives through the Bee Where program at www.BeeWhereCalifornia.com by January 1 of each year or upon arrival in California and should update locations with any hive movement.
4. Avoid applying insecticides during bloom, as they can impact bee adults and brood (young developing bees in the hive). The one exception for application is Bacillus *thuringiensis* (Bt), for which the safety of adult and immature bees is documented.
5. Any fungicide application deemed necessary during bloom should occur in the late afternoon or evening, when bees and pollen are not present.
6. Provide clean water for the bees to drink to ensure they spend more time pollinating the crop than searching for water.
7. Do not directly spray hives with any pesticide application.
8. Do not hit flying bees with any spray application materials.
9. Report suspected pesticide-related honey bee incidents to the county agricultural commissioner's office as soon as possible.
10. Beekeepers and growers should ensure bees are removed at the time agreed upon in their agreement, ideally at 90 percent petal

fall of the latest variety, unless supplemental forage is planted.

11. Consider planting supplemental forage.

ABC-funded research shows that planting forage may provide honey bees with better nutrition, and healthy honey bees means better pollination.

Q: WHAT SHOULD GROWERS KNOW ABOUT FORAGE?

Curtis: We really want to encourage planting forage, either inside or outside of the orchard, as it has been shown to improve overall bee health. ABC-funded research shows that planting supplemental forage provides immediate and longer-term benefits for colonies. For instance, there is a trend toward increased colony strength with supplemental forage, especially mustard plants. Research also shows that orchards with supplemental forage plantings tend to have higher nut set than those without plantings. To better understand the topic of forage in a comprehensive manner, ABC is funding projects that look into the benefits and tradeoffs associated with planting forage cover in orchards. These include water use of in-orchard forage and the potential for frost damage.

In addition to improved pollinator health, planting forage could also result in a cost savings—we're starting to see more pollination contracts offering reduced hive rentals for growers who have planted forage.

Q: HOW DO THE ALMOND BOARD'S HONEY BEE BEST MANAGEMENT PRACTICES CONTRIBUTE TO THE ALMOND ORCHARD 2025 GOAL OF ENVIRONMENTALLY FRIENDLY PEST MANAGEMENT?

Curtis: As many in the industry have heard, the ABC Board of Directors recently released a set of goals for the industry, one of which aims to increase the use of environmentally friendly pest management practices. Ensuring that almonds are a good and safe place for bees and promoting good stewardship practices around pesticide application during bloom certainly fall under this goal and move us toward to achieving this industry-wide initiative.

It is important that growers implement best management practices to support bee health as their crops rely on honey bee pollination at some degree, and to consider honey bee health not only during the pollination season but throughout the entire year.

The Almond Board of California also planned a variety of opportunities regarding these best management practices to keep growers, PCAs, applicators, beekeepers and others informed about how the entire communication chain can work together to take care of the pollinators who are so critical to California almonds. Be sure to keep an ear out for upcoming outreach events, including in-orchard workshops.

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

All photos are courtesy of the American Pecan Council.

From the Super American Pecan-A-Thon to Super-fy

In the Face of Challenges, the American Pecan Industry focuses on Reaching American Consumers

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

While it's hard to believe we are already ushering in 2019, it's exciting to embrace the fresh start and renewed energy that the beginning of each year brings—especially after a particularly challenging year. Despite the significant headwinds created by tariffs, hurricanes and floods, last year brought unprecedented momentum and important milestones in marketing pecans to American consumers.

In the Spring, we introduced the first-ever, nationwide consumer marketing campaign and brand—American Pecans, The Original Supernut™—with a launch in New York City, a coast-to-coast media blitz, integrated digital campaign and a segment on Good Morning America. We also met face-to-face with industry all across the country, including a West Coast trip across California pecan country during the summer.

I had the pleasure of joining the organization soon after, and we continued to gain ground with our integrated consumer marketing campaign into the fall season. The year ended strong with The Super American Pecan-A-Thon, the first online variety show created by a commodity product or brand.

We shared some of the Pecan-A-Thon details with you ahead of the event, but now I'd like to take you behind-the-scenes of how the program was developed, the elements that helped make the show a success, and the men and women who took center stage to represent industry.

Creating the Super American Pecan-A-Thon

The Pecan-A-Thon aired two days before Thanksgiving, and the goal was simple—to bring pecans, and the people behind them, into the spotlight in a way that would entertain, educate, and inspire consumers nationwide to use pecans in new ways during the holiday season

when pecans are already top of mind.

The development of the Pecan-A-Thon concept was a direct result of consumer marketing research, which confirmed that consumers respond positively to humor. The APC therefore chose to collaborate with well-known actress, comedian and pecan lover Wendi McLendon-Covey, of television shows "The Goldbergs" and "Reno 911!" and the movie "Bridesmaids," to serve as the program's host. Wendi added her signature improvisational humor, light-hearted spirit, and genuine interest in the pecan industry to the program and helped us spread the word to her large social media following.

In determining how to reach our target audience effectively during the busy holiday season, the APC team also turned to third party consumer research. Research has found that 90 percent of "foodies" turn to websites and other online sources to get food information, so the Pecan-A-Thon was planned with a digital-first mentality. The APC partnered with online platform Epicurious to broadcast the show, a popular destination for our Gen X and Y moms target audience. As a top online destination for culinary inspiration, the site caters to this latest generation of home chefs who look for variety and versatility in their cooking ingredients.

Inspiration for Everyone

In order to highlight the true versatility of pecans, food and lifestyle tastemakers demonstrated a wide variety of recipes and entertaining ideas.

Bobby Parrish of FlavCity often features dishes that are healthy twists on classic recipes and are compatible with the Keto diet lifestyle. On the Pecan-A-Thon, Bobby made his Pecan-Crusted Green Bean Casserole and Pecan-Crusted Prime Rib with Horseradish Cream sauce, both sure-fire stars of the holiday dinner table.

Jessica Murnane of the blog One Part Plant is an advocate of a plant-based diet, and shared delicious recipes such as Pecan Banana Bread and Sweet Potato Casserole with Bourbon Pecan Crumble that are customizable for vegans and vegetarians alike.

Amber Kemp-Gerstel of Damask Love not only took pecans beyond the pie—but also beyond the kitchen! Her Pecan Show Globe Jar Topper, Pecan Wreath, and holiday tablescape ideas showed viewers how to use in-shells as the perfect creative seasonal décor.

Uniting Growers from California to Georgia

The real stars of the show were the American Pecan growers who hosted alongside Wendi and the social influencers. Consumer insights show that today's shoppers care about using locally-sourced ingredients in their cooking and put a premium on knowing the origins of their food. The Pecan-A-Thon introduced the Epicurious audience to some of the families that grow and

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harvest The Original Supernut—highlighting the strong heritage of pecan growing that for many is a family tradition going back generations.

Each industry member brought their own unique perspective and shared family stories, showing American consumers the personalities behind the product. Our incredible cast represented our industry coast-to-coast and included Marianne Brown (Georgia), Kortney Chase and The Iveys Band (Texas), Mike Spradling (Oklahoma) and Heather Salopek (New Mexico).

Showcasing West Coast Pecan Growers

Representing the West Coast were California's own Ben and Laura King of Sacramento. Having spent most of my life in California, I can appreciate the West Coast sensibility and lifelong love of California agriculture country that Ben and Laura bring to pecan farming. They place an emphasis on long-term orchard productivity and sustainable strategies, and are passionate about connecting consumers to the people behind their food.

While hosting alongside the other growers, the Kings shared their own story about how pecans have become a key ingredient in their son's vegan diet. The use of pecans in specific and personal diets is just one of the many pecan-inspired

ideas shared by our growers and food and lifestyle bloggers during the show.

Turning Inspiration into Action with #PledgePecans

The Super American Pecan-A-Thon program worked far beyond the duration of the show by design. Its purpose to drive nationwide demand for pecans lived on through the #PledgePecans movement, where consumers could pledge online to make a pecan recipe to show support for our industry. Throughout the holiday season, the American Pecans website featured tasty seasonal favorites, like sweet potato casserole, stuffing and cranberry relish—all with a pecan-inspired twist. Targeted ads on social media encouraged consumers to #PledgePecans by adding one of the recipes to their holiday meal lineup.

A New Year For American Pecans

As we work to maintain the momentum generated in 2018 and remind America that pecans aren't just for holidays, we are starting the new year with our Super-fy social campaign. What exactly is Super-fy? It's taking any dish on any day from standby to super standout—simply by adding American Pecans. We believe any dish or snack is more nutritious, more delicious and even more American with the addition of The Original Supernut.

We are also highlighting the nutrition story of pecans, capitalizing on a time when many have made New Year's resolutions. In addition to sharing heart-healthy recipes featuring pecans, we have engaged with registered dieticians who specialize in supermarkets to help drive our nutrition story to consumers, right at the checkout line.

Staying Connected

If you haven't already, we also encourage pecan industry members to sign up for our industry newsletter at AmericanPecan.com so you can be the first to hear more about the consumer marketing efforts. You can also access marketing program updates and resources for your own business, as well as a recap and results of our successful Pecan-A-Thon and #PledgePecans campaign by visiting the newly revamped Industry Toolkit at americanpecan.com/toolkit (password: pecans18).

It's our goal to keep the pecan industry continually informed, but we also want to hear from you. Your input is valuable, and you can reach us at industry@americanpecan.com or by calling the APC office at 817.916.0020.

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

MAXIMIZE YOUR YIELD POTENTIAL

Add AGRO-K nutrition to your pink bud/bloom sprays

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Right time
Right form
Right mix

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 Sysstem Leaf Max should be discussed with your PCA.

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Bees, Registration & Communication

All photos courtesy of Jenny Holtermann.

By JENNY HOLTERMANN | Contributing Writer

Bees. Without them, we wouldn't have an almond. Almonds are completely dependent on bee pollination to create a fruit. Pollen from one variety must be transferred to the flower of another variety to make an almond. Much like our dependency on bees, they too rely on almonds. Almond pollen helps to provide ten amino acids to the bee diet that they require. Almond pollen can be looked at as the kick start to their spring healthy eating. Bees often times leave stronger, after almond pollination, than they did when they arrived. Much like almonds are the nutritious snack humans need, almond pollen is the nutrition that bees need. It is a mutually beneficial relationship between the bees and almond trees.

According to the Almond Board of California, 94 percent of farms coordinate with their beekeepers about what pest control materials may need to be used during bloom and how the beekeepers will be notified in advance. Having a positive working relationship benefits both the beekeeper and the almond grower. Almond growers want to ensure that bees are healthy and have a positive experience at their farm, or the bees may not be as effective in pollinating their crop. It is in the best interest of the beekeeper and the almond grower to have a positive relationship as well.

Communication

A way almond growers can ensure the bee colonies are healthy is to guarantee they maintain this relationship during any onset of pest control activity. Communication is key to ensure the beekeepers are aware of any unexpected activity that may be going on. If any pest control materials are going to be applied, the grower needs to make sure it is done at hours when the bees are not active, typically at night. This should still only be done when absolutely necessary.

To ensure proper communication with your beekeeper and the beekeepers of any surrounding fields, the county Agriculture commissioner has created an Apiary Notification and Movement Registration. This can be found by contacting your county agriculture commission office or by checking their website for all the appropriate registration documentation. It is important to

have the conversation with your beekeeper as to ensure they are registering their bees with the county Agriculture commissioner.

This registration will ensure the beekeeper is notified when pest control applications are scheduled to occur near the beehive placement area. It is also for the grower to know if they should avoid any applications because of beehives nearby. There is a 48-hour notification that comes with the registration, so if a grower can't avoid an application, the beekeeper will have ample time to relocate the hives.

Growers and Beekeepers Working Together

Another way growers can work with their beekeepers is to ensure the hives have a positive environment surrounding them. Growers can provide clean water for the bees to drink in the orchards. This helps to provide bees with a place to cool themselves as well as drink while they are pollinating. Providing a water source in your orchard will help to keep the bees in your field and prevent them from flying away to find a water source. Anything growers can do to keep the bees happy and healthy will in return help the productivity and pollination process of the bees.

Contrary to public opinion, the United States Department of Agriculture (USDA) Honey Production Reports stated that US honey bee hives are at a record 20 year high. Beekeepers and growers have been working diligently together to ensure bees are strong. There are still bee losses over winter months and during pollination but with the high demand of beehives that are coming to California for almond bloom, it is proportional.

Beehives travel from as far as Canada and across the United States to make their trek to California for the almond bloom season. Being that almond pollen is such a nutritious diet for bees, many beekeepers see the need to make the relocation for the almond bloom timeframe. For many parts of the country, their home is a frozen tundra, and the bloom period in California is

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a refreshing experience for the bees. Almond trees generally require two hives per acre for pollination. With roughly one million acres of almond trees in California, there is a high demand for beekeepers from out of state.

Five Key Risks

Even with the twenty year high for bee hive populations, there are still risks for bees and beekeepers. Much like anything there are predators and environmental factors that bees deal with. The USDA outlines five key risks that beehives work to overcome.

Varroa mites are the leading predator related to Colony Collapse Disorder. Beekeepers find it very difficult to control the pest efficiently without damaging the bees, especially the queen bee. Miticide has been proven effective, but it is difficult to produce honey and use miticide without contamination problems. There is extensive research being done investigating possible treatment options. There is great work being done in collaboration with almond growers and beekeepers together.

With the distance that many beehives travel to come to California for almond bloom, there are also a number of other pests and diseases they encounter along the way. There is a team of researchers specifically looking into the path bees travel to get to California. The researchers monitor hives along their journey

All photos courtesy of Jenny Holtermann.

and prescribe necessary treatment methods through the process. Pests and diseases that bees may encounter that are specific to a certain area and not something a beehive would be adapted to.

For much of the bee industry there is also a lack of genetic diversity within the colonies. Beekeepers find what works for them and don't tend to seek out new queens from too far away. There is new research being done on introducing foreign genetic material and the best way to collaborate with the existing bee colonies to improve the breeding stock.

The use of pesticides on crops during the period when beehives are present in our fields is another factor. Pesticide exposure to the bee colonies can be extremely detrimental. With proper collaboration and understanding between the beekeepers and growers, exposure can be minimal.

With the increase in commercial agriculture, more open grassland is being converted to production agriculture. There is a lack of forage crops and natural vegetation for bee colony nutrition. There are great organizations that are trying to support the distribution of seed to some of the natural habitat areas for bees. There is a need for additional nutritious feed supply for bees before and after almond bloom. Many growers across the nation are aiding to help with the bee habitat rebuilding process.

Researchers, beekeepers and growers are working together to be informed, educated and productive for beehive health. With their teamwork bee colonies will be strong in pollinating the food supply for our world. Over the years, many growers and beekeepers alike have changed their practices to promote bee health and help bee colonies to be robust, all while contributing to increase yields in growers' crops. By adopting these best management practices for bees and pollination, we will make a stronger agriculture industry.

Jenny Holtermann, writes an agriculture blog 'Almond Girl Jenny' and farms almonds with her family

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

THE BENEFITS OF AN INTERNAL AUDITING SYSTEM

By JON KIMBLE | Safe Food Alliance

If you're someone who's audited to a Global Food Safety Initiative (GFSI) scheme such as Safe Quality Food (SQF) or British Retail Consortium (BRC), you know that internal audits are a key part of your certification. In addition to being a critical element of your program verification, internal audits are one of the most common items that companies receive non-conformities for in an audit. Meeting these GFSI requirements involves developing a strong internal audit program that utilizes trained auditors and is intentional, thoroughly planned out, and comprehensive.

Common Gaps

An internal audit is a complete review of the food safety system against major GFSI Audit Schemes, like SQF or BRC Standards. If your internal audits are primarily comprised of facility walk-throughs for general Good Manufacturing Practices (GMP) and hygiene compliance, you've missed the target. The intent of effective internal audits are a comprehensive review of all of your programs.

To get the most out of an internal audit, make sure it includes:

- A multi-disciplinary internal audit team that can independently and objectively audit different departments, functions, and processes within the organization.
- A well-trained team that can effectively follow the audit plan and audit procedures.
- A systematic, planned, independent and documented process for obtaining evidence to review and evaluate against pre-arranged standard requirements.

Auditing and the PDCA Cycle

Your internal audit program fits into the concept of the Plan, Do, Check and Act (PDCA) Cycle, also known as the Deming Wheel. The PDCA cycle is a repetitive four stage cycle and is used for continuous improvement in many business processes. Approaching audits with this process in mind allows companies to:

- Drive continual improvement in their operation
- Improve process efficiencies and reduce waste
- Better direct valuable company resources where they're most needed
- Confirm compliance with your food safety standard
- Be well prepared for your third-party audit

PLAN The planning stage is the beginning of any production process. Carefully developing your company's production processes and food safety programs will help ensure effective, efficient processes. Once we have our plan in place, it's time to get started.

DO The "Do" stage is the process of implementing the programs as they're documented. This is the execution stage, where the majority of our efforts are spent.

CHECK The "Check" stage is where the internal audits fit in. This step, if done correctly, leads us to make the largest gains for our company. And yet, too many companies don't provide adequate resources to conduct these activities. During this step you gather information and analyze it, working to understand how efficiently your operation is running. The "Check" stage allows you to identify potential risks to your business, and creates opportunities for proactive improvement. Results include lower food safety risks for consumers, lower risk of recalls, and improved efficiencies.

ACT The final stage, "Act", is where the improvements in your processes occur. This stage involves strategic, well-informed actions to improve our programs based on information gathered in the previous stage. These improvements depend on having good data and analysis from internal audits and other process checks. If your company doesn't take a rigorous approach to these activities, there won't be adequate information to make well-informed decisions, resulting in lost opportunity to make significant gains in your operation.

START AGAIN

Finally, the process starts over. After you act on what you've

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learned above and change your programs, you plan out the next day's operation and start the production process all over again.

Crafting Your Program

So, what does an effective internal audit program look like? An internal audit program can involve a variety of tools applied at different times, depending on the situation:

- Procedure and record review
- Direct observation of activities
- Interviews and confirmation of employee awareness

In addition to what happens the day of the audit, your audit programs should include some structure. To make sure audits are consistently performed, effective, and meet you GFSI or Hazard Analysis and Critical Control Point (HACCP) audit requirements, you'll need the following:

- Auditor training (and associated records of their training!)
- An annual audit schedule that includes all aspects of the operation
- A standardized form or record used to record audit results
- A system for tracking corrective actions and making sure they are followed up on
- A systematic or scheduled review of audit results with management, where they discuss needed changes and allocation of company resources

Auditing: Verification or Validation?

One of the required elements of your food safety program is conducting both verification and validation activities. Depending on how they are done, internal audits can be either. If done thoroughly, they can help meet both internal audit requirements and validation requirements in a single activity, which can save you time and resources.

An audit conducted to verify an operation might look like this:

1. Quick review of any relevant procedure, to ensure the auditor understands what's supposed to be done by employees
2. Observe employees and equipment for a few minutes, confirming practices
3. Check the forms being completed that day
4. Reporting results to management via an email or in a meeting

This approach is fine, but it's simply a "spot check" verifying what's happening today. We're basically answering the question, "are we doing it?", or are we following our programs as designed.

In contrast, let's take a look at how an internal audit might be used to not only satisfy the requirement of doing internal audits, but to actually validate our programs—leading to a much more effective, useful audit. In this case we're not only asking "are we

doing it?", but we're asking the question "is it effective?" Using internal audits as a validation activity might look like this:

1. Review the procedure before, and again after the audit, to identify any improvement opportunities or needed updates.
2. Observe a sampling of employees—not just one employee who's on the line today, but perhaps multiple shifts or multiple employees.
3. Talk to the employees as well. Confirm their knowledge of the process, why they're doing it, any associated food safety risks, and whether they understand appropriate corrective actions if anything goes wrong.
4. Do a thorough sampling of completed forms over the past months, spot-checking more than just what's being recorded on today's records
5. Review customer complaints, results on inspection of product, or any other relevant data or information that might help you assess effectiveness of the particular activity that you're auditing
6. Meet with management to discuss effectiveness of the program, and determine whether changes are needed in equipment, people, or other resources, or if the program is effective as-is.

The Bottom Line

Regardless of the size of your operation, you can't afford to not have an effective internal audit program in place. These audits can be scaled to fit the operation, and will look different from company to company, but the benefits of having a good program outweigh the resources needed to do it. You may audit some programs with simply a verification approach, and you may audit others with an approach designed to help validate that they are effective.

Need more help? We understand that putting a system like this together can seem daunting. That's why we have put together a list of resources to help you get started.

- Register for our online Internal Auditor course. This program offers easy to understand audit training to help you verify the effectiveness of your food safety system. Whatever the management system, this training provides participants with the knowledge and skills needed to perform a successful internal audit of planning, prerequisite programs, and critical control points.
- Visit https://safefoodalliance.com/newsletter/2018-11/the-benefits-of-an-internal-auditing-system/ to download this article as a PDF and keep it as a resource as you set up your program
- Internal Auditor Quiz—test your knowledge to see if you are ready to audit your system

Still need more information? Contact us at foodsafety@safefoodalliance.com and sign up for our newsletter to get the latest information on all things food safety.

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Sterile Insect Research Going Forward

By CECILIA PARSONS| Associate Editor

Photos courtesy of Cecilia Parsons.

WITH THE FIRST RELEASES OF IRRADIATED navel orangeworm (NOW) moths over Kern County almond and pistachio orchards completed this fall, researchers are now looking at the future of the sterile insect technique project.

Sterile Insect Project

The sterile insect technique (SIT) project, where NOW adults are mass-raised, irradiated to make sterile then released to outnumber fertile NOW, is in it's third year at a cost of $4 million. California Pistachio Research Board began funding to determine if sterile NOW releases are effective in reducing NOW pressure. The SIT project is aimed at area-wide suppression of NOW in the approximately one million acres of almonds, 250,000 acres of pistachios and 250,000 acres of walnuts in production in California.

The first step in the sterile insect project was determination if this lepidopteran pest could be mass raised.This step was accomplished at a re-purposed United States Department of Agriculture (USDA) facility in Phoenix, Arizona, that had been used for the pink bollworm eradication project. Irradiation doses were determined for NOW sterilization and this year the first NOW were shipped to California for release by plane over targeted orchards. Releases of 750,000 moths at a time were made five to six times per week for several months with the belief that the irradiated male and female sterile moths would mate with wild NOW, reducing the number of offspring.

Although NOW damage was reportedly lower in most orchards this year, the pest has caused millions of dollars of damage to nut quality in recent years. Most growers are using a combination of orchard sanitation, insecticides and mating disruption to control NOW populations in their orchards. The SIT project is not meant to replace those control methods, but to supplement those efforts.

Long Term SIT

Houston Wilson, an assistant Cooperative Extension specialist in tree crop integrated pest management, has been looking at the effectiveness of this years sterile release program and developing a long term plan for the program. As part of Kern Ag Day, Wilson outlined some long-term suggestions and noted findings from this year's release program.

Wilson, who is working out of the Kearney Agriculture Research Center in Parlier and conducting the studies with USDA researcher Chuck Burks at additional release sites said the goal of this pilot program is to develop a competitive sterile moth and figure out how to best use it.

Sterile moth releases were made over commercial blocks of almonds and pistachio trees in Kern County where additional control practices, including mating disruption were in use. Wilson and Burks were also releasing sterile moths in two sites, a Kettleman City block of conventional pistachios with no mating disruption and a two-acre block of pistachios in Parlier. The Kettleman City site had weekly aerial releases

July 1-October 15 and the Parlier site had weekly ground releases.

One of the critical aspects of the program, Wilson said, was the over flooding ratio of sterile moths to the wild NOW in the orchards. At the Lost Hills site in Kern County, 750,000 NOW moths were released five to six times per week July-October. The Kettleman site received 750,000 moths once a week and the Parlier site received 6,000 moths once a week.

Trap Finds

Wilson said he and his field assistants checked lure traps in the orchards to determine the levels of sterile moths that were active. The sterile moths are distinguished from wild NOW by a red dye ingested at the mass rearing facility. What Wilson found in the traps were very low numbers of sterile moths. After asking the facility to improve on the dye marking, he said sterile numbers were still below expected.

Releases were done in a grid pattern at the Kearney site, Wilson said, and the focus was on the female moths which were marked by a clipped wing. Mating activity the first night after the release was low, but improved by the third night. He said this showed that the shipping process, where the moths are in darkness inside a container and they may have to adjust after release.

In a trial meant to determine activity of irradiated male and female NOW, Wilson said irradiated males rarely showed up in pheromone traps and never in the mating tables meant to show mating activity. Wilson said at Kearney, 4,455 moths were trapped and only 11 were marked with red dye. At the Kettleman site, 15,493 were trapped and only 54 marked. As for the irradiated females, Wilson said they do attract wild males, but activity is better then second or third night after release. Irradiated females call and mate at about the same time as wild NOW.

Key immediate issues were moths not flying or male moths not following pheromone plumes.

Down the Road

Wilson said his suggestions for a long term SIT program include work to produce a NOW moth that is equivalent and competitive with wild NOW. A ratio of 20 sterile moths to one wild is one example of over flooding, but Wilson said different programs could have different ratios. Determining an effective over flooding ratio could be done in the laboratory and then field cage studies. The sterile moths' lack of proven activity in the field may be genetic or it could be due to the shipping and release protocol, he said. Making sure the moths will be competitive in an orchard situation will include work to determine ideal strains of NOW, adjusting production conditions, radiation dose and shipping and release methods. Currently the releases have been made by plane. Wilson said ground or drone releases are options.

When time of the year releases are made is another component of the project that should be considered, Wilson said. Should key periods be identified for releases or year around releases scheduled?

A next step in the program could also be larger scale field trials with paired plots with or with sterile moth releases. Wilson also suggested dispersal studies to determine movement of moths in an orchard.

To develop area-wide IPM programs with SIT, Wilson suggested determining the best situations for use of irradiated moths, regional monitoring of populations and coordination of Integrated Pest Management efforts.

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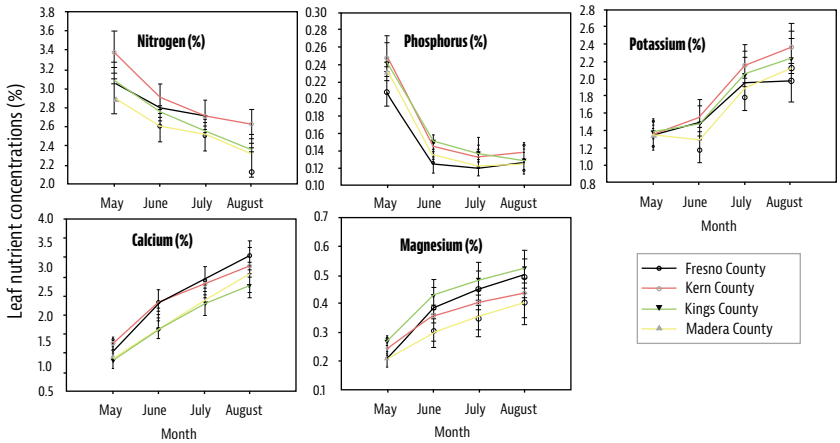
Pistachio Nutrition Similar but Different to other Nut Crops

By RICH KREPS | Contributing Writer

Pistachio's are like most nut crops in that they have similar nutritional requirements. Removal rates are a little different, nutrient demand curves have some date of application shifts, and irrigation schedules begin at different times than your almond and walnut orchards. But typically, they follow similar curves. Which brings up a good point: is anything typical in farming? In one of my recent lectures I put up a meme of Brian Williams stating, "We can get you to believe just about anything if we preface it with the line 'a new study shows'". The global warming argument had to be switched to climate change because it's easier to perpetuate the argument. Well, "a new study shows" that the climate has been changing pretty drastically from ice ages to tropical conditions for approximately 4.5 billion years. Apparently, the earth's 365 day trek around the sun has a little 'warble' in it. Luckily for us we've only had to deal with it in structured agriculture since the time of the Egyptian Pharaohs and the Ming dynasty. So, what have we learned about tree nutrition and farming? Every year is different and it seems like every year we have 'a new study'.



Objective: 1.
Variability across orchards

Figure one shows changes in nitrogen, phosphorus, potassium, magnesium and calcium in leaf during different biological phases and across different locations.

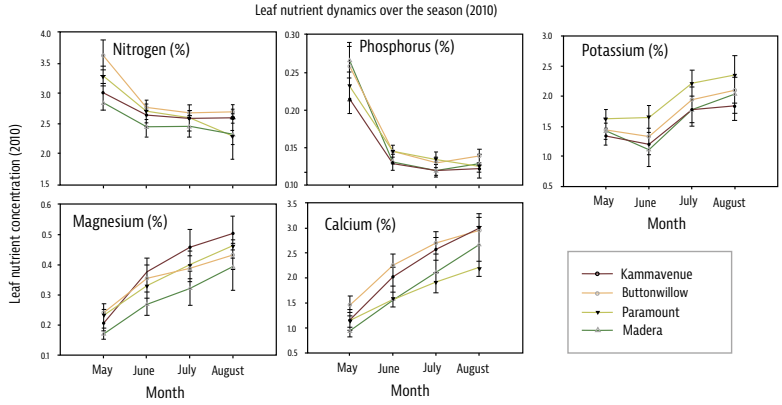


Figure: 1. Leaf nutrient dynamic over the season in 2010.

Chill Accumulation Hours

This time of year, we have been tracking our chill accumulation hours. Some decent rainfall and cooler temps hit California in late November and early December, so even trees that weren't sprayed with heavy shots of zinc lost their leaves and went into dormancy before the frost. Evapotranspiration stopped. Post-harvest nutrition should have been applied by Halloween for maximum efficiency. That was the beginning of *this* year's crop! Post-harvest nutrition is more important than many farmers give credit. After a crop comes off 'studies show' magnesium kicks into high gear in chlorophyll to produce as many carbohydrates as possible to store in the roots. Phosphorous creates the energy to drive the system and nitrogen (N) is assimilated into amino acids. Potassium opens and closes the gates that move nutrition through a plant. 'Studies show' calcium gives structure to the postharvest root flush and builds mass to create a bigger storage tank. That storage is the basis of early season nutrition as we hit the first root flush and get ready for bloom.

First Root Flush

When that first root flush hits, the ground is usually (and hopefully) pretty well saturated; however, it is still cold. Without leaves and photosynthesis, we are drawing on those nutrient stores in the roots. If you didn't have a good postharvest program in the fall those stores are already low. Cold wet soils won't allow the roots to pick up a phosphorus (P) source that is unavailable. 'Studies show' cold temps and wet soils won't allow poly phosphates to transform to orthophosphates for up to 100 days. That's too late. You'll already

be at an energy deficit. If the gypsum you may have applied in the fall to the surface of the soil is still visible, that'll tie up a poly P source quickly when applied. That will render both of those nutrients unavailable and will lose efficiency. Hit them with a small fertigation shot (in a short irrigation set!) of an orthophosphate source. That is plant ready P. As we roll into March and April, stored N from the roots will no longer keep up with the demands of the tree and we need to start our nitrogen program. Many of my farmers prefer to start with a soluble calcium and nitrate fertilizer for quick assimilation and root support. Later in the season they'll switch to more ammoniacal and urea forms to extend the time release and avoid nitrate leaching. 'Studies show' that calcium thiosulfate will also act as a urease inhibitor and extend the release of nitrogen from many nitrogen fertilizers. Keep that in mind as an option to prolong N applications.

Nutrient Demand Curve

If we look at a typical nutrient demand curve, we see that N and P start very high in April and May. They become lower as tissue concentrations as the season progresses. Potassium (K), calcium (Cal) and manganese (Mag) continue to rise in percentages as the season rolls along. Cations get removed in significant amounts with the crop. We need to apply non-mobile calcium more often throughout the season instead of just a big shot or two. My farmers use many of the K sources we've mentioned in earlier articles based on their analysis with other nutrients. Potassium thiosulfate is a great source for K in soils that are also low in sulfur and sulfate. MKP (magnesium, potassium, phosphorus) may be the perfect fit for chasing potassium and phosphate at the same time if both of those nutrients are low. Potassium carbonate or potassium hydroxide can be used to chase K. But with a high pH, they need to be blended or buffered with a follow up of sulfuric, phosphoric or hydronium acid to neutralize it. Foliar adjustments can be a quick fix for micronutrient deficiencies. With late rains it can be tough to get into fields early. Don't be afraid to apply nutrition foliarly to early fungicide or pesticide sprays. Just make sure they are compatible. In the words of Reagan, "trust but verify." Don't just assume a chlorotic appearance is an iron or zinc deficiency. Pull a tissue sample and confirm the levels of manganese, copper and even molybdenum are adequate.

Don't Limit Your Yield

We have to remember a tree is stuck in the ground and can't go to the refrigerator for food when its hungry. They are pretty efficient at assimilating the nutrition they need from the soil, but sometimes they fall short. News alert: 'Studies show' that nutrient deficiencies limit yield. Don't limit your yield. Have a plan to correct any deficiencies you had last year. Look at your soil samples with your crop nutrition specialist and decide which nutrients will be available, which will tie up, and which to apply to the soil or spray foliarly. Most importantly, at what time are the trees needing those specific nutrients based on this year's weather patterns and soil conditions? Have a plan and make changes to the program based on where last year come up short. Adjust it as this year's tissue sample levels fluctuate. You can't run a jet engine on diesel, so don't just apply more nitrogen when your trees need phosphorus. Dialing your nutrition in to match demand and weather curveballs will optimize yields. Make your farm the example they use for higher yields when the experts say, 'a new study shows'.

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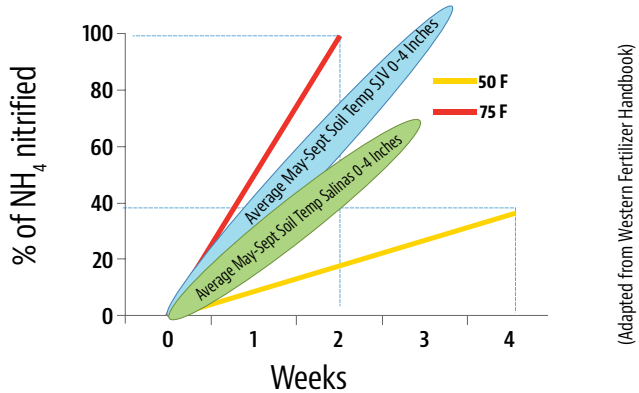
NITRIFICATION: HOW QUICKLY DOES IT OCCUR?

Nitrification rate governed by temperature and adequate moisture:



(Adapted from Western Fertilizer Handbook)

Alternaria Late Blight of Pistachios

Closeup of Pistachio Nuts. Photo courtesy of Kathy Coatney.

Pistachio Tree. Photo courtesy of Kathy Coatney.

By PHOEBE GORDON | UCCE Farm Advisor

Alternaria late blight (ALB) of pistachios is a fungal infection caused by several Alternaria species, Alternaria alternate being the most common. These species can also cause Alternaria leaf spot in almonds, which tends to show up in the summer. Severe infections will result in leaf loss, and the fungus will move into the fruit, causing staining and molding and thus lower nut quality. This is unlike almonds, where Alternaria infections only damage the leaves, though defoliation can be severe if the disease is unchecked.

Symptoms

Alternaria infections have differing symptoms depending on whether infections happen on the leaves or fruit. Leaf infections can be angular or circular and start out small with either dark brown or black coloration. As they grow, they will merge together and form light brown spots that can be as large as an inch. When humidity levels increase the fungus produces spores on the surface of the lesions which results in them blackening. You can differentiate ALB from Botryosphaeria panicle and shoot blight by rubbing your fingers on leaf or fruit spots: the spores from ALB will coat your fingers. Alternaria infections on pistachio fruit and panicles remain small—no more than a few millimeters in diameter, and these spots stay black. Red haloes will surround the lesions on immature fruit, some of which will grow and merge.

Humidity

Like most foliar fungal diseases in orchard crops, ALB thrives in high humidity conditions generated in dense canopies, flood or sprinkler irrigation, or from nearby bodies of water. Sodium affected soils, which reduce the rate of water infiltration and can result in water being ponded on the soil surface for longer periods of time, can also increase humidity levels in the orchard. To combat a severe ALB problem, you must address orchard humidity levels in addition to your spray program. Alternaria evolves resistance to fungicides readily, so reducing sprays ensures that existing fungicides can remain effective.

Lowering orchard humidity can be achieved by pruning to open the orchard canopy, which in turn increases air flow. More effective measures are to address irrigation delivery and management. While shifting irrigation systems can be a pain, ALB is a problem that can absolutely linger in orchards if humidity levels are not addressed. Severe ALB infestations

can result in losses of up to $1000 per acre, so fixing a problem block can repay itself quickly.

Irrigation Systems

If the orchard is irrigated with flood or sprinklers, conversion to microsprinklers or drip decreases the surface wetted area, which reduces orchard humidity. Ensure you are not overirrigating by monitoring evapotranspiration, and only applying what the trees lose. If possible, decrease the frequency of irrigation and irrigate more deeply, though do not irrigate for longer than 24 hours in an irrigation set to reduce the danger of Phytophthora infections. In past studies, subsurface drip irrigation managed in such a way that surface wetting was minimized reduced ALB in a severely affected orchard (Goldhamer et al., 2002).

Spray Applications

Severely affected orchards will need sprays in addition to lowering orchard humidity; getting the problem under control cannot rely on one method alone. Early June is the time to start treatments, and three applications are recommended. There are a wide variety of available fungicides, so if you decide you need to conduct multiple sprays, ensure you rotate chemistries, and do not bring a mode of action back into the orchard in a growing season once it has already been sprayed. For instance, if you spray with a group 11 fungicide, conduct your second spray with a group 3 fungicide. Changing the formulation is not enough. For a complete list of fungicides and their FRAC groups, visit http://ipm.ucanr.edu. As always, check with your pest control advisor (PCA) or pesticide manufacturer so that you are up to date on which fungicides are registered for use in pistachios.

Cited Open Source Article:

Goldhamer, D.A., T.J. Michailides, and D.P. Morgan. 2002. Buried drip irrigation reduces fungal disease in pistachio orchards. California Agriculture. 56(4): 133-138

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Mid Valley Sessions Draw Large Numbers

By CECILIA PARSONS | Contributing Writer

From food safety risk management to tree nut nutrition, the 2018 Mid Valley Nut Conference in Modesto covered all the bases for the large crowd of tree nut growers in attendance. Timely updates on almond and walnut markets and pesticide safety basics filled out the one-day conference agenda.

Band Canker

University of California (UC) Davis researcher Leslie Holland presented information on the increasing rates of band canker infections in almonds and grower options for managing this disease. One of the recent UC research efforts was a survey of 120 almond orchards ranging in age from first leaf to 20 years. Multiple cultivars and rootstocks were represented in the survey due to concern that the disease was invading orchards earlier in their lifespan and in severe cases, causing tree death.

Holland said the survey showed that the bulk of the cankers found (36 percent) were caused by Botryosphaeria pathogens, which are the most aggressive. Twenty-eight percent were Ceratocystis cankers, which are associated with shaker injuries.

Band cankers are distinguished by a growth pattern circling tree branches or trunks. During the growing season, infected trees exude amber colored gum from the cankers. Botryosphaeria infections, Holland said, are the most aggressive and the cankers can girdle and kill infected branches, scaffold limbs or entire trees. Spores from this fungal pathogen are carried in orchards by rain or irrigation water that splashes on the trees. These spores invade openings on the tree bark and cause the cankers.

Ceratocystis cankers develop as elongated water-soaked areas on the tree.

To manage current canker infections, Holland said the affected area could be cut down to clean wood and the site cleaned. Removing sources of inoculum like tree stumps is also advised.

The on-going study will next focus on spore trapping to monitor pathogen presence or absence.

Navel Orangeworm (NOW)

It's no secret that overall navel orangeworm (NOW) damage in this year's almond crop was less than last year's. There was an upswing in NOW populations early on, but it petered out by harvest said United States Department of Agriculture (USDA) research entomologist Joel Siegel. The potential reasons for this include better sanitation practices, better timing of spray applications and a significant

Terry Brase discussing what the future holds for ag technology.

Leslie Holland discussing the latest on Almond Canker Disease management. All photos courtesy of Cecilia Parsons.

increase in the number of acres under mating disruption (MD).

Effective monitoring of NOW played a part in NOW control reported Jhalendra Rijal, University of California Cooperative Extension (UCCE)/Integrated Pest Management (IPM) advisor in Merced County. Monitoring tools for NOW include egg traps/female traps, pheromone traps, harvest samples, mummy nut samples and orchard history of NOW pressure. All of these can be used in planning NOW control strategies.

Area-wide use of mating disruption also had an impact on NOW damage. Rijal said in the southern San Joaquin Valley, use of MD reduced NOW damage by an average of 46 percent. Other economic considerations with the use of MD include increased crop value, reduction of aflatoxin levels, and value of MD use as a marketing tool promoting sustainability. Cost-benefit ratios, Rijal said, are higher in high-pressure orchard situations.

Tree Nutrition

Certified crop advisor Richard Kreps provided direction to growers on asking questions of their pest control advisors (PCA) about tree nutrition. Don't waste money, he advised, on nitrogen that can't be used or isn't needed.

"Judge your products by specific needs at the time," he said. Growers should know how certain nutrients move in the soil and are taken up by plants and how they interact with other nutrients.

Growers should think total nutrition for the crop and make sure the balance of nutrients applied is correct for the crop and stage of production.

The nutrient phosphorus, which can be critical, has two forms: poly and ortho. Plants can only take it up in ortho form and

Continued on Page 58

Continued from Page 57

moisture, heat and soil microbe activity are needed to convert this nutrient into the useable form. In cold weather that conversion can take up to 100 days, Kreps said. Growers should know that heavy applications of this nutrient could also tie up other nutrients, including calcium and zinc.

Kreps advised growers to have a plan for their nutrition program and to use soil tests, soil amendments, smaller fertigation events, multiple tissue samples, foliar adjustments as needed and to make comparisons with yield data. Growers should also understand the differences in growing conditions. What may work well in northern California would not apply in the west side of the San Joaquin Valley.

Trust your PCA, Kreps said, but verify that their plan is sound.

"Have your advisor build your plan, not theirs."

New Technologies for Agriculture

New technologies and how they are used in agriculture and who is adopting the use of these new technologies was covered by West Hills College director of Farm of the Future Terry Brase.

Brase, who teaches precision agriculture courses at the western San Joaquin Valley school, said growers should be aware of new technology and be prepared for the changes it can bring to the agriculture industry.

"You have to understand the technology to make critical decisions," Brase added.

Enabling technologies with applications in agriculture include unmanned aerial systems, variable rate technology, automated irrigation systems, food quality systems and robotic field systems.

There are several stages of expectations—or a "hype cycle"—with the introduction of new technologies. These expectations are triggered with first announcement and move to a peak of inflated expectations—soon to be followed by a trough of disillusionment when the early expectations are not met. The next stage is the slope of enlightenment as there is a realization that the technology can be applied in a way that has value. Finally, there is the plateau of productivity when the technology is put to use.

Following along with the stages are the potential users. The first group, Brase said, are the innovators who are eager and willing to try new things. Next come the early adopters, but there is a lag due to disillusionment about the technology. Once the slope of enlightment is reached, adoption rates pick up.

New technology, Brase said, used to be adopted at about a 10 year pace. That time frame has shortened up as early adopters and growers invest time and money, banking on the value of new technology. More people are also willing to be innovators, Brase added.

Growers need to consider where they are on the cycle.

Return on investment is another consideration. Not all new

technologies have the economic aspect worked out, Brase said. One example is GPS. Installing the system on a 500-acre production area can save five percent on farming costs and have a two-year payback on investment.

Complying with regulations will require use of more technology, Brase said, as growers will have to document use of fertilizer and water.

West Hills, Brase noted, is the only college in the top 20 schools for precision agriculture. The concept is more mainstream in the Midwest, he said, as there is a critical mass of technicians to assist growers with adoption and application of new technology.

Food Safety Modernization Act (FSMA)

Jon Kimble of Safe Food Alliance and Roger Isom of Western Ag Processors Association, advised growers on compliance with Food Safety Modernization Act (FSMA) rules.

"With food safety it is all 'risk based', " Kimble said. "You have to manage risk to the consumer."

Health and hygiene are the two most important aspects of state inspections, Isom said. The state inspectors are going to ask about training employees. Documentation of all training to manage food safety risks is important.

"They will ask about cleaning, sanitizing equipment and dead squirrels. A lot of what they are asking is common sense," Isom said. The inspectors want to know what you are doing to address risks to food safety.

Kimble recommended that at least one employee attend the Produce Safety course.

Growers who hire contractors are still responsible for food safety, Kimble said.

"You have to make sure the contractor is doing the right things in regard to food safety and verify through their records that their employees are trained," Kimble said.

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Photo courtesy of WAPA.

DON'T FORGET Your Air Pollution Permit!

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

It's been a while since we penned a story about air pollution permitting, but with numerous issues arising over the last two months, it has become necessary for us to remind hullers and processors of the requirements for obtaining an air pollution permit. With an industry that is continually growing, permit limits are being challenged everywhere and we have several notices of violation we are fighting and permit actions we are addressing. We advise and encourage all hullers and processors to give us a call before making any changes to their operations to be sure of any possible requirements.

When do I Need to Obtain an Authority to Construct?

Any time there is a change in equipment, throughput, air flow or emissions, a permit application may be triggered. It depends on the air pollution control district (ARB) and the degree of the change, but you almost always trigger the need for an "authority to construct". In recent months, several nut processors have been faced with having to increase their fumigant usage, because they have now exceeded their current limits. We advise everyone to check and monitor their fumigant usage and make sure they are within limits. In two other cases, hullers made equipment modifications without an authority to construct and paid a penalty as a result, and still had to file an application for the authority to construct. If you change any equipment from what is listed on the permit, even if it is simply removed, an application to modify the permit must be filed.

Things That Trigger a Permit:

- ✔ Adding equipment
- ✔ Removing equipment
- ✔ Increasing nut throughput
- ✔ Increasing fumigant usage
- ✔ Changing fumigants
- ✔ Changing airflow
- ✔ Installing an air curtain burner

Another area that needs attention is for folks looking at bringing on an air curtain burner to their site. If you plan on operating an air curtain burner to burn sticks for any length of time onsite, you must first obtain an authority to construct. We must warn you this is not an easy process, and there are many limiting factors based upon the emissions from these units. While they solve one problem, they could cause others. Be sure to consult with someone knowledgeable before purchasing one of these units.

Challenges with Fumigation Permits

There are new and increasing challenges to fumigation permits. With new modeling and risk assessment requirements that have been tightened, it is tougher to get a permit for increases in fumigant usage. In some cases the height of the stack or the size of the exhaust fan has had to change in order for the project to pass the risk assessment, or in some cases the stack has had to move. Also, the permitting of methyl bromide has been made more challenging as well due to the health risk associated with emissions of methyl bromide. However, there is some good news in that the Western Agricultural Processors Association has worked out an economic analysis with the San Joaquin Valley Air Pollution Control District that demonstrates carbon adsorption or chemical scrubbers are not feasible for most methyl bromide applications.

Once you have completed your installation and are ready to "implement" your authority to construct, remember to notify the air pollution control district. They must be made aware of the implementation so that they can conduct an inspection. When they do the inspection is up to them and does not stop the operation, but you must notify them.

Be sure to check your authority to construct for emissions source test requirements. This is a must for any new almond huller or almond huller that is expanding significantly. Also, be aware that anyone installing an air curtain burner must have an opacity test performed by an ARB certified source test contractor. This is a must, and is a requirement of federal regulations governing "other solid waste incinerators" that local air districts must enforce.

Permit Compliance

On an ongoing basis, please be sure to check all permit conditions. Many times some form of recordkeeping is required, such as tracking nut throughput or fumigant usage. But there are also other requirements that sometimes get forgotten, such as daily monitoring of baghouse pressure drops or watering of the huller yard. These requirements should be check frequently and ensure that personnel are keeping them up to date. Violations are not cheap, and the fines are continuing to increase. Make sure you aren't one of those statistics.

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BUILDING A SAFETY FOUNDATION

Your Safety Programs

By AMY WOLFE | MPPA CFRE | President and CEO, AgSafe

An effective IIPP includes training and instructions. Train new employees on safety, annually thereafter and any time you assign a new job task. Photo courtesy of AgSafe.

Navigating safety and compliance in the workplace can feel overwhelming. But, you have to start somewhere, so begin with the foundation, the actual written program. These programs serve as your plan for navigating risk in your operation and are then presented via employee training and maintained with regular hazard assessments and correction. Begin with your Injury and Illness Prevention Program (IIPP), this program functions as your first building block, then tackle more specific programs that pertain to your operation, like heat illness prevention and pesticide safety.

#1 Injury and Illness Prevention Program:

The Injury and Illness Prevention Program (IIPP) is a written workplace safety program. Title 8, Section 3203 of the California Code of Regulations (T8CCR), requires every employer to develop and implement an effective IIPP. An effective IIPP improves the safety and health in your workplace and reduces costs through good management and employee involvement.

The eight required Injury and Illness Prevention Program elements are:

RESPONSIBILITY
This section identifies who in your operation has the authority and responsibility for implementing the provisions of the IIPP.

COMPLIANCE
This component outlines the system that ensures all workers comply with the rules for maintaining a safe work environment.

COMMUNICATION
This element captures the plan for facilitating a continuous flow of two-way communication between management, supervisors and employees.

HAZARD ASSESSMENT
Periodic inspections of the workplace are essential to evaluating and reevaluating safety concerns; this section outlines the formalized plan for timely assessments.

ACCIDENT/EXPOSURE INVESTIGATION
This section identifies the actions to be taken in the case of an actual incident or near-miss to help identify the root cause and then take corrective action.

HAZARD CORRECTION
This component identifies the process for correcting unsafe or unhealthy workplace conditions, practices or procedures.

TRAINING AND INSTRUCTION
As with any plan, there needs to be training to aid in implementation. This element provides details as to who, when and what needs to be trained.

RECORDKEEPING
This section outlines documentation requirements.

To be effective your IIPP must address the following areas:

- Fully involve all employees, supervisors and management.
- Identify the specific workplace hazards to which employees may be exposed.
- Correct identified hazards in an appropriate and timely manner.
- Provide effective training.

For useful tools in creating or updating your IIPP, take advantage of Cal/OSHA's IIPP e-tool found at: https://www.dir.ca.gov/dosh/etools/09-031/how.htm

#2 Heat Illness Prevention Plan:

The employer must develop, put in writing, and implement effective procedures for complying with the requirements of T8 CCR 3395, the Heat Illness Prevention Plan (HIPP). Each company needs to have a written heat illness prevention plan at the worksite, that contains the following elements, and include specific details as to how you will ensure that the provisions are met:

- The designated person(s) that have the authority and responsibility for implementing the plan in the field.
- Procedures for providing sufficient water.
- Procedures for providing access to shade.
- High-heat procedures.
- Emergency response procedures.
  - Don't forget your lone workers (e.g. irrigators).
- Acclimatization methods and procedures.

When drafting your plan, it is important to consider the size of your crew, the length of the work day, the ambient temperatures, and any additional personal protective equipment (PPE) that contributes as an additional source of heat. The plan needs to be in English and also the language understood by the majority of the employees. Like the IIPP, Cal/OSHA has an HIPP e-tool to help with drafting your program: https://www.dir.ca.gov/dosh/etools/08-006/index.htm.

#3 Pesticide Safety:

Unlike the previous safety programs mentioned, the pesticide safety plan requirement falls under Title 3 of California Code of Regulations, with California Department of Pesticide Regulation (CaDPR) as the enforcing body. For this requirement, the employer shall assure that employees who handle pesticides have been trained, prior to handling pesticides. The program shall contain the following elements:

- Description of the materials used (e.g., study guides, pamphlets, pesticide product labeling, Pesticide Safety Information Series leaflets, Safety Data Sheets, slides, video tapes).
- Information that will be provided and used to train employees and identify the person or firm that will provide the training.
- The trainer's name and qualification to be a trainer.
- The employer shall maintain a copy of the training program while in use and for two years after use, at a central location at the workplace.

Be sure that your program includes all of the required training topics. The Worker Protection Standard was changed in 2016 and as such, CaDPR adopted the updates thus increasing the number of training elements to be covered annually with all pesticide handlers. To see the full list of topics, visit the CaDPR website: https://www.cdpr.ca.gov/docs/legbills/calcode/030302.htm.

Whether it is your IIPP, HIPP, or pesticide safety program, ensure that you are reviewing the program, annually to ensure that the program still addresses your actual farming operation. If you add a new piece of equipment, acquire a new field or begin using a new pesticide, it is likely that

Continued on Page 64

Be sure that your program includes all of the required training topics. The Worker Protection Standard was changed in 2016 and as such, CaDPR adopted the updates thus increasing the number of training elements to be covered annually with all pesticide handlers. Photo courtesy of AgSafe.

Continued from Page 63

your program will need an update. While creating a safe workplace is the ultimate goal, employers are concerned with compliance. Create the habit of detailed documentation and recording keeping, this will aid is regulatory compliance. Don't forget the training. Train new employees, annually thereafter, any time you assign a new job task, add new equipment, or change a product like a pesticide. The key to an effective safety program is the implementation; a beautifully designed safety program sitting dusty on a shelf doesn't achieve a safe work environment or compliance.

For more information about safety programs, worker safety, human resources, labor relations, pesticide safety, or food safety issues, please visit www.agsafe.org, contact us at (209) 526-4400 or via email at 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, and food safety issues for the food and farming industries. Since 1991, AgSafe has educated nearly 75,000 employers, supervisors, and workers on these critical issues.

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NORTH VALLEY Nut Conference

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Jan 30, 2019

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AGENDA

DPR Approval Pending | DPR: 0.5 Laws & Regs and 3.5 Other
CCA: 4.5 hour

7:00am	Registration, Trade Show Open
8:00am	Laws and Regulations Update Marcie Skelton, Glenn County Agricultural Commissioner
8:30am	Mite Control in Almonds David Haviland, UCCE IPM Advisor, Kern County
9:00am	Walnut Husk Fly Management Dr. Bob VanSteenwyk, Entomology Specialist Emeritus, UC Berkeley
9:30am	Preventing and Managing Walnut Crown Gall Dr. Dan Kleupfel, Plant Pathologist, USDA ARS, Davis
10:00am	Break; Trade Show Open
10:45am	Butte-Yuba-Sutter Water Quality Coalition Update Rachel Castanon, Program Coordinator, Butte County Farm Bureau
11:00am	Navel Orangeworm Research Updates Dr. Emily Symmes, UCCE IPM Advisor, Sacramento Valley
11:30am	Early Season Irrigation: Do We Know When to Start? Dr. Ken Shackel, Department of Plant Sciences, UC Davis
12:00pm	Lunch
1:00pm	Botryosphaeria and Band Canker update Dr. Themis Michailides, UCCE Plant Pathology Specialist, Kearney Agricultural Research and Education Center
1:30pm	Weed Management in Young Orchards Dr. Brad Hanson, UCCE Weed Specialist, UC Davis
2:00pm	Adjourn

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In Conjunction with the UCCE Butte/Glenn/Tehama Counties Almond & Walnut Day

UC CE | University of California
Agriculture and Natural Resources | Cooperative Extension

UPCOMING EVENT

50th Tri-County Walnut Day

On:
Feb 7th, 2019

At:
Wyndham Visalia
9000 W. Airport Drive.
Visalia, CA

CE Credits:
PCA: 1 Hour
CCA: 3.5 Hours

	Registration
7:00 AM	**Coffee and Danish Courtesy of California Walnut Commission/Walnut Board** 2B Moderator: Elizabeth Fichtner, UCCE Farm Advisor, Tulare and Kings Counties
8:00 AM	**8 Welcome Walnut Growers, PCAs, and Members of Allied Industries** Elizabeth Fichtner, UCCE Farm Advisor
8:05 AM	**Working for the Future** California Walnut Commission
8:30 AM	**The Call of the Wild: Taming the Sleeping Dragon (Botryosphaeria and Phomopsis)** Themis Michailides, Professor, Dept. of Plant Pathology, UC Davis
9:00 AM	**Biology and Management of Walnut Husk Fly** R. A. Van Steenwyk, Research Entomologist and emeritus, Dept. E. S. P. M. UC Berkeley
9:30 AM	**Update on Training Walnut During the Canopy Development Phase** Bruce Lampinen, CE Specialist, Dept. of Plant Sciences, UC Davis
10:00 AM	**Break** 3B Moderator: Mohammad Yaghmour, UCCE Farm Advisor, Kern County
10:30 AM	**Whole Orchard Recycling and the Effect on Second Generation Tree Growth, Yield, Fertility, and Replant Disease** Brent Holtz, UCCE Farm Advisor and County Director, San Joaquin County
11:00 AM	**Water Management in Walnuts: Spotlight on Early Season** Allan Fulton, UCCE Farm Advisor, Tehama, Glenn, Colusa, Shasta Counties
11:30 AM	**Applying Crown Gall Research-Based Knowledge to Orchard Management** Elizabeth Fichtner, UCCE Farm Advisor Tulare and Kings Counties.
12:00 PM	**Lunch Graciously Provided by Our Sponsors**

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UPCOMING EVENT

08:00 AM	**Welcome and Announcements Elizabeth Fitchner** UC Cooperative Extension Specialist, Tulare County, Pistachio Day Chair
08:10 AM	**Industry Update—** Bob Klein, Research Director, California Pistachio Research Board
	Session 1 Moderator: Elizabeth Fichtner, UC ANR Cooperative Extension Advisor, Tulare County
08:30 AM	**Managing Groundwater Quality in Pistachio** Thomas Harter, UC Cooperative Extension Specialist, Department of Land Air and Water Resources, UC Davis
09:00 AM	**25 Years of Salinity Research: What We Know** Louise Ferguson, UC Cooperative Extension Specialist, Department of Plant Sciences, UC Davis
09:20 AM	**A New Technology for Determining Salinity** Blake Sanden, Farm Advisor Emeritus, Kern County
09:30 AM	**Choosing Reclamation Amendments and Rates for Effective Salinity Management** Mae Culumber, Farm Advisor, Fresno County
	10:00 AM Break
	Session 2 Moderator: Bruce Lampinen, UC Cooperative Extension Specialist, Department of Plant Sciences, UC Davis
10:30 AM	**Pistachio Potassium Needs, Application and Availability** Phoebe Gordon, Farm Advisor, Madera County
11:00 AM	**Understanding the Pistachio Tree's Response to Mechanical and Hand Pruning** Bob Beede, Farm Advisor Emeritus, Kings County
11:30 AM	**Growing and Producing Golden Hills Pistachios** Craig Kallsen, Farm Advisor, kern County
	12:00 PM Lunch
	Session 3 Integrated Pest Management (IPM) Moderator: Houston Wilson, Extension Entomologist, Kearney Agricultural Research and Extension Center, Parlier
1:00 PM	**Pest Management in Young Orchards: Ants, Mealy Bugs, Aphids, Pacific Mite, Darkling Ground Beetle** Kris Tollerup, Area Entomology Farm Advisor, Kearney Agriculture Research and Extension Center, Parlier
1:30 PM	**AF 36** Themis Michailides, Professor, Department of Plant Pathology, UC Davis and Kearney Agriculture Research and Extension Center, Parlier
	2:00 PM Break
2:30 PM	**Insect Management Update: Gill's mealybug, BMSB< and Mating Disruption for NOW** David Haviland, Entomology Farm Advisor, Kern County
3:30 PM	**Navel Orangeworm Management: Nut Susceptibility, Insecticides and Sanitation** Bradley S. Higbee, Field Research and Development Manager, Trécé Inc.
	4:00 PM Adjourn

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2019 STATEWIDE PISTACHIO DAY

On:
Jan 16th, 2019

At:
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303 E Acequia Ave
Visalia, CA

CONSUMER PANEL SHEDS LIGHT ON ALMOND KNOWLEDGE

By CECILIA PARSONS | Associate Editor

Almond orchards at bloom. All photos courtesy of Kathy Coatney.

Almonds received 'gold stars' for their nutritional value, but a consumer panel recruited off the streets of Sacramento at the Almond Conference shed light on the paucity of the urban public's general knowledge about California almond production.

Some members of the panel were not even sure that almonds grew on trees, or where in California they are grown, but they remembered reading something about water use. Almonds were not even listed by the panel as being among the top crops grown in California—(beaten out by avocadoes).

One of the Almond Board's 2025 goals highlighted at the Almond Board of California (ABC) conference was to bring the public along on the journey of responsible growth. The consumer panel, led by moderator Rob Renegar, associate insight director with Sterling-Rice Group, found it an effort to determine current consumer perceptions about almond production and expectations of the crop's environmental impacts.

Asked to list industries with positive or negative impacts on the environment, panelists targeted automakers on the negative side, but failed to list agriculture and almonds on the 'good' side of the impact question. Panelists said they were less concerned about the economic impacts of sustainability than environmental impacts of almond production.

Almond orchards being harvested. All photos courtesy of Kathy Coatney.

Almond growers in the audience may have been surprised by how little the panelists knew about their crop, but the answers they gave may help industry leaders shape their consumer messages in their quest for transparency.

In a nutshell—the panelists said they do not completely trust information from news sources, and were likely to search the Internet for information. They were also concerned about negative impacts on the environment and wanted to know not just where their food came from, but the process involved from the field to the store. 'Gold stars' were awarded to almonds, panelists said, because they believed almonds were a healthy food and were not overly processed. They also appreciated that almond by products could be recycled.

The only negative response was the price paid in the store, but the tradeoffs for panelists were quality and nutritional value of almonds. All reported buying and consuming more almonds in recent years.

The take-away was almonds have a good image overall, but water use was still an issue.

Visibility of almonds compared to the higher TV profile of pistachios was noted by panelists.

"We don't see almonds on TV like we do pistachios. We would like to see more."

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Hazelnut trees. All photos courtesy of Kathy Coatney.

Imagery Improves Oregon Hazelnut Acre Count

By CECILIA PARSONS | Associate Editor

The rapid growth of hazelnut acres in Oregon continues, though 2018 appears not to reach the peak levels of 2017. Through efforts of the Hazelnut Marketing Board, estimation of newly planted acreage and the age of non-bearing acreage is being realized with use of Geographic Information System. As better quality and expanded imagery coverage has become available the hazelnut industry is better able to make accurate forecasts of hazelnut production. This information assists the industry in determining marketing plans and price.

New acreage for 2017 was revised upward significantly due to better quality and expanded coverage. Marion and Yamhill counties continue to have the largest total acreage while Benton and Linn counties are experiencing the fastest growth in new acreage.

The updated industry total for 2018 is 78,603 total acres. Total number of acres with trees one to five years of age is 39,716. Total number of acres with trees 6-10 years of age is 11,284. Total number of acres of mature trees is 27,603. There are 30,389 acres of new and maturing trees in double density planting.

There were 399 acres of mature trees removed in 2018. In 2017, there were 877 acres removed.

Marion County has the largest number of acres of one to five year old trees at 11,573. Yamhill county has 6,739 acres of young trees, followed by Linn at 6,426 acres and Benton at 4,226.

Up until 2018, there has been a steady growth of new hazelnut acres. The upward trend began in 2014 when 4,358 acres were planted. Last year's total was 10,881 acres. A little over 2,000 fewer acres were planted this in 2018.

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Walnut Tonnage Falling Short of Forecast

By CECILIA PARSONS | Associate Editor

Photos courtesy of Kathy Coatney.

With 99 percent of the 2018 California walnut harvest off the ground and delivered to processors by mid-December, the tonnage total is falling short of the United States Department of Agriculture (USDA) forecast of 690,000 tons. California Walnut Handler Coalition chairman Pete Turner said the total walnut harvest appears to be closer to 670,000 tons, still above the 2017 total of 628,000 tons.

Had the crop matched the forecast, it would have been the largest on record, surpassing the 689,000 tons harvested in 2016.

Turner said there could be several growing conditions that affected this year's lower than expected total yields but the crop quality and kernel color were excellent.

The lower Chandler variety crop accounted for a large part of the decreased total tonnage. This variety represents about 55 percent of the state's 350,000 bearing walnut acres and kernel yields appear to be in the 45 percent range, down about one and half yield points from last year. Turner said the Tulare variety crop was up considerably over last year.

Prices paid to growers have trended lower than last year. Turner said in shell market prices were in the 95 cent to $1 per pound range compared to $1.80 in 2017. Kernel prices are also off at least $1 per pound. Standard price for halves and pieces has been $2.25 per pound.

While a smaller crop can help with prices, Turner said that Chile's walnut crop is adding to available inventories, creating a larger supply against a smaller demand.

Total walnut shipments to date are 215,000 tons compared to 231,000 at this time last year. In addition, due to the larger 2018 crop, the industry will have about 60,000 tons more supply than in 2017.

Exports take a large share of the inventory, but Turner reported that due to the extra supply from Chile, tariffs and currency issues in Turkey, export demand for U.S. walnuts is down but may come back in early 2019.

Domestic shipments are up about 10 percent of last year due in part to California Walnut Board's aggressive advertising budget.

Jennifer Williams, domestic marketing director for California Walnut Board confirmed that there has been an early push to move volume through in the fourth quarter. Advertising began earlier in the fall and included several new marketing programs.

The Golden Walnut Sweepstakes, which ended in December, was a social and online effort to increase retail walnut sales. Consumers who submitted a digital photo of their store receipt listing walnuts and uploaded the photo to the walnuts.org website were eligible to win a $5,000 Golden Walnut Grand Prize. Another 100 winners received $100 VISA e-gift cards. Other domestic advertising included a Costco promotion and an increased number of television spots.

On the export side, promotions vary by market. Pamela Graviet, senior marketing director international, said in-store promotional displays, sampling in stores, print and digital advertising and recipes are part of the marketing strategies. In Korea, two different television ads are targeting families and younger audiences with an emphasis on health and fitness.

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The importance of winter sanitation for pistachio trees. Photo courtesy of Kathy Coatney. Photos courtesy of Kathy Coatney.

The dormant period is a key time for growers to meet with crop consultants to review pest management history and develop a plan for the coming year.

NAVEL ORANGEWORM
RESISTANCE MANAGEMENT

By EMILY J. SYMMES, PhD
Sacramento Valley Area IPM Advisor
University of California Statewide IPM Program and Cooperative Extension

The dormant season is one of the most critical times for navel orangeworm management in nut crops (almond, pistachio, walnut). Given the multitude of recent articles in this publication and others, readers are already well-aware that winter sanitation is absolutely vital to minimize in-season navel orangeworm (NOW) populations, and ultimate crop damage come harvest. I won't detail this critical cultural management activity here, aside from referring you to the great content in recent issues detailing winter mummy sanitation and saying "Sanitation—Just Do It!"

The dormant period is also a key time for growers to meet with crop consultants to review pest management history and develop a plan for the coming year. Evaluating the successes (and failures) of recent years will help determine what adjustments should be made to best protect the next crop, maximize returns on investments, and continue to improve upon effective and sustainable integrated pest management programs. January may seem early to begin thinking about possible pesticide applications for NOW in the late spring and summer, but as my mother always quoted: "if you fail to plan, you plan to fail!" Indeed, having a plan in place for all of the scenarios you might face in the coming season will allow you to be proactive and thoughtful in your pest management approach, rather than reactionary. Developing strategies well in advance will allow you to address important issues, such as resistance

Continued on Page 76

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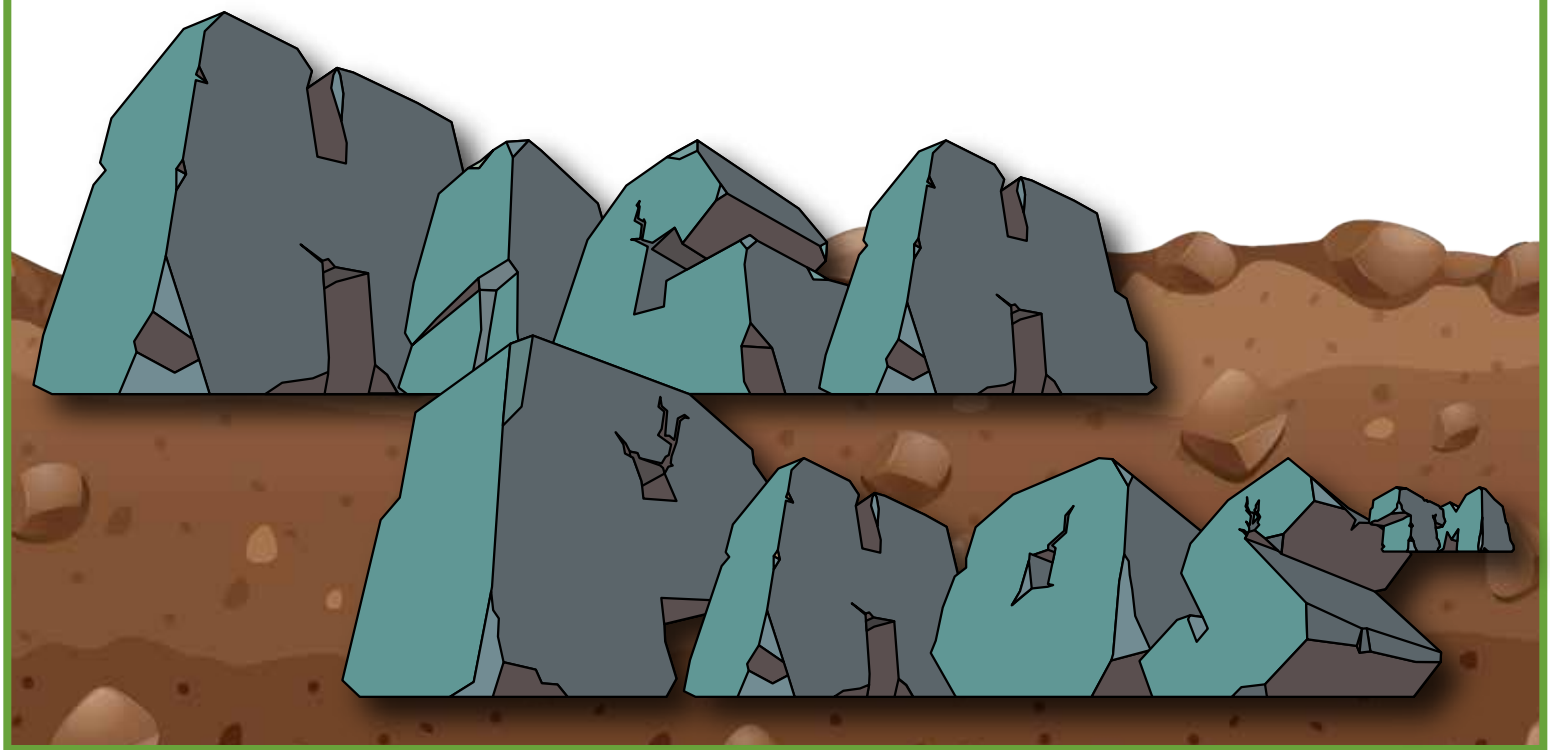

Contact Joseph Witzke: 209.720.8040 or Visit us online at www.wrtag.com

Continued from Page 74

management, which is the focus of the remainder of this article.

In general, 2018 seems to have seen less harvest damage caused by NOW in California nut crops relative to 2017. Following that high damage year, nut crop growers throughout the state took more aggressive approaches to managing NOW, including more intensive sanitation efforts, increased adoption of mating disruption, and in some cases, additional in-season insecticide treatments. Growers who embraced this multi-tactic IPM strategy saw the best improvements to harvest damage. However, NOW remains a formidable pest with the potential to cause severe damage and losses in economic returns if growers do not remain vigilant. While maintaining NOW damage at or below industry standard levels is of utmost importance, producers need to exercise caution when it comes to increasing pesticide applications for this pest because of the potential for resistance development.

Pesticide Resistance Development

How does pesticide resistance develop? Innate genetic differences in pesticide susceptibility exist among individuals in pest populations. That is to say that certain "resistant" individuals in a population possess heritable genetic characteristics that allow them to tolerate or overcome the same level of exposure of a toxicant (in this case, a pesticide) than the "susceptible" individuals in the population. The "resistant" individuals will have greater survival, and pass their resistance traits to their offspring, resulting in a shift in the population to a greater proportion of individuals with the resistant genetics. The simple graphic in **Figure 1** (**see page 77**) demonstrates pesticide resistance development in a theoretical pest population. In this example, the susceptible individuals are white, and the resistance individuals are red. In the first generation, the proportion of susceptible individuals is far greater than the resistant portion of the population. Following a pesticide application, this ratio is substantially reduced. The surviving individuals go on to reproduce the second generation, and pass along their resistant or susceptible genetics proportionally, resulting in an overall shift in the genetics of the population toward resistance. When the second generation is faced with the same selection pressure (same pesticide in this case), this process is repeated, and will continue to result in more and more resistant individuals and fewer and fewer susceptible individuals in future generations faced with the same selection pressure.

In pest management, it is important to understand the factors that drive resistance development, so that we can mitigate (or slow) this natural evolutionary process. How quickly resistance develops in a population depends upon biological, ecological, and genetic factors, coupled with the nature and frequency of the applied selection pressure (operational factors). Biological factors may include reproduction strategies (e.g., sexual vs. asexual, number of generations per year, mobility of the organism). Ecological factors may include characteristics of the orchard, proximity to

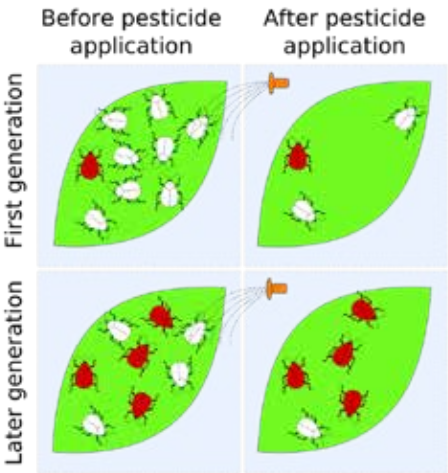

Figure 1. Simple graphic showing the progression of insecticide resistance development in a pest population.

The importance of winter sanitation for pistachio trees. Photo courtesy of Kathy Coatney.

untreated pest habitats, and immigration potential of the pest (which may allow more or less mixing of susceptible and resistant genetics). Genetic factors may include the mechanism of resistance or tolerance, how well resistant genes are passed to offspring, and whether there are differences in growth or reproduction abilities in resistant and susceptible individuals. In pesticide resistance development, the selection pressure is the pesticide itself, and operational factors are primarily the frequency and method(s) of application. These operational factors (the selection pressure we are applying that can drive resistance development) are the ones over which we have the most control in an agricultural environment.

NOW Management

Back to the pest at hand—navel orangeworm. As mentioned, in 2018 many nut crop growers were faced with intensifying their pest management programs for NOW following the alarming harvest damage levels of 2017. Increased sanitation efforts and adoption of new techniques (e.g., mating disruption, mass trapping) all played a role in this, and should continue to be relied upon heavily for NOW damage reduction, as they are unlikely to result in development of resistant pest populations at any measurable rate (if at all). We also saw an

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overall increase in insecticide applications for NOW in 2018, a perfectly understandable response to avoid a repeat of 2017 damage numbers. However, it remains important to be cautious of over-reliance on insecticides to manage NOW for a number of reasons. Reductions in pyrethroid efficacy indicate that NOW populations may be developing resistance to this chemistry. Organophosphates (OP) continue to fall out of favor, and their use is becoming increasingly difficult due to regulation. There are limited effective and unique chemistries available for NOW management (i.e., methoxyfenozide and chlorantraniliprole have become the primary chosen alternatives to pyrethroids and OPs), with little development of new chemistries underway.

Mitigate Pesticide Resistance

What can I do as a grower or pest management consultant to mitigate pesticide resistance development in navel orangeworm? Employ a thoughtful and knowledge-based integrated pest management program. Gather data that can help with decision support (i.e., need to treat), monitor pest population densities and cycles, consider orchard history, and incorporate non-chemical management approaches as much as possible. Insecticides certainly have their place in an integrated pest management program for NOW. Employ this management tactic judiciously. Know pesticide modes of action so that you can rotate chemistries if multiple treatments in a single season are needed. Rotating modes of action applies different selection pressures, and can help mitigate/slow pesticide resistance to particular chemistries.

Make a plan with your pest management consultant early in the year to determine how you will approach your NOW insecticide rotation strategy if multiple applications are needed. The Insecticide Resistance Action Committee updates the insecticide and acaricide mode of action table annually. Download a pdf here https://www.irac-online.org/documents/moa-classification/?ext=pdf. There is also an IRAC MoA (mode of action) mobile app with this information. The treatment tables in the University of California IPM Program online Pest Management Guidelines for navel orangeworm in various crops also show mode of action numbers for the pesticides listed. Remember that a "new product" or "new material" does not necessarily contain a novel chemistry and unique or new mode of action. Refer to insecticide labels, as those for agricultural use are required to contain the mode of action number for each active ingredient(s).

Happy planning and best wishes for a healthy and prosperous new year!

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