

# WEST COAST NUT

July 2017 Issue

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### Dust Control

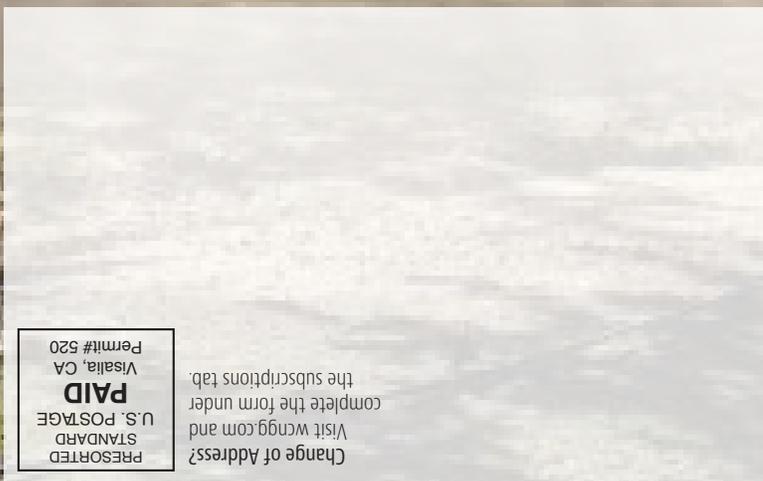
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## In This Issue:

IPM Updates and Summer Considerations

Pistachio Nut Phenology

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# WEST COAST NUT

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### FEATURED ARTICLE

Good, thorough dust control has many benefits from reducing topsoil erosion, to mite control, to safety. Dust control is not just at harvest. It goes through the entire season, according to David Doll, University of California Cooperative Extension (UCCE) farm advisor for Merced County.

*See the full story on page 20*



Photo courtesy: Kathy Coatney



**Photo 1:** Adult frosted scale on walnut.  
*Photo credit: E.J. Symmes*

# IPM UPDATES AND SUMMER CONSIDERATIONS



By **Emily J. Symmes**  
*Sacramento Valley Area IPM Advisor  
University of California Cooperative  
Extension and Statewide IPM Program*

## Walnuts

The first codling moth flight this year (1A and 1B peaks) were reported to be quite high in many orchards, and applications targeting one or both of these flight peaks were common. Keep in mind that a good codling moth program can help minimize early-season navel orangeworm (NOW) infestation, thus limiting in-house build-up of NOW and reducing the numbers that will be looking to lay eggs on walnuts at husk split. Keep a close eye on trap counts going into the second and third flights, numbers of codling moth-infested dropped nuts, and canopy strikes

in the orchard. All of this information will help to make decisions on the need to treat codling moth for the remainder of the season.

Although wet winters can cause increased overwintering mortality of navel orangeworm, significant survival was apparent in walnut mummies examined this spring (March 2017). Bear in mind neighboring orchards may not have been able to execute their normal NOW sanitation programs last winter either, and these may be a source of immigrating populations as the season progresses (in addition to any carry-over populations that may have built up within the orchard). Prior to husk split, NOW will go back into mummies and into this-season's damaged nuts (codling moth-infested and blighted nuts). With all of the spring rainfall,

there are plenty of blighted nuts in many orchards to serve as early-season NOW development sites. Couple this with a high codling moth year, and the potential for NOW damage in walnuts remains high, in spite of any help with overwintering mortality that the winter rains provided. Placing traps in the orchard (pheromone, kairomone, and/or egg traps) is worth the time invested and can give you a sense of NOW activity and relative abundance.

Significant populations of frosted scale were evident in a number of orchards this year (**Photo 1**). It is not entirely clear why this pest, which it typically present only at low levels, has increased so dramatically in recent years. Research is underway examining this phenomenon, as well as best practices and timings for effective popula-



**Photo 2:** Frosted scale crawlers and adults on walnut. *Photo credit: E.J. Symmes*

tion reduction. Frosted scale produces honeydew when feeding (walnut scale does not). This favors growth of sooty mold, which increases the chances for sunburn damage, so keep an eye on this if the orchard was heavily impacted by frosted scale this spring. Frequent rains throughout winter and early spring limited the ability for many growers to get into the orchards to apply dormant/delayed-dormant scale treatments, necessitating applications targeting the spring crawler stage. Crawler emergence was observed late in the second week of May 2017 (compared to the first week of May 2015 and last week of April 2016), with peak crawler activity noted approximately two weeks later (**Photo 2**). This highlights the importance of monitoring the populations, rather than applying treatments based on “typical” calendar timing (which would have been too early this year to target peak crawler activity). Our research trials this year are examining efficacy of different treatment materials and timings specifically for frosted scale (walnut scale has been the focus of research in recent years). If treatments were applied for frosted

scale (either dormant/delayed-dormant or crawler), monitor the populations during the next dormant period looking for the overwintering nymphs (**Photo 3**, page 6). Frosted scale has only one generation per year, so the effects of this season’s spray program will be best observed at this time, and as next spring’s populations begin to develop.

Walnut husk fly (WHF) trap catches began the week of June 5 in the Sacramento Valley. Remember that WHF treatment decisions should be made on a site-specific basis and take the time to hang traps high in the tree canopy—this will provide better accuracy in detecting activity. If trapping indicates the presence of treatable WHF populations, all insecticides should be applied with a bait (i.e., molasses, Nu-Lure®, Monterey Insect Bait®). The exception is GF-120 which contains its own bait. For low-to-moderate-populations, coverage is not critical and low-volume and/or partial coverage applications (e.g., alternate row) of bait with insecticide can be

*Continued on Page 6*

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Continued from Page 5

effective. However, in high population orchards with extensive previous damage, high-volume, full coverage, and/or multiple applications of bait with insecticide may be necessary to achieve adequate control. If you miss a timing and are observing fresh stings, full cover neonicotinoids that have some ovicidal (egg-killing) activity mixed with an adulticide will provide partial control of eggs if applied immediately after stings are observed. Generally, a short-residual insecticide-plus-attractant will kill walnut husk fly for 10 days. With the egg development period added to this time, there is about 3 weeks of protection after an application (GF-120 treatments often must be applied more frequently).

Spider mite activity in walnuts remains low as I write this but will likely begin to pick up soon with sustained warmer temperatures. Prophylactic May applications of abamectin, while still favored by many almond producers, have shown to be less effective and

economically-viable in most walnut orchard situations. Treatments should be based on thresholds of spider mites and their natural enemies (particularly predator mites and sixspotted thrips). In general, the goal is to manage the ratio of predators-to-spider mites (not

just spider mite numbers alone) to achieve a balance in which predators can provide free control services. Also consider the impacts of other pesticides on spider mite and predator populations (organophosphates and pyrethroids are highly detrimental to spider



**Photo 3.** Overwintering frosted scale nymphs.  
Photo credit: University of California Statewide IPM Program/Jack Kelly Clark

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mite natural enemies and often result in spider mite flare-ups). More information on treatment thresholds for mites and predators in walnuts is available at: [ipm.ucanr.edu/PMG/r881400111.html](http://ipm.ucanr.edu/PMG/r881400111.html) and a detailed article on monitoring and management of spider mites in walnuts was published in the May 2017 issue of West Coast Nut. Best practices for getting the most out of your miticide in walnuts include choosing the right material for the job (i.e., those softer on predators if they are present, desired residual activity and pre-harvest intervals, quick and effective knock-down if needed, etc.) and obtaining optimal coverage (high volume, slow speed).

## Almonds

As mentioned for walnuts, wet winters can help in the fight against navel orangeworm but make sanitation efforts much more difficult to achieve. Wet weather can help but will provide the most benefit if almonds are on the orchard floor prior to the bulk of the rainfall. A greater number of orchards were not sanitized this past winter, either due to weather-related access issues, or the practice was considered unnecessary because of all the precipitation.

In these orchards, where many mummies remained in the tree canopy through spring, there is no shortage of viable mummies for early generations of NOW to oviposit on and develop in (Photo 4, page 8), leading to potential build-up of populations as hullsplit approaches. Remember that even if your orchard is fairly “clean,” NOW can migrate in from nearby orchards (up to a quarter mile). Continue monitoring populations and crop phenology to time any hullsplit applications. Along with sanitation (whenever possible) and insecticide applications, early, rapid harvest and timely removal of nuts from the orchard are the other keys necessary to minimize NOW damage.

*Continued on Page 8*

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Continued from Page 7

Maximize your spray efficacy by using higher volume applications (150-200 gpa) and maintaining slow ground speeds (do not exceed 2 mph).

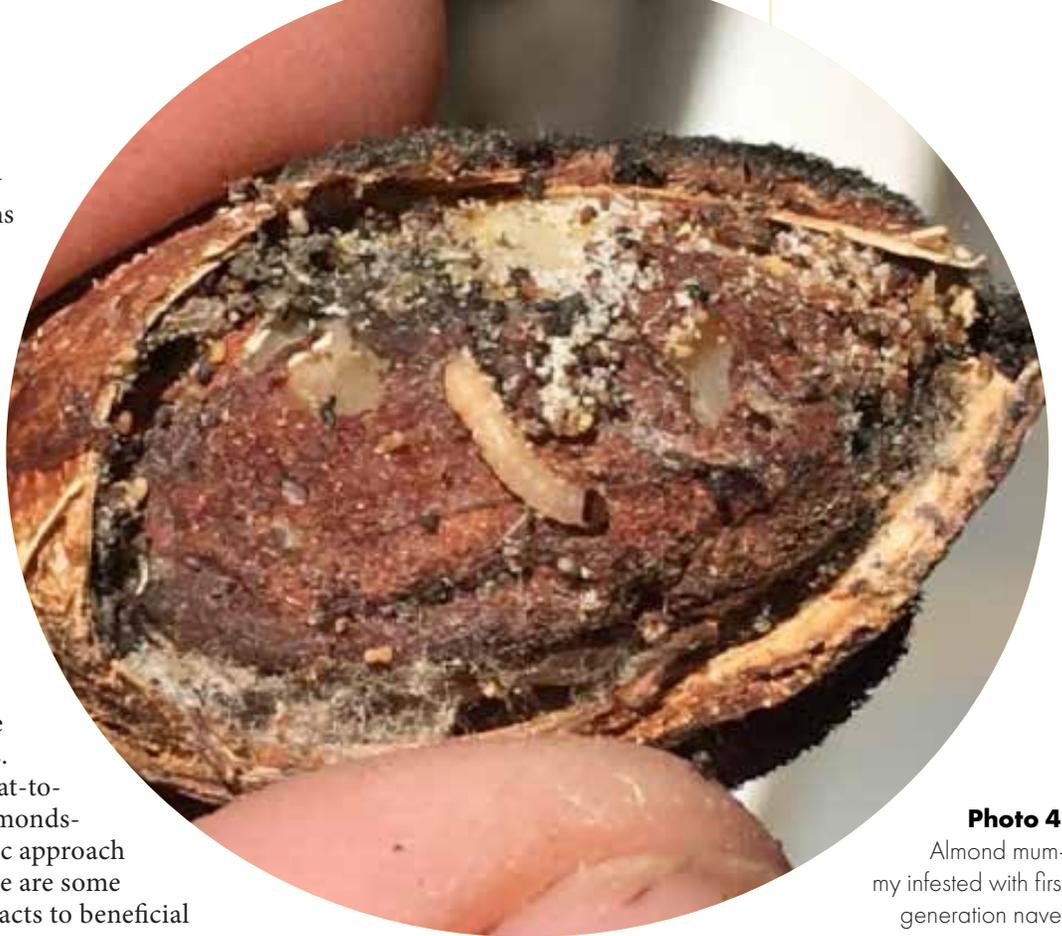
Many almond growers in the state have adopted the prophylactic approach to spider mite management (early abamectin sprays, typically in May). If you treated your almond orchard in May this year with abamectin, UCCE Farm Advisor Franz Niederholzer wrote a recent blog post on how to follow up with the rest of the season's mite management ([sacvalleyorchards.com/almonds/insects-mites/what-to-if-you-applied-abamectin-to-almonds-in-may/](http://sacvalleyorchards.com/almonds/insects-mites/what-to-if-you-applied-abamectin-to-almonds-in-may/)). While the prophylactic approach can be an effective method, there are some drawbacks, particularly the impacts to beneficial predators.

Early season destruction of natural enemies and/or their food sources will likely mean that they will not be present, or not present in enough numbers at the right time, to provide measurable impacts later in the season when we need them to help fight flare-ups.

An alternative is to use a threshold and conservation biological-control based method of determining treatment timing(s) and materials selection. Admittedly, predators alone may not be sufficient to keep spider mites below economically-damaging levels, and miticides may be needed based on your site-specific monitoring when thresholds are reached. Know which predators are present and choose materials accordingly. Using a miticide that is gentle on beneficials helps keep them around to suppress spider mites missed by the pesticide. This link contains a table of almond pesticides and their impact on beneficials, including predatory mites and sixspotted thrips: [ipm.ucanr.edu/PMG/r3900311.html](http://ipm.ucanr.edu/PMG/r3900311.html).

Employ best practices for getting the most out of your threshold-based miticide application: choose the right material for the job (i.e., those softer on predators if they are present, desired residual activity and pre-harvest intervals, quick and effective knock-down if needed, etc.), obtain optimal coverage (high volume, slow speed), and apply with oil to maximize efficacy. A detailed article using this approach to monitoring and management of spider mites in almonds was published in the May 2017 issue of West Coast Nut.

**Comments about this article?** We want to hear from you. Feel free to email us at [article@jcsmarketinginc.com](mailto:article@jcsmarketinginc.com)



**Photo 4:**

Almond mummy infested with first generation novel orangeworm in spring.  
Photo credit: E. J. Symmes

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Cooper Out West, Bob Molloy,  
Linden, CA (December, 2016)

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Peter Vink, Vink Bros,  
Tracy, CA (January, 2016)



# Almond Pest ID Workshops: Provide Sustainability Tools for Almond Growers

By **Marni Katz**,  
Contributing Writer

**A**lmond Board of California's California Almond Sustainability Program (CASP) held a series of three pest identification workshops throughout the Central Valley designed to encourage monitoring, identification and sustainable management of regional pests.

In Ripon, California, fourth-generation grower Matt Visser, who farms 60 acres of almonds with his brother Patrick at Visser Family Farms, welcomed nearly two dozen growers, farm managers and others into his orchard to hear the latest. Jhalendra Rijal, IPM Farm Advisor for Stanislaus County, noted that stink bugs are also becoming an increasing concern in the area.

"While it is not common, we are finding stink bugs in ag areas for the first time," he said.



Rijal largely focused on monitoring and control strategies for spider mites, ants and navel orangeworm.

Monitoring during the summer through harvest is essential for spider mite control to preserve beneficials and maintain balance for natural predation.

Monitoring should focus on areas of the orchard that are more prone to mites, such as edges, drier areas and weaker trees.

The University of California IPM program recommends a presence/absence sampling method based on the percent of leaves sampled. Check 75





leaves in the orchard using a hand lens, inspecting both sides of the leaves for eggs or live mites and the presence of predators.

If up to 50 percent of leaves sampled have mites or eggs present but there are also predators, such as predator mites, thrips or beetles, it is OK to wait to treat. If no predators are present, but more than 30 percent of leaves have mites it's best to treat.

Rijal said it is important to rotate among classes of chemistry and use each class only once per season to slow the development of resistance.

"We have about a dozen effective miticides so we have plenty to choose from," he said.

Abamectin is good for early season control because its translaminar activity works well on younger leaves. For contact miticides, good spray coverage is important to ensure contact with pests.

Rijal also helped growers identify pest ants in almonds, including

southern fire ants, pavement ants and the less common thief ants, and distinguish them from native gray ants. The main distinguishing characteristic of the pest ant species is two humps between the abdomen and the thorax. Native gray ants have only one hump. Fire ants have an amber colored head and thorax and black abdomen.

Distinct differences can also be seen in ant mounds to help determine if they are a pest species in almonds. Pest species typically have multiple mound openings.

While there are few monitoring tools for ants, pest identification should be determined at five different locations in the orchard (examining about 1,000 square feet per location.) The number of mounds and level of nut damage should help determine if treatment is necessary. Bait treatments are the best option to target the brood and queen that often remain underground. Early treatment with insect growth regulators work well early in the season but take time to work and should be applied three to four weeks before harvest. For later applications, faster acting contact insecticides work within about a week but must be timed around irrigation.

In addition, growers can help reduce damage to almonds by minimizing the amount of time harvested nuts lay on the ground.

"Even reducing by 1 to 2 days can really minimize the chance of ant damage to the nuts," Rijal said.

Navel orangeworm remains one of the biggest insect pests in almonds, though pressures vary from orchard to orchard. Rijal said mating disruption, while still new, is likely to be the next frontier in managing navel orangeworm (NOW). Winter sanitation, howev-

er, to prevent NOW larvae from overwintering inside mummy nuts, remains an essential first step in control.

Mating disruption works by confusing male moths as they emerge looking to reproduce. The first generation emerges from April to May, looking to lay eggs in mummies, and the second generation emerges in late June and July to lay eggs in split nuts.

Egg traps in spring are an important monitoring tool for navel orangeworm. By checking weekly to determine biofix based on the presence of eggs, almond growers can time controls based on heat units after biofix. The UC no longer recommends once conventional May sprays and instead recommends hull split sprays based on 1,200 degree days after biofix.

"It's important to time it right, because if you don't time sprays based on degree days, you could miss them altogether," Rijal said.

Rijal said newly available mating disruption puffers and adult lures show promise for commercial management of NOW. Researchers are still working to determine how best to relate adult pheromone lures to management.

"We are doing that work now in almonds to provide an idea about how to treat," he said. "But mating disruption is effective for NOW, although it's relatively new and expensive."

He said an integrated program that includes winter sanitation, mating disruption and insecticides at hull split, as needed, are likely to become the industry norm.

**"My feeling is that this technique will eventually become a standard practice used by growers in California."**

Mating disruption works to confuse males and prevent them from reproducing with the female. The techniques have been used successfully in pears and



**Left (cover photo):** Cliff Ohmart of SureHarvest guided almond growers through the California Almond Sustainability Program.

**Left:** UC IPM Advisor Jhalendra Rijal helps growers identify and manage key pests.

*Continued on Page 12*



**Left:**

Ripon almond grower Matt Visser shares information about his 60-acre almond orchard.

**Right:**

UC IPM Advisor Jhalendra Rijal helps growers identify and manage key pests.

# Almond Pest ID Workshops

*Continued from Page 11*

other crops for years, but it is a newly developed concept in almonds.

Rijal recommends installing one to two puffers per acre in spring, targeting the top third of the tree. The success of

mating disruption can be impacted by topography—the more uniform, the more effective. Wind direction is also a

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factor. With high pest pressures, puffers can be used in conjunction with insecticides, particularly on border areas, to keep populations down.

The CASP Pest ID workshops provided practical tips for integrating sustainable pest identification and management practices in the orchard and also explained sustainability tools available to almond growers in California.

Almond Board of California's Jenny Nicolau noted that CASP helps provide collective information about how almonds are farmed sustainably in California to meet the growing demand for such information from food manufacturers, retailers and consumers of California Almonds.

Cliff Ohmart with SureHarvest, which has worked since 2009 with the Almond Board to develop its sustainability program, guided growers through the process of establishing an online CASP account and shared some of the added value tools available to growers who participate in the program. He noted that the program is voluntary and individual data is secure and confidential.

Online tools like the nitrogen calculator help growers manage inputs and can

convert required orchard profile information into a Nitrogen Management Plan report required by the Irrigated Lands Regulatory Program. The irrigation calculator is a popular tool for those who haven't invested in complex irrigation monitoring and reporting systems. It uses the latest UC research and recommends the amount and timing of water to be applied based on local evapotranspiration (ET) data pulled from the nearest CIMIS station.

"We have more than 1,000 almond

growers using the CASP platform, now, and it is quite user friendly," Ohmart said. "It's designed with all the information you need to manage in your orchard in an easy way. It's all there in one spot so you can come back to it year after year."

For more information on the California Almond Sustainability Program visit [www.almonds.com/growers/sustainability](http://www.almonds.com/growers/sustainability).

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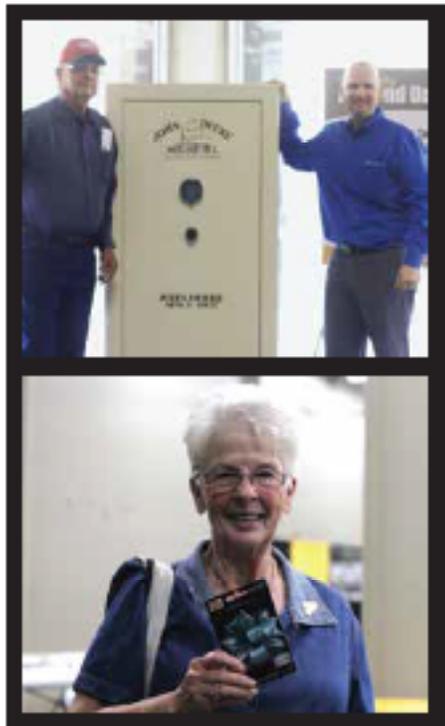
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# PISTACHIO NUT

## PHENOLOGY: CALIFORNIA STUDIES ADDRESS CROP DEVELOPMENT AS A FUNCTION OF HEAT UNIT ACCUMULATION

By **Elizabeth Fichtner**, UCANR Advisor, Tulare and Kings Cos;  
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California pistachio growers have likely noticed the influence of the cool 2017 spring on crop development. This observation illustrates the

limitations of modeling anticipated crop development based on calendar date. Nut development trends will also vary based on geographic area or local

microclimates in which pistachios are planted, and are subject to influence from large-scale trends such as global climate change. As a consequence, scientists utilize alternate methods to define developmental growth stages as a function of heat unit accumulation. This allows for comparisons of crop development between cultivars across sites, years, and even decades. Thermal unit modeling may also be used to facilitate pest control, irrigation scheduling, and prediction of harvest time.

Some variability may exist between various model types; however, the unifying concept is that they strive to correlate milestones of plant development with accumulated heat. The time of fruit set is a biofix at which thermal unit (TU) accumulation is equal to zero. Heat unit measurements are determined by tracking hourly data using data loggers installed in the field. Thermal units are calculated by taking a daily average temperature and subtracting the base temperature threshold. In pistachio models, 7 °C is utilized to indicate the base temperature beneath which growth does not occur. The work of Allan et al. 2014, focused on relating six variables (nut length, width, height, volume, penetrability, embryo size) to



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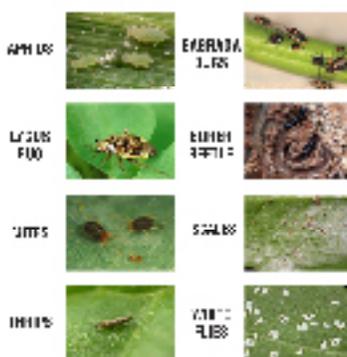
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accumulated heat in each of 5 cultivars of pistachio.

Pistachio nut development is defined in three overlapping stages. Stage 1 is defined by the growth of the pericarp to its final size; stage 2 is defined by the hardening of the endocarp (ie. shell); stage 3 is characterized by growth of the embryo (Figure 1). In pistachio, Stages 1 and 2 and Stages 2 and 3 have overlapping curves, indicating that portions of these developmental phases occur simultaneously (Allan et al 2014). Stages 1 and 3, however, are mutually exclusive of each other such that the pericarp is fully formed before embryo development is initiated (Figure 1). The final volume of the pericarp is achieved after accumulation of approximately 670 TU (Figure 2). In 2016, this would

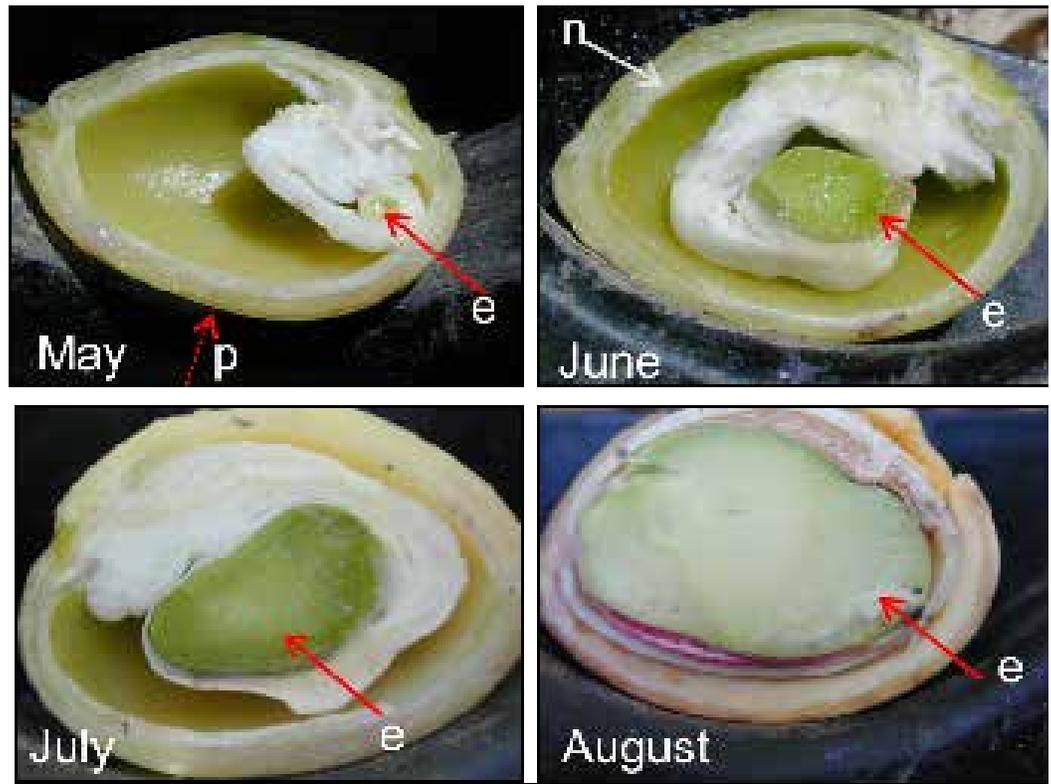


Figure 1. Embryo (e) development does not begin until the pericarp (p) has reached its maximum size. Although endocarp (n) hardening is initiated prior to embryo development these two processes do occur simultaneously (Allan et al., 2014).



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development of a model that predicts the number of heat units to complete all three growth stages in the Kerman, Lost Hills, Golden Hills, Kaleghouchi and Pete1 cultivars and to develop the software to convert calendar dates to thermal units based on historical temperature records and two weeks weather forecast. Growers will be able to predict optimal harvest date conveniently by logging into our website and inputting the location, cultivar and blooming date.

**Select References**

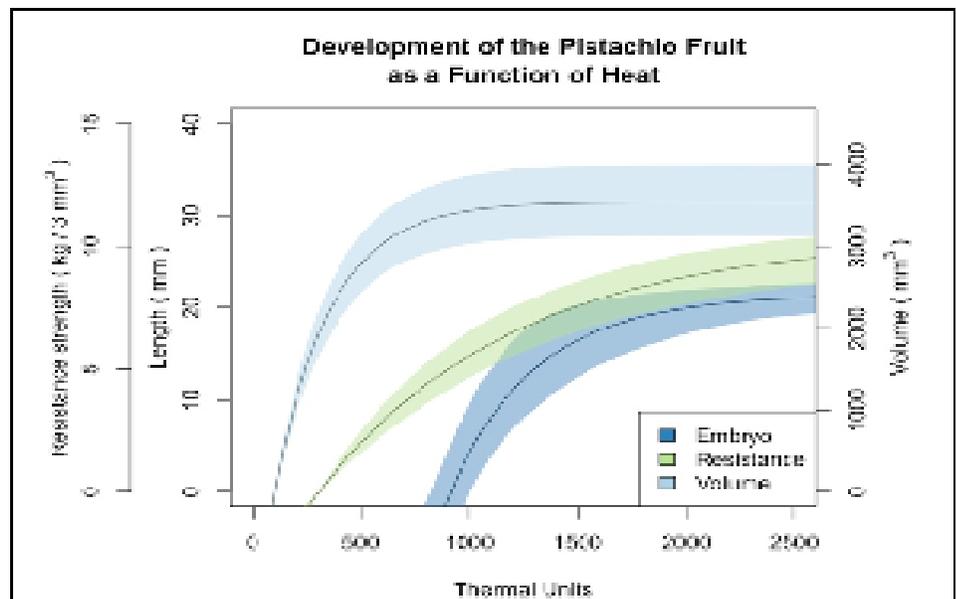
Allan, C.A., Ferguson, L., Bourgeois, G., Cristosto, C., Thur, K., Ramacho, F.A., Jiminez, F.J., Saracoglu, T. Pistachio nut phenology and development in five cultivars as a function of heat units. Report to the California Pistachio Research Board. [www.calpistachioresearch.org](http://www.calpistachioresearch.org).

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have occurred around the beginning of June in the southern San Joaquin Valley (SSJV). Stage 2, the process of shell hardening, requires approximately 2423 TU. Embryo growth (Stage 3) is initiated after around 900-1000 TU accumulated (mid-June in 2016; SSJV) and maximum embryo length requires approximately 1880 TU (mid-August in 2016; SSJV). Stage 2 requires more heat units for completion than Stage 3. The variability of these mean values is largely contributed by differences in cultivars.

This year, we are building the pistachio nut growth models and strengthening the prediction ability of the model by continuing weekly fruit sampling from early fruit set to harvest. In addition to current equation of TU accumulation, we are also improving the method of calculating heat units using Asymmetric Curvilinear Growth Degree Hours (GDH) Model, as well as to predict the base, optimum and critical temperatures for pistachio growth in California. Our final objective is



**Figure 2:** Summary of the three growth stages of a pistachio fruit using a non-linear model. The data are a summary of five cultivars, at six sites over two seasons. The growth curves for the stage 1 pistachio growth (volume), light blue curve, was generated using data from length, width, and height data from 2013 and 2014 and applying it to the equation for the volume of an ellipsoid. The curve for stage 2 (penetrometer), green curve, was derived from the recorded hardness of lbs/3mm² over the 2013 and 2014 growing seasons. Stage 3, kernel growth, (embryo length), dark blue curve, was measured from detectable embryo presence through harvest for the 2013 and 2014 growing seasons. The shaded region shows the 95% credible interval.



# 6

## Steps to Effective Dust Control

By **Kathy Coatney**, Editor

Good, thorough dust control has many benefits from reducing topsoil erosion, to mite control, to safety. Dust control is not just at harvest. It goes through the entire season, according to David Doll, University of California Cooperative Extension (UCCE) farm advisor for Merced County.

“I think many people focus at harvest because of how much dust you throw out just through the harvesting process,” Doll said, but if good practices are employed earlier, it will also reduce dust at harvest, which is better for the trees. Franz Niederholzer, UCCE farm advisor for Colusa, Yuba, and Sutter Counties, said, dust control is an environmental, safety and even a pest control issue.

### 1 SAFETY

Dust is kind of like spray drift when it’s close to roadways, Niederholzer said.

“Nobody wants to be throwing dust out in the road and risking collisions out on the county roads and highways,” Niederholzer said, adding dusty orchard roads can also be a hazard to workers and impact visibility.

Doll agreed safety is another factor, and a good reason for dust control. Gabriele Ludwig, director of sustainability and environmental affairs for the Almond Board of California, said, as acreage has grown, the visibility is really



something to think about.

Growers should be thinking about who and what are around when they’re harvesting, Ludwig said. Also, be mindful of nearby roadways, neighbors, other crops with crews working, and consider what you as a grower can do to try and minimize dust, particularly in those situations, she added.

If harvesting near a busy road, consider placing traffic signs to warn motorists of harvest activities.

### 2 MAINTAINING ORCHARD ROADS

Maintaining orchard roads with water, oil and different salt solutions will help reduce dust, Doll said.

Scott Hunter, part of Hunter Farms in Livingston, California, does dust control on his orchard roads and there are several dust reducing agents available, he said.

“We use a product called Dust-Off, which is actually food grade. It’s a good product,” Hunter said.

Some growers are using magnesium chloride for dust control on orchard roads, Niederholzer said.

“Some materials are latchkey where there’s an applicator that comes and applies the product,” Niederholzer said, and others just use water.

“Dust control on roads is also part of a mite management program, and everybody wants to keep mites under control. So, keeping dust under control is double duty. Dusty trees tend to be where mites show up first,” Niederholzer said.

### 3 MITES

“The dust that we create in an orchard is just going to consolidate, it’s going to settle on the trees and eventually continue to build. And when a tree becomes dusty, it becomes stressed, and the stress brings in mites,” Doll said.

Mite damage has what Doll calls a hangover effect.

“It doesn’t necessarily impact this year’s crop as much as it can impact next year’s crop because you’re defoliating the trees and then the tree will release, and when it releases, it reduces the number of buds that will develop into fruit buds for the next year,” Doll said, adding dust control is one method for controlling mites.

### 4 ORCHARD FLOOR MANAGEMENT

Good dust control practices also help prevent problems with erosion, Doll said.

“I’ve been in more and more orchards where you’re seeing the berm that people plant the trees on has been eroded over time. And that erosion is usually due to the harvesting practices—the multiple times they’re sweeping, the multiple times they’re picking up in these orchards,” Doll said.

Reducing compaction is an important way to reduce dust. Doll advises growers to avoid driving

through the orchard when soils are wet to prevent ruts from forming. Ruts have to be graded prior to harvest, and grading creates more dust, he said.

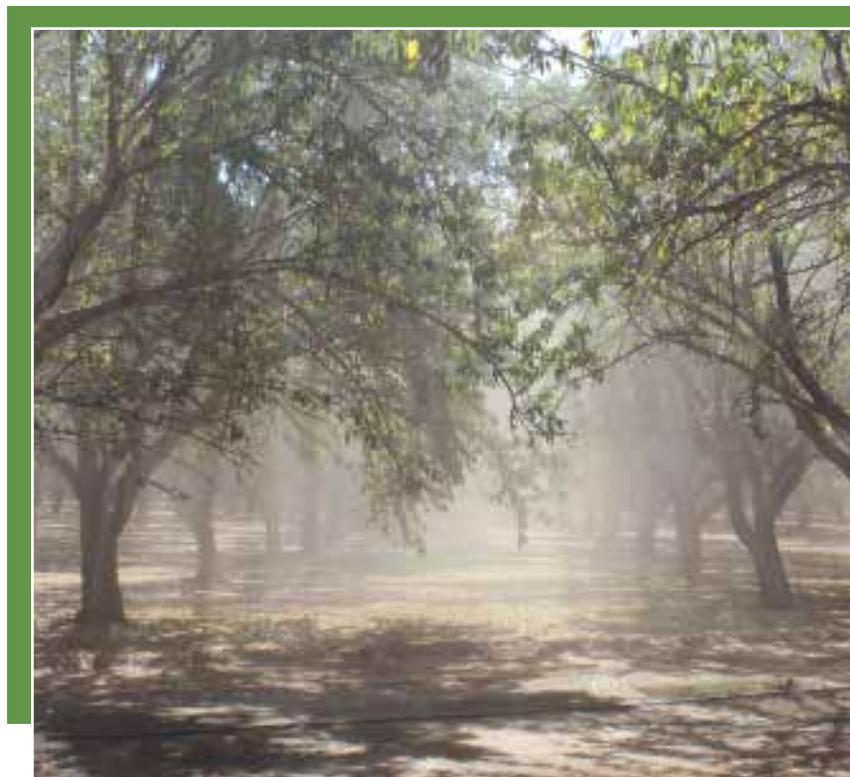
Cover crops can reduce compaction and dust. While cover cropping is not necessarily convenient with other practices, it does help reduce compaction and dust in the field, Doll said.

Driving on a bare orchard floor will kick up more dust than an orchard with a cover crop. But at harvest, cover crops can be a struggle and a challenge to manage, according to Doll.

### 5 EQUIPMENT CALIBRATION

Equipment calibration is a critical component to dust control, Doll said. Don’t set the heads any lower than necessary. Wire tines can be set as high as 0.5 inches off the ground and still do a good job sweeping. If they are set too low, the sweeping head will move an excess amount of dirt into the windrow and substantially increase dust from the pickup machine. Using wire tines on sweeper heads without rubber flaps will also help reduce dust.

*Continued on Page 22*



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“You don’t want to go too deep in harvesting,” Hunter said, adding when you’re sweeping, you don’t want to go too slow either.

Good orchard practices and having a good orchard floor is probably going to be the biggest thing that you can do to reduce the dust because it allows you to go through the field faster, Hunter said.

“It’s like you’re in a car. If you’re getting from point A to point B without traffic, you’re probably going to have less emissions than if you were sitting in traffic for an extra hour,” Hunter said.

“If you can go through the field at a good pace, and get a large percentage of the almonds without having to go back and slow down, and have to really sit there and turn the blower up all the way, and blow around

the berms, you’re able to go much faster, which would equate to much less dust,” Hunter said.

Hunter does about 50 percent of his harvesting at night. Harvesting at night means there’s generally less wind to move the dirt, and it settles back down, he said.

Ludwig also suggested using the trees to capture some of the dust by blowing into the orchard instead of out.

Plan passes and travel direction so that dust is directed away from roads, homes and sensitive locations like schools, hospitals and day-care centers, Ludwig said.

There is new equipment available that is more effective for managing dust at harvest, Doll said.

Ludwig agreed investing in new equipment that’s been engineered to reduce dust is another way to reduce dust. There are two ways to do this, Ludwig continued. One way is to actually go out and buy reduced dust equipment, or two, use the EQUIP program through United States Department of Agriculture (USDA)/National Resources Conservation Service (NRCS).

Eligible equipment is limited to specific harvesters from demonstration trials at Texas A&M that were found to reduce particulate matter by at least 30 percent.

This isn’t a cost share program for directly buying equipment, Ludwig said. Instead, qualified growers will receive \$10.52 per acre for up to three years for use of qualified harvesters.

“Part of the reason they did that is there is quite a bit of custom harvesting

**“It helps us, too, to schedule people. There’s a lot of benefits to doing it at night,” Hunter said**

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going on. So, this allows a grower who's not doing his or her own harvesting to choose to work with a custom harvester who has low dust equipment, and then get some funding from NRCS," Ludwig said, adding it also encourages custom harvesters to invest in the reduced dust equipment.

Applications are accepted year-round through your local NRCS office. Growers considering this for the current year's harvest should contact their local office as soon as possible.

For more information on dust control, go to [www.almonds.com](http://www.almonds.com) click on grower, then harvest.

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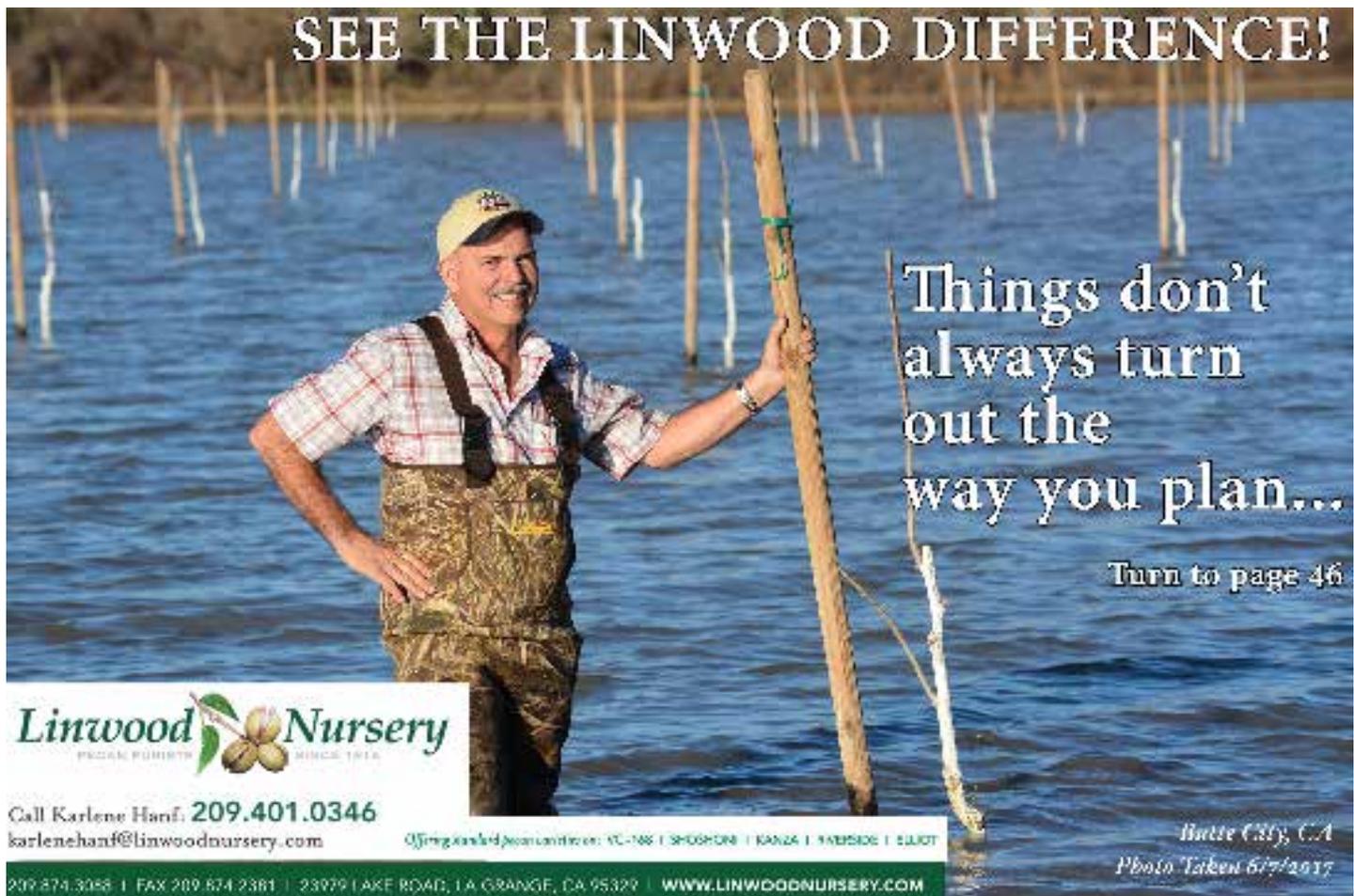
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# Micropropagation of Hazelnut: THE OPPORTUNITIES, CHALLENGES AND LIMITATIONS

By **Kathy Coatney**, Editor

**E**astern filbert blight (EFB) is a fungus that has infected hazelnut orchards throughout the Pacific Northwest. EFB causes severe cankering and branch dieback. The only way to control the disease is by pruning back infected limbs. For severely infected trees, removal may be the best option, especially with susceptible varieties like Ennis or Daviana, and replace them with blight-resistant varieties.

Ron Chapin is a hazelnut grower, and he works with his two sons and three nephews. The family run farm has a total of six families involved in the operation in Gervais, Oregon.

Chapin said they have roughly 250 acres of the Ennis variety that are rapidly dying of the disease.

“They’re very hard to look at these days to tell you the truth. They still

make us money, but they’re going to be out of production in the next five years totally,” Chapin said.

There are another 50 acres of mature Lewis, which are holding their own with the blight. We also have 60 acres of Jefferson, a blight-resistant variety, which are just coming into good production. Another 280 acres of Jefferson are third leaf or less, Chapin said.

During this period where they are waiting for the new blight-resistant varieties to come into production, Chapin is counting pretty heavily on the nursery end of their business to actually provide income until the acreage gets on track.

## Micropropagation

Chapin has been using micropropagation where tissue is taken from a plant and grown in a laboratory to produce plantlets that are genetically identical to the parent.

“We’ve been developing microprop-



**Top:** Attendees listening to Ron Chapin demonstrate, Hazelnut Summer Tour

**Left:** Plants that have been micropropagated by Ron Chapin in Gervais, Oregon.

Photo courtesy: Kathy Coatney

agation here for a number of years because it's a way of mass producing our plants," Chapin said.

"I've worked over the years with grafting, and with layering, and all of the various other methods with varying degrees of success," Chapin said. "There's no other method where we can get the numbers that you can with the micropropagation."

"It's (micropropagation) an amazing process. You can get through about eight to nine cycles a year, and multiply by a factor of three or four each time, and you can get one plant to several thousand by the end of the year," Chapin said, adding it's a way of very rapidly getting your numbers up.

"I'm really a hazelnut grower far more than a micropropagator," Chapin said, "But we needed access to the new varieties, so that was my main interest in doing micropropagation."

Initially, the micropropagation started with a few thousand plants a year. Today, it's grown to about 150,000 plants a year, Chapin said.

"Every year we use about 40 percent of the 150,000 we produce annually," Chapin said. "The other 60 percent is sold to other nurserymen to sell to the industry, plus we also do a major business in bare-root tie-offs."

### Potted Plants



**"We're going to be looking at \$30 or so for that plant," Chapin said.**

Chapin experimented growing the Jefferson variety in 15 gallon pots. "I just threw them in pots, and I found that in two years I could grow a pretty nice looking tree in a 15 gallon pot," he said.

"We planted out small numbers with it, and finally last year, we planted out 40 acres," Chapin said. He was very impressed with the trees.

"I think I truly can take two years off the time to putting the orchard into production by that method," Chapin said.

Initially Chapin thought it would put them three years ahead by using the potted trees, but he found they lost a year due to the transplant shock.

While Chapin has seen good results, he doesn't think it's practical to ship in 15 gallon pots by truck. It took several loads just to plant one acre of trees this year, Chapin said.

"But it's fun to look at, and I need to understand it, to understand the process to tell other people how to do it," Chapin said, plus it's also expensive.



**Above:** Plant samples

**Left:** Ron Chapin, a hazelnut grower speaks about micropropagation of hazelnut trees.

**Photos courtesy:** Kathy Coatney

This is staggering cost for the grower, but after taking into account ground costs for two years, Chapin thinks it might be worth it. It's an expensive process, but there could be ways to do it cheaper as an industry, Chapin said.

"We've got a good industry that innovates a lot," Chapin said.

### Pitfalls to Micropropagation

There are definitely pitfalls to micropropagation, Chapin said.

"Most of us that have worked with micropropagated stuff have had some real colossal disasters. There's been times that we've just killed off really major groups of plants, and then there's a lot of times, too, you get some really just beautiful stuff out. But it's not for everybody," Chapin said.

"Once a plant comes out of micropropagation, it goes into our rooting facility, and we take it through a process. It's kind of like detoxing somebody that's been on drugs. Every day we stress it just a little harder. We lower the

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humidity a little bit. We increase the light a little bit. We try to get it actively growing and putting on fresh leaves, and then we take it clear out of there,” Chapin said.

The plants are grown for a short period of time in a greenhouse to put on more growth and get them climatized to a little harder conditions before they go to another nurseryman’s greenhouse, Chapin said.

“There’s a lot of things that happen in micropropagation,” Chapin continued.

Some plants come out of micropropagation that are growing well while others may come out yellow and do not do well, Chapin said.

Some will go into dormancy. There’s nothing that can be done to make it grow except maybe a hormone shot to make it wake up, and hopefully put another eight to 12 inches of growth on it, Chapin said.

When plants are micropropagated and come out of the micropropagation, they are used to 16 hour days, Chapin said.

**“You bring them out in the springtime, in March or something like that, they see about a 12 hour day and that just triggers them to go to sleep,” Chapin said.**

“With micropropagated plants, they have a lot of extra vigor—it’s something we call juvenility,” Chapin said, a term that no one in the industry likes because it’s kind of a catchall.

“Juvenility would be like a newly sprouted plant, and you kind of revive that when you run it through the micropropagation process—you do the rapid generations, you do the high

hormone levels, and you get back to a plant that really likes to grow extremely vigorously,” Chapin said.

“The trick to growing them is you get them growing hard, and you keep them growing hard, and then you get a great plant,” Chapin said.

“But if you let them stagger, they don’t have the reserves and everything that a normal plant does, and you can get them in kind of this stupor where they don’t know which way is up, and it’s hard to break them out of it,” Chapin said.

There are a lot of things that can go wrong, Chapin said. “Anytime that you’re growing in a greenhouse, there’s a lot of ways to kill a plant and do it quick,” Chapin said.

Micropropagation is not for the faint of heart, Chapin said.

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# AB 1732: Single-User Restrooms and the Impact on Production Agriculture

By **Amy Wolf, MPPA, CFRE**  
President and CEO, AgSafe

In 2016, the legislature and governor brought to fruition Assembly Bill (AB) 1732: Single-User Restrooms. The law changed the California Health and Safety Code Section 118600 and took effect on March 1, 2017. At its core, the law requires all single-user toilet facilities in any business establishment, place of public accommodation, or state or local government agency be identified as all-gender toilet facilities by signage that complies with Title 24 of the California Code of Regulations, and designated for use by no more than one occupant at a time or for a family assisted use. The law is fairly straightforward but its implementation for production agriculture is not nearly as simple.

## Impact on Production Agriculture

The change to the law includes the term “single-user toilet facility” which is a critical element for production agriculture. As of May 6, 2017, the phrase has been defined as one water closet (or flush

toilet) and one urinal with a locking mechanism controlled by the user. According to the Division of Occupational Safety and Health (Cal/OSHA), chemical/non-flush toilets are not included in the “single-user toilet facility” definition. As such, portable restrooms commonly used in production agriculture are exempt from the law.

That being the case, the number of gender-specific portable restrooms available in the field is still dictated under the requirements of the California Code of Regulations, Title 8, Section 3457 – Field Sanitation. The standard specifically states the following:

- Separate toilet facilities for each sex shall be provided for each twenty (20) employees or fraction thereof.
- One hand-washing facility shall be provided for each twenty (20) employees or fraction thereof.

- Where there are less than five employees, separate toilet rooms for each sex are not required provided toilet rooms can be locked from the inside and contain at least one water closet.
- Urinals may be installed instead of water closets in toilet rooms to be used only by men provided that the number of water closets shall not be less than two-thirds the minimum number of toilet facilities.

Exception: An employer may provide transportation to toilet and hand-washing facilities, as an alternative means of compliance if:

1. Employees perform field work for a period of less than two (2) hours (including transportation time to and from the field),
2. Fewer than five (5) employees in any agricultural establishment are

engaged in hand-labor operations on any given day, or

- 3. Employees are not engaged in hand-labor operations.

It is important to remember that while chemical/non-flush toilets are currently exempt, any single-user flush toilet in an office, shop or processing facility must be labeled gender-neutral. In addition, employers need to officially communicate with employees that if they self-identify with a gender different from the one on their official identification provided at the time of hire, they are encouraged to share their gender restroom preference. It is critical to remember that legally you cannot arbitrarily decide an individual's gender based on appearance, conjecture or any other information other than the individual self-identifying. You also can not require employees to self-identify. However, you can encourage self-identification, and once that information is provided, ensure the appropriate number of gender-specific portable restrooms are available in the field.

Lastly, the definition of "single-user toilet facility" has yet to be finalized. According to Cal/OSHA Chief Juliann Sum, the Fair Employment Housing Commission (FEHC) recently adopted regulations that define "single-user" as flush toilets as well as non-flush toilets. Her agency, as well as the FEHC, are currently reviewing their interpretations of both laws and are determining the final definition for the purposes of AB 1732. Chief Sum encourages employers to visit their website often as their AB 1732 Frequently Asked Questions document will be updated when or if the definition changes and chemical/non-flush toilets are no longer exempt: <http://www.dir.ca.gov/dosh/toilet-facilities-FAQ.html>.

For more information about AB 1732 or any worker safety, health, human resources, labor relations, or food safety issues, please visit [www.agsafe.org](http://www.agsafe.org), call us at (209) 526-4400 or via email at [safeinfo@agsafe.org](mailto:safeinfo@agsafe.org). AgSafe is a 501c3 nonprofit providing training, education, outreach and tools in the areas of safety, labor relations, food safety and human resources for the food and farming in-

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Under the new law, "single-user" has been defined as one water closet (or flush toilet) and one urinal with a locking mechanism controlled by the user.

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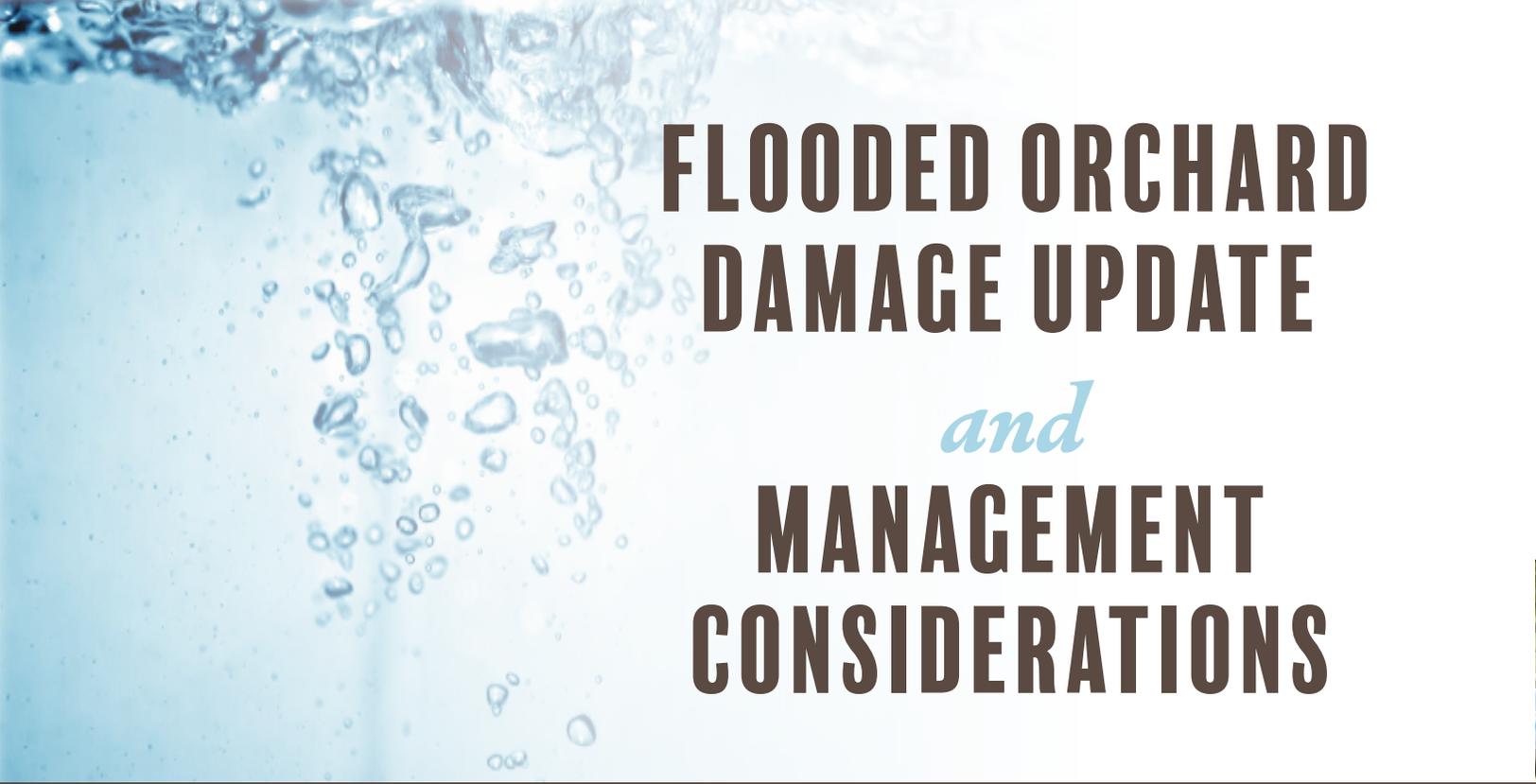
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# FLOODED ORCHARD DAMAGE UPDATE *and* MANAGEMENT CONSIDERATIONS

By **Janine Hasey**, UCCE Farm Advisor, Sutter/Yuba/Colusa Counties

Contributing Writers: Greg Browne, USDA Plant Pathologist, UC Davis Astrid Volder, Plant Sciences, UC Davis  
Bruce Lampinen, UCCE walnut Specialist, UC Davis

In 2017, high and fluctuating water flows, unprecedented for their duration, passed through the Sacramento and Feather Rivers. Orchards were hurt by these flows due to direct flooding, indirect flooding via under-levee seepage, and loss of land through river bank erosion. Many orchards had standing water from January through mid-May. In other orchards, ditches overflowed with nowhere to pump water out. Unlike previous years where floods occurred from levee breaks, such as 1986 and 1997, trees in 2017 had a much longer exposure to waterlogged conditions. This article details our observations on flooded orchard damage as of early June, research plans, management considerations, and an update on potential resources available for flood damaged orchards. For details on flooding damage generalities and past flood events, please see our article in the 2017 spring newsletter issue, which can be viewed in 3 parts at [www.sacvalleyorchards.com/walnuts](http://www.sacvalleyorchards.com/walnuts).

## Thoughts and Observations to Date

- By early June 2017, many flooded or waterlogged walnut and peach

orchards exhibited tree death or severe decline, but assessing losses should be delayed until the end of summer when the extent of damage will be clearer. There may also be effects seen next year and subsequent years.

- Since peach trees start blooming in late February and are very sensitive to wet conditions, the first peach tree damage was noticed in late March/early April. Walnut root activity begins in later spring, with waterlogging symptoms appearing in early May.
- Some peach and walnut trees had healthy crowns and roots in the top foot of soil even though they were leafing out late or had leafed out and died back. These symptoms were caused by water logging of deeper roots where soils were still saturated. In previous years, flooded trees usually had dead crown tissue and rot of shallow roots from waterlogging and/or Phytophthora.
- In early April, after a peach or-

chard on heavier soil bloomed and started to leaf out, shoots began to die (**Photo 1**). However, some buds (mainly on larger limbs) tried to push. Once the soil dried out, the trees began to recover (**Photo 2**). This illustrates why it is best to wait and leave trees through the summer to more fully evaluate potential recovery.

- Preliminary results show Phytophthora in several locations where we sampled surface water.
- In river bottoms where walnut trees were partially submerged for prolonged periods, we isolated Phytophthora species from bleeding root and aerial trunk cankers first noticed around mid-May (**Photos 3 & 4**).
- In a young Chandler orchard on RX1 rootstock, a third of the orchard had seepage from January to early May, whereby only the tops of the berms were not submerged. Flooded trees leafed out about a



**Photo 1:** Peach collapse from waterlogging taken April 5, 2017.

**Photo 2:** Same orchard on June 1, 2017 with new shoot growth after soil dried out.



**Photos 3 & 4:** Bleeding cankers associated with aerial *Phytophthora* on a river bottom walnut tree (taken on May 23, 2017).



**Photos 5 & 6:** Late leaf out of waterlogged Chandler on RX1 rootstock. The tree on the right appears to be recovering as soil dries out (taken on May 23, 2017).

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Continued from Page 30

month later than those not flooded. Some trees are struggling while others are continuing to leaf out and grow (Photos 5 & 6, page 31).

### Research Plans

Our approach is to study two potential problems of concern: 1) diseases caused by Phytophthora and 2) impact of water-logging on the root system.

- We know the “water mold” Phytophthora is found in surface water and infested soils. In May, we sampled water in the Sacramento and Feather Rivers, in swales of standing flood water in the Feather River bottoms (Photo 7), and in seepage water from under levees along both rivers for the presence of Phytophthora.
- We sampled several walnut trees with symptoms of aerial Phytophthora and examined the crown and upper roots on declining trees. We will monitor these sites through the summer and backhoe trees to examine root systems.
- We will study the impact of long-term flooding from continued-seepage on walnut root health and tree water status.

### Management Considerations

- Flooded orchards will likely respond to irrigation differently than normal, since root systems are compromised.
- In saturated soils, fine roots die, and depending on the extent of flooding, larger roots can die as well. It takes time for the root system to regain functionality and re-start new fine root production after flooding.
- If the water table level below the soil surface drops gradually, trees



**Photo 7:** Walnut in foreground collapsed in a swale of flood water that we sampled (background) in the river bottom (taken on May 23, 2017). All photos taken by Janine Hasey.

Continued on Page 34

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Continued from Page 32

may be able to continue to produce functional roots at increasingly deeper levels over time. Initial irrigation could be delayed for some time, as deeper roots may maintain water uptake.

- However, if the soil remains saturated at some level below the surface, the only functional roots may be at a very shallow depth and irrigation may have to be initiated earlier than normal. In this case, shorter but more frequent irrigations could help avoid further damage to roots in the upper zone.
- Carefully monitor both soil water levels and tree water status so that the trees can be gradually brought back to health. Soil based monitoring, using Watermark® soil moisture sensors installed at different depths, will let you know the level where the

soil is saturated as the water level drops, as well as the amount of water that is being moved up above this level of saturation by capillary rise. Apply enough water to bring the soil to field capacity to enable plant water uptake from the upper soil, but avoid prolonged periods of saturation that may damage roots. It is easy to saturate the soil, particularly when the water table is close, so irrigate judiciously, ideally using both soil moisture monitoring and plant pressure chamber data to aid in determining irrigation duration and frequency.

- Do not initiate irrigation until pressure chamber measurements show trees are 2-3 bars below the fully watered baseline (more dry) and only irrigate enough to bring the trees back up to about 0.5 to 1 bar below the baseline by applying short sets of irrigation.

- It is not a good idea to prune or fertilize trees after flooding. Pruning will reduce both carbohydrate reserves and leaf area, while fertilizer applications may mostly go to waste and delay or damage root production. The best approach would be to wait, and let the tree adjust to the altered environmental conditions while managing irrigation as described above to avoid further damage to the root system.

#### Potential Resources for Orchards Damaged by Flooding

We still don't know fully which programs are available and who will qualify for what programs. For more complete summaries of the resources available below and how to report tree damage visit:

<http://www.sacvalleyorchards.com/blog/almonds-blog/resources-for-flooded-orchards/>

### 1. Farm Service Agency (FSA)

Contact your local office for program details and deadlines to qualify. Note that to qualify for FSA programs, dead trees from 2017 flooding/seepage need to be left in orchards for loss assessments that will be conducted later this summer. All the programs available through the FSA can be accessed at

<https://www.fsa.usda.gov/>

### Tree Assistance Program (TAP)

The TAP provides financial assistance to eligible nursery and tree crop growers to rehabilitate or replant eligible trees or vines lost by natural disasters. To qualify, there must be more than 18 percent (15 percent + normal three percent) mortality loss in an orchard block. Final date to submit an application and supporting documentation is 90 days after the disaster event or the date when the loss is apparent.

[https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2015/tap\\_fact\\_sheet\\_oct\\_2015.pdf](https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2015/tap_fact_sheet_oct_2015.pdf)

### Emergency Loan Assistance

A program which provides emergency loans to help cover production and physical losses in counties declared as disaster areas by the President.

### Emergency Conservation Program (ECP)

Tehama County and Butte County FSA offices are waiting to hear final approval for the Emergency Conservation Program. This program may help assist with debris removal, releveling or grading, and restoring irrigation systems. Contact the respective office if you have land in Butte or Tehama counties. This program will not apply to orchards inside the levees.

### 2. County Assessor

The Revenue and Taxation Code allows reassessment of property damaged by misfortune or calamity. If there is at least \$10,000 worth of losses of tree value currently on

the tax roll, you can obtain a claim form from the Assessor's office.

### 3. Tree loss calculators based on UCCE cost studies through Agricultural & Resource Economics at UC Davis.

When an individual tree or vine is destroyed in an orchard or vineyard due to natural causes, vehicle accident, shaker damage, or other causes such as flooding, the link below provides workbooks on specific crops to calculate the value of a single tree or vine lost to any cause taking into account the loss of

future income. There are two worksheet versions: "With Replanting" and "Without Replanting".

<https://coststudies.ucdavis.edu/tree-vine-loss/>

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LONG AFTER THE 2017 FLOOD WATER RECEEDS -

# THE IMPACT CONTINUES FOR Walnut & Almond Growers

By **Julie R. Johnson**

Contributors to the article include: Janine Hasey, UCCE Farm Advisor, Sutter/Yuba/Colusa Counties; Greg Browne, USDA Plant Pathologist, UC Davis; Astrid Volder, Plant Sciences, UC Davis; and Bruce Lampinen, UCCE walnut Specialist, UC Davis.

It's hard to complain about this winter and spring's rainfall amounts as the state recovers from a historic drought, but for some farmers living along the Feather River in Northern California, the rainfall, in combination with the failure of the Oroville Dam spillway, spelled disaster.

"High and fluctuating water flows, unprecedented for their duration, passed through the Sacramento and Feather Rivers in 2017. Orchards were hurt by these flows due to direct flooding, indirect flooding via under-levee seepage, and loss of land through river bank

erosion," reported Janine Hasey, University of California Cooperative Extension (UCCE) Farm Advisor, Sutter/Yuba/Colusa counties, in a research document, "Flooded Orchard Damage Update and Management Considerations."

Such is a case for Marysville walnut grower Brad Foster, who farms acreage surrounding the Marysville area, including 400 acres of walnuts in river-bottom land adjacent to the Feather River. The riverbank serves as a natural buffer between his orchards and the Feather River. With rainfall and the spillway collapse, large amounts of water poured

downstream from the Oroville Reservoir into the Feather River. When California Department of Water Resources (DWR) authorities sharply reduced water flow into the river to enable repair work, countless acres of riverbank eroded and washed away.

"I'm not the only grower to have lost acreage along the river and to have orchards standing in flood waters for weeks on end," said 58-year-old Foster, who has been farming for 30 years. "I have neighbors up and down the river who have suffered as much, if not more than I have."

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## The Crisis

On Feb. 27 the Feather River from Gridley south averaged 89 feet. That was the day DWR engineers temporarily stopped the reservoir flow to make critical repairs to a power plant, according to reports.

In less than two days, the river dropped 15 feet and slowed from 46,000 cubic feet per second to 2,500 cubic feet per second.

Normally, a significant reduction in reservoir outflow from the dam occurs over a period of days. That wasn't the case in February.

Foster explained the river acts as a support for the riverbanks and when the water recedes quickly it sucks the bank with it.

"You could literally watch acreage washing away," he added.

He described the water saturated wall of riverbank flowing away as looking like “applesauce.” Such occurrences are referred to a “sloughing,” when heavy, saturated soil is ripped from the riverbanks by its own weight.

Foster estimates he lost at least five acres of river bottom land to the erosion. Assessing damage to sections of his orchards had to wait until the water receded. Foster was then joined by experts in the field, such as Hasey, to study his orchards, conduct tests, research and assessments.

“What I am seeing now is a lot of black stain on my trees,” Foster said. “I’m hoping the research will be able to determine what the blackness is and what can be done about it.”

#### In Other Areas

Fortunately, the rains didn’t result in a crisis for the majority of growers in Northern California. Los Molinos walnut grower Brad Call said the rains have been nothing but a blessing.

Call grows walnuts on acreage adjacent to the Champlin Slough, a tributary to the Sacramento River. He recorded 33 inches of rain this year, saying the average for the region is 21 inches.

“With a wet winter and spring like we just experienced, either the trees grow like crazy or they die. As I have traveled between here and Sacramento I have seen a lot of damage in orchards and a lot of dead trees. For me, the majority of my trees grew really well, lots of growth, it has overall a very positive year,” Call said.

However, not everything was incident free. A problem Call ran into this spring was the delay and difficulty of getting into his orchards on a timely basis.

“We didn’t want to compact the wet ground. It doesn’t come back and that leads to water sitting on the ground in the future,” he said. “Also, the rains delayed us in clearing brush out and when I couldn’t clear the brush and I couldn’t mow, it delayed spraying herbicide and blight control.”

At this point in time Call doesn’t see any signs of increase in disease or pests among his orchards, but he said time will tell.

Another positive he ran into from the abundant rain was a month’s delay in needing to start spring irrigation.

“In addition, the amount of rainfall we experienced has created a reserve of moisture in the soil. The rainfall goes down and water is stored deep in the soil creating a reserve that will benefit in the summer,” he added.

#### What Researchers Found

Call and Foster do have one thing in common from this year’s generous rainfall—a cautious outlook when it comes to the possibility of disease within their orchards due to extended increase in moisture, and the potential for orchard and crop losses.

However, Hasey reported assessing losses should be delayed until the end of

*Continued on Page 38*



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*Continued from Page 37*

summer when the extent of damage will be clearer. In addition, she believes there may also be effects seen into next year and subsequent years.

“Many orchards had standing water from January through mid-May. In other orchards, ditches overflowed with nowhere to pump water out. Unlike previous years where floods occurred from levee breaks, such as 1986 and 1997, trees in 2017 had a much longer exposure to waterlogged conditions,” Hasey said.

Researchers found that waterlogging symptoms started appearing in May. Walnut trees had healthy crowns and roots in the top foot of soil, even though they were leafing out late, or had leafed out and died back.

“These symptoms were caused by waterlogging of deeper roots where soils were still saturated. In previous years, flooded trees usually had dead crown tissue and rot of shallow roots from waterlogging and/or Phytophthora,” Hasey reported.

In river bottoms where walnut trees were partially submerged for prolonged periods, the research team first noticed and isolated Phytophthora species from bleeding root and aerial trunk cankers first around mid-May.

Another observation of the team concerned a young Chandler orchard on RX1 rootstock, of which a third of the orchard had seepage from January to early May. In this orchard, whereby only the tops of the berms were not submerged, flooded trees leafed out about a month later than those not flooded. Some trees were struggling while others are continuing to leaf out and grow.

### Two Potential Areas of Concern

In their study the research team has found two potential problems of concern: Diseases caused by Phytophthora; and impact of waterlogging on the root system.

“We know the ‘water mold’ Phytophthora is found in surface water and

infested soils. In May, we sampled water in the Sacramento and Feather Rivers, in swales of standing flood water in the Feather River bottoms, and in seepage water from under levees along both rivers for the presence of Phytophthora,” Hasey said.

The team also sampled several walnut trees with symptoms of aerial Phytophthora and examined the crown and upper roots on declining trees.

Continued study of both issues will go on throughout the summer and into an extended period of time, with trees backhoed for examination of root systems, and the impact of long-term flooding from continued seepage on walnut root health and tree water status.

### Orchard Management Conditions

The research team provides the following information to growers:

- Flooded orchards will likely respond to irrigation differently than normal, since root systems are compromised.
- In saturated soils, fine roots die, and depending on the extent of flooding, larger roots can die as well. It takes time for the root system to regain functionality and re-start new fine root production after flooding.
- If the water table level below the soil surface drops gradually, trees may be able to continue to produce functional roots at increasingly deeper levels over time. Initial irrigation could be delayed for some time, as deeper roots may maintain water uptake.
- However, if the soil remains saturated at some level below the surface, the only functional roots may be at a very shallow depth and irrigation may have to be initiated earlier than normal. In this case, shorter but more frequent irrigations could help avoid further damage to roots in the upper zone.
- Carefully monitor both soil water levels and tree water status so that the trees can be gradually brought back to health. Soil based monitoring, using Watermark® soil moisture sensors installed at different depths, will let you know the level where

the soil is saturated as the water level drops, as well as the amount of water that is being moved up above this level of saturation by capillary rise. Apply enough water to bring the soil to field capacity to enable plant water uptake from the upper soil, but avoid prolonged periods of saturation that may damage roots. It is easy to saturate the soil, particularly when the water table is close, so irrigate judiciously, ideally using both soil moisture monitoring and plant pressure chamber data to aid in determining irrigation duration and frequency.

- Do not initiate irrigation until pressure chamber measurements show trees are 2-3 bars below the fully watered baseline (more dry) and only irrigate enough to bring the trees back up to about 0.5 to 1 bar below the baseline by applying short sets of irrigation.
- It is not a good idea to prune or fertilize trees after flooding. Pruning will reduce both carbohydrate reserves and leaf area, while fertilizer applications may mostly go to waste and delay or damage root production. The best approach would be to wait, and let the tree adjust to the altered environmental conditions while managing irrigation as described above to avoid further damage to the root system.

### Where to Find Help

Hasey and her team said there are several potential resources and programs for growers who suffered flood-related damages. Resources include: Farm Service Agency; Tree Assistance Program; Emergency Loan Assistance; Emergency Conservation Program; County Assessor; and Tree loss calculators based on UCCE cost studies through Agricultural & Resource Economics at UC Davis.

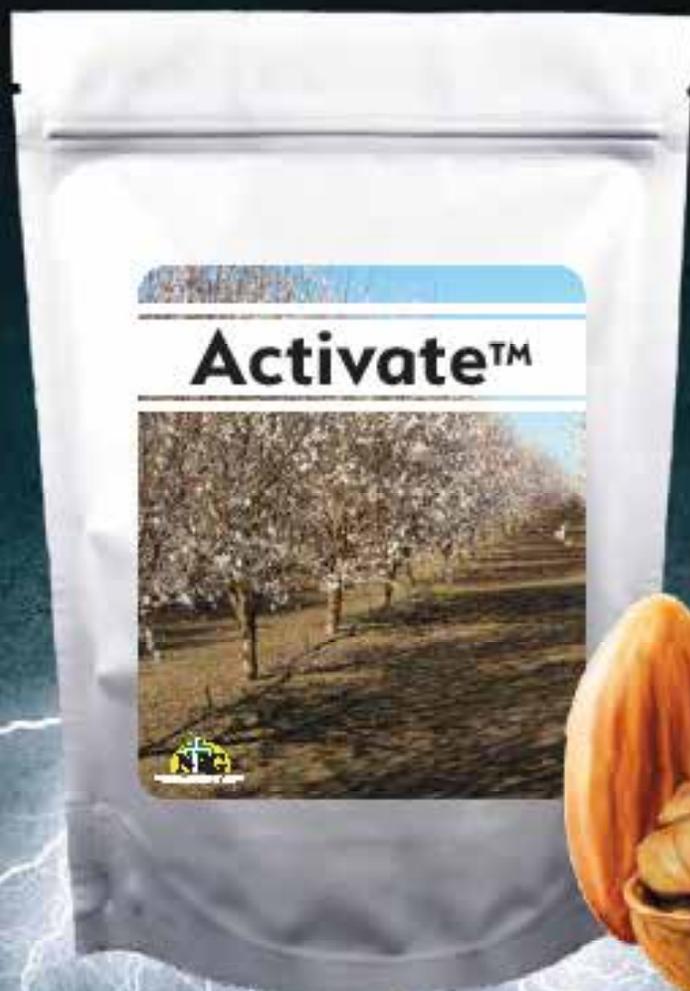
For more complete summaries of the resources available and how to report tree damage visit:

<http://www.sacvalleyorchards.com/blog/almonds-blog/resources-for-flooded-orchards/>

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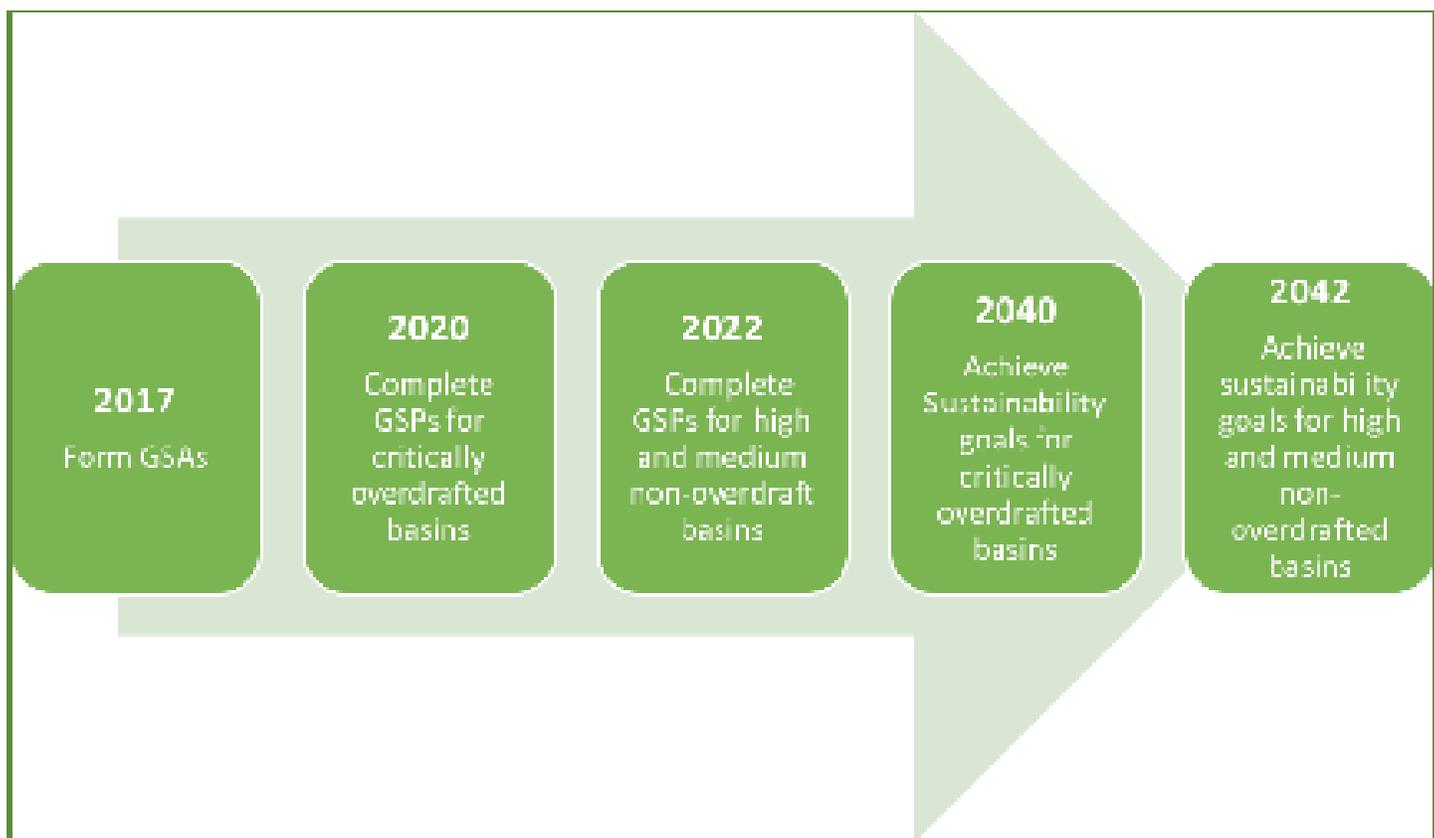
By **Roger A. Isom**  
President/CEO  
Western Agricultural Processors Association



In 2014, the California Legislature passed, and the Governor signed, a three bill package that will most likely become the most impactful regulation to California in a long, long time. Driven by the huge drawdown in groundwater due to the multi-year drought, pumping restrictions in the Delta, and counties starting to ban further well drilling, the Legis-

lature felt compelled to pass a law that ultimately will regulate the pumping of groundwater. Known as the Sustainable Groundwater Management Act (SGMA), it will not only impact agriculture, but cities and anyone else who pumps groundwater.

The act requires the formation of local groundwater sustainability agencies (GSAs) that will assess groundwater conditions in their areas and create plans to manage groundwater sustainability. So what does this mean? Once GSAs are formed, they will have several management tools to help bring the basin to a



sustainable level. The GSAs can require registration of groundwater wells, mandate extraction reports from wells, and even impose limits on wells. And yes, they will have the ability to assess fees to support the development and management efforts.

Once formed, the GSAs will have 20 years to develop and implement groundwater management plans to achieve “sustainability”. These plans are called Groundwater Sustainability Plans or GSPs. GSPs are due by January 31, 2020 for critically over-drafted basins, and January 31, 2022 for high and medium priority groundwater basins not in a condition of critical overdraft. Much of the San Joaquin Valley is listed as “critically over-drafted”. Once submitted, the California Department of Water Resources (DWR) will review the GSPs for compliance. Compliance is determined on whether or not DWR believes the GSA can achieve sustainability within 20 years. If DWR determines that the GSA most likely will not achieve sustainability or is inadequate, DWR will consult with the State Water Resources Control

Board (SWRCB) on any inadequacies. After this consultation, the SWRCB will notify the GSA that they will be designated “probationary” unless they can address the deficiencies within 180 days of notification. If they fail to address the deficiencies, the SWRCB can create their own interim plan and assume authority over the GSA until the GSA can create an approvable plan.

So what does “sustainable groundwater management” mean? Well, the legislation calls for managing a groundwater basin in such a manner as that it does not cause “undesirable results.” The legislation defines “undesirable results” as the following:

- Chronic lowering of groundwater levels
- Significant and unreasonable reductions in groundwater storage
- Significant and unreasonable seawater intrusion
- Significant and unreasonable degradation of water quality
- Significant and unreasonable land subsidence

• Surface water depletions that have significant and unreasonable adverse impacts on beneficial uses

While DWR does not say this will take away the ability of water users to pump groundwater, it is pretty obvious what has occurred over the past several years will not be allowed to continue under SGMA. It does not affect water rights, but it can be reasonably assumed that restrictions will follow, especially in critically



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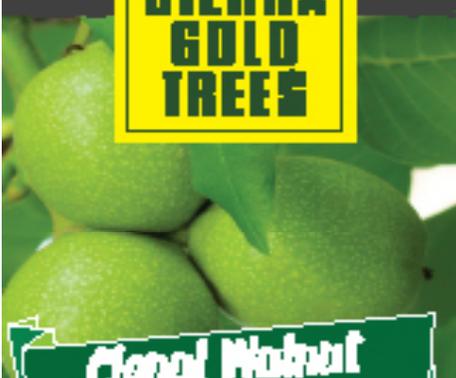
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over-drafted basins.

Once the GSA has been formed, the real work begins. The development of the GSP is where the details are and where growers need to be involved. If you are not involved in your GSA, you need to be. The legislation allowed for, and the Governor and the DWR staff have maintained, that “groundwater management is best accomplished locally.” The SWRCB will only step in if the GSP is insufficient. This is where the questions begin. How will the local GSA accomplish “sustainability?” What practices will be put in place for growers to follow? Will cropping patterns change? The answers to these questions set the stage for what is to come, and it is not pretty. It is not a matter if restrictions will be employed, it is a question of when

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**Figure 1.** English walnut (*Juglans regia*) infested with WTB and severely affected by TCD. Symptoms of branch dieback, bleeding at emergence/entry holes.

Photo credit: M. Yaghmour

# 1,000 Cankers Disease: Everything You Need to Know For Walnuts

By **Mohammad Yaghmour** and **Elizabeth Fichtner**

The walnut tree (*Juglans* sp.) is well known for its valuable wood and timber quality and its nutritious nut. Different native species of walnut are an important part of the ecological system in North America. Eastern black walnut (*Juglans nigra*) is native to eastern North America from the northeast in Vermont and southern Ontario to Minnesota and south to Florida. It also ranges east from the Atlantic coast to central Texas except the Mississippi River Valley and Delta. *Juglans nigra* has an important economic value estimated at more than \$500 billion for its wood and timber alone. Among the other species that are considered native to the US with natural range are Arizona walnut (*Juglans major*), Texas walnut (*Juglans microcarpa*), and California black walnuts (*Juglans californica* and *Juglans hindsii*).

In California, there are two native ranges of California black walnut species; Southern California black walnut (*J. californica*) and Northern California black walnut (*J. hindsii*). Beside their impor-

tance in the ecological system as a source for food and shelter for wildlife, *J. hindsii* has an economic value for its wood, and as a rootstock for English walnuts (*J. regia*) in commercial orchards or as a parent in the hybrid rootstock 'Paradox' (*J. hindsii* × *J. regia*).

California is also considered the number one state for producing English walnuts with approximately 99 percent of the total U.S. production. English walnut, which is native to Asia and was first introduced to California later in the eighteenth century with the first commercial orchard planted in 1843. Walnut is a high value crop and considered one of the major nut crops grown in California and ranks in the top ten commodities in California with approximately 300 thousand acres and a market value of approximately \$977 million in 2015.

In early 1990's, black walnut decline and mortality was observed in Utah and Oregon and was not associated to any biotic cause at the time. It was not until

later in 1997 and 2001 that black walnut mortality in Utah, Oregon, and New Mexico, and somewhat later in Colorado, was associated with walnut twig beetle (WTB) *Pityophthorus juglandis*. However, it was not until 2008 that tree mortality was attributed to WTB feeding in the phloem, and to canker formation around the WTB galleries caused by a new fungus. The fungus was later described as *Geosmithia morbida* and the disease was called Thousand Cankers Disease (TCD). The name was proposed due to the many cankers developed around beetles' galleries that coalesce and girdle twigs and branches resulting in decline and mortality.

Currently, TCD is considered a complex and emerging disease in the US and California, and it is responsible for decline, dieback, and death of eastern black walnut in western US, and is currently spreading in the native range of the eastern black walnut. It is also widespread in California causing decline in California black walnuts and disease in English walnut orchards. Beside its spread in the US, it was reported in Italy on eastern black walnut and English walnut trees and vectored by the WTB.

Any plant fungal disease is a function of three major factors, the pathogen, a susceptible host, and environmental conditions conducive to disease development. In this case, the pathogen is being vectored by an insect making the insect an important part of disease development. Thus, an understanding of the biology of the insect, the fungus, host susceptibility and their interaction is necessary to understand the disease biology and development, and thus help in developing effective control methods. In this article, we will introduce the signs and symptoms of this disease as well the different factors contributing to its development, and how the current advances may help control this disease.

## Signs and Symptoms

Affected walnut trees will show symptom of branch die back and flagging (**Figure 1**). Once we see those symptoms, it is always advised to examine the

tree and take a closer look at the bark surface of twigs and the main trunk for signs of entry/exist holes created by the beetle. These will be tiny holes with a size less than 0.04 inch in diameter (**Figure 2**). The beetle prefers to attack branches that are greater than ½ - ¾ of an inch in diameter. In many cases, affected trees exhibit bleeding around beetle holes, and removal of the surface bark will show cankers development around beetle galleries in the phloem tissue, with sometimes presence of the beetles in the galleries, or signs of fungal mycelium and spores that could be visible in the galleries (**Figure 3**). As the cankers increase in size, they may coalesce girdling branches and causing tree decline and mortality under severe infections and beetle colonization.

### The Beetle

The WTB is very small and it's approximately 0.06 inch in length (**Figure 4**). The beetles and the larvae overwinter in the host tissue and emerge between January and March in California. Once they emerge, male WTB looks for a susceptible host and starts to colonize the tree first by initiating new galleries in the twigs or the main trunk. During this process, they produce an aggregate pheromone to attract two to three females for mating. The females lay the eggs in galleries in the phloem and xylem surfaces, and once the eggs hatch, the larvae start to feed and create feeding tunnels along the wood grain. After that, the larvae pupate and emerge as adults and move to colonize the same tree or move to a different tree.

Entomologists at UC Davis and the US Forest Service identified the aggregate pheromone which was a tremendous help in studying the beetle's biology and behavior. They found that the beetle generally has two flights during the season after their initial emergence between January and March. The primary flight is between May and July; and a secondary flight from September to October. The importance of these studies is that now we have a better idea about WTB seasonal flights and biology allowing us to monitor the WTB using the pher-



**Figure 2 (top left):** Entry and exit holes created by the walnut twig beetle (*Pityophthorus juglandis*) on English walnut. Photo credit: Elizabeth Fichtner



**Figure 3 (left):** Signs and symptoms of thousand cankers disease. (A) Peeling the bark from a Paradox branch reveals canker development around beetles' galleries. (B) Beetle boring into the phloem of an English walnut tree.



**Figure 4 (above):** Walnut twig beetle (*Pityophthorus juglandis*). Approximately 0.06 inches long. Photo credit: L. L. Strand. (Source: <http://ipm.ucanr.edu/EXOTIC/thousandcankers.html>)

omone and possible future use to enhance IPM programs to control this pest such as the use of mating disruptions techniques. Excellent detailed information about monitoring guidelines for the WTB as well detecting and identifying the beetle can be found

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# Nutrient Management of Zinc in Pistachios

By **Sabrina Hill**,  
Contributing Writer

**Z**inc is among the most likely deficient micronutrients for pistachios in the California growing areas, but there are ways for growers to monitor, prevent, and treat low zinc levels in the orchard. As summer progresses, growers should be considering leaf sampling to check for zinc deficiency in the orchard.

Author's note: Information herein was collected from scholarly papers and presentations by University of California (UC) advisors Bob Beede, Brent Holtz, and Craig Kallsen.

## Importance of Zinc

Zinc is necessary for formulation of Auxin, which plays a role in cell elongation and the forming of chloroplast. It is needed for the development of pollen, along with flower bud differentiation and fruit set.

## Factors and Signs of Zinc Deficiency

There are several factors relating to zinc deficiency in pistachios and other nut crops. First, cut areas are more likely to be deficient. In addition, zinc has restricted solubility and movement in soils, which is made worse in alkaline soils and limitation in water flow. Root health is important for zinc uptake, so

soils that limit root growth can also be problematic. Methyl Bromide fumigation causes a temporary loss of mycorrhizal fungi and ultimately less zinc. Lime reduces zinc availability as well, as do high magnesium or phosphorous levels.

With the Environmental Protection Agency (EPA) phaseout of Methyl Bromide more than ten years ago, there is less issue with the temporary loss of mycorrhizal fungi. Arbuscular mycorrhizal fungi are microscopic fungi naturally occurring in soil that form a symbiosis with plant roots. Studies show that this process helps plants absorb zinc through the roots.

Alkaline soils are more susceptible to zinc deficiency. Alkaline soils have pH values of 7.0 or greater and can lead to deficiencies in other nutrients as well. The solubility of several nutrients lowers as the pH level increases, including iron, phosphorus, copper, boron, and manganese. When these nutrients are

not soluble, they remain in solid forms that the plants cannot absorb properly.

Look for symptoms of zinc deficiency in spring. The seasonal onset of symptoms of zinc deficiency is mid to late season, especially in young bearing trees. Younger leaves show zinc deficiency while older growth does not, due to the limited mobility of zinc in the plant. Over the course of the season, growers can look for delayed bud opening, terminal leaves that are small and yellow, wavy leaf margins, terminal dieback, reduced nuts and more blanks.

## Testing for Zinc Levels

Growers can use soil sampling and leaf sampling to get an accurate picture of the zinc needs and uptake in their crop.

A single orchard can have several different soil types within it, due to conditions such as sand deposits, cuts or fills, or a number of other factors. In





Photos courtesy of Sabrina Hill

addition, soils often change with depth. Unlike leaf sampling, soil sampling typically does not need to be performed every year.

Other UC guidelines for soil sampling are:

- Take three to ten sub samples for each area. Then combine them by depth into single samples
- Repeat the samples throughout the orchard
- Though pistachios are deep rooted, the suggested protocol is to sample at one foot increments down to three feet

Leaf sampling is a widely prescribed testing procedure for zinc and other nutrients in nut crops. It shows how successfully the tree is pulling nutrients from the soil and transporting those nutrients throughout the plant. Leaf sampling should be performed every year. Zinc levels for mature trees in late

*Continued on Page 50*

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July and August are suggested by UC advisors to be 10 to 15 PPM (parts per million).

The UC guidelines for effective leaf sampling are:

- Collect the sample from late July through mid-August
- Sample non-fruiting branches, six ft. (1.8 m) from the ground
- Choose fully expanded sub-terminal leaflets
- Collect four-10 leaflets per tree
- Sample 10-20 trees/orchard block
- Do not include leaflets that have received in-season nutrients sprays

- Deliver the sample to the lab within 24 hours
- Optimal leaf tissue concentration: 10-15 ppm
- Critical value seven ppm

### Treating for Zinc Deficiency

Once a grower has identified zinc deficiency in the orchard, there are several possible courses to take and considerations to keep in mind. Treatments can include applying fertilizers, different irrigation management techniques, and changing the pH of the soil.

Zinc cannot be 'stored' by the plant, therefore over-applying zinc for later use by the plant is not effective and ultimately can be a waste of money. Foliar fertilizers benefit only the tissues sprayed and do not help plant growth that is developed after application. Fertilizers have limited long term effectiveness, therefore, repeat applications may

be needed.

Acidifying soils with sulfuric or phosphoric acids will correct some nutrient deficiency in alkaline soils. It is also possible and in some cases beneficial, to treat soil with sulfur dust where there is lime.

Other recommendations from UC farm advisors include:

- Zinc sulfate in late postharvest or bud-swell.
- Single post-bloom foliar spray of zinc sulfate and copper applied when canopy is 50-90 percent fully.
- Fertigating with non-chelated zinc and copper in alkaline soils is NOT effective.
- Fall application in late October (50 percent defoliation) requires high

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- In season sprays correct deficiency on new growth, NOT old.
- Repeated treatments may be required.
- Supply required throughout all stages of growth and reproduction

Zinc is a vital nutrient for pistachios. Deficiencies in this micronutrient and others can lead to low levels of pollen and poor fruit set, which ultimately result in a smaller yield and loss of potential profits for the grower. Local farm advisors are available to assist in creating sampling programs and to answer questions. Growers are encouraged to contact UC farm advisors with any concerns and/or inquiries.

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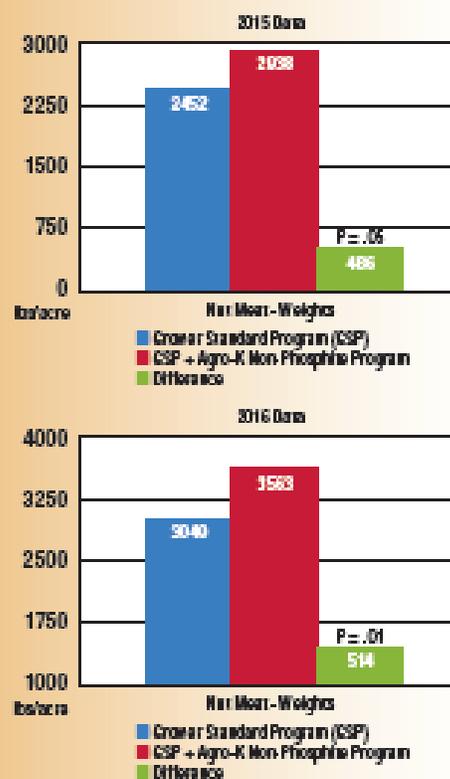
Many almond growers with late varieties or early leaf drop who rely on custom spray application often find post-harvest applications difficult logistically. Growers in this situation can take advantage of Agro-K nutritional tools during hull split applications to help prepare their trees for future nutritional demands next season. Applying Zinc Plus +4 D.L., at hull split with other early-season peak demand nutrients like phosphorus and boron, build bud strength and provide critical nutrients for next year's developing buds so they are available when the tree breaks dormancy next spring.

Building nutrient levels in the buds this year, leads to more uniform bud break, faster early growth with larger leaves that have more photosynthetic capability and stronger flower buds for increased nut set. In addition, trees that are not nutritionally stressed experience less post bloom nut drop. Maximizing yield starts with nut set and post bloom nut retention. Ensuring peak nutrient demand timing is met leads to higher nut set and retention. The end result... higher yields, larger and longer nuts next season.

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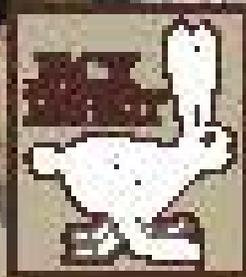
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