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PRECISION FARMING

Ryan Kaplan collects a leaf for testing from a young almond tree. A plastic bag is wrapped around the selected leaf and left for ten minutes to stabilize the sample. A leaf sample is taken from five trees to obtain a good average. The site of the sample should be representative of the area, as far as soil and moisture are concerned.

See the full story on page 50

Photo Credit: Len Wilcox

Almond Replant Disease and Anaerobic Soil Disinfestation

Cecilia Parsons
Contributing Writer

Overcoming replant disease in the face of fewer fumigant options will be a challenge for California almond growers as this disease complex affects more acres in the orchard replacement cycle.

Prunus replant disease (PRD) is a distinct, specific and widespread condition that can seriously delay growth and productivity in a newly planted almond orchard. University of California researchers believe that the disease is caused by a complex mix of soil microbes that remain after an orchard has been removed. The residual microbe population can overwhelm the root system of a newly planted tree, compromising future growth and yields.

Replant disease is not the only condition that can stunt new trees, but it can be found in more acres of prunus orchard removals than plant parasitic nematodes that infest as much as a third of the state's almond and stone fruit acreage. Studies of the root structures of affected and diseased trees show significant differences in density of fine roots and in the case of diseased trees, the presence of pythium a pathogen associated with the disease.

Mohammad Yaghmour, University of California Cooperative Extension (UCCE) farm advisor for Kern, Kings and Tulare counties, outlined some of the newest research on replant disease and results from soil disinfestation trials at the recent Kern County Almond Day.

An almond tree lifespan of 23-25 years means a significant number of acres of almonds planted from 1992 to 1995 will be pulled in the next five years, Yaghmour said. Most of those acres are expected to be replanted in almond trees. Preplant soil fumigation has been

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an effective means of control for biological replant disease, but the phase-out of methyl bromide and limits on volume of fumigation chemicals due to VOC regulations point to a need for management options.

Replant disease can be managed with judicious orchard replacement planning and pre plant soil fumigation, Yaghmour said, but it is important to first identify what is causing the growth delay in the trees. There can be abiotic factors present in a field, including soil compaction, salinity or residual herbicide that slows growth of trees in replanted fields. Biotic factors affecting tree growth can include plant parasitic nematodes, including ring, lesion and root knot nematodes; pressure from aggressive pests including gophers, phytopthora or ten-lined June beetle or microbe induced growth suppression- replant disease.

Replant disease is most common on loam, sandy loam and sandy soil textures. Severity of the disease varies from field to field. The disease can occur on its own or in combination with other pest and soil conditions that impair tree growth. Using resistant rootstocks and pre-plant fumigation have been the two main avenues to avoid PRD challenges.

Choosing the appropriate fumigation treatment for PRD requires testing to determine if the soil is infested with nematodes, pathogens associated with PRD or a combination of both. Chloropicrin is effective against PRD, but not nematodes, Yaghmour said. If only nematodes are present in the soil, Telone is effective. A mixture of those fumigants will work, he said.

Fumigant treatments have been broadcast, applied in planting strips or spot treatments at planting sites. Use of GPS software and hardware systems have been developed to deliver spot fumigation at tree planting sites. This system is safer and faster than spot fumigation using a hand held probe. Yaghmour said the spot treatments, done after mapping an orchard site, could reduce the amount of fumigant by 50-90 percent.

Yaghmour cited a fumigation trial in Firebaugh where the GPS technology was used to apply preplant soil treatments. Strip treatments with combinations of chlorpicrin and 1,3-D had the highest net returns in yields, but the GPS-controlled spot treatments provided greater returns than strip with 1,3-D alone, which has been an industry standard.

The trial showed that in orchards at risk for PRD and not plant parasitic nematodes, the most effective route is strip treatments with chlorpicrin or mixtures of that fumigant with 1,3-D. Spot treatments may be more useful where air quality regulations limit the amount of fumigant used.

Rootstock choices are also important in avoiding PRD.

Yaghmour said more work needs to be done on rootstock susceptibility to PRD, but trials have yielded some

information. Replacing orchards on Nemaguard or Lovell peach rootstocks with peach rootstocks or Marianna 2624 rootstocks, can reveal PRD in the soil. Peach-almond hybrid rootstocks have less sensitivity to PRD, but may be sensitive to ring nematodes in sandy soils.

Researchers in the rootstock trials report development and selection of resistant rootstocks will significantly contribute to PRD management and reduce dependence on soil fumigation. Growers should consider all demands expected in a planting site when choosing a rootstock including nematode pressure and poorly drained soils.

Yaghmour highlighted an alternative route to overcoming challenges of PRD.

"Every year we are seeing more fumigant restrictions. Anaerobic soil disinfestation may be another way to manage this disease on a commercial scale," he said.

How anaerobic soil disinfestation works is not completely understood, Yaghmour said, but it is proven to be lethal or at least suppressive to many soil pathogens.

The process, which was developed in Japan and Netherlands and is being tested in California strawberry production, involves adding a carbon substrate to the soil, tarping with clear plastic and keeping soil moisture at field capacity for several weeks. Heat generated in facilitates the process.

United States Department of Agriculture (USDA)-Agricultural Research Service (ARS) researcher Greg Browne is also conducting trials on the effect of anaerobic soil disinfestation on PRD affected soils.

An available and inexpensive carbon substrate source is key to using this process. Rice hulls have been used and Yaghmour reported that a mixture of ground almond hulls and shells or wood chips have been used in trials.

Trials over the last three years at the University of California (UC) Kearney Research Center and in Wonderful orchards in Kern County evaluated different substrate rates, and compared water use, tarp components and application methods. Nemaguard and Hansen 536 rootstocks were used along with fumigation standards in strip and GPS spot applications. Oxygen sensors were used to measure oxygen levels to ensure a two-three week anaerobic environment.

Degree of anaerobic conditions was highest with use of wood chips and anaerobic soil disinfestation (ASD). Survival of pythium was lowest with fumigation treatment.

Although all trial data is preliminary, Yaghmour said growth rate of trees in the ASD plots is nearly equal to those in fumigated test plots. Signs that the soil disinfestation is working would be survival rate of pythium. Yaghmour noted that the trial plot using wood chips and ASD still had pythium present.

The real test of anaerobic soil disinfestation will be growth and production of the trees, Yaghmour said.

"ASD may be a new tool for growers," he said.

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

Almond Disease and Control

Photos by: Julie Johnson

Julie R. Johnson
Contributing Writer

From planting to maturity and crop production, almonds trees can be host to a plethora of diseases, be it bacterial, fungal, viral, parasitic or phytoplasmal.

Dr. Jim Adaskaveg, professor and plant pathologist with the Department of Plant Pathology, UC Riverside, presents Almond Disease Control during this year's North Valley Nut Conference in Chico.

These diseases and how to control them was the topic of Dr. Jim Adaskaveg's presentation during this year's North Valley Nut Conference hosted by West Coast Nut in conjunction with the UCCE Butte/Glenn Counties Almond and Walnut Day at Silver Dollar Fairgrounds in Chico.

Adaskaveg, professor and plant pathologist with the Department of Plant Pathology, UC Riverside, who specializes in foliar disease of almonds and other tree crops, shared the springtime diseases of almond that can be problematic in a wet spring season are blossom blight, jacket rot, anthracnose, shot hole and bacterial spot. Late spring-summertime diseases include scab, alternaria, leaf spot, anthracnose, rust and hull rot.

In an effort to control these and other almond diseases, Adaskaveg emphasized monitoring and risk assessment by determining pathogen population size, the possibility of disease outbreaks with weather forecasts, assess if, when and where disease management has to be implemented, and optimize disease management that is both effective and economical.

Another essential component in the fight against almond disease concerns optimum timing for implementing management practices, he said.

With inoculum-based disease, such as shot hole, scab, rust and bacterial spot, it is important to know the levels in the current and previous seasons as indicators for risk. This helps the grower to determine at what level the inoculum may or may not be present and disease progress can be monitored.

Once the inoculum is found, management practices can be implemented.

For host phenology-based diseases like blossom blight and Rhizopus hull rot, the disease occurs on specific host tissues during a limited time in the season and the inoculum is commonly present.

Diseases, such as alternaria, anthracnose and bacterial spot, which are microclimate based, again the pathogen inoculum is commonly present and climatic conditions determine disease progress.

"There are a number of fungicides and fungicidal formulations for man-

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aging almond diseases. Both inorganics and conventional synthetics," Adaskaveg said.

Among the line of fungicides are new pre-mix formulations that combine two active ingredients having different modes of action against the target pathogen, he added, those include Inspire Super, Quadris Top, Quilt Xcel, Pristine, Luna Sensation, Merivon, Luna Experience and Viathon.

"Fortunately, we are still getting lots of new products registered and part of our job is to keep on top of these new products, such as Kenja and Rhyme which are new products registered this past year for almonds," Adaskaveg said. "In addition, there are other new products coming out on the market which is very good for the industry and provides growers with a lot of good choices."

He reminded growers of the necessity to be out in the field looking, knowing, monitoring and scouting to learn and recognize "what is out there" and what type of problems they might be faced with in their orchards.

"It is important to know what is taking place concerning pathogens as they have to build up from year to year. If you find a problem late in the fall you can be pretty well guaranteed to have that problem in the spring," Adaskaveg added. "When the weather turns wet and we know what is going on in our orchards, growers can be better prepared and knowledgeable on how to apply our disease management programs."

He said some of the determining factors for timing of bloom applications concerns environmental conditions such as rainfall and temperature.

When environmental conditions are less favorable to disease and fungicide properties have locally systemic action, a single spray at 30-40 percent bloom is acceptable.

However, Adaskaveg recommended when conditions are favorable to disease, rain forecast and warm temperatures, fungicide properties should be protective or locally systemic action and two sprays applied, at 5 percent bloom and at 80 percent bloom.

During a presentation at a conference in Monterey, Adaskaveg noted that fungal organisms are quite dynamic and can develop resistance to fungicides rapidly, and called for an effort by both growers and the ag chemical industry to keep their "guard up" for pitfalls in introduction of new materials and methods, as strategies are developed for future use of them.

He emphasized the objective is to minimize pathogen survival by

avoiding repeated exposures to the same class of fungicides to pathogens, especially in areas of high disease populations.

There are already several reported cases of disease resistance to fungicides in almonds and Adaskaveg said growers need to be aware of these instances and educate themselves on alternative applications and the need to rotate uses.

Brown Rot and Green Fruit Rot

For brown rot fungus infection during the 7 to 14 day bloom, Adaskaveg said any type of wet weather, be it rain or fog, are important factors.

Adaskaveg recommends spraying a fungicide once at pink bud, at least once at full bloom or two weeks after the first spray, and, depending on the weather, once at petal fall.

It is the same for green fruit rot with the elimination of applications at pink bud.

"Timing is based on host phenology, environmental conditions, and acreage to treat," he said. "Again, we have a lot of new fungicide products on the market and soon to be registered and released that give growers a large margin to choose from."

Blossom Blight and Gray Mold

Adaskaveg said blossom blight is actually a canker fungus that goes down through the spurs and gets into the branch of the almond tree and forms a canker that can last for several years.

"So prevention from getting brown rot blossom blight from ever starting is critical if you don't want subsequent years problems," he said. "Once it is in there it is hard to control, although it will eventually die out."

He shared a number of fungicides on the market for treatment of both these diseases, such as Approach and Quadris Top.

Adaskaveg said research has found applying fungicide at full bloom and petal fall is recommended, however, if the weather is wet an application at pink flower is also recommended.

Bacterial Spot

According to Adaskaveg, bacterial spot is a fairly new disease in California, first diagnosed in the spring of 2013 and is caused by the bacteria Xanthomonas arboricola pv. pruni.

The almond variety Fritz appears to be the most susceptible to bacterial spot at this time.

Bacterial spot occurs on the tree's leaves, twigs, and with the most obvious symptoms on the fruit. Typically, almond hull lesions start as small,

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watery blemishes that produce light to dark amber gumming. The amber color of the gumming is important as it helps distinguish bacterial spot from the clear gum of leaffooted bug feeding injury. The infection can reach the kernel and cause off grades or unmarketable fruit.

The pathogen overwinters in fruit mummies on the tree.

"So the winter shakes to get rid of those mummies for other pests and diseases is also helping to protect against bacterial spot," he added.

The most effective management program for bacterial spot is a delayed dormant application to reduce inoculum and at least one or two in-season applications around rainfall events and rising temperatures to prevent new infections.

Adaskaveg recommends the use of copper at full bloom and petal fall, twice in the spring and in the summer, as well as application of mancozeb at petal fall and in the spring.

Courtesy of Dr. Jim Adaskaveg, Professor and Plant Pathologist, UC Riverside

"That program should work well for management of bacterial spot," he said.

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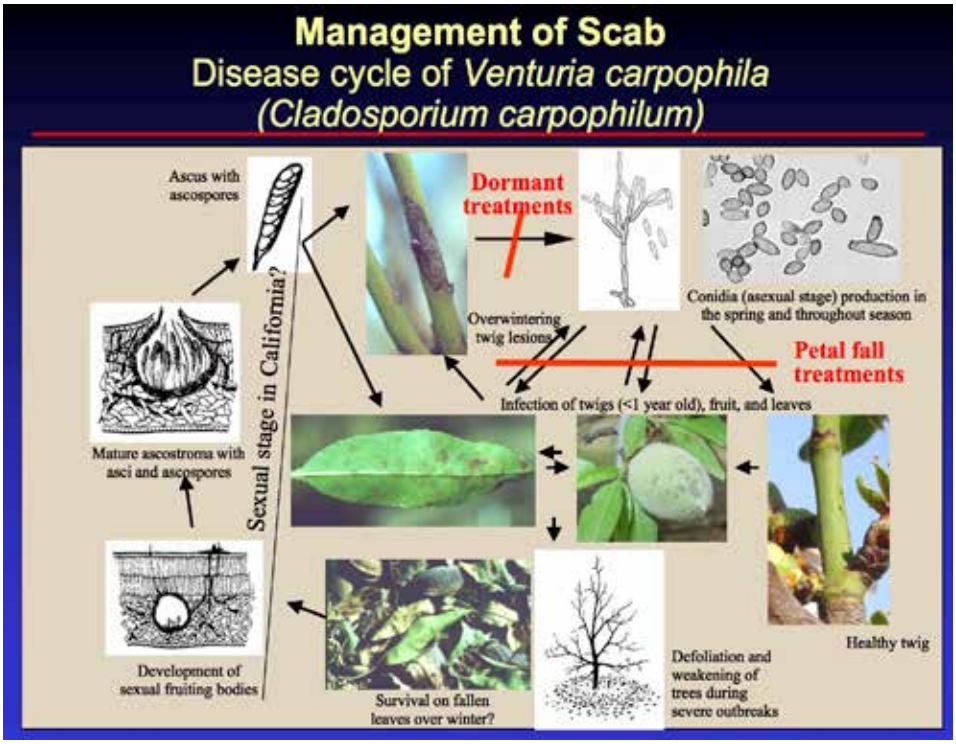

Courtesy of Dr. Jim Adaskaveg, Professor and Plant Pathologist, UC Riverside

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Late Spring, Summer Diseases

Anthracnose can cause a lot of problems with a lot of rainfall, Adaskaveg explained, and that is something growers need to be aware of, especially this year.

Almond scab, hull rot and alternaria were other spring and summer bacterial problems he discussed.

Adaskaveg said almond scab has become a common disease at many locations in recent years and needs to be managed.

Effective management requires knowledge of the disease history of the orchard, application of dormant treatments to delay twig sporulation, monitoring for twig sporulation in the spring and fungicide application at petal fall and at the beginning of twig sporulation.

Adaskaveg warned that almond scab has some fungicide resistance and not to apply single-site mode of action fungicides once the disease is developing.

"Plan for rotation programs and integrated strategies," he added.

There are a number of almond varieties reported to be highly susceptible to scab – Carmel, Merced, NePlus Ultra, Peerless, Price, Ruby, Sonora and Winters. Less susceptible is Butte, Fritz, Mission, Monterey, Wood, Colony and Thompson, with Nonpareil being the least susceptible.

The majority of these late season diseases cause damage to leaves which then fall off the trees prematurely, "And this is not good for the tree," Adaskaveg said.

He recommended in an effort to manage scab and other diseases, growers practice planting design that allows for air circulation, tree pruning that increases air movement and reduces relative humidity, irrigation management that reduces relative humidity, clean cultivation, and avoidance of heavy late-summer/fall fertilization with nitrogen to reduce production of highly susceptible host tissues.

He cautioned growers that "if your neighbor is battling a particular disease, you can pretty well count on that disease moving into your orchard, so be prepared."

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Managing Spider Mites in Almonds and Walnuts

Emily J. Symmes
UCCE Statewide IPM Advisor
Sacramento Valley Area

Spider mites are considered indirect pests in almonds and walnuts, in the sense that they do not feed directly on the harvested product. Rather, they cause injury to plants by sucking cell contents from foliage. Signs of feeding injury include leaf stippling, yellowing, and dropped leaves. High populations of mites can also be recognized by webbing on leaves and tree terminals. Significant spider mite injury can become economic crop *damage* in almonds in subsequent seasons in the form of reduced vegetative tree growth and crop reduction. In walnuts, early season defoliation can reduce nut yield and quality that year. In both commodities, excessive leaf drop can interfere with harvest operations.

Effective management of spider mites is a good example of how the integration of multiple tactics is necessary to achieve optimal population suppression and damage reduction. For spider mites, we must focus on three key management tactics: cultural practices, biological control, and miticide applications when treatment thresholds are reached.

Cultural practices. Properly-irrigated, vigorous trees are less susceptible to spider mite damage. Ensure that trees are not stressed due to inadequate irrigation, fertilization, or other factors. Reduce dusty conditions by oiling or watering roadways and, where possible, maintaining ground cover.

Biological control: Spider mites have a suite of natural enemies that can occur to varying degrees in the orchard environment. The most impactful of these biological control agents in California almond and walnut orchards are typically predator mites **(Photo 1)** and sixspotted thrips **(Photo 2)**. When we think of biological control in practice in most orchard environments,

Photo 1. Western predatory mites (top and bottom), spider mite (center). Photo courtesy University of California Statewide IPM Program (Jack Kelly Clark).

Photo 2. Adult sixspotted thrips. Photo courtesy University of California Statewide IPM Program (Jack Kelly Clark).

we are largely discussing *conservation biological control* – in other words, with respect to the beneficial predators, "don't starve them, don't kill them." This means that we have to be willing to tolerate some level of food source in the orchard to maintain predator populations. Food sources may come in the form of other mite species early in the season (e.g., European red mite, brown almond mite), as well as subeconomic populations of spider mites themselves throughout the season. We must also be mindful of the impacts of all pesticide applications on natural enemies (more on that below).

Pesticide applications: When deciding whether or not to treat spider mite populations in almond and walnut orchards, multiple factors should be considered. Applications of pyrethroids and organophosphates (used to manage insect pests) are particularly disruptive to natural enemy populations. If scouting indicates presence of beneficial insects such as predatory mites and/or sixspotted thrips, bear in mind the impacts of your chosen material(s) when making applications targeting other pests as well as spider mites throughout the season. The University of California Integrated Pest Management Guidelines regularly update the "Relative Toxicities of Pesticides to Natural Enemies and Honey Bees" online. These can be found for almonds and walnuts at: http://ipm.ucanr.edu/PMG/r3900311.html and http://ipm.ucanr.edu/PMG/r881900111.html.

Based on years of research, the University of California has developed monitoring and treatment guidelines for managing spider mites in almonds and walnuts. These thresholds take into account the population densities of both spider mites and their

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predators (as well as the use of disruptive insecticides). Ideally, the goal is to maintain an adequate predator-to-spider mite ratio in the orchard to allow the natural enemies to assist in keeping spider mite populations below economically damaging levels. Decision trees based on these guidelines are shown in **Figure 1** (almonds) and **Figure 2** (walnuts) and can be found at www.sacvalleyorchards.com.

In almonds and walnuts, monitoring involves presence/absence detection of spider mites and their predators. This process saves time because it is not necessary to count individual spider mites and predators. Instead, the goal is to tally the numbers (or percent) of total leaves sampled that contain one or more spider mites and/or their predators. Monitoring in most years should begin by May (almonds) and June (walnuts) and continue at least weekly through August. Remember that warm conditions drive spider mite development and reproduction rates. Monitoring may need to begin

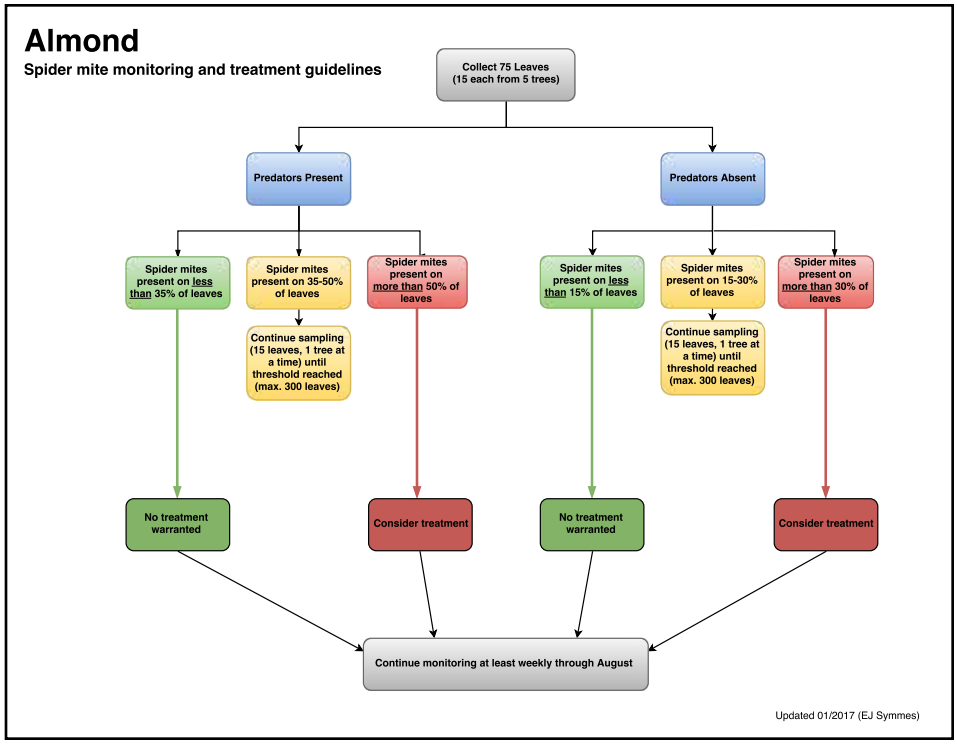

Figure 1. Almond Decision Tree: Spider mite monitoring and treatment guidelines.

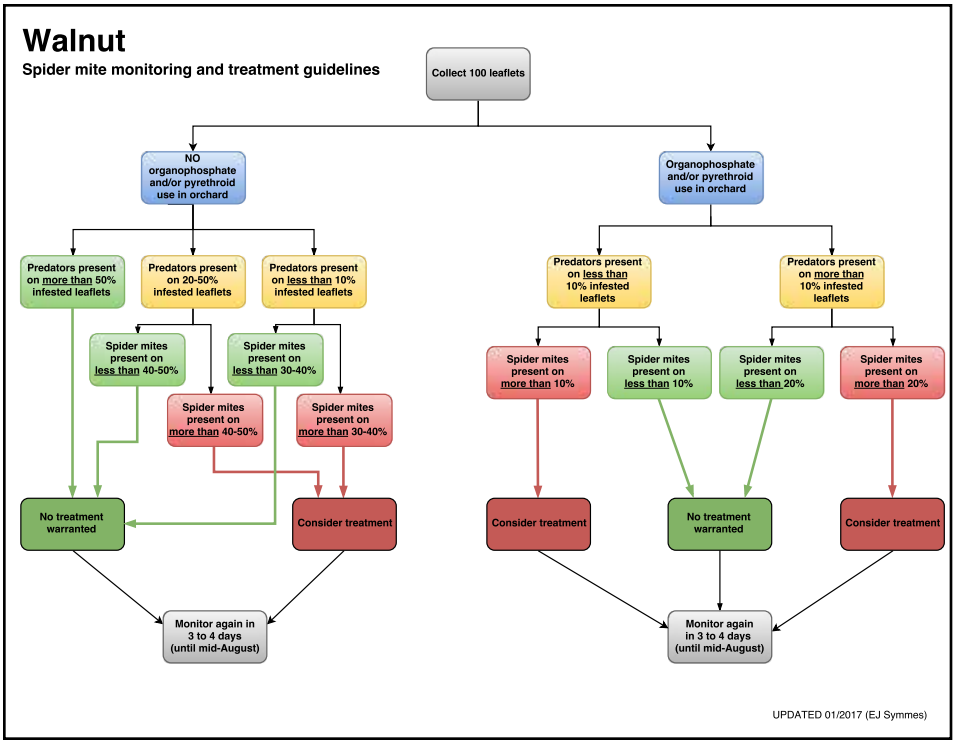

Figure 2. Walnut Decision Tree: Spider mite monitoring and treatment guidelines.

earlier some years and the frequency of monitoring should increase as temperatures increase.

In almonds, early season monitoring should focus on known hot spots or areas along dusty roads or with water-stressed trees. Once a treatment threshold is reached in these areas that are prone to developing spider mite outbreaks first, sample the remainder of the orchard to determine if spot treatments may be sufficient. Later in the season (typically after mid- to late June), monitor the entire orchard, dividing it into sampling areas that could be treated separately if thresholds are only reached in certain areas. Monitoring for spider mites in almonds involves a sequential sample, in which the total number of trees and leaves examined depends on numbers of leaves detected with spider mites and/or predators. The process begins by selecting 75 leaves (from 15 trees) in your defined sampling area, and looking for presence/absence of the pest and natural enemies.

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Randomly select leaves from all sides of the tree, and from inside and outside of the tree canopy. Tally the total number of leaves with spider mites and total number with predators. A monitoring form can be found at http://ipm.ucanr.edu/PMG/C003/almonds-mites.pdf. Results can then be compared to the decision tree **(Figure 1, p.18)** to help determine whether treatment is warranted at that time. If a decision is not clear after the initial 75-leaf sample, the process continues (15 leaves, a tree at a time, up to a maximum 300 leaves) until a decision can be made.

In walnuts, randomly select 10 trees per sampling block. Examine leaflets from low branches and from high branches in each tree, again noting presence or absence of spider mites and their predators on each leaf. A monitoring form can be found at http://ipm.ucanr.edu/PMG/C881/walnut-mitemon.pdf. Compare results to the decision support tree **(Figure 2, p.19)** to help determine whether treatment is warranted at that time.

Effective and sustainable spider mite management in almond and walnut orchards will only be possible through adoption of sound IPM practices. It may be tempting to treat spider mites prophylactically (i.e., before economic thresholds are reached), but take caution when choosing this method. Overuse of certain materials and the perceived benefits of a "free ride" (adding a miticide when treating for other pests or pathogens earlier in the season) may ultimately result in increased difficulty in managing these pests due to resistance development and destruction of natural enemy populations. While every orchard environment has its own unique set of circumstances, diligent monitoring and careful decision-making are the keys to maintaining economic and ecological viability when faced with our many pest management challenges.

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Sterile Insect Technology and Navel Orangeworm (NOW) in Pistachios

Kathy Coatney
Editor

Research is underway in Phoenix, Arizona, at the United States Department of Agriculture (USDA)/Animal and Plant Health Inspection Service (APHIS) on sterile insect technology (SIT) for navel orangeworm (NOW) management in pistachios, according to Bob Klein, manager of the California Pistachio Research Board.

The pink bollworm program is phasing out and about to be declared eradicated. "That program will be closed," Klein said.

"We have a number of former cotton growers and current cotton growers who are now growing pistachios, and they were quite interested in seeing whether this technique could be used to manage navel orangeworm," Klein said.

"We're starting to look at how that might be done. Our biggest problem, so to speak, is mass rearing navel orangeworm," Klein said.

Sterile Insect Technology

SIT is where the insect, in this case NOW, is sterilized through cobalt irradiation and then released. The idea is to make these moths sterile so that they can't reproduce once they're in the field. This was successfully done with pink bollworm in cotton, according to Earl Andress, an entomologist with USDA/APHIS in Phoenix, Arizona.

The navel orangeworm is a different species, and they have slightly different behaviors, and their size is a little different as well as what they eat, Andress said.

In order to raise mass numbers, we needed a different diet mix, Andress said.

"The procedures have to be changed a little bit. We can use a lot of the same equipment, and the same facility for mass production, but there are some little tweaks that have to be done with it, and there's a good bit of field research that has to be done," Andress said.

"Pink bollworm and navel orangeworm have two different ways of laying their cocoons," Klein said, adding so the big trick is to figure a way to mass produce NOW.

Brad Higbee, field research and development manager for Trécé in Bakersfield, California, agreed that there are challenges to SIT, but if they can be overcome, it could be beneficial to the pistachio industry.

SIT would be another tool in the toolbox, Higbee said.

"We have so few management tools. We just desperately need some more tools to fight this pest. It's a bad bug," Higbee said.

Mass Insect Production

Research began about a year ago, and researchers have been able to raise a few million a week, but it needs to get to the point where they're raising 30-60 million a week, Klein said.

"There's still quite a bit of work to do," Klein said.

Andress agreed, and said, "Our results so far look like we'll be able to mass produce this bug."

The research will also look at how competitive the sterile moths are with the wild moths, and how many of the sterile moths have to be released in order to effectively reduce the wild population, Andress said.

There will also be some field testing done to see if the sterile moths are sufficiently competitive in the field for SIT to work, Andress said.

"We've just started, and we've got a lot

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of work to do," Andress said.

Insect Distribution

Another issue could be the distribution of the sterile insects. With cotton, low flying airplanes were used to release the sterile insects onto the fields, Klein said.

"They survived without any problem. But if navel orangeworm can't do that, then we have problems there, too," Klein said.

"I expect we'll have a good idea about the feasibility within two or three years," Klein said.

"And if we assume that it is feasible, then we're going to have to talk to the growers of all the crops that suffer from navel orangeworm and come up with a control board that everybody can agree on that would be funded separately with all the growers," Klein said, adding pistachio growers couldn't do it alone.

Other Control Strategies

The pink bollworm project was done in combination with other techniques, and it has been quite successful. They have eradicated the pink bollworm from production areas in the U.S. and into a significant part of Mexico, Klein said.

Preliminary research has shown that NOW is a bit tougher than pink bollworm, Klein said.

"It takes a little bit longer to sterilize them, but we haven't done any field tests yet to determine how well they preform in the field," Klein said.

"The pink bollworm project was quite successful, but cotton has advantages with the pink bollworm that we don't have with navel orangeworm, and will probably not ever have," Klein said.

"For one thing, cotton can do a great job of sanitation because they had that mandatory plowdown date, and that did a great job of reducing populations to a very, very low level," Klein said.

When they came out with the GMO cotton, that also put an additional crimp in the pink bollworm reproduction, allowing them to eliminate the remaining population with sterile insects, Klein said.

The GMO variety and plowdown won't be options in pistachios and almonds, Klein said.

Another advantage with the pink bollworm was it had a host range that was very limited to cotton. NOW's host range is much wider, Klein said.

"Almost all of the host plants for navel orangeworm are perennials, so you can't plow them down. We just can't get the sanitation that cotton growers were able to get," Klein said.

But that doesn't mean that sterile insect technology wouldn't work for navel orangeworm, it will just have to be more finely targeted, Klein said.

Sanitation Challenges

Sanitation with pistachios is challenging because of the physical nature of the nut, Higbee said.

The same equipment that does a pretty good job of shredding almonds, isn't as

effective with pistachios, Higbee said.

"I always like to say, trying to shred pistachios is like trying to shred marbles—they're hard, they're small, they're round," Higbee said, adding we just need a new approach to the equipment that we use.

"There are some things coming along that might prove to be good for that purpose, but until the research is completed, it remains to be seen whether it'll be effective and economical," Higbee said.

And with the sanitation issues in pistachios, the SIT might be help in the meantime—if that research works out, Higbee said.

SIT is not going to be the answer to everything, Klein said.

"It's still going to require growers to invest in sanitation because we're obviously going to be fixed to some extent with the number of sterile moths we can produce, and if there's more fertile moths out there than you have sterile ones, you're probably not going to make that much impact," Klein said.

We also want to do over-flooding—make sure that far more sterile moths are released than there are fertile moths in the field, Klein said.

"We have of course insecticides, and we have mating disruption, pheromone puffer type thing, and so each of those would probably come in at different points in the life process," Klein said, adding it will be an IPM approach in conjunction with SIT.

Going Forward

If it looks like sterile insect technology research will be successful, the research will go on for a very long time, Andress said.

"It's not a one shot out there and we're done kind of deal," Andress said.

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

Cal/OSHA Considers New Regulation on Indoor Heat Stress

Roger Isom
President/CEO,
WAPA

Once again, the State of California has set out to create a solution for a problem that doesn't exist. Last year, the legislature in its infinite wisdom decided it was necessary for California to not only be the only state with an outdoor heat illness regulation, they passed legislation to mandate the Cal/OSHA adopt an "indoor heat illness" regulation. Accordingly, Cal/OSHA has now drafted and released a proposed standard entitled *Heat Illness Prevention in Indoor Places of Employment*. If enacted, the proposed standard would require employers to conduct the following:

- Establish, implement and maintain an effective heat illness prevention plan for "indoor heat illness"
- Measure the wet bulb globe temperature (WBGT)
- Identify each individual employee's work activity levels and clothing adjustment factors
- Conduct heat stress hazard assessment of all facilities
- Provide access to potable drinking water
- Provide for preventative cool-down rest periods of no less than 5 minutes
- Establish effective first-aid and emergency response procedures for responding to possible heat illness
- Monitor and observe unacclimatized employees
- Provide engineering controls to reduce employee exposures to reduce heat stress including but not limited to: isolation of hot processes or work areas, shielding of radiant heat sources, insulating hot objects, and local exhaust ventilation
- Provide administrative controls including but not limit to: reduced

activity levels, work-rest schedules and cooled rest areas
- Remind employees throughout the work shift to drink plenty of water
- Conduct pre-shift meetings to review high heat procedures
- Ensure that employees take a minimum ten-minute preventative cool-down rest period every two hours
- Make personal protective equipment, such as water-cooled garments, air-cooled garments, ice-packet vests, wetted over-garments and heat-reflective clothing available to employees exposed to high heat sources
- Provide effective training to each employee before the employee begins work
- Keep records of heat stress hazard assessments and trainings

The Association has reviewed the proposed standard and attended the recent workshop held in Oakland on the proposed standard. Based upon that review we have serious concerns with the proposed regulations and the impact they could have on agricultural operations, including tree nut farms, hullers and processors. We feel strongly that the proposed standard is not warranted or justified in the agricultural industry, is overly cumbersome and too complicated and costly to implement.

First and foremost, while we understand that legislation was passed and signed by the Governor that requires Cal/OSHA to "propose to the Standard Board for the board's review and adoption" a standard that minimizes heat-related illness and injury among workers in indoor places of employment, it does not state or require that the standard be applied across all industries, facilities or operations. In fact, the legislation (SB 1167) specifically states that the standard could be limited to "certain industry sectors." We believe that to mean industry sectors where indoor heat illness has been shown to be a demonstrated problem, and most likely sectors that have sources of high heat located within the buildings. In reviewing all reported accident information that we are aware of, we cannot find a single incidence of a worker in an agricultural building, (i.e. farm shop, cotton gin, huller, etc.) reportedly suffering from a heat related injury or illness. The applicability of this standard to the agricultural industry under this mandated standard appears to be unnecessary and unwarranted.

Second, for those that would be subject to the proposed regulation, the standard is much too difficult to understand and follow, let alone comply with. It is not reasonable, or prudent, for supervisors or foremen to be knowledgeable on "wet bulb globe temperature (WBGT)" or to utilize a

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WBGT device. Nor is it reasonable for supervisors or foremen to refer to a "chart" and compare and consider work activity levels, clothing adjustment factors, and acclimatized vs. unacclimatized employees. For those facilities that will ultimately be subject to this regulation, Cal/OSHA should utilize standard temperature thresholds and measuring devices and to limit the variables in terms of triggers. Any such standard must be easily understood and easy to implement, if the goal is to ensure widespread compliance.

Related to this concern with complexity is the proposed requirement to use a WBGT measuring device. Upon a search of www.amazon.com, (referenced by Cal/OSHA during the workshop) to determine the cost of a WBGT meter similar to the one on display at the Cal/OSHA meeting, it was determined that the cost to be $2,180.49. This is an unbelievable and unacceptable amount of money to determine rule applicability. This could be done much simpler and cheaper by using a simple thermometer and simple temperature thresholds. Since Cal/OSHA is required to follow the Administrative Procedures Act (APA), which would require a Cost Effectiveness Analysis to be performed, this section of the rule should change.

One particular area of concern is the requirement in subsection (c)(1) of the proposed rule, which requires the procedures in the Heat Illness Prevention Plan to obtain the active involvement of employees "and their representatives". For employees in a non-union setting, this is not only not applicable, it is not appropriate or legal. The need to have employees involved in the development of the heat illness plan is clear, but bringing outside direction, separate from the company will be highly problematic and opens the door to a lot of unwaranted issues. The requirement that includes "their representatives" must be stricken from the proposed code.

This was only the first draft of the proposed regulation and it is expected that many comments will be submitted to Cal/OSHA. What the final regulation will look like no one knows at this point. Only that there will be a regulation due to the legislative mandate. The Association will be commenting on the proposed regulation and urge Cal/OSHA to limit applicability of this rule to where it is truly needed.

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

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2017 ANNUAL MEETING

Wednesday, June 14th, 2017

Monterey Marriott Hotel – Ferrantes Bay View

5:30 pm Associate Member Appreciation Reception
7:00 pm Dinner "On Your Own"

Thursday, June 15th, 2017

Carmel Valley Ranch – Carmel

8:00 am WAPA Golf Tournament & PAC Fundraiser

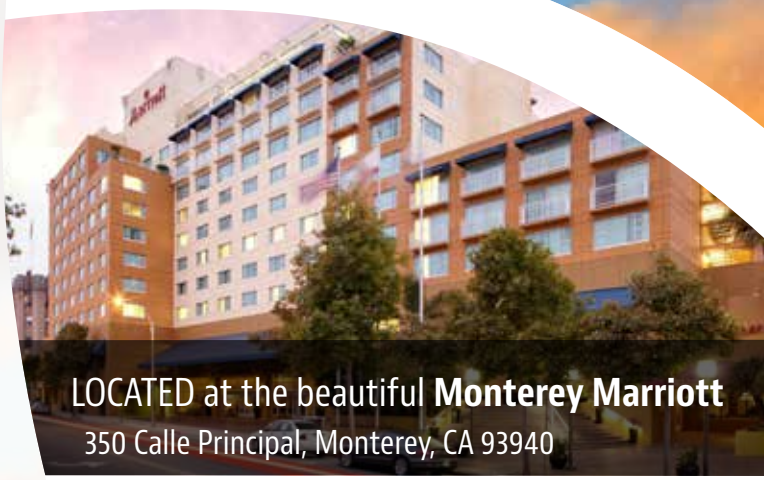
Monterey Marriott Hotel – Ballroom

12:00 pm Exhibitor Set-up Begins
5:00 pm WAPA Annual Meeting Reception & Exhibits
6:45 pm WAPA Annual Meeting Dinner
6:55 pm Dinner Sponsor Comments
7:05 pm Dinner
7:45 pm Passing of the Gavel – Recognition of Outgoing Chairman
8:00 pm Introduction of Guest Speaker
8:05 pm Special Guest Entertainment - Russ Stolnack, Comedian
8:45 pm Evening Wrap-up & Closing Remarks
9:00 pm Adjourn

Friday, June 16th, 2017

Monterey Marriott Hotel – Ballroom

7:30 am Continental Breakfast and Exhibit Opening
8:00 am Welcome and Introductions - Michael Kelley, Chairman, WAPA
8:10 am WAPA Financial Report - Todd Landry, Eadie & Payne
8:20 am Biomass – Where Do We Go from Here?
West Biofuels - Matt Summers
Technikon – Jim Stewart
9:05 am FSMA Implementation Panel
FDA – Mary Ellen Taylor, Health Communications Specialist, San Francisco District Office, US Food and Drug Administration
CDFA – Natalie Krout-Greenberg, Director, Inspector Services Division, California Department of Food and Agriculture
CDPH – Jane Reick, Unit Chief, Food Safety Inspection Unit, California Department of Public Health
9:50 am ***Break & Exhibits***
10:30 am Labor Update - Michael Saqui, The Saqui Law Group
10:50 am Sacramento Update - Louie Brown, Kahn, Soares & Conway
11:10 am Regulatory & Legislative Issues Update - WAPA Staff
11:45 am Board Actions and Closing Remarks
12:00 pm *** Lunch ***
12:30 pm Luncheon Speaker – Wells Fargo Agricultural Economic Outlook
Mike Swanson, Ph.D., Senior VP, Ag Economist and Consultant, Wells Fargo
1:00 pm Adjourn



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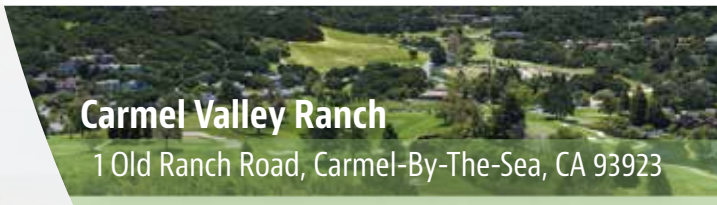

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Flooded Orchards

Past Experiences and What to Do in 2017

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

Greg Browne
USDA Plant Pathologist, UC Davis

Experiences with the 1986 and 1997 levee breaks in Yuba and Sutter Counties and other "high–water" events over the past thirty years afford us some expectations for the types and extents of tree damage that may result from orchard flooding in 2017. This article will first discuss some generalities of flooding damage and two key types of damage that tend to follow prolonged orchard flooding, i.e., waterlogging and Phytophthora diseases. Next, the article reflects on the floods in 1986 and 1997 and considers ways in which specific conditions associated with those floods seemed to affect orchard outcomes. Finally, we offer management steps to consider in dealing with orchard flooding in 2017.

Flood Damage Generalities

Tree damage from flooded soil is usually minimal if the flood occurs when the trees are dormant and the water continues to flow rather than remains standing in the orchard area. However, where water stands for extended periods in an orchard, two potential problems are of concern: **1)** waterlogging of the root system, and **2)** diseases caused by *Phytophthora*.

Waterlogging. Waterlogging can be viewed as an "oxygen starvation" effect of flooding. When an orchard soil is flooded or otherwise saturated with water, the air in its pore spaces is displaced, removing the supply of oxygen to the roots. The terminal portions of new walnut roots can be killed within one to four days in a saturated soil. As saturation is prolonged, damage to roots becomes greater and can lead to chlorosis, leaf wilting, and in extreme cases, entire root systems can be killed. As soil temperatures increase, the negative effects of waterlogging are accelerated. Walnut trees apparently survive waterlogging events during winter due to a combination of low soil temperature and a lack of active roots.

Waterlogging risk tends to be greater in "heavy" or compacted soils because of slower reentry of oxygen after saturation. Following floods in previous years, we observed less injury to trees growing in deep, permeable soils than to trees growing on soils with impaired vertical drainage caused by a claypan or hardpan.

Waterlogging damage to walnut trees can vary in severity, may not be immediately manifest, and can be difficult to discriminate from Phytophthora damage. For example, decline of walnut trees is sometimes not obvious until late spring or summer, when backhoe excavations can be used to confirm suspected waterlogging damage on walnut root systems. Boundaries between dead, waterlogged portions of major roots and crowns and living parts of the same roots tend to be poorly defined and occur in the absence of distinct cankers and lab diagnostics that indicate Phytophthora crown and root rot. Waterlogged tissues often have swollen lenticels.

Swollen lenticels (white raised areas) on clonal Paradox roots. *Photos by: Janine Hasey*

Phytophthora Diseases. Several species of the "water mold" *Phytophthora* are found in surface water sources such as our rivers and canals, as well as in infested soils. These fungal-like organisms can be carried along by the water and swim in it. After a levee break, the river water is a potential source of spreading *Phytophthora* inoculum throughout the flooded area. Flooding can bring active *Phytophthora* inoculum in contact with the aerial portions of trees, resulting in infections of the tree trunk, scaffolds and shoots. Flooding also increases the risk of root and crown infections by *Phytophthora*. Some Phytophthora species preferen-

Continued on Page 32

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tially infect roots, but many preferentially infect the root, crown, or aerial tree parts.

When *Phytophthora* infects woody tissues of trees above or below ground, it typically causes cankers (i.e., continuous, often-elliptical areas of dead bark, ranging from less than an inch to more than a foot across). The cankers often "bleed". Removing the outer bark from the margin of a canker typically reveals a distinct, zonate (with concentric lines) margin, which is in contrast to the typically diffuse, non-zonate margin and vascular streaking evident at the edges of dead areas of waterlogged roots.

In general, cool to moderate temperatures and water-saturated conditions in or on soil favor tree infection by *Phytophthora* species. Some *Phytophthora* species are more virulent than others, and risk of disease also depends on genetic resistance of the rootstock or scion. Within a given rootstock or scion, susceptibility to *Phytophthora* can vary with time of year. For example, in experiments on seasonal variation in susceptibility of walnut, almond, and peach rootstocks to *Phytophthora citricola* (which can cause root and crown rot and trunk and branch cankers), the rootstocks were least susceptible to infection during wintertime and most susceptible during the growing season. In contrast, infection by *Phytophthora syringae* in almond and peach is most likely during the cool conditions of fall, winter, and early spring. These cankers cease development when summer temperatures become lethal to this "cool-temperature" pathogen.

Reflections on 1986 and 1997 Flooding

1986. A subtropical storm brought heavy precipitation to northern CA and moderately high snow levels lasting for nearly 10 days, from February 11-20. Rainfall in the northern Sierra Nevada at 5,750 feet registered almost 56 inches. The water roared down the Yuba River where the levee broke February 20th in the evening flooding Linda and Olivehurst and acres of orchards. Walnut and prune orchards were flooded for 45 days from late February through mid-April.

1997. A polar system left several feet of snow in the Sierra Nevada on December 21-22, 1996. From December 26, 1996 through January 3, 1997, the weather pattern shifted to warmer and wetter storms of tropical origin that brought relentless precipitation, excessive runoff, and significantly melted the snow pack leading to widespread flooding. Oroville dam was spilling 160,000 cfs by January 1st and water was again roaring down the Yuba River. Late on January 2nd, a levee broke on the Feather River at Country Club Road in Yuba County flooding thousands of acres of orchards. Three weeks later, another levee gave way on the Bear River, causing more flooding in some of the same areas. In Sutter County, the west side of the Sutter Bypass levee broke in early January flooding the Meridian basin.

Based on what we learned from orchard responses to the widespread flooding in 1986 and 1997 and less-extensive flooding of river bottoms in several additional years, we have some expectations of the problems growers will face in orchards flooded this year. A major difference between the 1997 flood and that of 1986 was that the flood occurred in later February in 1986, when many tree crops were becoming active.

In 1997 by March, we observed waterlogging damage on collapsing peaches on heavier soil that had only been flooded a short time in January. Where trees are actively growing and then flooded, as in the river bottoms during our wet springs such as in 1995, most of the trees that died were in low areas where the water sat for prolonged periods. Those trees that were only in the fast-moving, cold water did fine,

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except for the submerged shoots.

After the 1986 levee break, water sat for several weeks in certain low lying areas. In these areas, as the water receded, symptoms of aerial infection by *Phytophthora* were apparent in some orchards. Aerial infections by *Phytophthora* were indicated by bleeding cankers in aboveground parts of trees, i.e., on trunks, scaffolds, branches, limbs, and hangers, as opposed to crown and root infections, which originate in soil. The aerial *Phytophthora* cankers on walnuts and prunes in 1986 tended to occur in orchards that had been flooded for about 45 days, from late February through mid-April.

After the 1997 levee breaks, we sampled flood waters in several orchards in the Arboga area (Yuba Co.) and Meridian (Sutter Co.) in early February. Using pear fruit to "bait" the *Phytophthora*, we found that every orchard location had species of the pathogen present. By mid-February 1997, we observed the first symptoms (amber colored gum) of aerial infections by *Phytophthora* on peaches, and soon afterwards the symptoms were seen on prunes. Cutting into the tissue below the gumming revealed reddish brown cankers. Many of these cankers, more on peach than on prune, continued to look active. With peaches in the flood zones and the river bottoms, there were multiple aerial *Phytophthora* infections on every tree in every orchard we surveyed, regardless of orchard age. Many of these orchards were flooded less than a week. By March 1997, we still had not seen aerial *Phytophthora* in flooded walnuts (bleeding in limbs and branches), suggesting that dormancy

In the 1986 flood, some walnuts were flooded for 45 days.

This resulted in aerial Phytophthora bleeding cankers and tissue damage (evident where bark removed).

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had offered them some protection from *Phytophthora*.

2017 Flooding and Management Considerations

Flood overview. From a series of tropical storms, we have experienced record-breaking rainfall events in January and February which have resulted in very high river flows for many weeks. At this writing, orchards **outside the levees** along the rivers either are or have been flooded from river seepage due to high flows and/or overflowing ditches/canals. With the record-breaking snow pack, there is uncertainty as to how long the rivers will have high flows or if we have a flood event during springtime. It likely will take months before the extent of losses from waterlogging and/or disease can be assessed. As the trees become active and the weather warms up, we can expect to start seeing losses that could continue through the hot summer when trees with damaged root systems or crowns typically collapse. From recent research, substantial root growth in walnuts begins about a month after leaf-out and peaks in the summer. This should work in our favor for orchards that are flooded or saturated this spring.

Management Guidelines to Consider

- Drain or pump standing water out of orchards.
- Reduce vehicle/farm equipment traffic. Wet soils are easily compacted. Delay all operations that can wait until soil is dry enough to crumble at a depth of five to six inches rather than slick over or pack.
- Apply sprays by air. The Department of Pesticide Regulation issued the emergency application of several fungicides to orchards with **standing water only** including Butte, Colusa, Glenn, Sutter, Tehama, Yolo, and Yuba Counties This will be in effect until June 1, 2017. See your local Ag Commissioner for more information on allowable fungicides.
- Apply a phosphonate spray in May where *Phytophthora* is found or suspected. A summer and early fall application may also be needed.
- Ridomil application is another option but is considered by some to be less cost effective than phosphonates for some Phytophthora diseases.
- Remove deposited silt and debris around the root crowns when possible to decrease the chances of root/crown decay.
- Plants are effective in drying waterlogged soils. Encourage the growth of cover crops or even weeds that will help dry the soil after flooding.
- Fill in eroded areas in orchards if soil is available. Deposited materials in many instances are beneficial.
- Check for salts (chloride and sodium); a continued high water table saturating surface soil may result in these salts accumulating or alkalization of certain spots which have shown these troubles before. Neither leaching nor gypsum treatments will be effective until the water table is lowered and good drainage can be achieved.
- For new orchards or replants where seepage is problematic, consider using clonal Paradox RX1; it has high resistance to *Phytophthora*, but more observations are needed to determine how it performs under prolonged waterlogging.

For additional resources please see Hasey's blog at: http://www.sacvalley-orchards.com/blog/walnuts-blog/ The blog covers several flooding-related issues not covered here, including guidance on documenting and reporting damage and losses, and locating possible disaster relief resources for flooded orchards outside and inside the levees, including riverbank sloughing, such as occurred extensively along the Feather River.

Reprinted from the Scramento Valley Walnut News, Issue 28, Spring 2017

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Almond Set and Subsequent Nut Drop

Kathy Coatney
Editor

Not all of the flowers on an almond tree will set a nut. It can range from between 15-40 percent set, but most orchards will set between the 20-30 percent, with an average of about 25 percent, according to David Doll, University of California Cooperative Extension (UCCE) tree nut farm advisor for Merced County.

This percentage varies year-to-year, and it is dependent on flower density, temperature at bloom and post-bloom, and tree health, Doll said.

Nut Set

Spur dynamics play a key role in fruit bud density and the ability for a flower to set. Research has found that a fruiting spur, if maintained in a position with ample light for photosynthesis, tends to alternate bear. These spurs may flower the year after cropping, but they rarely set a nut.

It's believed this is due to carbohydrate and nutrient depletion within the spur, so orchards that have a high set percentage deplete the spur pool, which means a reduced set the following year, Doll said.

Generally, most orchards are able to re-develop spur positions, which will lead to sustained yields, Doll said.

Developing and maintaining spurs requires proper irrigation, nutrition and adequate potassium levels. This will help to reduce spur mortality, Doll said.

Research has also found that set percentage is generally inversely related to flower density.

"This means that trees that have fewer fruit buds/flowers will set at a higher percentage than trees with a high fruit bud/flower count. This most likely is due to a greater amount of resources able to be allocated to a fewer number of buds. This compensation for the lower bud count, however, does not typically lead to a higher yield," Doll said.

Temperature

Temperature can also impact set. While, almond pollination and fertilization can occur over a wide range of temperatures, the ideal temperature or pollen tube germination and growth occurs between 50F and 70F, Doll said.

"Generally sunny temperatures during bloom in the 60s is a good thing as it actually can increase the rate of fertilization," Doll said, but rain will decrease pollination.

"Temperatures below (50F) or above (70F) can slow or prevent devel-

Photos by: Kathy Coatney

opment. Of even more importance is that the flower only remains receptive for three to four days. Extreme temperatures, rain or wind, can impact flower receptivity, decreasing nut set. Rain or excessive free moisture can also cause pollen grains to burst, preventing pollination," Doll said.

Nut Drop

There are three nut drops and this is nothing new, Doll said.

The first drop generally happens soon after bloom when defective flowers drop from the tree.

The second drop is when the nuts begin to get a little bit of size, about the size of pea, then they will drop from the tree, Doll said.

"That usually means that it was pollinating, but it wasn't fertilized. So that process of the pollen moving down the pollen tube kind of triggers the growth response of that nut, but for some reason it doesn't fertilize—make the seed in there before it drops," Doll explained, and that's somewhere around two for four weeks after bloom, depending on the variety.

"The third round is what we call—some people will call it a fourth because you can see kind of multiple rounds of this—but what you tend to see is this drop associated with the tree kind of coming into balance—what we call carbohydrate balance. The tree is kind of re-balancing it's crop load," Doll said.

The tree only has a certain amount of carbohydrate reserves that it's able to dedicate to certain growing points, Doll said. "It kind of realizes at some point that it's set too heavy, and that's when that third round will begin."

In the third round, the nuts can be from the size of a pea to the size of the pad of your finger—around a half to three quarters inch in length, Doll said.

"That's what usually gets farmers the most concerned. The first two drops, they kind of expect, but the third one, especially when they extend over a long period of time, that's usually when they get really concerned. And that's just natural—the tree's trying to balance it's load," Doll said.

There's really nothing growers can do to prevent nut drop besides having good pollination and the tree being in good health, Doll said.

Disease and Nut Drop

Nut drop can be related to disease, so it's important to be able to identify between normal drop and disease

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drop, Doll said.

"If you're seeing drop, you need to be looking at the nuts and if they're gumming, if they're orange, if they're blighted," Doll said, adding that's a different drop, and that drop could be associated with a disease.

"It's important to look at what's dropping from the tree and make sure that it's not disease or insect damage," Doll said, the bottom line is, know why the nuts are dropping.

"If it's heavier than normal, they (growers) should look back to the previous years' crop. Usually if you have a heavier than normal drop that means you set a pretty big crop the previous year," Doll said, and this is more than likely an alternate bearing situation.

"And if it's not an alternate bearing situation then you might want to look back at those post-harvest practices," Doll said.

Those would include:

- Irrigation
- Nitrogen
- Proper fertilization
- Any type of deficiency

"To recap, there are three nut drops," Doll said.

- The first occurs shortly after bloom when defective flowers drop from the tree
- The second about a month after bloom when flowers are about pea-sized, haven't shed their jackets, and drop from the tree—larger nuts may have been fertilized, but may also drop during this period
- The third drop are nuts that have been fertilized and dropped because the tree is re-balancing it's load

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Green Harvest from Down Under

Shaking in the USA.

Shaking in Australia.

Lighter almond kernels.

Photos by: Michael Coates, University of South Australia

Cecilia Parsons
Contributing Writer

Australian almond growers may have a smaller size industry compared to California, but they have big plans for their future.

Those plans involve initiating earlier stage harvest, keeping nuts off the ground at harvest, and on-farm hulling, drying, and storage of in-shell nuts.

While Australia's almond production does not match California's, it is still significant, now totaling eight percent of the global supply. The planting boom in the southern portion of the continent began in the mid 2000s and total acreage has reached 31,115 hectares or nearly 77,000 acres. Almond sales are about one-third of all crop exports from Australia.

Michael Coates, a researcher from the University of South Australia's School of Engineering, answered some of the burning questions about his "green harvest" research for West Coast Nut. He also presented some of his recent research on early harvest at the 2016 Almond Conference.

The phrase "green harvest," used for this research project, was meant to reference both the green hull color of the crop and sustainability, but Coates said it caused confusion and led to the belief they were aiming to harvest prior to hull split, which is not the case. He has suggested an alternative title for his research be "Advanced Harvest."

Coates explained the reasoning for this project that has been in the works since 2014.

"We wanted to have more control over when and how we harvest," Coates said in an email. "Getting fruit off the tree a bit earlier reduces pest damage and keeping the fruit off the ground introduces a whole new level of food safety."

Australia's almond growers have some challenges unique to their country that may be answered by more on-farm processing, Coates said. In Australia, long transport distances from orchards to hullers and handlers comes at a high

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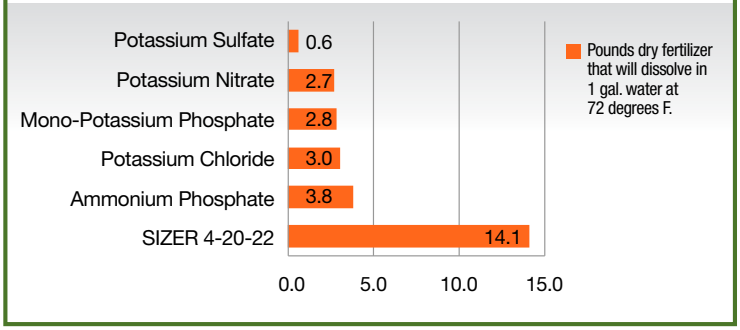

For more information including research results and scientific publications, contact:
Mark Brady, Western Marketing Manager, Plant Food Systems, Inc. (559) 731-1267

Plant Food Systems

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cost. Removing the hulls on-farm can reduce the volume by 60 percent, reducing costs and the number of trucks needed for transport. Dust concerns are another issue, Coates said, and by substituting the catch frame type harvest for the shake and sweep method, dust generation during harvest can be nearly eliminated.

Weather is another factor in the move to early harvest. South Australian almond growers have a good chance of getting rain towards the end of their harvest season while they are still shaking later cultivars.

Coates said that looking at the University of California's Integrated Pest Management hull split categories, the D and E stages appear to be good harvest windows. The A stage is a fully green, unsplit hull while the F stage is a gray color, fully split and dry hull. The D and E stages of hull split have a fully opened hull that is now beginning to turn gray on the edges and is losing its crisp shape. In these stages the hull is brown, but there is still significant moisture in the kernel—about 11 percent. This timing is about three weeks prior to normal start of harvest, he said. The majority of the nuts would be in the D–E stage, but there would also be nuts in the F and C stages. Any nuts still in the A and B stage are likely stick tights and next year's mummies.

Coates said that in the almond trees monitored for his study, there have been some nuts that develop early and some late, with the majority in between the extremes. Both the early and late tend to have a smaller, lighter kernel, but most have good kernel weight and a stable nutrient profile about three weeks prior to the traditional harvest window.

Reduction of crop damage from insect pests is an incentive to initiate early harvest. Coates said there is plenty of research that shows early harvest reduces the occurrence of navel orangeworm. In Australia, the carob moth is a similar pest. Shaking the trees prior to the third flight will reduce damage and improve quality. Removal of hulls on-farm will also expose the eggs prior to hatching.

Use of modified machinery to shake and catch the nuts fits in well with both food safety concerns and dust reduction efforts. In his presentation, Coates showed use of harvest equipment similar to that used in pistachio harvest, with the nuts moved on belts to storage bins. Smooth orchard floors are necessary for movement of machinery, but they do not have to be entirely free of ground cover.

Success with in-field hulling is moisture dependent, Coates said. Traditionally hulls are removed by shearing the hull, but that requires a very dry hull. With the advanced harvest, hulls are removed with an impact style huller that creates an in-shell product and a loose hull or hull fragments. Coates said impact hulling has produced good results in almonds that still have a moist, flexible hull in the mid stages of hull split.

Mechanical dehydration of the in-shell almonds and aerated on-farm storage are key components in the advanced harvest study. Preserving kernel quality in the dehydration process has been part of the research. Main concerns are skin quality, brown centers and cavities. According to United States Department of Agriculture (USDA) Agricultural Research Service (ARS), the pellicle or seed coat of almonds is affected be environmental conditions. Genetic factors also play a part.

Coates' presentation at the annual Almond Conference showed that almonds harvested in the earliest stages of hull split and dried outside the shell had uneven color, inconsistent texture and detached pellicle. High temperature drying, over 60 degrees Centigrade in-shell, led to a flaky pellicle. Lower temperature, below 40 degrees Centigrade produced consistent golden color and no pellicle damage.

Cavities exist under current drying conditions, Coates said. Avoiding rapid removal of moisture will result in reduced incidence of cavities. Early harvested nuts cannot be held at high temperatures while drying or brown centers will occur. Quality can be preserved in early harvested almonds, he said, if the 11 percent moisture level is targeted and if drying is intermittent to manage rate of moisture loss to prevent cavities and if low kernel temperature is maintained to prevent brown centers.

Like California, the traditional use for almond hulls in Australia has been for cattle feed. This market is changing, Coates said, and there are no longer the same returns growers are expecting and the market is shrinking. The move to on-farm hulling will mean looking at alternative uses for the hulls. Coates noted that there is significant value in keeping the hulls on farm to return nutrients to the soil. One method is to grind them and spread on orchard floors. With shake and catch harvest, there is no immediate need to incorporate the hulls into the soil to maintain a smooth, clean floor. Once the hulls are ground, he said they break down at a rate that will not create a biological hazard. If the hulls are kept from reaching the ground they qualify for food grade processes that can make use of the sugars, fiber and polyphenols contained in the hull. In addition, there are many biomass applications such as gasification, torrefaction and fillers for a range of products under exploration.

Safe storage of in-shell nuts on farm is also dependent on moisture and temperature. Maintaining water activity below 0.65 will prevent growth of aflatoxins and other pathogens that affect food safety.

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

Distribution Test Is the Foundation of Irrigation Accuracy, Efficiency

Almond Board of California
Contributing Writer

Whether your almond orchard's irrigation system is old, new or somewhere in between, chances are some trees are getting too much water and others not enough. A simple distribution uniformity (DU) test will reveal your system's accuracy, and suggest where adjustments need to be made.

Would you assume a professionally engineered and newly installed system will deliver the expected amount of irrigation water to each tree? Not necessarily, as first-time almond grower Aim Khan found out the first season after he planted a block of Nonpareils with Aldrich and Wood Colony varieties in Stanislaus County in 2015.

"The following year, leaves on some trees were turning yellow because they were getting too much water, and in other areas, the trees were not even growing," Khan said. He had hired a company to come up with a design that would work best on his sloping 40-acre block, and another company to install the system according to the design.

Water Pressure Variation

But Khan found out that "you cannot rely on the design [of the system]." He added, "In reality, the water pressure could be different from what was expected. We were supposed to be getting 40 pounds per square inch on top of the hill, and some of those trees were not even growing."

Khan turned to Irrigation Matters, a service-based irrigation and water management company, to assess his irrigation system and determine what adjustments were needed. After noticing large differences in the wetting patterns and standing water in some areas of the field, John Denlinger, water agronomist for Irrigation Matters, decided to perform a distribution uniformity test on Khan's system. "By evaluating the distribution uniformity of the field, we were able to determine that the issue was that the designed irrigation system was not the same system that had actually been installed," Denlinger said.

Design, System Different

Because the system did not match the design, consequently, 70% of the field had above-average pressure, while 30% of the field had average or below-average pressure. Where ideal

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Stanislaus County almond grower Aim Khan recommends a DU test, even for a new system, which may not have been installed according to the design.

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pressures would have been 20 and 26 pounds per square inch (psi), respectively, instead, they were getting 16 psi and 42 psi. As a result, a big portion of the field had 173% of the expected pressure, while another part of the field was getting 82% of the expected pressure.

Khan's system uses microsprinklers rather than drip in order to address the potential to frost. Originally, these were Nelson R10 0.5 gpm FC nozzle P4 9-degree plate sprinklers, which began malfunctioning in the first year. And with the difference in pressure, "Some of the trees were getting no water, and some trees were getting flooded because the sprinklers were not functioning properly," Khan pointed out.

Pressure-Compensating Sprinklers

To compensate for the uneven distribution, Khan said that he replaced the sprinklers with pressure-regulating Rivulis S2000 microsprinklers "just to be sure each tree gets some water." And, he noted, "The flow control provides a little more consistent output."

Now that Khan's microsprinklers are different from the originals, the entire system's infrastructure has to be altered to match up with the new sprinklers, explained Spencer Cooper, senior manager, Irrigation and Water Efficiency, Almond Board of California. "Flow control only works if your system is within a certain pressure range, according to manufacturer's specifications," he remarked.

The system will be retrofitted so that there is a more uniform pressure throughout the orchard, and a flow meter will be installed to monitor the pressure from one end of the system to the other to be sure there is uniform pressure throughout the field, observed Khan. Once the infrastructure has been retrofitted, and armed with data from two real-time soil moisture sensors installed last fall, Denlinger

Khan installed pressure-compensating microsprinklers as an interim fix when a DU test revealed uneven irrigation distribution across his sloping orchard.

will work with Khan to determine when to irrigate, using evapotranspiration (ET) and soil moisture information gathered from his real-time soil moisture and weather station.

"I would definitely recommend a DU test, even for a new system," Khan said in retrospect. "If I had done this when the system was first installed, the trees would not have suffered, and I would not have wasted so much money. Testing is a benefit all the way around, resulting in less water use and more uniform tree growth."

Almond Irrigation Improvement Continuum

Step-by-step directions for evaluating the accuracy of microirrigation and other types of irrigation systems can be found in the section on Irrigation System Performance of the online document "Almond Irrigation Improvement Continuum 1.0," available both as a PDF and a mobile-friendly EPUB.

Before you take steps to personally evaluate your irrigation system, Cooper recommends you check to see if there is a mobile irrigation lab in your area. Mobile labs across the state are sponsored by a local agency (county, Resource Conservation District, water district, etc.) in partnership with the California Department of Water Resources. They are experts in irrigation system evaluation and will do the evaluation for minimal or no charge. Currently, there are 12 to 15 mobile labs working in California, with five in the Central Valley. Commercial companies in your area may also do irrigation system evaluations for a fee.

Maintenance, Adjustments

"It's important for growers not only to maintain their irrigation systems, but to also understand the overall impact that maintenance has on the life of their irrigation infrastructure," Cooper stressed. "Taking the steps to evaluate your irrigation system and making adjustments has the potential to improve your distribution uniformity, and could also greatly improve your irrigation efficiency."

If there is more than a 20% difference between pressure readings, it is likely that the application uniformity is not as good as desired. Therefore, consult an irrigation professional, who may be able to make a recommendation to improve the pressure uniformity.

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

The ABCs of ATVs

Amy Wolfe, MPPA, CFRE
President, CEO
AgSafe

In today's agricultural industry, all-terrain vehicles (ATVs) have become an increasingly critical tool in managing operations in the orchards. Starting in the 1980s, when companies began exploring how ATVs could be used in a variety of on-farm capacities, there are now tens of millions of these pieces of equipment being used in agriculture across the United States. As a result, it is critical to know the hazards associated with ATVs and how to operate them safely.

The Law

It is important to understand that ATVs, when used in an agricultural operation, are legally viewed differently than when being operated recreationally. If you are enjoying an ATV for fun or in any personal capacity, the safe use is governed by California Vehicle Code 38503 and enforceable by both local law enforcement agencies as well as the California Highway Patrol.

Alternatively, when used in an agricultural operation, the legal jurisdiction falls to the Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA) and is guided by the California Code of Regulations, Title 8, Section 3664. This section specifically refers to the operating rules of agricultural equipment. It specifically lays out what is required of an operator in terms of safely using the equipment. To read CCR, Title 8, Section 3664 in it's entirety, visit https://www.dir.ca.gov/title8/3664.html.

All-terrain vehicles (ATVs) have become increasingly popular in ag operations, gaining momentum in use starting in the 1980s. Photo by: Kathy Coatney

Essential Elements of an ATV Safety Program

Given that CCR, Title 8, Section 3664 is so explicit in its directive on how to safely operate agricultural equipment, it should come as no surprise that an organization needs to have a written ATV safety program that includes a number of important elements. Programs need to outline expectations of safe operation, maintenance, vehicle pre-inspection, appropriate personal protective equipment (PPE) to be worn, and how the protocol for responding to an ATV-related emergency. As with any written program, employees operating these machines need to be trained in the program's elements as well as be educated in how to safely operate the ATV.

Here are a few key concepts to keep in mind relative to the needed elements of an ATV safety program[1]:

Safe Operation

Use the elements outlined in CCR, Title 8, Section 3664 as your guide:

- Avoid operating the ATV near ditches, embankments, and holes.
- Reduce speed when turning, crossing slopes, and on rough, slick, or muddy surfaces.
- Stay off slopes too steep for safe operation.
- Watch where you are going, especially at row ends, on roads, and around trees.
- Do not permit others to ride.
- Operate the ATV smoothly—no jerky turns, starts, or stops.
- Hitch only to the drawbar and hitch points recommended by ATV manufacturers.
- When ATV is stopped, set brakes securely and use park lock if available.

Vehicle Pre-Inspection

- Create an ATV pre-inspection checklist log to be reviewed and signed daily by operators.
- Ensure that the log has space for operators to note any maintenance-related issues.
- Coordinate log review by the operators' supervisor and/or maintenance staff to ensure that maintenance issues are reported to maintenance in a timely fashion.
- Pre-inspection checklists should include, at minimum, review of:
  - Tires and wheels
  - Controls and cables
  - Lights and electrical systems
  - Oil and fuel levels
  - Chain and/or drive shaft
  - Brakes
  - Caution and warning labels
  - Emergency tool kit
  - First aid kit

[1]*This is not a complete list of elements. A complete ATV safety program must include company-specific protocol, hazards, unique identifiers and other applicable processes unique to each individual operation.*

It is imperative that ATV operators wear the correct and complete personal protective equipment (PPE), including a USDOT helmet, gloves, long sleeve shirt/jacket, long pants, gloves, and boots. Photo courtesy of: AgSafe

Personal Protective Equipment

The leadership of each business needs to consider the various uses for ATVs within their operation to best determine the most complete list of personal protective equipment that needs to be worn by operators. All PPE must be provided by the employer at no cost to the employee. PPE should include, at minimum, the following:

- US Department of Transportation (USDOT) approved helmet
- Eye protection
- Gloves
- Boots
- Long-sleeved shirt
- Long pants
- High visibility vest/jacket/outer clothing

Now What?

With the busy season upon us, it is critical that agricultural operations use the precious remaining time to ensure they have a complete and robust ATV safety program in place. According to the US Department of Labor, California leads the nation in the number of annual ATV fatalities which is as much a reflection the wide-spread use of these pieces of equipment as it is our not having holistic safety operating programs in place. Do not allow your employees to become a statistic and invest the time now into creating the safest possible ATV program.

For more information about ATV safety, do not hesitate to contact AgSafe at www.agsafe.org or 209-526-4400. AgSafe is a non-profit organization whose mission is to advance the food and farming industries commitment to a safe, sustainable workforce and food supply, by providing practical education and resources.

Since its formation in 1991, the organization has trained over 60,000 growers, farm labor contractors, packers, shippers and processors, along with their supervisors and workers, in the most critical safety, health, human resources and food safety issues.

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

Agriculture Technology

Pressure Bomb App Simplifies Precise Irrigation Management

Ryan Kaplan collects a leaf for testing from a young almond tree. A plastic bag is wrapped around the selected leaf and left for ten minutes to stabilize the sample. A leaf sample is taken from five trees to obtain a good average. The site of the sample should be representative of the area, as far as soil and moisture are concerned.

Photos by: Len Wilcox

Len Wilcox
Contributing Writer

Precise irrigation management is a matter of achieving the right balance of water in the soil to the amount of water needed to efficiently create the best crop. It's much easier to define than to achieve, however. Too much water is almost as bad as not enough. So how much is the ideal amount of water?

It's a burning question, one that 2nd-generation farmer Ryan Kaplan from Chico, Ca., wanted to answer during the recent drought. Ryan and his father, Ken Kaplan, farm 600 acres of walnuts, pistachios and prunes. While finding the answer to his question, Ryan developed a software program that greatly simplifies using a pressure bomb system to monitor moisture in his trees. He tested it out and fine-tuned it on his own farm then found ways to use it to improve their crop. His finished software—"Pressure Bomb Express"—

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Continued from Page 50

makes it possible for any commercial grower to incorporate pressure bomb testing into their irrigation management system.

From his studies at California State University, Chico, Ryan knew that finding out how much water is enough has been the goal of colleges around the state. From the reams of data they have accumulated, a picture is emerging that balances the amount of water in the soil with the amount of water in the plant. This information helps the grower to apply what the trees actually need—taking into account the crop, growing conditions, soil, weather, solar heat load, and so on. By using this data, Ryan works to grow the best crop possible, ensuring their plants always have the ideal amount of water.

"Pressure Bomb Express takes the guesswork out of the picture," he said, "while at the same time increasing the orchards' health and reducing the risk of diseases."

The device used to measure moisture in the plant is a pressure chamber, which shows how much water stress the plant is experiencing.

A UC Davis web page explains how pressure testing works. "…the pressure chamber is just a device for applying air pressure to a leaf (or small shoot), where most of the leaf is inside the chamber but a small part of the leaf stem (the petiole) is exposed to the outside of the chamber through a seal. The amount of pressure that it takes to cause water to appear at the petiole tells you how much tension the leaf is experiencing on its water: a high value of pressure means a high value of tension and a high degree of water stress[1]." The resulting number directly relates to the dryness of the plant and the soil around the root system.

This number tells the grower the amount of stress the tree is experiencing at that moment. The problem is, getting to that point requires collecting extensive data, skilled labor, and quite a few calculations. Growers end up having to build a custom spreadsheet that takes into account the many variables that need to be measured, or they must record it all by hand. This ends up being time-consuming and inefficient.

And that is the problem which Ryan Kaplan's software solves. He has simplified the process so that almost anyone can be trained to conduct the test and interpret the data.

"The software instantly does all of the calculations and shows the grower exactly how stressed each of their irrigation blocks are," he said. "And it will give them guidance on how to adjust in order to keep their trees in perfect condition throughout the growing season."

Collection of the data is done in the orchard by a trained field worker who collects five samples from

The leaf petiole is inserted into the viewing chamber while the rest of the leaf hangs into the pressure chamber.

A PMS Instrument Company Model 615 Pressure Chamber Instrument.

the trees at a specific location. This location should be chosen wisely with appropriate soil and moisture conditions that represent the field. As many locations as needed can be created for testing purposes.

Local weather data and the pressure chamber test results are recorded in a cell phone app. This data is uploaded later, whenever cell or internet service is available, to a web page accessible to the grower. The grower can review the results as soon as the data is uploaded.

With data provided by the UC on databases accessed by the App, the grower compares his readings with levels recommended by the UC, and knows when and how much to irrigate. Kaplan is quick to point out that the purpose of the App isn't to save water so much as it is to increase crop size and quality.

"If an individual grower has historically been stressing their trees then they may use more water than they did the year before, but their orchard health is going to benefit," he said. "If a grower has historically been over irrigating their orchards the pressure bomb is going to alert them of it. They will be able to cut back and save water while at the same time increasing their orchard's health and reducing the risk of diseases. The pressure chamber helps some growers save water. But it also helps others by having them apply more… It really depends on how the grower has been irrigating in the past."

For more information about Pressure Bomb Express, visit the company's website at http://www.pressurebombexpress.com.

Editor's note: We are always pleased to hear from our readers with requests for information or review of high-technology farming equipment and apps. We'd like to know more about your needs and interests in this field. Let us hear from you. Feel free to send us an email at article@jcsmarketinginc.com with suggestions of Ag Apps or Ag technology to review.

Resources

1. http://fruitsandnuts.ucdavis.edu/pressure_chamber/

Almond Board of California (ABC) has unveiled its 2017 Almond Leadership Program class, a group of 18 future leaders representing nearly every aspect of the industry: growers, processors, suppliers, retailers and pest control advisers.

Participants will spend the next year in a structured program, with the oversight of volunteer mentors, preparing them to become leaders not just within the California Almond industry, but also in their communities.

The class will complete specialized training in a wide variety of topic areas, such as food safety, biomass utilization, honey extraction and nutrition research. Over the course of the year, they will spend time in nurseries, almond orchards, a U.S. Department of Agriculture (USDA) research facility, and other venues where they will get hands-on experience and training.

Along the way, the participants will build relationships and develop communications skills; gain a clear understanding of current social, political, scientific and economic issues facing the almond industry, as well as how to effect change; and learn how all sectors along the almond supply chain work together to provide a safe, sustainable[1] product.

At the end of the year, each participant will have to present their findings from a yearlong self-directed project designed to advance industry knowledge in an area of interest to them. In the past, some of these projects have led to important breakthroughs for the industry. ABC is currently conducting follow-up research on the promising initial project of one of last year's Almond leaders around an alternative use of almond hulls and shells.

"We are so fortunate to have this program," said Kent Stenderup, a member of the ABC Board of Directors and also a volunteer mentor for this year's Almond Leadership Program. "As an industry, we get to interact with the best and brightest individuals who will lead us in the decades to come. This program grounds these participants in the latest industry knowledge, but also teaches them how to be leaders, and to understand the responsibilities that come with that."

This year's class has also pledged to raise $25,000 for California Future Farmers of America (FFA) scholarships.

Over the past eight years, the program has graduated more than 100 participants. Daniel Bays of Westley is one of those alumni. The third-generation grower was in the program in 2013.

"I loved going through the Almond Leadership Program," he said. "It was invaluable for me. Even as someone who grew up in the industry, I had a lot to learn. The attention to the curriculum, as well as the emphasis on leadership and the responsibility we have to give back to our communities, are what I took from the program."

Members of this year's class include: Lucas Avila, Farmland Management Services; Annie Benisch, Stewart & Jasper; Christina Brichetto, Terra Nova Trading Inc.; Brennon Christopher, Semios; Devin Clarke, Stanislaus Farm Supply; Kevin Esau, Arysta LifeScience; Luke Heuer, Heuer Farms; Ashley Hollis, Almond Alliance of California; Robert Holtermann, Holtermann Farms; Marcus McClure, Gar Tootelian, Inc.; Chris Parreira, RPAC; Michelle Penney, Del Rio Nut Company; Sharon Rucker, Law Office of Sharon E. Rucker, PC; Bret Sill, Sill Properties Inc.; Bikramjit Singh, Bapu Almonds Co., Inc.; Katelynn Staack, Grizzly Nut; Ryan Sunzeri, Sunworks; and Cameron White, Sierra View Ranch.

The Almond Leadership Program is sponsored by Sunworks, Inc. for 2017.

About California Almonds

Almonds from California are a natural, wholesome and quality food. The Almond Board of California promotes almonds through its research-based approach to all aspects of marketing, farming and production on behalf of the more than 6,800 almond growers and processors in California, many of whom are multi-generational family operations. Established in 1950 and based in Modesto, California, the Almond Board of California is a nonprofit organization that administers a grower-enacted Federal Marketing Order under the supervision of the United States Department of Agriculture. For more information on the Almond Board of California or almonds, visit Almonds.com or check out California Almonds on Facebook, Twitter, Pinterest, Instagram and the California Almonds blog. For additional facts and statistics about almonds and the almond industry, please read the 2016 Almond Almanac.

Have an update to share about industry news, events, or products? We want to hear what you have to say! Submit your content to:

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Central Valley Almond Day

June 9, 2017
7:30am - 1:30pm

FREE EVENT
& Trade Show

Fresno Fairgrounds Commerce Building
1121 S. Chance Ave, Fresno, CA 93702

Central Valley Almond Day Agenda

2.5 CE Credits* (0.5 Laws, 2.0 Other) and CCA Credits Will Be Requested

7:00am - 7:30am	Registration, Coffee, and Donuts
7:30am - 8:00am	Trade Show*
8:00am - 8:30am	Micro-irrigation System Design, Maintenance and Management for Almonds Dan Munk, UCCE Irrigation and Water
8:30am - 9:00am	Laws and Regulations Update* Gilbert Urquiza, County Ag. Commissioner's Office
9:00am - 9:30am	Zinc: The Mighty Micronutrient! Bob Beede, (Retired) UCCE Farm Advisor Emeritus
9:30am - 10:00am	Identification of Pest and Non-pest Ant Species for Management Decisions* Kris Tollerup, UCCE IPM Advisor
10:00am - 10:30am	Break
10:30am - 11:00am	Whole Orchard Recycling and the Effect on Second Generation Tree Growth and Soil Fertility Brent Holtz, UCCE Farm Advisor
11:00am - 11:30am	Management of Almond Replant Disease & Anaerobic Soil Disinfestation* Mohammad Yaghmour, UCCE Orchard Systems Advisor
11:30am - 12:00pm	Weed Control Update for Tree Nut Orchards* Brad Hanson, UCCE Weed Specialist
12:00pm - 12:45pm	Industry Tri-tip Lunch Yara Sponsored Presentation: Benefit of Calcium Nutrition for Almond Production Daniel Cathey, Farmer Engagement Manager
12:45pm - 1:30pm	Trade Show*
1:30pm	Adjourn

*Sessions counted toward CE credits pending DPR approval

Hosted By:
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