Pomology Notes - Almonds

Preharvest, 2016

University of California
Agriculture and Natural Resources | Cooperative Extension

In This Issue

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UPCOMING MEETINGS

Dust Control/Sustainability Field Day

Friday, July 8, 2016 -- 8:30 to noon. Nickels Soil Lab. Green Bay Ave, Arbuckle
CCA CE hours requested. Hosted by Almond Board of CA and the Nickels Soil Lab. Free lunch. Please RSVP to Rebecca Bailey at rbailey@almondboard.com or 209-343-3245.

- Demonstration of Flory 8700 low dust, self-propelled harvester
- Review practices to maintain good nut sweeping and pickup while reducing dust and equipment wear.
- Review CASP program and sustainability modules

Almond Production Short Course

November 8-10, 2016 -- Modesto, California
Registration will be open on July 1 for this integrated orchard management short course featuring UC faculty, Cooperative Extension specialists and farm advisors, and USDA researchers who will provide an in-depth, comprehensive study of all phases of almond culture and production.

This course is designed for new and experienced growers as well as other industry members interested in commercial almond production. For more information, go to http://ucanr.edu/almondshortcourse.

New Website Resource for Sac Valley Tree Crop Production

The UC Cooperative Extension orchard crop advisors in the Sacramento Valley are excited to announce the launch of our new website – the Sacramento Valley Orchard Source! This site will bring together the wealth of information we provide in one location, including:

- Timely newsletter articles through our Blog (we'll continue to send email and hard copies of the whole newsletter for those who prefer it that way).
- Weekly Soil Moisture Loss (ET) Reports for the Northern and Southern Sacramento Valley
- Pest Catch Reports based on weekly scouting in the Northern Sacramento Valley
- Crop-specific production and management information for almonds, prunes and walnuts
- Calendar of area Cooperative Extension meetings & events

We've built this site for you, the growers, PCAs, managers and allied industries. Please let us know what you think so we can continue to improve it.

Visit us at http://www.sacvalleyorchards.com/ to check it out!

PREHARVEST/HARVEST ALMOND ORCHARD PRACTICES TO CONSIDER

JUNE:

- **Irrigation**: Moderate water stress (roughly -15 bars measured by pressure bomb) early in hull split (late June-early July) can speed up time of 100% hull split, improve nut removal and/or reduce hull rot incidence. This practice, known as Strategic Deficit Irrigation (SDI), is a key piece of a complete hull rot control program. Because strong irrigation stress (at or below -20 bars) can cause leaf loss and reduce future crop size, this SDI should be approached with caution and carried out using a pressure bomb to carefully track orchard water stress. See details for this practice at: http://thealmonddoctor.com/2012/08/05/irrigating-from-hull-split-to-harvest.
- **Hull split spray**: Decide if an early hull split spray is needed using trap catches and past grade sheets. Almond nuts are vulnerable to feeding by navel orangeworm (NOW) and/or peach twig borers (PTB) once hull split begins. NOW is the major concern every year. PTB can damage nuts, especially when hull split starts at spray timing for PTB (1300-1400 DD from biofix). [It looks like PTB spray timing will be ahead of hull split this year, at least in the Arbuckle area of Colusa Co.]

  Excellent spray coverage is needed for best worm control with insecticides (although, even then, only 30-50% control may be gained as the drying hulls expose more vulnerable tissue after sprays have been applied. Slow sprayer speed (2 MPH) deliver the best possible NOW control in UC and USDA trials. Night spraying (higher relative humidity) allows better spray coverage compared to warm daytime (dryer air) spraying. If you spray around the clock, consider upping your spray gallons per acre when relative humidity is less than 40%.
- **Spider mites**: Monitor spider mites -- as well as beneficial insects or mites -- on a weekly basis. Mite populations build quickly in hot weather. Beneficial insects and mites can keep a lid on spider mites if the weather isn't constantly very hot. (So far this season, I haven't seen mites flare up…yet.) Defoliation at harvest due to mite feeding (or rust or water stress) can hurt next year's crop and slow the drying of this crop. Even if you have put on an early miticide (abamectin, Onager®, Envidor®, etc.), spot check to make sure mites stay under control once the miticide residue fades.
- **Ants:** The longer harvested nuts are on the orchard floor, the higher the risk of damage from ant feeding. If protein feeding ants are in your orchard at damage causing levels (see ant monitoring details at http://ipm.ucanr.edu/PMG/C003/almond-antcolony.pdf), bait for ants ahead of harvest. For the most effective ant control, match application timing and ant bait material. In recent research by David Haviland, UCCE Kern Co, Clinch® ant bait applied in late June needed 5 weeks to reduce feeding ant numbers compared to untreated controls, but the control lasted into September. In comparison, Altrevin® -- applied at the same time as the Clinch® -- reduced ant feeding within four days, but ant counts were back to untreated control levels by mid-August. Check with your PCA about ant bait timing and irrigation sets.
- **Hull rot:** Consider applying a fungicide early in hull split if a block has a history of hull rot and/or conditions favor hull rot (higher humidity or rain/showers). Tank mix with a hull split spray if spraying for NOW. Non-pareil is particularly sensitive to hull rot. For effective materials for hull rot control, see http://ipm.ucanr.edu/PDF/PMG/fungicideefficacytiming.pdf. Fungicide programs for hull rot control reduce the number of strikes by 40-80%. For best hull rot control use cultural (water and nitrogen management) plus fungicide(s). Moderate irrigation stress early in hull split (SDI) and limiting nitrogen fertilizer application to avoid excessive summer leaf N levels are part of a complete hull rot management program. [David Doll, UCCE Farm Advisor in Merced Co, recommends no N fertilization between mid-May and harvest in blocks with hull rot history.]

JULY:

- **Hull split spray**: If there is a history of worm damage or high egg trap counts this season, a second hull split spray targeting Non-pareil and pollinizers may be helpful in reducing reject numbers. Timing of second hull split spray depends on your harvest schedule and NOW generation timing. [Very little to no NOW eggs are laid on nuts on the orchard floor.] If you can get the Nonpareil nuts on the ground before the third generation egg laying starts (about 1800 DD from biofix), then consider applying the second spray when the residual from the first spray is expiring. If you can't get the Nonpareil nuts on the ground before the start of the 3rd generation egg laying, it might be better to wait until just ahead of the egg laying (3rd gen) before spraying. Consult with your PCA regarding the need for a second spray and the best timing that spray in your orchard(s). Check PHI and harvest schedule before spraying. In recent UC research by Dr. Frank Zalom, Intrepid® (14 day PHI) provided 4 weeks of insecticide activity; Altacor® (10 day PHI) gave 3 weeks protection of sprayed tissue and Brigade® (7 day PHI) delivered 2 weeks of control. Note: PHI is based on shake timing, not pickup.
- **Irrigation**: Deliver 100% of ET once 100% hull split reached, then reduce irrigation ahead of harvest.
- **Spider mites**: Keep watching for mites –every week -- as harvest approaches. If mites flare, consult with your PCA about PHI and miticide selections.
- **Leaf samples**: Take leaf samples in July – at least 100 leaves from non-bearing spurs in healthy trees (one or two per tree across a block). Keep the leaf samples cool after picking and ship to a reputable lab as soon as possible. Key nutrients to track are nitrogen (N), potassium (K), zinc (Zn) and chloride (Cl), but an occasional complete analysis is a good idea.

AUGUST:

- **Irrigation**: Recent research has shown that almond yield **next year** is very sensitive to water stress and early leaf drop **this year**. If possible (without getting irrigation water on nuts) irrigate orchard between harvests. Once the nuts are up, irrigate to full ET if possible.
- **Harvest nut sample**: Take a harvest nut sample (500 nuts per block; after shake, before sweeping) from each variety in a block. Crack out to see what damage/pests are present. See images to determine what pest = what damage at: http://ipm.ucanr.edu/PMG/C003/m003hcharvstsmpl.html.
- **Insect control after Non-pareil harvest**: If Non-pareil harvest sample shows more NOW or ant damage than desired, consider additional control options (for example, Altrevin® PHI is 5 days) or speed up harvest schedule if possible to limit damage to pollinizer nuts. If the early harvest samples show little to no damage, then further treatments may not be necessary.
- **Hull samples**: In almonds, hulls are the tissue to check to assess tree B status. So, while taking your harvest nut sample, pull a hull sample (about a pint of dried hulls) from windrows across the orchard just ahead of pickup and send to a lab for boron (B) analysis.

SEPTEMBER:

- **Irrigation**: Once the nuts are up, irrigate to full ET if possible. As the days get shorter, less water is needed to keep the orchard moisture status in the adequate range (1-2 bars below baseline). Don't let the orchard become water stressed after harvest.
- **N fertilizer**: If summer leaf N levels showed moderate to low N levels and you haven't fertilized since before hull split, consider adding a small shot of N fertilizer after harvest – no more than 20% of annual N fertilizer budget.

- **Foliar fertilizer**: Zinc fertilizer should be applied early in the postharvest period for best absorption, so a light rate of foliar zinc fertilizer (for example, 5 lbs/acre of 36% zinc sulfate) in September or October is a good idea if summer leaf Zn levels are low. This rate of zinc will not remove leaves. If hull sample analysis results for B come back "low" from the lab, add the equivalent of 2 lbs Solubor®/acre to the zinc spray, but buffer the solution to pH 5 so that the tank mix is clear (not hazy).

  If the goal is to increase orchard zinc nutrition and remove diseased leaves, hold off on zinc spray until late October/early November and use 20 lbs zinc sulfate per acre at that time. This should drop leaves within 7-10 days if the orchard is well irrigated. Adding the B to a later, high zinc rate spray will not reduce boron uptake. It takes longer for the leaves to drop than for the boron to get into the trees.

Did you notice yellow, flagging branches this spring? Beware of anthracnose!

Joseph Connell, UCCE Farm Advisor Emeritus, Butte County

The anthracnose fungus, *Colletotrichum acutatum,* overwinters in infected mummies left on the tree and in dead twigs or branches resulting from infections the previous year. This year's infections start when spores are splash dispersed by rain to the bloom or to new nuts. If small nuts are infected, they shrivel and turn a rusty orange color. Later in the season, if hulls are infected when nuts are full size, hulls gum and begin to shrivel. The initial circular hull lesions turn pinkish-orange as spores develop.

Toxins produced by the fungus move back into the branch at the point where a spur with infected nuts is attached. Leaves begin to yellow and develop necrosis from that point out to the end of the branch. Defoliation follows, ultimately leading to limb die back to the point where infected nuts are attached.

Price, Peerless, NePlus Ultra, Fritz and Winters are highly susceptible varieties that usually become infected first. If the disease builds up, most other varieties including Carmel and Butte are susceptible, while Nonpareil is least likely to have a problem.

Ongoing rain triggered this disease in some orchards this spring. Infections can occur as long as rains continue thus requiring extended fungicide protection. Summer infections can occur if high-angle sprinkler irrigation contacts the tree canopy.

Anthracnose symptoms on almond nuts

If you experienced this disease, both cultural practices and well-timed fungicide sprays will be important for control in the future. Dead wood should be pruned out and removed before the end of the season to eliminate this source of disease inoculum the following year. In our experiments, simply pruning out dead wood reduced the following year's infections by 50% compared to trees where dead wood was not removed.

The costs of pruning out dead wood and the loss of future production as fruitwood dies greatly exceed the cost of preventing the problem in the first place. If you expect your fungicide dollars to work for you, spray materials must be applied in a timely fashion and with good solid spray coverage. Preventing this disease is money well spent.

See the UCIPM website, http://www.ipm.ucdavis.edu/PDF/PMG/fungicideefficacytiming.pdf for more information on effective fungicides registered to control this disease.

Herbicide Symptom Gallery

Dani Lightle, UCCE Orchards Advisor, Glenn, Butte & Tehama Cos.

I've fielded numerous calls this season that turned out to be herbicide damage. Identifying herbicide damage can be frustrating because the symptoms frequently look as though they are caused by a pathogen. If the symptoms you're observing don't seem to match up to any pathogen you've seen before, it might be time to investigate what else you've applied to the orchard that may be having an impact.

Dieback in almond after an application of penoxsulam (one of two active ingredients in Pindar GT®).

A newer resource available is the Herbicide Symptom Gallery, compiled by Dr. Kassim Al-Khatib, CE Specialist at UC Davis. The website can be accessed at: http://herbicidesymptoms.ipm.ucanr.edu/. This database is comprised of hundreds of photos with crops suffering from herbicide damage. Filter through the images by herbicide, crop, or symptoms observed.

Unfortunately, if you've got a case of self-inflicted herbicide injury, there isn't much you can do except be more careful next time around. Make sure equipment is properly calibrated, applicators are properly trained, and weather conditions are favorable before treating with herbicides.

An all-day class on Diagnosing Herbicide Symptoms will be held at UC Davis on Friday, July 8. The class --- combining classroom and field learning -- will be taught by UC weed control experts Al-Khatib, Hanson and Roncoroni. More information at: http://wric.ucdavis.edu/events/diagnosing_herbicide_symptoms_2016.htm

Managing Soil Variability for Increased Almond Production

Allan Fulton, UC Farm Advisor, Tehama, Glenn, Colusa, and Shasta Counties

As consumer demand for almonds has increased and land with deep, well-drained soil has become scarce and more expensive, almond production has expanded to more marginal soils. These lands often consist of soils with more variability in depth of profile, texture, structure, and water holding capacity. They may also vary in topography, field slope, salinity, and fertility.

Drip and micro sprinkler irrigation have been critical to successfully growing almonds on marginal soils. These methods of irrigation enable water to be applied more uniformly from tree to tree in an orchard in timely, small volumes that are retained better within the tree root zone. Nitrogen and other nutrients that are essential to healthy trees can also be applied with the irrigation water in properly timed, small amounts that closely match tree uptake.

However, even with micro irrigation and fertigation, potential yield can be lost when variable soils are managed using the same irrigation and fertigation timing and rates. For example, results from an orchard evaluation at Nickels Soils Laboratory near Arbuckle, CA suggested there may be potential to increase long term average almond yields by 400 to 1000 lbs/ac/year across 87 percent of an 22 acre orchard, if it were possible to understand the nature of the soil variability and implement an effective strategy to manage it (Fulton, et. al., 2010). Variable soils contribute to irregular patterns of crop water stress and in turn more variable crop development and pest problems over the course of a season. Some examples include mite population growth and control, hull split development and navel orange worm control, and non-uniform nut maturation and harvestability.

Zone Irrigation Concepts

One concept to irrigating highly variable soils that is gaining some adoption in the Central Valley of California is zone irrigation. Some may consider it a form of variable rate irrigation. Zone irrigation is being used in some orchard settings in the Sacramento Valley where changes in topography are gradual and variability in soil profile depth, texture, structure, and water-holding capacity exists.

With traditional irrigation designs, more than one soil type may exist within the same irrigation set. With extreme soil variability, the manager may be challenged to determine the ideal irrigation frequency and duration due to the wide range in water infiltration rates and water holding capacity of the soils.

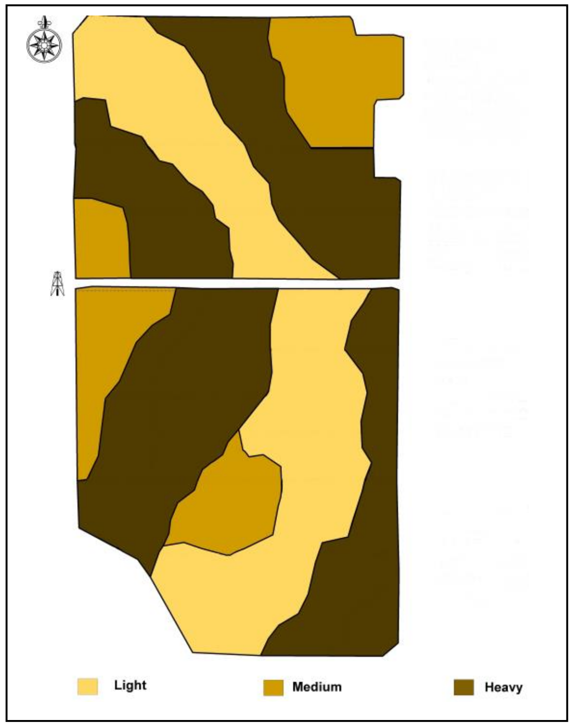

Fig. 1. Illustration of an actual zone irrigation system in an almond orchard grown in the northern Sacramento Valley.

Within reason, zone irrigation systems are designed to account for the natural variability of the soils in a parcel of land. Areas that have similar soils (depth, texture, structure, and water-holding capacity) are grouped into irrigation zones. A manager has more flexibility to adjust irrigation frequency and duration to match the soil characteristics. An orchard (40 to 80 acres) with zone irrigation may consist of three or four zones to keep the design reasonable. Figure 1 shows an 80 acre almond orchard where a zone irrigation system has been implemented. In this example there are three irrigation zones. The lightly shaded zone represents a gravelly, sandy loam soil profile extending at least 5 feet deep and accounts for 22.9 acres. The medium gray shaded area represents a soil profile with about 1 to 2 feet of silt loam soil overlying the gravelly, sandy loam subsoil to a depth of five feet and accounts for 13.1 acres. The dark shaded area represents a soil profile with at least 4 to 5 feet of silt loam soil and accounts for 34.9 acres. Highly variable water infiltration rates and water-holding capacity were anticipated with these soil conditions and motivated the use of zone irrigation to manage it. A mini sprinkler with the same nozzles and plates was installed across this orchard.

The irrigation zones vary in acreage so a variable frequency drive to regulate pump flow and pressure is an essential part of the irrigation system. With zone irrigation designs, the underground pipeline conveyance design is modified to deliver water to the above ground drip or micro sprinkler system where it is needed and at the appropriate flow rates. The above ground lateral lines are cut to lengths needed to match the variable soil patterns. The same drip emitter, micro sprinkler, or mini sprinkler is used across the entire orchard to ease maintenance and repair of the system and avoid any potential confusion with replacing plugged or damaged parts. To date, commercial installation of zone irrigation systems appears to cost about $200 to $300 per acre more than traditional designs. Zone irrigation systems also improve the effectiveness of soil moisture monitoring since the soils within a zone are more uniform. If zone irrigation systems are implemented over several fields and a large enough area, automation may be important to assure the correct zone is operated at the correct frequency and for the appropriate duration.

Electromagnetic Induction (EM) and Four-Probe Soil Resistance Sensors (VERIS)

A good understanding of the soil variability patterns is essential to optimally design and install a zone irrigation system. Rapid, non-intrusive methods of measuring soil electrical conductivity combined with global positioning systems (GPS) are used to map the soil variability patterns and provide waypoints to guide the design and installation. Figures 2 shows a simple example of electromagnetic induction (EM). Each EM instrument contains two electronic coils, a primary and secondary coil. When energized, the primary coil radiates an electromagnetic field through the soil to the secondary coil. The electrical conductivity of the soil is measured to a depth of about 3 feet with this model of EM instrument. Other models can measure deeper.

Fig. 2. Two EM instruments are housed inside a PVC casing and towed behind an ATV with GPS system. The inset shows the orientation of the two instruments inside the PVC housing. One is horizontal (shallow) and the other is vertical (deep) mode.

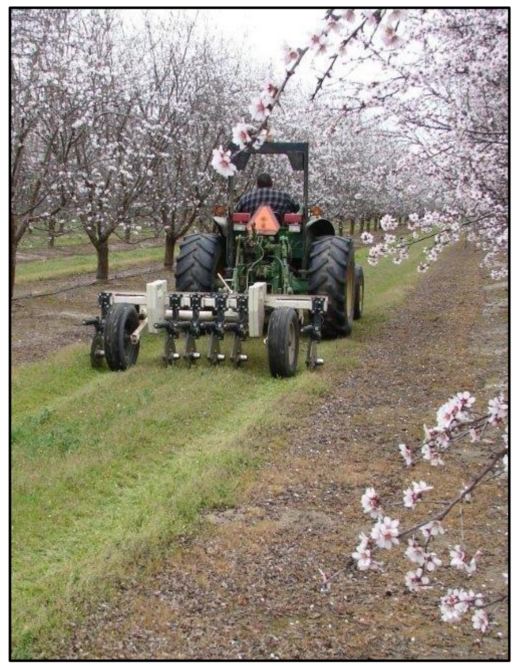

Fig. 3. VERIS instrument being towed through an existing almond orchard.

Figure 3 shows an example of a four-probe resistance sensor (VERIS) that can also be used to map soil variability. It also measures electrical conductivity of the soil. A pair of coulter electrodes penetrate a few inches of the soil surface and inject an electrical current. Another pair of coulters receives the electrical signal. The measure of voltage drop due to the resistivity of the soil is measured. The distance between the pair of coulters determines the depth of measurement. In this photo the measurement depth is about three feet. Wider spacing measures deeper soil depths. GPS is also used to track the position in the orchard. UC research published in 2010 documented that well trained and experienced commercial operators of EM and VERIS sensors can accurately map and define the soil variability in a parcel of land (Fulton et.al., 2010).

Figure 4 provides an example variability map developed with one of these techniques (EM). An EM instrument was towed in a serpentine pattern at a 60-foot spacing and provided multiple transects of electrical conductivity measurements. Electrical conductivity of the soil was measured at over 5000 points in this orchard and then the map was developed by interpolation. The white and lighter gray areas represent soils with very low and low electrical conductivity, respectively. The dark gray and black areas represent soils with medium and high electrical conductivity, respectively.

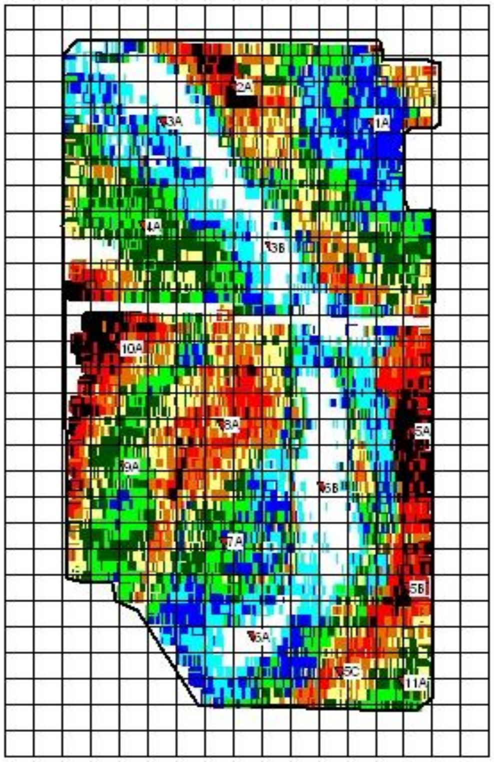

Fig. 4. Example "variability map" derived by operating an EM instrument.

It is important to understand that the variability map only indicates where contrasting soils are located and provides a sense of the spatial pattern. The map does not indicate the source of variability. Further investigation using backhoe pit evaluations and soil sampling, directed by the EM or VERIS data, are necessary to understand the nature of the variability. Electrical conductivity is most sensitive to soil moisture content and soil salinity. Since most land in the Sacramento Valley where almonds might be grown consists of non-saline soils, both the EM and VERIS methods have been used effectively to distinguish soil patterns with distinct differences in texture, structure, and water-holding capacity. Variation caused by soil moisture depletion can be reduced if the mapping is conducted in the late winter or early spring following the rainfall season when soils are at field capacity.

Future of Zone Irrigation Systems

Zone irrigation systems are among many options available as the almond industry strives to produce more crop with less resources. Public sources of data evaluating almond production, water savings, economics, and other responses by implementing zone irrigation concepts are not readily available. Anecdotal experience over time will verify its role and value. At this time, the concept shows promise and is gaining in interest.

Additional References

1. Bassett, B. and A. Fulton, Designing Irrigation Systems to Manage Variable Soils. American Society of Agronomy – California Chapter, 2013 Conference Proceedings. pp. 96 – 104. http://calasa.ucdavis.edu/files/160703.pdf

2. Fulton, Allan, Larry Schwankl, Kris Lynn, Bruce Lampinen, John Edstrom, and Terry Prichard. Using EM and VERIS technology to assess land suitability for orchard and vineyard development. Journal of Irrigation Science.DOI 10.1007/s00271-010-0253-1. December 2010. *http://openagricola.nal.usda.gov/Record/IND44717461*.

3. URL: www.h2O-optimizer.com – A commercial provider's description of four phase process to designing a zone or variable rate irrigation system.