University of California
Agriculture and Natural Resources
Cooperative Extension Butte County

Almond Notes

June 2016

In this issue:

Submitted by:

Dani Lightle,

UCCE Farm Advisor

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.

Flagging leaves and lesions caused by anthracnose on Price almonds.

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.

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.

UC Cooperative Extension, Butte County 2279 Del Oro Ave., Suite B, Oroville, CA 95965
(530) 538-7201 FAX (530) 538-7140 Email: cebutte@ucanr.edu Web Page: cebutte.ucanr.edu

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.

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.

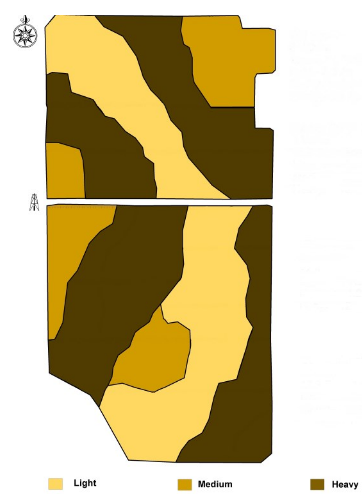

Fig. 1. Illustration of an actual zone irrigation system in an almond orchard grown in the northern Sacramento Valley.

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.

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).

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

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.

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

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

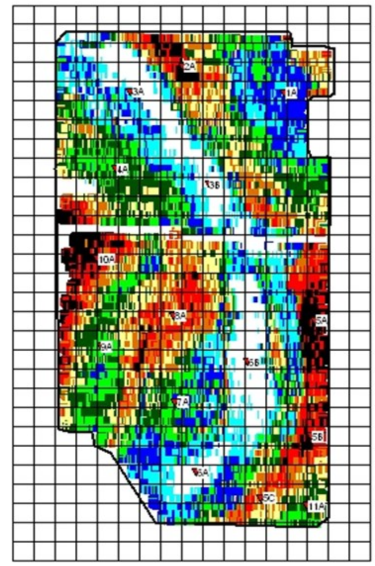

Fig. 4. Example "variability map" derived by operating an EM instrument.

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

2016 Advances in Almond Production Short Course, November 8-10, 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.

Pre- & Post-Harvest Almond Orchard Management Considerations

Katherine Pope, UCCE Orchard Advisor Yolo, Solano, & Sacramento Cos.

JUNE

- *Get ready for an early hull split!* UC models predict hull split in late June this year for Nonpareil. To predict hull split using data from you nearest CIMIS station, visit http://fruitsandnuts.ucdavis.edu/Weather_Services/almond_hullsplit_prediction/Hull_Split_Calculator/
- *Assess Navel Orangeworm and Peach Twig Borer populations.* If the next generations come prior to hullsplit they will go back to mummy nuts and shoots respectively. Generations can be predicted using your biofix and Degree Day models. If NOW or PTB egg laying is predicted to occur at hullsplit or later and is of sufficient concern, apply a hull split spray at the beginning of hull split on sound nuts. Back up degree-day predictions by checking traps. For more, see http://ipm.ucanr.edu/PMG/r3300311.html.
- *Monitor for mites* weekly in the orchard's hot spots. Treat the hot spot if presence-absence sampling indicates the treatment threshold is exceeded. Expand monitoring as the orchard dries down for harvest. For more on monitoring and treatment, see http://ipm.ucanr.edu/PMG/C003/m003fcspdmites02.html.

JULY

- *Regulated Deficit Irrigation (RDI)* promotes earlier, more even hull split and reduces hull rot. Beginning at hullsplit initiation, shorten normal irrigation time by 50% for the first two weeks. Then catch up the last two weeks before harvest by providing full irrigation (matching ETc). Moderate water stress can be achieved and monitored by keeping mid-day stem water potential between -14 to -18 bars using a pressure chamber. For more, see http://thealmonddoctor.com/2012/08/05/irrigating-from-hull-split-to-harvest/.
- *Take leaf samples* mid-July to measure nutrient status. Adjust your nutrient management plan for the rest of the season based on July leaf sample results. For more on collecting samples and interpreting results, see http://thealmonddoctor.com/2014/07/04/leaf-analysis-salinity-monitoring.

AUGUST

- *Watch for rust in young orchards.* Prevent early defoliation that can negatively affect flower bud formation for next. For more, see www.ipm.ucdavis.edu/PMG/r3100711.html
- *At harvest, collect nut samples for damage analysis.* Grab them now and think about them later. Gather and freeze at least 100 nuts per orchard after shaking, but before sweeping. These samples will allow you to better understand damage results on your grade sheets and adapt IPM strategies for next year. Sampling and pest damage diagnosis help can be found at: www.ipm.ucdavis.edu/PMG/C003/m003hcharvstsmpl.html take nut samples.
- *If boron toxicity or deficiency is a concern*, collect and submit hull samples at harvest for B analysis. For more information, see http://thealmonddoctor.com/2014/07/12/hull-sampling-for-boron.
- *Apply a last shot of nitrogen either shortly before or just after harvest to support bud development for next year.* Generally, no more than 20% of the total season's nitrogen should be applied between hull split and early post-harvest. Decreased planned application if July leaf levels were higher than 2.8% N. See https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Almonds.html for more on rate and timing of nitrogen applications.
- *Manage post-harvest irrigation to minimize water stress.* Water stress in late August to early October can interfere with flower bud development for the following spring. Defoliation reduces tree vigor by reducing sugar production. This is particularly important for orchards with a long window between harvest of Nonpareil and late pollinizers.
- *Assess hull rot and shaker damage post-harvest.* Hull rot symptoms can be found at www.ipm.ucdavis.edu/PMG/r3101811.html.

Sacramento Valley Orchard Source
Your source for orchard news & information in the Sacramento valley

University *of* California
Agriculture and Natural Resources

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!

Return Service Requested

University of California
Cooperative Extension
2279-B Del Oro Ave.
Oroville, CA 95965

Non-Profit Org.
U.S. Postage Paid
Permit No. 268
Oroville, CA 95965