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UC Cooperative Extension-Tehama County
1754 Walnut Street, Red Bluff, CA 96080
Phone (530) 527-3101
E-mail: rpbuchner@ucanr.edu

Fruit and Nut Notes

Website: cetehama@ucanr.edu

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Richard P. Buchner
UC Farm Advisor -Orchard Crops, Tehama County Director

Prepared by Cindy McClain
Office Manager/Ag Secretary

SACRAMENTO VALLEY REGIONAL
ALMOND NEWSLETTER

IN THIS ISSUE:

The "SACARAMENTO VALLEY REGIONAL ALMOND NEWSLETTER" is a collaborative effort of almond research specialists working together to provide Sacramento Valley growers and industry leaders the latest research and information effecting almond production in today's changing environment. This newsletter will be published quarterly, be sure to look for upcoming issues!

New Farm Advisor Introduction

Dani M. Lightle, UC Farm Advisor Glenn, Butte & Tehama Counties

On February 10th, 2014, I began working as the new Orchard Systems farm advisor based in Glenn County. Some of you may have seen me at the Walnut Day/Almond Institute meeting in Chico in February.

I grew up in northern Ohio and earned my bachelor's degree in Biology in 2007. Subsequently, I worked and studied invasive forest insect pests for a year at The Ohio State University. I moved to Corvallis, Oregon in 2008 and switched to research in small fruit agricultural systems. In 2013, I completed my PhD in Entomology with a minor in Plant Pathology from Oregon State University in 2013. From 2008 to 2013 my research focus within small fruit cropping systems included biological control, transmission and control of insect-transmitted plant pathogens, and management of plant viruses.

Throughout my time in Oregon, I strove to maintain a strong working relationship with small fruit producers in order to make sure my research was both relevant and useful. I look forward to creating similar relationships with Sacramento Valley farmers and invite you to contact me with your questions, concerns, or just to introduce yourself. I can be contacted by email at dmlightle@ucanr.edu or by phone by calling the Glenn County extension office at 530-865-1107.

Irrigation management

Franz Niederholzer, UC Farm Advisor, Colusa/Sutter/Yuba Counties

Life has a way of reminding us what really matters. Unfortunately, it is often the lack of something that drives home the point. 2014 looks to be a year that reminds all of us that water is the number one thing needed to successfully farm almonds in California. With a range of water availabilities reported around the state, from nothing to deep wells on good aquifers, this article covers general information on water stress in almonds, the tools needed to manage almond orchards under reduced water availability, and different practices specific to different water availability situations. More complete information is available, free, from several UC websites listed at the end of this article.

Under limited water availability, orchard irrigation management shifts from maintaining optimum orchard hydration throughout the season, like an athlete training for peak performance, to avoiding extreme stress season-long, like a hiker in the desert, nursing their canteen, balancing their thirst against the water level in the canteen to keep moving and hold some reserve for later. Reduced irrigation is most easily and accurately applied with pressurized irrigation systems – solid set, drip, or micro-sprinkler irrigation.

The pressure bomb is the key tool to managing almond orchards under reduced water availability. This device measures plant water status as Stem Water Potential (SWP). No other tool a grower can buy today does this. It is highly flexible, allowing a grower or consultant to check multiple trees per block across multiple orchards on any given day. The portable, pump-up units fit behind the seat of a pickup. The larger, heavier air-tank models fit on the back of an ATV or on a "mule". Measuring SWP with a pressure bomb takes time and a trained person. That costs money, but a lot less than crop loss due to extreme water stress.

To complement pressure bomb data, install (if you haven't already) soil moisture sensors throughout the orchard to ensure that irrigation, when applied, just fills the root zone and no more. Water that reaches below the root zone is not plant available. If you are applying full irrigation sets when a certain stress level in the tree is reached – by measuring SWP with the pressure bomb – soil moisture sensors tell you when the root zone soil is just refilled. What about managing irrigation by "letting the trees tell you when they need water"? Trees do tell you when they need water, but, in my experience, they tell you about 2 weeks too late, when interior spur leaves yellow and drop.

The same water stress level has differing impacts on almond trees, depending on when in the growing season it happens. Almond trees are most vulnerable to water stress at two distinct times during the growing season: from leaf out through mid-June when crop nut growth for this year plus shoot and spur growth for future crops occurs, and again in late summer/early fall when flower buds differentiate and carbohydrates are stored to provide energy for nut and shoot growth early the next year.

Mid-summer to hull split is a time when moderate water stress can be tolerated without much impact on the crop or trees. However, if water stress is not carefully managed and severe water stress occurs in the whole orchard or in localized areas, yield reduction can occur from water stress during this time as well. In a four year study of regulated deficit irrigation, applying approximately half the normal amount water at regular irrigations for two weeks starting at hull split in July, then, returning to full irrigation with the last irrigation(s) prior to harvest, provided a managed stress. There were no negative effects on yield during this four year trial and some water was saved. Implementing this practice carefully in a water short year should have no negative effects and is good stewardship of a limited resource.

Finally, dial –in your irrigation system to avoid any water loss and maintain uniform irrigation delivery to the orchard. This includes irrigating at night to reduce evaporation losses (less costly electricity, too), time sets to avoid runoff, remove competing weeds, maintain the irrigation system to avoid plugging and uneven delivery in general, and monitor soil moisture to avoid applying more water than the root zone can hold.

Younger orchards that are still filling their space need more water than mature orchards to drive vegetative growth as well as crop growth. Depending on cash flow, overall water availability, and the relative percentage of acres of different ages in your operation, you might want to consider allowing slightly more stress in mature, full canopy orchards and managing to lessen relative water stress in those younger orchards still filling their space. This should improve future bearing space and income, while perhaps reducing crop in the current year. The following are several scenarios for drought irrigation management drawn from UC research reports and the drought management website at: http://ucmanagedrought.ucdavis.edu/Agriculture/Crop_Irrigation_Strategies/Almonds/

No irrigation water available. There isn't much to do under this very difficult situation. In fact, I can't give you any information that will help improve the situation. I can pass along what *didn't* work in a recent UC experiment where almond trees got no irrigation water all season. In that study, pruning off major scaffolds to reduce canopy leaf area and/or spraying the orchard with white clay (Surround™) to reduce stress didn't make any real difference in the water stress in the trees. So, don't do anything drastic, spray out the winter weeds to conserve any spring rain you may have/get and hope for a wet fall to recharge the soil profile and reservoirs for next year. Unfortunately, while the trees may survive if the orchard started the season with 6-8" of rainfall stored in the soil, the crop loss in this year and next year (if full water is available) will be 50-80% compared to a fully irrigated orchard.

Severe reduction in water available (25-50% ET available). Early season stress is inevitable when working with this little water. Start irrigating when SWP reaches -12 to -14 bars in the spring. Once June arrives, shift the irrigation threshold to -22 bars until hull-split. Apply a good shot (in the range of 2") of water as hull split begins to avoid/reduce stick-tights. Apply postharvest irrigation with similar target SWP as spring. This program will not avoid crop loss compared to fully irrigated trees. Research results indicate that it will take 2 years of full water availability to return production to that of unstressed trees.

Moderate reduction in water availability (70-85% ET available). There are two general approaches to working with relatively modest reductions in water availability – the "frequent sips" or the "full drinks spaced far apart" approach. The first strategy is to apply 15-30% less water – depending on water allocation/well water availability -- with each irrigation set than recommended by ET calculation. This doesn't mean you apply the same amount of water for each month, rather a percent reduction over time. For example, if ET_c + system efficiency adjustment calls for 1" of water in late April/early May, apply 0.70-0.85" in that same period. If ET_c calls for 2" per week in late June, then apply 1.4-1.7" of water. The second strategy is to fully irrigate (following SWP, ET_c, moisture sensors, etc.) until June 1. Between June 1 and hull split, use an irrigation threshold of -20 to -22 bars with a solid shot (2" or so) at hull split to avoid stick tights. In a four year study in the Manteca area of the northern San Joaquin Valley, this second program reduced water use by a third, without harming yield – although vegetative growth was reduced relative to fully watered trees and that may have had an effect on yield if the project had run longer.

Full water availability. Even for growers who have good wells – this year – water conservation should be a current and future priority. That's why the following information is worth reviewing. For mature trees that have filled their space, recent research has demonstrated that water can be saved without harming production – in a certain, small window ahead of harvest. How is that? When slight water stress is imposed in the two weeks following the beginning of hull split, almond trees tolerate moderate stress (-15 to -18 bars of SWP) without yield loss or vegetative growth reduction while hull rot is significantly reduced. Full irrigation must be returned after two weeks to avoid stress (stick tights, etc.) as harvest approaches. Why worry about this relatively small savings in water? It saves expensive, limited water and helps manage hull rot. For more information on this practice, see a recent article at: http://ucce.ucdavis.edu/files/repositoryfiles/ca6502p90-85607.pdf

Growers and CCAs/consultants supporting them will need as much information as possible during this difficult irrigation season. Much of the information presented above came from information provided by the UC farm advisors and specialists at the following on-line sites:

UC Drought Management web site: http://ucmanagedrought.ucdavis.edu/Agriculture/Crop_Irrigation_Strategies/Almonds/
Allan Fulton, UC Water Resources Advisor in Tehama County: http://cetehama.ucanr.edu/Water___Irrigation_Program/
Blake Sanden, UC Irrigation Advisor in Kern County: http://cekern.ucanr.edu/Irrigation_Management/

Foliar Nutrient Sprays: a quick but short term correction for nutrient deficiencies

Joseph Connell, UC Farm Advisor, Butte Co. and Carolyn DeBuse, former UC Farm Advisor, Solano and Yolo Counties

When thinking about fertility in your orchard, the first step is to quantify tree nutrient status with a leaf tissue analysis in July to determine if any nutrients are borderline or deficient. Micronutrient deficiencies often show symptoms in only a small part of an orchard, or, if due to weather, may only appear during part of the season. Foliar nutrient sprays can provide quick correction of deficiency and improve tree color and vigor if indeed that is the reason trees were performing poorly in the first place.

Potassium (K) deficiency symptoms began to show up recently in some almond orchards. When first leafing out, trees appear pale in color and have small leaves with little new growth. Later, trees show rolled leaves with marginal leaf burning. This symptom is classic when it occurs in the treetop on leaves in the middle of new shoot growth. The Butte variety is a good indicator of this deficiency because it is likely to exhibit leaf scorching before other varieties show symptoms.

Heavy nut set creates significant competition for trees' potassium resources between shoots and the rapidly developing nuts. Normally, potassium leaf levels start the season high, decrease to a plateau in mid-summer, and then fall off at the end of the season. Leaf samples I once collected in March in a symptomless orchard had 1.84% potassium--a good level that might be expected for that time of year. In an orchard showing deficiency symptoms, leaf potassium was 0.65%----a figure that would be low even in mid-summer but is especially low early in the season.

Fortunately, potassium deficiency can be corrected at this time of the year by foliar sprays of potassium nitrate when sufficient material is applied. The old standard researched approach using dilute sprays (400 gal/ac) called for application of 10 pounds of potassium nitrate per 100 gallons of water. This spray was applied at least three times at seven to ten day intervals between each application if deficiency correction was to be achieved for the season. This meant 40 pounds of potassium nitrate was applied per acre with each of the three 400 gallon dilute applications for a total of 120 pounds of potassium nitrate per acre. This approach effectively corrected potassium deficiency in the past.

If you apply 10 pounds per 100 gallons in three concentrate sprays (100 gal/ac), you apply a total of only 30 pounds of potassium nitrate per acre. Don't expect to see fantastic results if you have a deficiency showing. If you're spraying every other row (not good for fungicides or nutrients), your application will be less effective. Three half sprays (every other row) at 10 lbs./100 gal. only applies a total of 15 pounds of potassium nitrate per acre! A 15 pound total application is a long way from the 120 pound total that U.C. researchers found effectively corrected the problem. In a typical concentrate spray applied at 100 gal/ac, rates of 20-30 pounds of potassium nitrate per acre can still be safely applied to almonds.

Zinc (Zn) is part of the enzyme system that regulates terminal growth and plant cell expansion. Trees with severe deficiency may experience dormant flower bud drop and decreased fruit set, will have shortened internodes and small 'little leaf' symptoms, and have chlorotic leaves with wavy margins (Photo 1). With mild deficiency, leaves may be slightly smaller than normal with areas of interveinal chlorosis. Young trees can be deficient without showing any visual symptoms so it is important to get a July tissue analysis even in young orchards. Zinc is deficient if a July leaf analysis is below 15 ppm.

Photo 1. Zinc defi-

Foliar sprays to correct Zn deficiency are effective and are relatively inexpensive. A spring foliar treatment can be timed once leaves have attained nearly full size. On spring foliage, basic zinc sulfate or zinc oxide sprays are normally safe and effective. Either form can be applied at 5 pounds per 100 gallons of water or at 15 pounds per acre when sprayed at 100 gallons water per acre. Zinc deficiency can also be easily corrected near natural leaf drop in fall with a foliar spray of zinc sulfate (10 to 15 lbs. $ZnSO_4$ in 50-100 gal. water/acre).

Iron (Fe) and Manganese (Mn). Both iron and manganese are important in chlorophyll formation so a deficiency of either will show an interveinal chlorosis in young leaves. Deficiencies in iron and manganese are rare in the Sacramento Valley but can be seen occasionally in orchards with soil pH above 7.5, on calcareous soils, or on heavy, poorly drained soils.

Iron deficiency will cause interveinal yellowing with the small leaf veins remaining green. When severe, leaves will be uniformly yellow throughout the leaf. Iron deficiency may show early in the season and continue until leaves yellow and drop or it may show in the spring and then gradually disappear as soils warm up and dry out. Leaf analysis is not a reliable indicator of iron deficiency so learn to recognize leaf symptoms. Trees will green up if foliar sprays of Sequestrene® 138 Iron Chelate are applied following label instructions.

Manganese chlorosis appears as a herring bone pattern with major veins green between yellow interveinal areas. Manganese is adequate when July leaf analysis is over 20 ppm. Manganese deficiency can be corrected with foliar sprays of manganese sulfate at 2 pounds per 100 gallons water sprayed at 100 gallons per acre. If you have a small problem area, banded soil applications of manganese sulfate at 10 pounds per tree have been effective for longer term correction.

Boron (B) plays an important role in pollen growth, fertilization, and fruit set. If you notice gummy almond kernels followed by nut drop (particularly on the Peerless variety), or areas in the orchard with a very light crop and vigorous willowy shoot growth year after year, B deficiency may be the problem. It can be corrected with fall or pink bud sprays of 1to 2 lbs. Solubor® per 100 gallons of water sprayed at 100 gallons per acre. B deficiency in severely affected areas in the orchard can also be corrected with a soil application of ½ pound of Solubor® material per tree broadcast in the tree row. This soil treatment will correct the problem for several years. Hull analysis at harvest provides a better measure of B status than July leaf analysis for this nutrient. Be sure B is deficient (hull B < 80 ppm or leaf analysis < 25 ppm) before applying treatments since B excess is toxic to almond trees.

Insect Activity, Spring 2014

Dani M. Lightle, UC Farm Advisor Glenn, Butte, & Tehama Counties

The warmer than average temperatures so far this year have led to early insect activity. Table 1 shows the biofix dates for five orchard insect pests trapped in Tehama County compared to the previous five years. As you can see, the biofix for all five pests is earlier this year than in prior years.

A biofix is a biological event in the lifecycle of the insect that marks the date to begin counting growing degree days. The "event" used for a biofix differs depending on the pest. For example, the biofix for peach twig borer is the date when the first male moth is trapped, while for navel orangeworm, it is the date when eggs are first laid by females on the egg monitoring traps. After reaching a biofix, the accumulated growing degree days for each pest can be tracked to time when control measures should be used to be most effective. A weekly update of accumulated growing degree days in Tehama County for each pest can be accessed from: http://cetehama.ucanr.edu/Orchard_Crops/Insect_Updates

Table 1. Historical biofix data from Tehama County for orchard insect pests. Biofix dates are earlier this year for insect pests when compared to the previous five years.

Insect	2014	2013	2012	2011	2010	2009
Codling moth	3/18	4/8	4/19	4/24	4/26	3/30
Oriental Fruit Moth	2/19	3/4	2/23	3/8	3/15	3/16
Peach Twig Borer	3/20	4/1	4/23	4/18	4/26	4/20
Navel Orangeworm	4/7	4/11	5/3	-	-	-
San Jose Scale	3/17	3/25	4/16	-	-	-

Nitrogen Use Efficiency in Almonds

Franz Niederholzer, UC Farm Advisor, Colusa/Sutter/Yuba Counties

Nitrogen (N) is a key mineral nutrient in almond production. Nitrogen deficiency reduces kernel yield per acre, and profitable almond production requires significant N input each year a large crop is set. Nitrogen is also an environmental contaminant, harmful to both air and water quality.

Efficient N management means matching N inputs (fertilizer, compost, etc.) to orchard N needs through the season to grow the largest crop in the cleanest way possible. How best to do this? Some practices are known, while others are the subject of current research. Current work by research teams led by University of California Professor Patrick Brown and funded by public (USDA, State of CA) and private (Almond Board of CA, fertilizer industry) dollars is helping growers and PCA/CCAs get a clearer picture of efficient almond orchard N management. The study site is a mature, commercial 50% Nonpareil/50% Monterey orchard on Nemaguard rootstock near Belridge in Kern County. Information on this overall project is available on the web at: http://ucanr.org/sites/scri/. Click on "Outreach" to see recent presentations and publications on this topic.

For now, growers and PCA/CCAs may want to consider the 4Rs of good nutrient management -- Right Source, Right Rate, Right Timing and Right Placement – when planning fertilizer use, especially N fertilizer. Here's a quick review of these four key factors in nitrogen management in almonds.

Right Rate. The annual fertilizer rate in a mature, producing orchard is mostly determined by crop size, although some N is needed to grow new shoots and spurs for future crops. In mature, producing almond trees, the crop contains the largest percentage of the whole tree nitrogen (and potassium) content. One thousand pounds of almond kernel yield (hulls, shells, and kernels) per acre in a well fertilized almond orchard contains 68 lbs. N based on extensive field work by Dr. Patrick Brown and his students at UC Davis.

When determining the actual rate of fertilizer N to apply in a particular orchard in a given year, consider both orchard N requirements minus other, non-fertilizer sources of N such as nitrate in irrigation water. For example, since a crop requires 68 lbs. N per 1000 lbs. of kernels, a block producing an average crop of 2600 lbs. of kernels per acre would need 177 lbs. N per acre. What about N needed for spur growth and N storage? If the crop is larger than 2000 kernel pounds per acre, then Dr. Brown's team suggests no additional N is needed for vegetative growth – there is enough N in the budget based on the crop requirement to provide adequate vegetative growth and N storage. If the crop is between 1000-2000 kernel pounds per acre, add 20 lbs. N per acre to the crop N requirement to support vegetative growth/storage. If the crop is very light – less than 1000 kernel lbs. per acre, use 30 lbs. N per acre for vegetative growth needs.

Non-fertilizer sources of N, including irrigation water (well water, not surface water) should be considered in the calculation of an annual N budget. See Figure 1 at the end of this article for formulas to convert irrigation water nitrate into pounds of N per acre. Finally, when calculating a nitrogen budget for an almond orchard, assume some inefficiency in the process of getting the fertilizer from the soil to the root surface. In an orchard where irrigation water is carefully managed to eliminate leaching, estimating 70% use efficiency is a good starting point. Adjust your N budget per acre after correcting orchard N requirement based on non-fertilizer N availability. For example, a 2600 lb. crop in an orchard where 20 lbs. of N per acre are provided in the irrigation water needs an additional 157 lbs. N added to meet crop needs. If you assume 70% use efficiency, then divide 157 by 0.7 to get a total of 224 lbs. N per acre needed. That's the annual N budget for that orchard. Use summer leaf N analysis to double check your budget and adjust as needed in the future.

Right Timing. Almond nuts and shoots use the most N (80% of annual demand) between bloom and mid-June. As nut and shoot growth slows, trees use less N in late summer/early fall. Deciduous trees essentially absorb no N between leaf drop and leaf out. To match fertilizer delivery with tree N use, Dr. Brown's group recommends delivering fertilizer N at four different timings and amounts through the season – February or March (20% of total annual N input), April (30%), June (30%) and September - October (20%). The last application should be applied as soon as possible postharvest, and potentially skipped if significant leaf loss has occurred at harvest. Overall, for the best returns and to benefit the environment, Sacramento Valley almond growers should apply most of their annual fertilizer N input in spring/early summer and do everything possible to limit the amount of nitrate in the soil as winter -- and the storm season -- approaches.

Right Placement. Fertigation delivers fertilizer to active roots. As long as irrigation is managed to deliver only needed water, fertigation is a highly efficient method of fertilization. Orchards using flood or solid set sprinkler irrigation systems should apply fertilizer N in the herbicide strips along the tree row, not as a general broadcast application. There are more almond tree roots in the tree rows than out in the middles, where competition with weeds for water and nutrients plus compaction from equipment traffic reduces N availability to the crop.

Right Source. There are a number of N sources available to growers – urea, UAN 32, ammonium sulfate, CAN 17, calcium nitrate as well as composts and organic fertilizers. Liquid materials such as UAN32 and CAN17 are popular. In Dr. Brown's work there has been no significant difference in yield between equal annual amounts of N applied as UAN 32 or CAN17. So, as far as I have seen, judged strictly on delivering N, material choice is really a function of price per unit N and local needs. Ammonium sulfate and urea are acid producing, as the ammonium from these materials is converted to nitrate in the soil. Fertilizer nitrate adds no acid to the soil. Ammonium and urea can be lost as ammonia gas if applied to the soil surface without rapid (1-2 days, max) incorporation with irrigation water or cultivation. Nitrate doesn't volatilize. Urea and nitrate will move with water during an irrigation event and can be moved below the root zone with excess water – either from rain or irrigation. Ammonium is less mobile during and shortly after application – until converted to nitrate. This process usually takes several weeks.

Figure 1. Formulas to determine the amount of N (lbs. N per acre), when reported as either 1) nitrogen as nitrate or 2) nitrate, contained in a certain volume of irrigation water:

__________ x _______________ x 2.7 = _________ lbs. N per acre

ppm $N\text{-}N0_3^-$ water applied (acre-ft)

Or,

__________ x _______________ x 0.614 = _________ lbs. N per acre

ppm $N0_3^-$ water applied (acre-ft)

Key points:

1 ppm nitrogen as nitrate ($N\text{-}NO_3^-$) is equal to 4.5 ppm nitrate (NO_3^-)

ppm = mg/l

FRUIT & NUT NOTES

SACRAMENTO VALLEY REGIONAL Newsletter

Cooperative Extension
University of California
1754Walnut Street
Red Bluff, CA 96080
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