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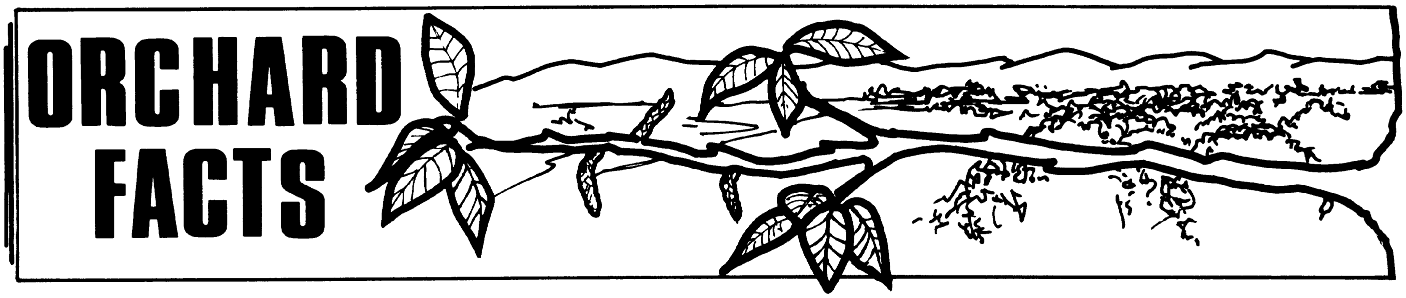

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Pam Geisel
County Director

Orchard Irrigation 2013

Richard P. Buchner – UC Farm Advisor, Tehama County
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Another irrigation season is underway and many almond, walnut and prune orchards have already been irrigated to recharge tree root zones. 2013 spring rainfall (figure 1) didn't help soil moisture much with January, February, and March totals, in the 1.77 to 2.78 inch range for four CIMIS stations in the Sacramento Valley. In addition, many of the rain events were insufficient to recharge soil moisture and could not be counted as "effective rainfall".

	CIMIS #8 TEHAMA	CIMIS #12 BUTTE	CIMIS #32 COLUSA	CIMIS #235 SUTTER
1/5	.18	.18	.39	.41
1/6	.01	.12	.09	.21
1/8			.01	
1/9	.07	.09	.02	
1/10		.01		
1/18			.01	
1/23	.56	.37	.44	.17
1/24	.04	.06	.05	.02
1/25		.01		
1/26		.01	.01	
2/3			.01	
2/6			.01	
2/7	.11	.05	.02	.06
2/8	.02			
2/19	.02	.16	.03	.39
3/3		.04	.13	
3/5	.18	.18	.05	.11
3/6	.12	.14	.11	.09
3/16		.03		
3/18				.04
3/19	.06		.23	.09
3/20	.03	.21	.10	.15
3/27				.02
3/28			.02	
3/30			.01	.31
3/31	.37	.63	.44	.71
TOTAL	1.77	2.29	2.18	2.78

Figure 1. January, February and March 2013 precipitation measurements (inches) for CIMIS weather stations located in the Sacramento Valley

Managing early season irrigation can be challenging because of the diversity of tree size and age and variability in soil types from orchard to orchard. One simple and effective technique is to auger holes and visually evaluate soil moisture for both location and depth. Soil color and how well the soil sample adheres to an auger and/or your hand are related to moisture content.

Increasingly, orchard producers are using various methods of monitoring and science-based information to more precisely decide when to begin irrigating and how much water to apply in specific orchard settings. This is especially true for those with drip and microsprinkler irrigation systems which enable greater control of the water application rate.

Some growers track real-time, weekly estimates of orchard ET and in-season rainfall. This information can be related to the soil water holding capacity of specific orchard soils and to the specific water application rates of their irrigation systems to help estimate how much soil moisture storage has been depleted before irrigation begins and then determine how long to run their irrigation system to replenish a portion of the depleted soil moisture. One strategy is to start irrigating when trees have used enough soil water to make room in the "soil water bank" to hold irrigation water. The challenge is to avoid water logging on the wet side and tree stress on the dry side. A fairly accurate estimate of soil moisture depletion can be made by adding up daily water use. Start summing daily water use when you know the soil profile is full. One way to approach the answer is to consider how much water can be applied per set time and start when at least that much water has been depleted. A convenient source of weekly, real-time estimates of crop ET for orchards can be found on-line at http://cetehama.ucdavis.edu. Select the "Water/Irrigation Program" option from the menu on the left. Then, select "On-farm Irrigation Scheduling Tools" from the expanded menu. This information is also published weekly in several local newspapers throughout the northern Sacramento Valley. Weekly email reports (Figure 2) can be requested by contacting aefulton@ucdavis.edu.

Figure 2: Weekly Soil Moisture Report

WEEKLY SOIL MOISTURE LOSS IN INCHES
(Estimated Evapotranspiration)
03/22/13 through 03/28/13

West of Sacramento River: Past Week of Water Use	West: Accum'd Seasonal Water Use	West: NOAA Forecasted Week of Water Use	**Crop (Leafout Date)**	East of Sacramento River: Past Week of Water Use	East: Accum'd Seasonal Water Use	East: NOAA Forecasted Week of Water Use
1.01	7.85	0.87	Pasture	0.89	6.91	0.81
1.01	7.86	0.87	Alfalfa	0.89	6.91	0.81
0.78	6.01	0.67	Olives	0.67	5.33	0.62
0.66	5.17	0.56	Citrus	0.58	4.59	0.52
0.70	2.17	0.66	Almonds (3/1) *	0.61	1.93	0.60
0.62	1.09	0.64	Prunes (3/15) *	0.54	0.95	0.59
0.00	0.00	0.27	Walnuts (4/1) *	0.00	0.00	0.26
0.78	5.37	0.82	Urban Turf Grass	0.67	4.72	0.76

Accumulations started on March 1, 2013 or on the approximate leafout date for a specific orchard crop as indicated in parentheses. Criteria for beginning this report are based on the season's last significant rainfall event where the soil moisture profile is estimated to be near its highest level for the new season.
* Estimates are for orchard floor conditions where vegetation is managed by some combination of strip applications of herbicides, frequent mowing or tillage, and by mid and late season shading and water stress. Weekly estimates of soil moisture loss can be as much as 25 percent higher in orchards where cover crops are planted and managed more intensively for maximum growth."

Weekly estimates of crop ET and soil moisture depletion are based upon real-time, regional weather conditions and other reasonable assumptions about orchard health and development. Actual soil moisture depletion in specific orchards is likely to be different. Many growers recognize this limitation and have employed advances in soil moisture monitoring. A variety of sensors are available to monitor soil moisture in the root zone of an orchard. They measure either soil moisture content or soil moisture tension. Advancements in remote data access enable soil moisture to be monitored continuously and relayed to growers on-line so that the information can be viewed anytime to guide irrigation decisions. General information about these advanced methods of soil moisture monitoring can be found at the "cetehama" website referenced previously. More information about specific soil moisture devices and services can be found at other sites on-line. Some suggested key words for searching additional information are "AgTelemetry.com", "Irrigate.Net", "Irrometer", "Climate Minder" and "PureSense".

In some situations, placing soil moisture sensors in areas that accurately represent an entire orchard can be challenging. Natural variability of soils and water infiltration properties, preplant tillage practices such as slip plowing, partially wetted soils by drip and micro sprinklers, water table influences, and uncertainty about root development and distribution may influence soil moisture monitoring readings. Recognizing this, other growers directly monitor tree stress with a pressure chamber. More information on the use of the pressure chamber to monitor "Midday Stem Water Potential" can be found at the "cetehama.ucanr.edu" website cited previously and by searching the UC Fruit and Nut Center in the Plant Science Department at UC Davis. Direct measurement of crop water stress coupled with estimates of crop ET or soil water depletion can be used to monitor orchard water status and how trees integrate complex orchard environments as well as estimate the soil moisture depletion and the need for irrigation.

Prune Tissue Sampling for Leaf Analysis

Joe Connell, UCCE Farm Advisor, Butte County

Leaf analysis is best taken in July when nutrient levels in leaf tissue are stabilized. Critical values to help with fertilization decisions have been established for prunes by University of California researchers. Analysis can reveal specific nutrient deficiencies or alert you to developing nutrient problems. Having a baseline of nutrient levels also provides a useful standard that allows you to compare to future trends. In addition, by keeping the trees in the optimum zone for nitrogen, leaf analysis can reduce costs by avoiding over fertilization.

Concentrations of nitrogen, phosphorus, and zinc on a leaf dry-weight basis start very high early in the season and decline rapidly to a fairly steady state after mid-June. Levels plateau and then drop off again from September to leaf fall. Potassium starts high in the spring then decreases reaching a plateau about the same time as nitrogen, phosphorus and zinc. Concentrations of magnesium, manganese, boron and chloride remain fairly constant or increase slightly during the season. Boron, chloride, and sodium however, will increase steadily if excess amounts are present in soil or irrigation water and leaching is not adequate. Calcium is the one element that always starts low and increases steadily over the season as leaves age.

Recent research in almonds has shown that to overcome typical tree to tree variability a truly representative sample must be collected from 18 to 28 trees. From each tree, leaves are collected around the canopy from 5 to 8 well exposed non-fruiting spurs located between 5 and 7 feet from the ground. Each sampled tree should be at least 30 yards apart. Although developed for almonds, this sampling scheme is not unreasonable to account for the tree to tree variability in a typical prune orchard as well.

To represent the nutrient status of a large uniform orchard collect the representative leaves in a survey pattern across the orchard. Collect one to two leaves picked from each sampled spur around the trees and place them in a paper bag (for example, sampling one leaf from 5 spurs on 20 trees gives you a 100 leaf composite sample for analysis). Leaves selected for analysis should be free of obvious tip burn, insect or disease injury, mechanical damage, etc., and should be from normal, healthy trees. If you have a weak area and you'd like to diagnose the problem, sample that area and compare the results with those of a sample from your best area to see if tree nutrition might be involved.

Critical Nutrient Levels for Prune Leaves in July

	Deficient Below	Optimum
Nitrogen (N)	2.2%	2.3 – 2.8 %
Potassium (K)	1.0%	adequate over 1.3 %
Zinc (Zn)	18 ppm	----------
Manganese (Mn)	---------	adequate over 20 ppm
Boron (B)	25 ppm	30-80 ppm

Deficiencies that are most common in this area are nitrogen, potassium, and zinc. Prune is an especially heavy potassium feeder and potassium levels should be watched closely. Zinc deficiency, most common in sandy soils and old barnyard locations, is easily identified in the field from leaf symptoms early in the season. Zinc residue from sprays containing zinc is difficult to wash off so zinc leaf levels are not meaningful if surface contamination has occurred. Boron is sometimes deficient near the foothills. Manganese deficiency is sometimes seen where soils are kept too wet or in areas with high water tables. Useful critical values are not established for iron or sulfur levels in prune leaf tissue.

Remember, leaf analysis is only a helpful guide in orchard management. Leaf levels should be considered along with past experience, orchard appearance, and current growth before corrective action is taken. Visual observation is an excellent complement to any lab analysis. Make sure that a deficient element is really the problem before you seek fertilizer applications as a solution.

Efficient Nitrogen Management in Prune Production

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

Nitrogen (N) is an essential plant nutrient necessary for growth and reproduction. A balance between too little and too much N is required to maximize grower return per acre in prune production. Nitrogen deficiency reduces yield in prunes compared to trees receiving adequate N. Nitrogen deficient prune trees are also more susceptible to bacterial canker infection than trees with sufficient N. Excessive tree N can increase the potential for fruit brown rot and may produce excessive shoot growth that must be pruned out. Excess soil N in the nitrate form can be leached from the root zone with water from heavy rains or excessive irrigation and move towards ground water. Ground water containing 10 ppm nitrogen as nitrate ($N\text{-}NO_3^-$) or 45 ppm nitrate (NO_3^-) – the same amount of N in each measurement, but presented with or without the added weight of the oxygen atoms in nitrate -- exceeds federal standards for drinking water.

Careful N management reduces grower costs and the potential of groundwater contamination. Following the Four-R's – delivering a nutrient to the root zone at the Right Rate, Right Time, Right Location, and Right Material -- is a good management program for any nutrient and especially so for N. The following is a quick review of the four R's for N in prune production in California. While more research on this topic is needed, the information presented below is a good starting place for N management in prunes.

Right Rate: Cropload drives mature prune tree N use. A four dry ton per acre prune crop contains 50-75 lbs. N in the harvested crop -- between 12-18 lbs. N per dried ton. Add an estimated 30-40 lbs. N per acre to maintain sufficient vigor in mature trees to maintain shoot and spur growth, and you have an annual per acre orchard N requirement of 80-120 lbs. N for a mature orchard. Depending on how efficiently the N is delivered to the roots, the amount of N added to the orchard soil in fertilizer, irrigation water, and/or organic amendment(s) can be 30-70% more than the orchard requirement (see more on fertilizer N efficiency in the Right Location section below). Multiple, small N applications (20-30% of annual orchard fertilizer N budget per application) are more efficient than one large application. Inefficient N input practices cost money and risk environmental contamination and increasing regulation.

Before you decide how much fertilizer N to apply to your prune orchard, check to see if you have any "free" N that you can "deduct" from your annual N fertilizer budget. If ground water is used in irrigation, it may contain a significant amount of N as nitrate – as high as 60 lbs. N per acre foot of water in some wells used for prune irrigation in the Sacramento Valley (surface water contains little to no nitrate). Take a sample of well water for nitrate analysis by a reputable lab. Pull the sample after the pump has run for several hours or even as much as 24 hours to make sure that the sample is representative of the water your orchard will receive through the growing season. How much of that irrigation water nitrate will be absorbed by the plant during a growing season is the topic of current research (in almonds). For now, a conservative number is the amount of nitrate-N in the water used by the crop in a growing season – annual crop ET. Examples of how to calculate the amount of nitrogen delivered to your orchard from a certain volume of irrigation water are found at the end of this article (See Figure 1). If you would like assistance calculating the "N credits" in your irrigation water, talk with your local UCCE advisor or a Certified Crop Advisor (CCA). Many PCAs are CCAs.

Right Timing: The most important time period for soil N availability and fertilization in prune production is spring through early summer. This is the time of rapid shoot growth and steady fruit growth. Prune trees use little to no N when leaves are off the tree, so applying N between October 1 and April 1 is not advised. If fertilizer N is applied postharvest, use only a small percentage of the annual N budget, as tree N uptake capacity is limited when there are no growing fruits or shoots.

Right Location: Target the roots when applying fertilizer or other N containing amendments. Most roots are in the tree row, not out in the compacted soil of the tractor aisle. In a flood or solid set sprinkler irrigated orchard, avoid broadcasting fertilizer, but apply it along the tree row. With micro-irrigated blocks, inject fertilizer solution into the irrigation water. Add the fertilizer to the middle third of the irrigation set, not early or late. Injecting fertilizer early in the irrigation can push some fertilizer deep in the root zone or even beyond the root zone if careful irrigation management is not practiced. Injecting fertilizer late in the irrigation set risks leaving a concentrated fertilizer solution in the root zone that might burn roots.

Right Material: Recent research in almonds suggests that there is no significant difference in crop yield between trees fertilized with UN-32 or CAN-17. It is likely the same is true in prunes and for other N fertilizer materials such as urea or ammonium sulfate.

Careful N budgeting and application saves money and protects the environment.

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 $N\text{-}NO_3^-$ — water applied (acre-ft)

Or

____________ x _____________ x 0.614 = __________lbs. N per acre
ppm NO_3^- — water applied (acre-ft)

Key points:

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

How hot was it at bloom, 2013?

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Rich Buchner, UC Farm Advisor, Tehama County
Bobby Johnson, UC/California Dried Plum Board Farm Advisor Intern

Maximum hourly average temperature (°F) on the day of full bloom at different locations throughout the Sacramento Valley, 2013. Temperature is the average of 12 consecutive measurements taken every 5 minutes throughout the day.

		Full Bloom Date									
County	Location	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22	3/23
Tehama	Red Bluff							62			
Tehama	Los Molinos								66		
Tehama	S. Los Molinos								66		
Tehama	S. Corning							62			
Tehama	E. Corning								65		
Tehama	W. Red Bluff									63	
Tehama	Tehama								66		
Tehama	S. Red Bluff						66				
Tehama	Jelly's Ferry										72
Glenn	SE Orland						65				
Sutter	Yuba City 1			78							
Sutter	Yuba City 2		78								
Sutter	South Yuba City				73						
Sutter	Tudor						68				
Yuba	S. Marysville 1*				72						
Yuba	S. Marysville 2*										72
Yolo	Woodland										70
Yolo	N Winters							65			
Solano	Winters						69				
Solano	W Davis							61			

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