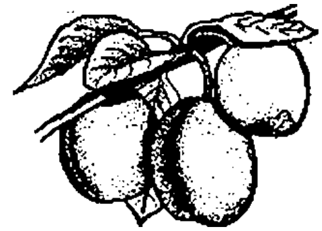
University of California **Cooperative Extension** **Butte County**

Prune Notes



In this Sacramento Valley Prune News:

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Prune Aphids in Spring & Summer

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

Growth of tender leaf tissue also signals the beginning of aphid season, especially if a fall or dormant aphid treatment was not applied. Two species of aphids overwinter as eggs on prunes and colonize prune trees in the spring. The first is leaf curl plum aphid (LCPA), which can be identified by its shiny green or yellow body. The second is mealy plum aphid (MPA), which is whitish or light green with three longitudinal dark green stripes and covered with a waxy coating. Both aphids can cause damage to prune trees, however damage differs depending upon the species. LCPA feeding causes prune leaves to twist tightly around their bodies, which protects the aphid while it feeds on the main vein of the leaf. MPA feed on the underside of leaves, causing cupping of the leaf, and dripping honeydew onto lower leaves and fruit, leading to a black fungal growth or "sooty mold".

The basic lifecycle of both species is similar. Aphids overwinter as eggs laid between shoots and dormant buds and are relatively difficult to find. At bud break, eggs hatch and aphids can multiply very rapidly for several generations, feeding on the tender leaf tissue. In late spring, aphids develop winged adults and migrate to an alternate summer host. This migration signifies the end of LCPA colonization until fall, when aphids migrate back to prune to lay eggs for the winter. Most mealy plum aphids will also migrate to an alternate host; however, a few remain behind and feed in orchards all summer long. Extensive feeding throughout the summer by MPA can lead to reduced fruit sugar levels and may be implicated in fruit cracking.

Monitoring. Orchards that did not have a dormant spray application should be scouted weekly beginning at petal fall and ending in mid-July to determine if a treatment is necessary (orchards that received a dormant application may choose to scout less frequently). Focus scouting in areas that are most likely to maintain higher aphid populations, such as near the perimeters or windbreaks or where aphids were found in previous years. Look for evidence of aphids: shiny sticky leaves may indicate aphids are feeding above; leaf twisting, cupping, or curling; or ants that may be feeding on aphid honeydew. If any signs of aphids are observed, examine the leaves more closely for the presence of live aphids.

Each week, check 40 trees for aphids. Each tree should take about 15 seconds to quickly check, or approximately 10 minutes to complete the scouting on all 40 trees. If greater than 10% of the leaves of a tree are infested with aphid colonies, the tree should be scored as having a "significant infestation". The treatment threshold is 12 out of 40 trees with a "significant infestation" of either species of aphid. A more detailed description of monitoring, as well as treatment guidelines (should treatment be necessary), can be found at the UC IPM website (http://www.ipm.ucdavis.edu/PMG/r606900211.html).

Irrigating French prune during a drought

Richard P. Buchner – UC Cooperative Extension Farm Advisor, Tehama County, Allan E. Fulton – UC Cooperative Extension Farm Advisor, Tehama, Glenn, Colusa and Shasta Counties

The first way to manage a limited water supply is to operate an irrigation system as efficiently as possible. A system that applies water uniformly across an orchard will enable water to be applied more efficiently. The Tehama County Mobile Irrigation Lab provides free irrigation system performance evaluations to growers in Tehama, Glenn, Butte and Shasta Counties. Call Kevin Greer at (503) 527-3013, ext. 102 to arrange an evaluation. Growers in Sutter, Yuba, and Colusa Counties may also ask about their availability.

The starting point for managing a high performing irrigation system is to understand the seasonal cumulative water use for prune trees where water supply is not limiting evapotranspiration (ET). Figure 1 shows the water use patterns for prunes grown in different areas of the Sacramento Valley during 2012 and 2013. Real-time information for the 2014 season is available at cetehama.ucanr.edu. Click on Water/Irrigation Program, then click on Weekly Soil Moisture Loss Reports.

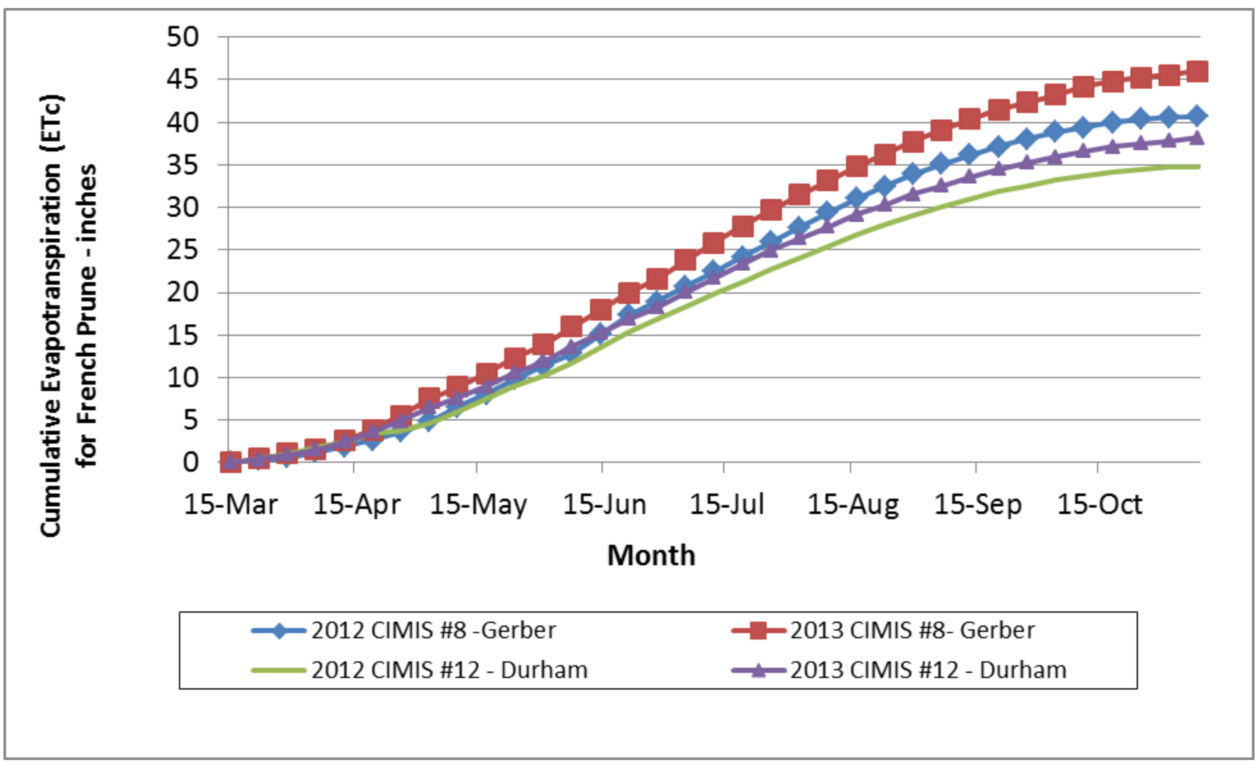

Figure 1. Cumulative water use by French prune orchard in Sacramento Valley.

These data show cumulative water use from bloom (March 15) to the end of the season (November 10) can vary between seasons and farming areas. Cumulative ET ranged between 35 and 45 inches in 2012 and 2013. Average annual ET is about 40 inches for prune. Assuming a 6 inch contribution from soil water storage in the root zone and 1 or 2 inches of effective rainfall in the spring, the net irrigation requirement for these examples would range from about 27to 37 inches plus any additional application to account for irrigation distribution uniformity.

Deficit or Regulated Deficit Irrigation (RDI) is the next consideration for managing limited water. RDI is a strategy of withholding irrigation water to levels less than full ET. Water is withheld at specific times and in specific amounts during the season that will limit detrimental effects on the tree, developing crop, and future production. It may be possible to realize benefit from RDI particularly during a drought. The challenge to managing crop water stress is evaluating when and how severe water stress really is. Fortunately, pressure chambers and measurements of Stem Water Potential (SWP) are gaining in use and interpretive guides are available to predict the impact of crop water stress on tree performance. In addition, several prune irrigation experiments have been published looking at the effects of water stress severity and duration.

Retired UC Irrigation Specialist, Dr. Dave Goldhamer and colleagues evaluated the effect of water stress applied at specific times and durations during the growing season. The research was done on drip irrigated French prune in the Gridley area of Butte County. Eight irrigation management strategies or treatments were evaluated for their effect on tree growth, fruit yield, and fruit size.

- T1 represents an unstressed control comparison where irrigation began in April and followed ET.
- T2 represents withholding irrigation until May 4
- T3 had irrigation off from May 5 until June 6
- T4 had irrigation off from June 7 to July 18
- T5 had irrigation off from May 5 to July 18
- T6 had irrigation off from July 16 to September 5
- T7 had irrigation off following harvest.

Figure 2 shows the effect of these irrigation treatments on fruit size. Notice that withholding water and creating even mild water stress at all pre-harvest stages of tree and fruit development between May 4 and September 5 (T2,T3,T4,T5 and T6 in Figure 2) decreased fruit diameter at harvest. When mild water stress was created early in the spring by delaying the start of irrigation until May 4 (T2), final fruit diameter was decreased about 10 percent. Final fruit size was reduced the greatest (about 25 to 35 percent) when water was withheld during the months of May through mid-July. The negative effect on fruit size increased as the duration of withholding water was lengthened. Post-harvest water stress (T7) had no effect on fruit size of the current crop. The purpose of the T7 treatment was to evaluate carryover effects from post-harvest water stress to the next crop season. The complete report is available at the on-line prune research reports http://ucanr.org/sites/driedplum. Search on 1990 and click on 1990, scroll to the bottom and select "Sensitivity of French Prune Seasonal Growth Stages to Water Deprivation: Second year results 89 CPB 2" then access the pdf file.

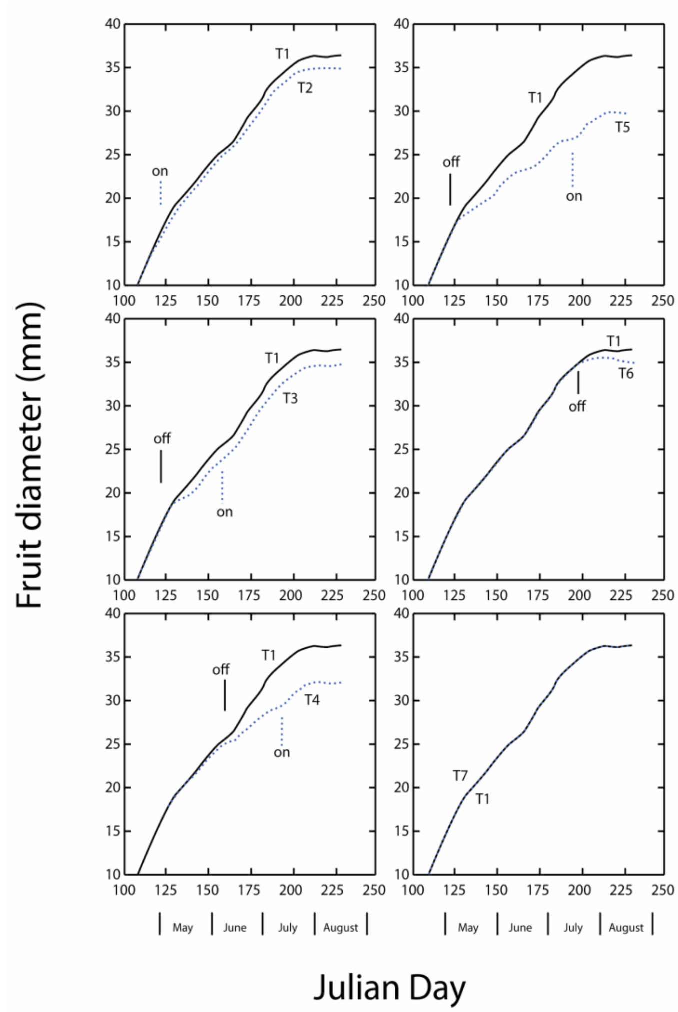

Figure 2. The effect of irrigation management on fruit diameter. The off arrows indicate when irrigation was withheld and the on arrows indicate when water was reapplied. T1 is the no stress comparison and T2, T3, T4, T5, T6 and T7 represent various water stress time and duration strategies. Goldhamer, et.al 1990.

The Goldhamer team also investigated irrigation cutoff regimes (Figure 3). After running the experiment for four years no significant differences in fruit drop were observed. They concluded that vegetative growth is reduced and fruit load can be lowered when very early season crop stress is imposed for consecutive years. Fruit size and weight were mildly reduced by early season cutoff.

Dry ratios tended to be lower and soluble solids higher with longer irrigation cutoff.

Treatment	Date of last irrigation	Days prior to harvest
1	July 3	44
2	July 10	37
3	July 17	30
4	July 24	23
5	July 31	16
6	August 7	9

Figure 3. Irrigation cutoff treatments investigated by the Goldhamer team. Applied water for the August 7 treatment was 30 ac-in.

In a third experiment , Dr. Bruce Lampinen and Dr. Ken Shackel at UC Davis evaluated the sensitivity of seasonal growth stages of French prune to water deprivation by measuring SWP with a pressure chamber. They concluded that for mid- and late season water stress up to about -20 bars SWP, there was no fruit growth stage of French prune that was particularly sensitive to water stress. Severe and prolonged crop prolonged stress of -20 to - 30 bars did lead to smaller fruit with lower quality and trees with less vigor.

In summary

- Early season water stress may reduce vegetative growth resulting in crop reduction due to less fruiting positions, especially if the early season water deprivation occurs over consecutive years.
- Early season crop water stress followed by more intensive irrigation to correct the water deprivation appears to increase end cracks. Avoid early season crop stress to prevent cracking.
- Mild to moderate irrigation deficit after mid-June does not appear to affect fruit drop.
- Moderate to severe irrigation deficit during green fruit sizing can reduce dry fruit size.
- French prune appears to tolerate mid to late season water stress fairly well.
- Late season irrigation deficit from reduced irrigation or earlier irrigation cutoff appears to improve dry ratio and soluble solids.
- If faced with a reduced water supply and unable to supply full ET, cutting back on water mid to late season and avoiding substantial crop stress early to mid season may be a reasonable strategy.
- The pressure chamber and use of SWP measurements is a useful management tool to help employ a successful drought management strategy.

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 return per acre in prune production. Nitrogen deficiency reduces yield and increases susceptibility to bacterial canker infection compared to trees receiving adequate N. Excessive tree N can increase the potential for fruit brown rot and stimulate excessive shoot growth that must be pruned out, increasing pruning costs. Excess soil nitrate can be leached below the root zone with water from heavy rains or excessive irrigation and can contaminate groundwater.

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 management for prune production in California. While more, much needed, research on this topic is planned, the information presented below is a good starting place for N management in prunes.

Right Rate: Crop load 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 for mature orchards to maintain shoot and spur growth, and you have an annual per acre orchard N requirement of 80-120 lbs. N per acre for an orchard producing a 4 dry ton crop.

Not every pound of fertilizer N applied to the soil reaches the trees. Soil microorganisms and weeds will rapidly absorb fertilizer N. In addition, fertilizer N can be lost as ammonia gas from urea or ammonium fertilizer on the soil surface and/or nitrate leaching with excess rainfall or irrigation. Additional fertilizer above the annual orchard N requirement needs to be applied to account for these losses and get sufficient N into the trees.

Nitrogen use efficiency is the term given to the ratio of the amount of N absorbed by the crop relative to the amount of N applied. Multiple, small N applications (20-30% of annual orchard fertilizer N budget per application) applied at different times of the season to match orchard N use are more efficient than one large application. To further increase N efficiency, minimize unintended losses of fertilizer N. Don't allow urea or ammonium fertilizers to sit on the soil surface for longer than a day or two – at most – before irrigating or disking into the soil. This will limit ammonia losses (volatilization) into the atmosphere. Since salinity is generally not a problem in our area, apply no more irrigation water than is needed to just refill the root zone to avoid leaching nitrate. Inefficient N fertilization is expensive, risks environmental contamination and could potentially increase 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 for 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 well water sample 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 irrigation water. How much irrigation water nitrate will be absorbed by the tree during a growing season is the topic of current research in almonds.

For now, a conservative estimate is the amount of nitrate-N in the water used by the crop in a growing season or annual prune evapotranspiration (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 (Figure 1). If you would like assistance calculating the "N credits" in your irrigation water, talk with your local UC Cooperative Extension advisor or a Certified Crop Advisor (CCA). Many PCAs are CCAs.

Right Timing: The most important time period for soil N availability and fertilization for prune production is April through June. This is the time when significant N is needed for rapid fruit and shoot growth. Prune orchard N use between July 1 and harvest is less than in April through June since shoot growth ceases and fruit N accumulation slows. From fall through early spring (October 1 – April 1) N fertilization is not recommended, as trees without leaves absorb little to no N without leaves. If fertilizer N is applied postharvest, apply only a small percentage of the annual N budget, as tree N need is limited between harvest and leaf drop.

Right Location: Target the roots when applying fertilizer. In a flood or solid set sprinkler irrigated orchard, avoid broadcasting fertilizer, rather, apply it along the tree row where most of the roots are located and weeds are controlled. With drip or micro-sprinkler systems, inject fertilizer solution into the irrigation water. Inject fertilizer later, rather than early, in the irrigation set. If careful irrigation management is not practiced, injecting fertilizer early in the irrigation risks pushing some fertilizer deep into or even below the root zone.

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 for prunes and for other N fertilizer materials such as urea or ammonium sulfate. Plant roots take up N as nitrate or ammonium regardless of the source.

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:

$$\underset{\text{ppm N-N}0_3^-}{\underline{\qquad\qquad}} \times \underset{\text{water applied (acre-ft)}}{\underline{\qquad\qquad\qquad}} \times 2.7 = \underline{\qquad\qquad} \text{ lbs. N per acre}$$

Or

$$\underset{\text{ppm N}0_3^-}{\underline{\qquad\qquad}} \times \underset{\text{water applied (acre-ft)}}{\underline{\qquad\qquad\qquad}} \times 0.614 = \underline{\qquad\qquad} \text{lbs. N per acre}$$

Key points:

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

Low Chill Winter?

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

Despite warm spring temperatures that usually produce a "tight" bloom, prune flowers were present in Yuba City area orchards for weeks this March. Extended bud break and bloom that follows is a consequence of low winter chilling conditions. What a low chill winter means to Sacramento Valley tree crop growers as this season develops is not certain. However, at the very least, this year is a good "test" year to review which chilling accumulation model most accurately describes orchard conditions. The new Dynamic Model of chilling accumulations calculated that the 2013-14 winter was one of the lowest chilling winters in some time, while the traditional Hours under 45^{o}F chilling accumulation model showed a usual winter chilling season. Using a more biologically accurate model -- the Dynamic Model -- will help growers better understand orchard conditions in future years. Chilling model data are available from the UC Davis Fruit and Nut Research and Information Center at:

http://fruitsandnuts.ucdavis.edu/Weather_Services/chilling_accumulation_models/ . The following is a brief review of current dormancy knowledge and chilling models.

Dormancy is a process by which fruit trees protect cold sensitive tissue -- flowers, shoots, and leaves -- from winter cold injury. Exactly how dormancy works is, as yet, unknown. Scientists think it is biochemical process. Field observations and lab research show that dormancy is a two-step mechanism that requires a certain amount of cold temperatures (chilling) followed by a certain amount of heat before bud break can begin. Differences in chilling from year to year influence the timing of bud break throughout the tree and, in some cases, the quality of flowers. Low chilling can cause non-uniform flowering and/or leaf out. In some tree fruit varieties, low chilling can produce reduced flower quality (smaller flowers, shorter pedicils, etc.), although this has not been documented in prune. Fruit trees native to temperate regions where colder winter conditions are common cannot be grown commercially in tropical or sub-tropical regions where very little chilling occurs.

In the past decades, some progress has been made in better understanding what environmental conditions contribute to chilling accumulation and bud break. The traditional model for chilling accumulation – the number of hours under 45^{o}F between November 1 and March 1 – was developed almost a century ago. In the last 20-40 years, researchers have determined that sub-freezing temperatures do not contribute to chilling accumulation and that warm temperatures immediately following chilling temperatures act to cancel that most recent chilling. The Dynamic Model, developed by Israeli researchers, has proven to be more biologically accurate than the "Hours under 45" model in research and field experience in fruit growing areas around the world. This model measures chilling in "Chill Portions"; which accumulate at the rate of roughly one unit per day under optimum chilling temperatures.

The winter of 2013-14 was a great example of how the new model performed compared to the "Hours under 45" model. Since we know that bloom was extended this spring, an indication of relatively low chilling, which model best measured low chilling? The Dynamic Model. See a comparison of the Dynamic and Hours under 45 chilling accumulations in the table below. Based on the Dynamic Model, this past winter was one of the lowest chilling seasons recently measured. What does this ultimately mean to growers? Beyond the extended bloom, we don't know what if anything will happen. However, knowing that the winter was "low chill" may help to explain any unusual orchard conditions that develop as the season progresses.

Chilling accumulations measured by the Dynamic and the Hours under 45^{o}F models at the CIMIS station in Durham, CA for the last nine winters.

Data from UC Davis Fruit and Nut Research and Information Center:

http://fruitsandnuts.ucdavis.edu/Weather_Services/chilling_accumulation_models/

Winter	Dynamic Model (Sept 1 – Mar 1)	Hours under 45^{o}F (Nov 1 – Mar 1)
2013-14	55	1095
2012-13	72	1166
2011-12	83	1132
2010-11	84	1007
2009-10	88	829
2008-09	74	1129
2007-08	86	1116
2006-07	77	1052
2005-06	71	862

How hot was it at bloom, 2014?

Franz Niederholzer, UC Farm Advisor, Colusa/Sutter/Yuba Counties,
Rick Buchner, UC Farm Advisor, Tehama County

It was hot in mid-March, during much of prune bloom. How hot? Here are the maximum hourly average temperatures (^{o}F) on the day of full bloom at different locations in north (Tehama Co) and south (Sutter Co) Sacramento Valley, 2014. Temperature is the average of 12 consecutive measurements taken every 5 minutes. Full bloom date represents 80% open flowers. We will know in mid-April how the crop sets.

		------------------------------------				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								**78**		
Tehama	S. Los Molinos									**78**	
Tehama	E. Corning									**79**	
Sutter	Dingville (S. of Yuba City)		**80**								
Sutter	W. Yuba City					**73**					
Sutter	N. Yuba City		**82**								

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