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ORCHARD FACTS

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Sacramento Valley Prune Newsletter

Winter Irrigation for Sacramento Valley Prunes

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For many orchards, time is running out for winter rainfall to adequately refill root zones. A full profile of moisture prior to leafout is beneficial because it provides a reserve to ensure orchards are adequately irrigated during the summer when crop water use is the greatest, soil infiltration rates are the slowest, and in the event irrigation is interrupted temporarily.

Table 1 below shows that rainfall has not been adequate to significantly replenish the soil moisture depletion from last fall. The light rains that we have received so far this winter tend to be less efficient at contributing to soil moisture storage because any small gains in soil moisture are lost to surface evaporation and extraction by resident vegetation. Observations, as of mid January, suggest some moisture has been stored in the upper root zone (12 to 18 inches) but little or no moisture has been stored in the lower profile (below a depth of 18 inches).

County	Station	Cum. Rainfall (inches)
Tehama	CIMIS #8	3.12
Glenn	CIMIS #61	3.17
Butte	CIMIS #12	2.09
Colusa	CIMIS #32	2.91
Sutter	CIMIS #30	3.83
Solano	CIMIS #139	2.27
Yolo	CIMIS #196	4.58

Table 1. Cumulative rainfall (inches) from November 1, 2008 to January 13, 2009 for selected CIMIS stations throughout the Sacramento Valley.

Roots, unlike canopies, have no distinct period of dormancy and grow whenever temperature, moisture and other climatic conditions are favorable. Roots grow rapidly as soil temperatures rise above 43°F, usually occurring by early spring. When the soil profile is dry due to the lack of rain, root growth is reduced. If the absence of rain continues this winter, a reasonable management approach for prune orchards would be to irrigate this winter to improve the soil moisture profile by mid February prior to early spring root growth.

Several methods exist to evaluate soil moisture but all of them require effort to evaluate deeper into the soil profile. Soil probes and augers provide a quick way to sample multiple locations and depths to visually evaluate soil moisture. In sandy loam and loam soils, soil will form a firm ball when squeezed and leave slight moisture on your hand when moisture is adequate. Soils with more silt and clay (silt loams and clay loams) will form ribbons if the soil is pinched between the thumb and index finger when the moisture is adequate. Dry soils will form a weak ball and crumble easily or ribbons will not form. Soil moisture sensors are another way to evaluate soil moisture depletion but should have already been in place to help evaluate the current situation. There are many good quality soil moisture devices available that work well. Collecting good representative information depends upon sensor placement, experience and a methodology to collect and analyze data.

Decisions to apply "winter irrigation" are orchard specific depending upon expected bloom date, soil moisture storage capability and how irrigation water is applied. A five foot root zone in a clay loam soil would need roughly 10 to 12 inches of applied water to refill to field capacity assuming 100% infiltration. Shallow root systems and/or sandy soils would have less soil moisture storage and require less applied water for refill (about 5 to 6 inches). The challenge is to determine how much water a full soil root zone will hold and how much water is currently in the root zone. Consider a four foot root zone with a loam to silt loam soil that requires two inches of water per foot of soil to refill. This site would hold eight inches of available water when refilled. Recent soil evaluation suggests the top 1 ½ feet are moist suggesting no more than 3 inches of water is currently in storage. The difference is the soil moisture deficit of five inches. Gambling that February will bring two inches of effective rainfall, a three inch irrigation would be a reasonable decision. The goal is to irrigate to augment rainfall and achieve a full soil profile without water loss percolating below the root zone.

Drip irrigation systems are not designed to refill the entire soil profile. A good strategy would be to make sure that drip zones are full by mid February and be prepared to operate those systems early to avoid early season moisture stress. Once leaves are fully expanded, Midday Stem Water Potential can be used to verify the orchard water status.

Hand and Mechanical Pruning Comparisons for French Prunes

Bill Krueger[1], Franz Niederholzer[1], Erick Nielsen[2] and Brian Mori[1]

Prune trees are pruned to thin fruitwood, improve fruit size, reduce alternate bearing and control tree size and shape. Hand pruning with ladders and loppers has long been thought to be the best alternative for pruning because of the selective nature of the pruning which cannot be matched by mechanical pruning. Previous studies of mechanical pruning have shown the limitations of mechanical pruning. In a study conducted in Glenn County during the 1990's, mechanical pruning severely enough to achieve equal fruit size and value per ton as hand pruned treatments resulted in reduced yield. New developments in mechanical pruning equipment have made different types of mechanical pruning possible.

During the winter of 2005-2006, a mature highly productive block of French prunes was selected. The block is a north-south planting with a spacing of 14 X 17 ft. or 183 trees per acre. In the winter of 2006, prior to the beginning of the trial, the trees were 17-18 ft. tall, and had been carefully pruned using ladders and loppers every year since planting. Nine pruning strategies were selected and applied. The hand pruned treatment with ladders and loppers (Std) has remained constant during the three years of the trial and is intended to represent a typical dormant hand pruning. The other treatments, in addition to the mechanical pruning treatments, have been hand pruned annually from the ground **without** the use of ladders using a combination of pneumatic pole pruners, pole chainsaws, pole loppers and long handled loppers. This pruning has generally been a less detailed type of pruning that removes fewer larger branches to allow for increased light penetration into the canopy. The differential mechanical pruning treatments have included flat topped (T) at approximately 15 feet, "roof topped" (RT) at 12 feet on the outside of the tree and 15 feet in the row center, "V" by making a slanted cut on the east and west side of the tree row to form a V in the center of the tree 12-14 feet at the bottom center and 17 feet at the top on the outside and a "Mohawk"(MH) where slots were cut in the shoulder of the canopy on both sides of the row, leaving the center uncut. Mechanical pruning timings included dormant (D), summer (S) in June and post harvest (PH) in September of 2007 prior to the 2008 crop. After the first year, because of an excessively vigorous response to the dormant mechanical pruning and research by others which indicated a less vigorous response when the mechanical pruning was done immediately post harvest, the timing was shifted from dormant to post harvest.

Since the trial began, there have been two moderately sized crops (2006 and 2008) and one heavy crop (2007). In 2006, all of the treatments had a higher yield and value per acre than the standard pruning treatment (Table 1). This was due to a moderate fruit set overall which resulted in good fruit sizes with no differences in value per ton between treatments. The standard pruning treatment reduced the total yield and, therefore, the value per acre. In 2007, fruit set was heavy and all of the treatments required intervention in addition to the mechanical pruning treatments to size the fruit and prevent tree damage. These steps included mechanical thinning, mechanical skirt pruning, cluster thinning with poles, mechanically cutting a narrow alley way (1 to 2 feet) in the row middle and propping as needed.

The estimated cost for the standard hand pruning with overhead has been $3.25/tree or $594/ac. The dormant ground pruning with overhead is estimated to cost about $200/ acre. The mechanical pruning is estimated to cost about $40/acre, so, the mechanical plus dormant pole saw pruning would cost about $240/acre.

Through the three years of the trial, combined values per acre for all mechanically pruned treatments has been greater than the standard pruned treatment (Table 1). These results indicate an opportunity to reduce pruning costs while increasing gross and net return per acre using a combination of hand and mechanical pruning without the use of ladders.

Table 1. Treatment and Value Summary 2006-2008

	Mechanical Pruning Trtmnt			Value/acre as % of Standard							
Trt	**2006**	**2007**	**2008**	**2006**		**2007**		**2008**		**Cumulative 06-08**	
1	DT			165%	ab	104%	dc	84%	bc	111%	bc
2	DT	S RT		145%	abc	113%	abcd	113%	abc	120%	ab
3	**Std**	**Std**	**Std**	**100%**	**d**	**100%**	**d**	**100%**	**bc**	**100%**	**c**
4	DV	SV		130%	cd	120%	ab	143%	a	129%	a
5	DV(eastside)		PH RT	162%	ab	126%	a	82%	c	120%	ab
6	SV		PH T	167%	ab	111%	bcd	103%	bc	121%	ab
7			PH V	171%	a	116%	abc	110%	bc	127%	a
8	D RT	SV		160%	ab	102%	d	115%	ab	119%	ab
9	D MH	S MH		125%	cd	119%	ab	114%	abc	119%	ab

Percentages followed by different letters are significant at the 5% level using Fischer's test

Mechanical treatments: T = flat top, RT = roof top, V = V_cut, MH = Mohawk

Timing: D = dormant, S = summer, PH = post harvest

[1] UC Cooperative Extension, [2] Glenn County Grower

What To Do If It's Hot During Prune Bloom

Franz Niederholzer, UC Farm Advisor, Sutter/Yuba Counties

Summary:

- High temperatures (above 75ºF) at bloom slow down or kill prune flower activity.
- Prune fruit set was reduced in 2004, 2005, 2007, and 2008 when maximum hourly temperatures exceeded 75ºF for several days during bloom.
- To try to increase set if temperatures are above 75ºF this year, consider:
- Cooling the orchard with irrigation water. Soil should be kept moist (not saturated) when high temperatures occur.
- Make sure bees are in the orchard to optimize pollination
- Leave grass long in the block if hot weather is predicted.

Heat at bloom (>80ºF) in 2004 resulted in the smallest California prune crop in almost a century. Temperatures over 80ºF at full bloom in 2005, and 2007 produced prune crop failures in Sutter and Yuba Counties. Full bloom timing differences of only 24-48 hours in 2005 or 2007 resulted in crop load differences of 200-300%. In 2008, temperatures above 75ºF, but less than 80ºF appeared to reduce set. If bloom temperatures head for 80ºF in 2009, the crop may again be at risk.

What exactly is the relationship between heat at bloom and low crop set? Recent research by Dr. Vito Polito, Plant Science Department, UC Davis, showed that pollen germination and pollen tube growth decline rapidly above 75ºF. At temperatures above 80ºF, Dr. Polito believes that flower parts are severely damaged or killed. It is not yet clear exactly what temperatures for how long will adversely affect fruit set. However, experience shows that it doesn't take much heat above 75ºF to damage flowers. The 2005 Sutter/Yuba prune crop was essentially destroyed when temperatures at full bloom were at or above 80ºF for a total of 11 hours over a three day period (March 10-12).

What can growers do if the temperatures of 75+ºF are predicted for bloom? While research has not yet developed rock solid recommendations for growers to follow, here's what has been learned over the past few years:

Cool the orchard with irrigation water. Evaporative cooling may reduce temperatures enough to help set a crop. Impact sprinklers or micro-jet irrigation systems have an advantage over flood irrigation systems for orchard cooling. There are reports of good crops in 2005 after running water, while other growers ran water with no benefit. Here are some key points to consider when using irrigation water to try to reduce temperatures in an orchard:

- The top one foot of soil should be moist (not saturated) when warm weather hits.
- If you can only irrigate part of the orchard per set, run water long enough to wet the soil and then shift flow to another part of the orchard. "Flash" irrigation water across irrigation checks and move on to others when using flood irrigation. If the soil surface dries and isn't rewet, the potential for evaporative cooling decreases significantly.
- Concentrate irrigation/cooling efforts on the upwind side of the orchard. Let the wind move the cooled air through the orchard.
- If I was a grower, I'd start running water (impact sprinklers or microjet sprinklers) when the temperature gets over 70ºF. If I only had flood irrigation to work with, I'd try to wet the soil surface in advance of predicted warm (over 70-75ºF) weather. If the warm weather stayed and the soil surface dried, I'd irrigate again.

Get bees in the orchard. This means renting bees, as native bee populations have weakened due to bee mites and poor food availability. Experience suggests better fruit set in 2005 and 2007 on trees close to hives, and poor fruit set away from the hives. It may be beneficial to spread hives throughout the orchard. In larger almond orchards beehives are distributed at 1/10 to ¼ mile intervals through the orchard for optimum pollination. If the orchard is smaller than 40 acres, hives can be distributed around the perimeter. **Leave grass long** in the orchard if heat at bloom is predicted. Tall, well irrigated vegetation should be 1-2^{o}F cooler compared to short mowed vegetation on the orchard floor. If frost is a threat at bloom, keep the orchard ground cover as short as possible. Delay the orchard floor management decision as long possible so that a better forecast of bloom weather is available and can be included in the final decision.

Brown Rot Blossom and Twig Blight and Preventing Fungicide Resistance

Joseph Connell & Richard Buchner, UCCE Farm Advisors – Butte & Tehama Counties
Jim Adaskaveg, Professor, Dept. of Plant Pathology, UC Riverside

Brown rot blossom/twig blight caused by *Monilinia* species is the most important blossom and pre-harvest disease of prune in California. *M. laxa* is the primary pathogen on blossoms, whereas *M. fructicola* is the main pathogen on fruit. Properly timed fungicide treatments can most effectively protect your trees and prevent this disease.

The brown rot fungus produces spores from fruit mummies on the orchard floor and from mummified fruit left in the tree, twig cankers on the branches, and on any remnants of infected flower parts. These old infections are the source of spores for spring infections and the spores can be both airborne or rain splashed. Good orchard sanitation including removing mummified fruit from trees, pruning out blighted shoots, and cultivating the orchard floor to bury fruit mummies are practices that reduce spore production.

All flower parts are susceptible to blossom infections from green bud through petal fall. Brown rot fungi grow and reproduce rapidly at temperatures ranging from 60° to 80°F. Infections do not develop below 50°F. Initially infected flowers turn brown, wither and remain attached to fruit spurs. Twig cankers form on the wood at the base of infected blossom spurs. Ultimately, as blossom infections extend into the twigs, shoot death is caused by girdling. Gumming occurs at infection sites and grey-brown spore masses may be visible under high humidity.

Orchards with a history of brown rot should be treated and all orchards are vulnerable in a severe brown rot year. The challenge is trying to anticipate or predict severe disease conditions. Sprays are preventive and do little if any good when applied after infection. Grower surveys following the severe brown rot year in 1993 suggested waiting to apply a single spray for brown rot at full bloom did not provide adequate control. A two-spray program (green bud/white bud and full bloom) aimed at both brown rot (green bud and full bloom) and russet scab (full bloom, only) may be a good choice. Fungicide treatments are most effective when applied in time to dry thoroughly before rainfall occurs.

PRUNE (OR DRIED PLUM)—TREATMENT TIMING

Note: Timings listed are effective but not all may be required for disease control. Timings used will depend upon orchard history of disease, length of bloom, and weather conditions each year.

Disease	Green bud	White bud	Full bloom	May	June	July
Brown rot[1]	+++	+++	+++	----	+	++
Russet scab[2]	----	----	+++	----	----	----
Rust[3]	----	----	----	+	++	+++

Rating: +++ = most effective, ++ = moderately effective, + = least effective, and ---- = ineffective

[1] Flowers are susceptible beginning with the emergence of the sepals (green bud) until the petals fall but are most susceptible when open.

[2] A physiological disorder; no pathogens involved.

[3] More severe when late spring rains occur.

PRUNE (OR DRIED PLUM)—FUNGICIDE EFFICACY 2008

	Resistance risk	Brown rot			
Fungicide	**(FRAC#)[1]**	**Blossom**	**Fruit**	**Russet scab**	**Rust**
Benlate[2] + oil[3]	high (1)	++++	++++	----	----
Distinguish*	medium (9/11)	++++	++	----	++
Indar	high (3)	++++	++++	----	+++
Orbit (Bumper)	high (3)	++++	++++	----	+++
Pristine	medium (7/11)[4]	++++	++++	ND	ND
Rovral[5] + oil[3]	low (2)	++++	NR	----	NR
Scala	high (9)[4]	++++	+++[6]	----	ND
Topsin-M2/T-Methyl + oil[3]	high (1)[4]	++++	++++	----	----
Vangard	high (9)[4]	++++	+++[6]	----	ND
Benlate[2]	high (1)	+++	+/-	----	----
Elevate	high (17)[4]	+++	+++	ND	----
Rovral[4]	low (2)	+++	NR	----	NR
Topsin-M/T-Methyl2	high (1)[4]	+++	+/-	----	----
Abound	high (11)[4]	++	+	----	+++
Botran	medium (14)	++	++	ND	ND
Bravo/Chlorothalonil/ Echo[7,8]	low (M5)	++	++	++	----[8]
Captan[7]	low (M4)	++	++	+++	----
Gem	high (11)[4]	++	+	----	+++
Rally	high (3)	++	++	----	----
Sulfur	low (M2)	+/-	+/-	----	++

Rating: ++++= excellent and consistent, +++= good and reliable, ++= moderate and variable, += limited and erratic, +/- = minimal and often ineffective, ---- = ineffective, ? = insufficient data or unknown, NR = not registered after bloom, and ND=no data

* Registration pending.

[1] Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode of action Group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode of action Group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode of action Group number.c.info/.

[2] Benlate label withdrawn. Strains of *Monilinia fructicola* and *M. laxa* resistant to Benlate, Topsin-M, and T-Methyl have been reported in some California prune orchards. No more than two applications of Benlate and Topsin should be made each year. Resistant strains of the jacket rot fungus, *Botrytis cinerea*, and powdery mildew fungi have been reported in California on crops other than almond and stone fruits and may have the potential to develop in prune with overuse of fungicides with similar chemistry.

[3] The oil is "light" summer oil, 1-2% volume/volume. If applied in summer causes fruit to lose bloom and look red. They dry to normal color.

[4] To reduce the risk of resistance development start treatments with a fungicide with a multi-site mode of action; rotate or mix fungicides with different mode of action FRAC numbers for subsequent applications, use labeled rates (preferably the upper range), and limit the total number of applications/season.

[5] Blossom blight only; not registered for use after petal fall.

[6] High summer temperatures and relative humidity reduce efficacy.

[7] Do not use in combination with or shortly before or after oil treatment.

[8] Do not use after jacket (shuck) split.

Good management can prevent disease resistance to fungicides:
You can preserve our material choices and provide effective disease control as long as you practice good disease resistance management. Each fungicide has a group number assigned by the Fungicide Resistance Action Committee (FRAC). Group numbers identify fungicides with different modes of action.
Good fungicide management:

1. Alternate fungicides with different modes of action. If a FRAC class 1 is used for the first application, choose a different fungicide class for the second application. For example, if you sprayed Vangard (FRAC 9) at green bud, don't use Scala (FRAC 9) at full bloom. Use Indar or Orbit (FRAC 3) or Rovral (FRAC 2) or another effective material not containing FRAC 9 material listed on the chart above.
2. Make certain materials are applied at full label rates. Sub-lethal treatments increase the chance for resistant *Monilinia* to survive.
3. Solid sprays providing good tree coverage are essential for good disease control. When poor spray coverage results in a sub-lethal dose, resistant *Monilinia* are favored.
4. Identify orchards with suspected resistance. If you suspect brown rot resistance, contact your local farm advisor so samples can be collected and analyzed.

Oil Burn in Prunes

Franz Niederholzer, UC Farm Advisor, Sutter/Yuba Counties

Young "red" wood or shoots are most sensitive to damage from dormant oil sprays. Oil burn can severely damage prune trees and can kill young prune trees in extreme cases. Exactly how oil damages wood in dormant prunes is not clearly known.

What can be done to avoid oil burn in 2009?

1) **Use no oil or a very low oil rate of oil**. Oil is not needed for excellent aphid or peach twig borer control. Oil is a very important material for scale control -- with or without synthetic pesticide such as diazinon, Lorsban, Seize WP, etc.. Take a dormant spur sample to find out if you have a scale problem. Many prune blocks will not need scale control.
2) **Wait until just before bloom to spray for dormant pests. The closer to bloom, the smaller the chance of oil burn. Delayed dormant is a much safer timing than dormant for using oil in prunes.**

Note: Certain pesticides are very toxic to bees. If spraying pesticides just prior to prune bloom, make sure to follow all guidelines to protect bee health. Contact your local County Ag Commissioner's office to determine local bee safety regulations. No bees = no prunes.

3) **Irrigate your orchard before spraying**. Dry soil is very strongly related to oil damage in prunes.
4) **Wait until tree bark is moist (wet conditions). I have seen significant oil damage when trees on wet ground are sprayed on the first calm day after several days of dry north winds. Once rain or fog rewets trees, the risk of oil damage is greatly reduced.**

Be sure you understand what can lead to oil damage and know what conditions are like in your field. Don't take chances. Oil can damage or kill several years of growth.

Conditions commonly associated with high or low risk of oil burn in prunes.

High Risk of Oil Burn	Low Risk of Oil Burn
Young Trees	Old Trees
Dry Conditions[1]	Wet Conditions[2]
Dry soil	Good Soil Moisture
High rate of oil	Moderate Rates of Oil
Early Dormancy	Delayed Dormancy
Air application	Ground Application
Poor agitation	Good Agitation
Moyer prunes	

[1] Example: The first clear, calm day after a dry north wind blows for 1-3 days

[2] Example: Immediately after a rain or after morning fog clears.

Oil Damage to a Young Replanted Tree. Sutter County.

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