MANAGING BLOOM TIMING IN 'FRENCH' PRUNE, 2010

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PROBLEM AND ITS SIGNIFICANCE

Consistent cropping is essential for economically sustainable prune production.

Virtually all commercial prune production in California is limited to a single variety ('Improved French'), and the full bloom "window" throughout the state can be limited to a single week. Consequently, the entire California prune industry is at risk of serious crop damage from even a short spike of extreme weather (cold or hot) at bloom.

Bloom temperatures above 80^{o}F severely limited prune fruit set in the southern Sacramento Valley in two out of the last three years (2005, and 2007) and in the entire state in 2004. Temperatures above 75^{o}F in later blooming regions of the southern Sacramento Valley reduced fruit set relative to earlier blooming dates in 2008. Low production 4 of the last 5 years has negatively impacted the entire industry, raising doubts about the future of commercial prune production in this state.

<u>California prune growers need a strategy to implement in existing orchards to reduce production risk from extreme weather at bloom</u>. High rates of horticultural oil (4-5 gallons/acre) in the dormant spray has long been used to advance or tighten prune bloom, with a general window of late December through the middle of January targeted to advance bloom. This timing window was identified over time, with no published information available to explain field experience and potentially maximize effect.

Research based practices from other orchard crops in California and other fruit growing regions could help California prune growers maximize benefit from sprays intended to manipulate bloom timing. California sweet cherry growers routinely apply dormant sprays to "break" dormancy, advance bloom and hence harvest timing for logistics and marketing purposes. Dormant applications of horticultural oil, fertilizer, or plant growth regulator are timed after a certain amount of chilling has accumulated. Chilling accumulation is measured using the 'Dynamic Model'. This model was developed to track chilling accumulation in regions with warmer winters (Mediterranean climates) and has been extensively tested in Israel and South Africa.

OBJECTIVES

1. Test a range of rest-breaking chemicals, including nitrogen fertilizers, horticultural oil, and a range of surfactants to advance bloom timings in 'French' prune and improve fruit set when bloom temperatures are above 75^{o}F.

2. Work with the UC Davis Fruit and Nut Research and Information Center

(http://fruitsandnuts.ucdavis.edu/) to fine tune the Prune Chilling Prediction Model that was launched in “test mode” in fall, 2009 for the Sutter/Yuba region. The model is available at: http://fruitsandnuts.ucdavis.edu/Weather_Services/Prune_Chilling_Prediction__About_Chilling_&_Dormancy.htm.

PROCEDURES

The 2009-2010 study was conducted in a mature prune orchard in Sutter County. Oil was eliminated from commercial dormant sprays in the study block by arrangement with the grower. Chill portions were calculated from temperature data recorded by a datalogger in the study orchard. Seventeen treatments were established between December, 2009 and mid March, 2010 (Table 1). All treatment materials and rates appear in Table 2. All treatments were applied with a Stihl mistblower to individual trees using a spray volume calculated to be equivalent to 100 gallons per acre. A completely randomized block design with four single tree replicates per treatment was used.

In early March, 2009, several branches, 0.5-1.0 inch in diameter and of similar orientation, from each replicate tree were chosen from each of three general locations in the canopy prior to flower bud break. Heavy pruning in the block reduced the number of branches available with >100 flowers. So, one or more branched were selected on the western, southern, and north-east sides of the canopy at approximately 6’ above the orchard floor. Buds (average = 53 buds/branch, with a range from 20-120 flowers/branch) were counted prior to flowering. Bloom progression over time, starting at first flower open and ending with the last open flower was measured by counting open flowers at 2-3 day intervals from March 5 to March 21. Fruit set was determined May 20-21. Ten fruit from each tree were sampled on August 20, just prior to the start of harvest. Fruit pressure was determined from opposite “cheek” sides of each fruit. Composite sugar samples or each tree were taken by blending fruit halves from each fruit per tree and measuring soluble solids with a hand refractometer.

Dates on which each treatment achieved 50% bloom were estimated using the logit transformation. These data were then averaged for each tree and analysed by GLM model determine if bloom dates were significantly different for each treatment. Fruit maturity and sugar levels were statistically analysed using the GLM model as well.

RESULTS AND DISCUSSION

Bloom date was significantly advanced by some treatments. Treatment material and/or timings affected response (Table 2).

- Nitrogen treatments – CAN17 + NIS and/or Erger-G + CAN17 -- significantly advanced bloom relative to untreated controls at 52 or 63 CP timings.
- Oil applications advance bloom when applied at 40 or 52 CP, but not earlier or later (Table 2).

Fruit set was unaffected or decreased by treatments (Table 2).

- Oil treatments at 52 CP or 63 CP significantly increased fruit set (Table 2). There was no statistical difference in fruit set between the untreated controls and all other treatments.

CONCLUSION

The most consistent advance in bloom date with limited risk of reduced set was achieved with 4% oil applied about 40 CP (Table 3). The exact amount of bloom advance appears to be linked to weather at application and bloom.

For now, from a production standpoint, targeting a roughly 40 CP timing for a 4% oil spray has provided the most consistently advance in prune bloom. Nitrogen – in the form of CAN17+NIS -- has the potential to produce earlier bloom compared to oil treatments applied at the same time, but the risk of flower loss in warm winters is significant.

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Table 1. Treatment materials, rates, and application timings measured as the number of chill portions at application during the 2009 – 2010 season in a commercial orchard in Sutter County.. Total spray volume was equivalent to 100 gallons per acre..

		--Chilling accumulated at spray timing--				
Treatment	Rate/acre in 100 gallons of water	**28 CP**	**39 CP**	**52 CP**	**63 CP**	**First flower**
4% oil[1]	4 gallons IAP 440 oil	X	X	X	X	X
CAN-17 + NIS[2]	25 gallons CAN-17 + 2 gallons Activator 90	X	X	X	X	
KNO_3 + NIS[2]	40 pounds KNO_3+2 gallons Activator 90			X		
CAN-17 + Erger-G®[3] (low)	1.0 gallon of CAN-17 + 1.5 gallons Erger-G®	X	X	X	X	
CAN-17 + Erger-G®[3] (high = label)	4.0 gallon of CAN-17 + 5 gallons Erger-G®			X	X	

1. IAP 440 horticultural oil
2. Non-ionic surfactant. Activator 90, Loveland Industries, Greeley, CO.
3. Erger-G® 8-0-0 liquid fertilizer. Nutrecology, Houston, TX

Table 2: The effect of spray treatments applied following certain chilling accumulation (CP) on the timing of 50% full bloom relative to untreated trees and % set on May 20-21, 2010 in French prune trees growing in a commercial orchard in Sutter County. Negative numbers indicate earlier bloom than the control. Positive numbers indicate later bloom. Estimated date of fifty percent bloom of control trees = March 19. Material details are the same as in Table 1. Data points in a column showing the same letter are not statistically different (95% certainty). Data points followed by no letters were not included in the statistical analysis so that the rest of the data could meet required assumptions for analysis of variance.

Treatment	Application Date	CP at application	Days difference in bloom from control.	% Set
Oil	Dec 14, 2009	28	-1.4 bcd	32 bcde
CAN17 + NIS	Dec 14, 2009	28	-2.7 b	19 a
CAN17 +Erger-G (Low)	Dec 14, 2009	28	-0.5 cd	20 ab
Oil	Dec 29, 2009	39	-2.4 bc	37 cde
CAN17 + NIS	Dec 29, 2009	39	-2.7 b	23
CAN17 +Erger-G (Low)	Dec 29, 2009	39	-0.6 cd	29
Oil	Jan 15, 2010	53	-2.3 bc	43 e
CAN17 + NIS	Jan 15, 2010	53	-5.5 a	36
CAN17 +Erger-G (Low)	Jan 15, 2010	53	-1.9 bcd	26 abc
CAN17 +Erger-G (High)	Jan 15, 2010	53	-6.7 a	39 de
KNO3 + NIS	Jan 15, 2010	53	-2.9 b	30 abcde
Oil	Jan 28, 2010	63	-1.6 bcd	43 e
CAN17 + NIS	Jan 28, 2010	63	-1.5 bcd	29 abcd
CAN17 +Erger-G (Low)	Jan 28, 2010	63	-0.9 bcd	28 abcd
CAN17 +Erger-G (High)	Jan 28, 2010	63	-2.1 bc	25 ab
Oil (first white)	Mar 15, 2010		+1.8 e	22 ab

Control	---	---	0.0 de	28 abcd

Table 3. The effect of a A) 4% oil spray or B) CAN17+NIS following certain chilling accumulation (CP) on the timing of 50% full bloom relative to untreated trees over a four year period. Negative numbers represent advance in bloom. Positive numbers indicate delay in bloom.

A) Oil

	2006	2006	2008	2008	2009	2009	2010	2010
Treatment	Spray Date	Days from control	Spray Date	Days from control	Spray Date	Days from control	Spray Date	Days from control
Oil @ 27-30 CP	16-Dec	**-14**	22-Dec	**-2**	23-Dec	**-2**	14-Dec	**-1.4**
oil @ 38-41 CP	6-Jan	**-11**	2-Jan	**-3**	6-Jan	**-3**	29-Dec	**-2.4**
oil @ 50-53 CP	--	**--**	18-Jan	**-3**	26-Jan	**-1**	15-Jan	**-2.3**
oil @ 59-64 CP	6-Feb	**0.3**	30-Jan	**-3**	11-Feb	**-1**	28-Jan	**-1.6**

B) CAN-17 + NIS

	2006	2006	2008	2008	2009	2009	2010	2010
Treatment	Spray Date	Days from control	Spray Date	Days from control	Spray Date	Days from control	Spray Date	Days from control
Oil @ 27-30 CP	16-Dec	**-12**	22-Dec	**-3**	23-Dec	**-2**	14-Dec	**-2.7**
oil @ 38-41 CP	6-Jan	**-15**	2-Jan	**-3**	6-Jan	**-3**	29-Dec	**-2.7**
oil @ 50-53 CP	--		18-Jan	**-3**	26-Jan	**-1**	15-Jan	**-5.5**
oil @ 59-64 CP	6-Feb	**1.6**	30-Jan	**-4**	11-Feb	**0**	28-Jan	**-1.5**