Mechanical Hedging to Manage Mature Almond Orchards

Project No.: **13-HORT19-Lampinen**

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Objectives:

Objective 1) Conduct pretreatment measurements of mid-summer midday canopy light interception and harvest yields

Objective 2) Impose hedging treatments in the winter of 2013-14

Interpretive Summary:

Density of California almond planting has been increasing in a linear fashion from about 80 trees per acre in the early 1980s to 112 trees per acre in 2012. 112 trees per acre correspond to a spacing of approximately 15 x 21 feet. However, when you consider that there are still many traditional planted orchards embedded in those statistics, the average new orchard is likely being planted at even higher densities than 15 x 21 feet. Although orchards at these close spacing's tend to come into production earlier than those at more traditional spacing's, there are often problems with lower canopy shading and difficulty with getting adequate sunlight to the orchard floor to dry the nuts at harvest as they mature. These likely results in increasing food safety risk suggesting there is a tradeoff between maximum production and food safety risk in almond. Recent recommendations from the author suggest that orchard photosynthetically active radiation interception at maturity should not be above 80%. This should still result in a yield potential of about 4000 kernel pounds per acre. This is substantially higher than the statewide average per acre yield of about 2400 kernel pounds per acre in 2012. This suggests that crowding related issues will continue to increase in the years ahead as average tree density continues to increase.

Preliminary light interception data showed light interception levels collected in July 2013 were just below 80% and that there were no significant differences across the orchard before treatments were imposed.

Simulated hedging was done over the winter of 2013-14 to predict impacts of the hedging treatments on yield. The actual levels of midday canopy light interception were greater than the predicted levels based on the simulated hedging. A likely cause for this

is the sagging (and regrowth) of limbs along the edge of the hedging cut. This suggests that impacts on yield may not be as great as predicted.

Materials and Methods:

A 13 year old almond orchard in Kern County was chosen for the hedging trial. The orchard has 50% Monterey, 25% Nonpareil and 25% Wood Colony and tree spacing is 24' between rows and 21' down the tree row. The orchard was hedged one time about 3 years previously to the initiation of the trial.

Preliminary measurements of midday canopy light interception and yield were done in the trial during the 2013 season before treatments were imposed.

The experiment was set up as a randomized complete block design with 12 replications of each of the four hedging treatments. The experiment is designed to be modified to have 6 replications of each of two different hedging regimes if that appears to be necessary after the 2014 season. Hedging treatments were imposed on December 10-11/2013. The widths of hedging treatments constituted 4 treatments, which were an unhedged control as well as 28", 38", and 48" hedging cuts. The hedging cuts were vertical and were imposed on all three varieties in each replication but yield data described above was only collected on the Nonpareil.

Weights of fresh prunings were collected by picking up all of the prunings in the row middles between 3 trees in the Monterey and Nonpareil as well as between the Wood Colony and Nonpareil.

Midday stem water potential was measured on one tree in each replication for all three treatments (total of 12 trees per treatment) approximately every two weeks during the 2014 season to assess if pruning treatments had an impact on midday stem water potential due to the changes in canopy light interception.

Midday canopy light interception was taken in the row middles on either side of the Nonpareil rows at least 3 times during the 2014 season.

More light hitting the orchard floor at midday results in higher soil temperatures and these temperatures may help to mitigate food safety risk (Danyluk et.al, 2007). Soil surface temperatures in the middle of the drive row and under the tree row will be measured with the mobile platform light bar. Light hitting the orchard floor is also important for drying the nuts after shaking.

The Nonpareil yields will be collected in the entire data row in all replications and subsamples will be taken for drying and cracking out to adjust the rough field weights to kernel weights. At the time of harvest, nut size distribution will be evaluated by weighing 100 individual nuts from each rep to determine if the hedging treatments impacted nut size distribution. In walnut, we have found that mechanical hedging tends to lead to increased variability in nut size low in the canopy due to exposing positions that formed in low light the previous year to high light in the current year.

Even though those positions are now well lit, they still produce small nuts due to low carbohydrate reserves from the previous year.

Based on regrowth of the hedged rows during mid-summer, we will decide on the hedging treatments to be imposed in the winter of 2015. Most likely the hedging cycles will be two to three years long.

Results and Discussion:

2013 Preliminary

Light interception data and yield data were collected before treatments were imposed in July 2013. There were no significant differences in midday canopy light interception, yield or yield per unit light intercepted in July 2013 (**Table 1**). This suggests that the blocking was set up such that the experimental layout should allow a good test of the treatment impacts.

Using the positional information from the mobile platform light bar collected in July 2013, we ran a simulation of how much canopy would be taken off with the 3 different hedging regimes and the predicted light interception and yield loss associated with these regimes and this data is shown in **Table 2**. The predictions are for a 9, 13 and 17% yield loss for the 28, 38 and 48" hedging regimes respectively.

2014

The weight of fresh prunings is shown in the last column of **Table 1**. The prunings in the unhedged treatment were due to the grower's crew removing limbs that impeded tractor traffic or herbicide spraying in the orchard. As expected, the fresh weight of prunings increased with increasing severity of hedging. The increase in weight of fresh prunings was linear (**Figure 2**).

The loss of midday canopy light interception by the hedging treatments (**Table 1**) was less than predicted by the simulated hedging. This was likely because branches along the hedging cut tended to bend down into the drive row which made the hedging cuts look less severe as the crop weighted the branches down.

Soil surface temperature data runs from the mobile platform just before harvest will be used to assess the impact of hedging treatments on nut drying potential and food safety risk. These data will be reported at the Almond Conference in December.

In 2014, the trees were moderately stressed early in the season due to limited water availability resulting from drought related water cut backs (**Figure 1**). As the season progressed, the midday stem water potentials tended to run closer to the baseline on most dates since the grower was able to allocate some more water to the plots. There were no significant impacts of hedging treatments on midday stem water potential for any of the varieties on any date (**Figure 1**).

Preliminary Conclusions:

The actual loss in midday canopy light interception due to the hedging (2014 data in **Table 2**) was less than predicted from the simulated hedging (second column of **Table 1**). This may be because the branches in the row middle on the hedged treatment trees tended to sag down (and regrow) into the open space left by the hedging. There were no significant treatments impacts on midday stem water potential, perhaps due to the sagging of branches along the hedging cuts into the row leading to less of a loss of light interception than was predicted by the simulated hedging. Based on the level of light interception measured in 2014, the loss in cropping potential due to the hedging may be less than predicted. Since the light interception measurements reported here for the 2014 season were early in the season, the decision whether or not to hedge any of the treatments during the winter of 2015 will be based on later summer measurements of midday canopy light interception (just before shaking).

References cited:

Danyluk, M.D., M. Nozawa-Inoue, K.R. Hristova, K.M. Scow, B. Lampinen, and L.J. Harris. 2007. Survival and growth of *Salmonella* Enteritidis PT 30 in almond orchard soils. J. Appl. Microbiol. 104: 1391-1399

Lampinen, B., G. Browne, S. Upadhyaya, V. Udompetaikul, D. Slaughter, S. Metcalf, R. Duncan, J. Edstrom, B. Holtz, B. Krueger, and F. Niederholzer. 2011. Development and testing of a mobile platform for measuring canopy light interception and water stress in almonds. Almond Board of California Annual Project Report 2010-2011 (10-HORT13-Lampinen). pp. 1-11.

Tables:

Table 1. Midday canopy photosynthetically active radiation interception (PAR), yield and yield per unit PAR intercepted for pretreatment conditions in 2013 and midday PAR interception for after treatment imposition in July 2014.

	Treatment	Midday PAR int. (%)	Yield (kernel lbs/acre)	Yield per unit PAR intercepted	Fresh weight of prunings (lb/ac)
2013	Unhedged	78.8 a	3226 a	40.9 a	183.1 c
	28” hedge	78.9 a	3178 a	40.3 a	624.0 b
	38” hedge	78.1 a	3351 a	42.9 a	749.8 ab
	48” hedge	77.5 a	3192 a	41.2 a	923.1 a

2014	Unhedged	76.7 a
	28” hedge	74.9 ab
	38” hedge	73.5 b
	48” hedge	72.9 b

Table 2. Simulation of loss in photosynthetically active radiation (PAR) interception and predicted yield for 2014 season for current hedging trial. 2014 yield estimate is based on 8.7 lower than optimum yield per unit PAR intercepted in 2013 becoming an 8.7 percent increase from optimum in 2014 as well as using predicted PAR interception based on hedging cut width. For unhedged example predicted yield = ((78.8 x 50) x 1.087).

Treatment	2013 Midday PAR int. (%)	Predicted PAR int. for 2014	Predicted yield in 2014 (kernel lb/ac)	Predicted percent loss in yield
Unhedged	78.8 a	78.8	4283	0
28” hedge	78.9 a	71.6	3891	9
38” hedge	78.1 a	68.3	3712	13
48” hedge	77.5 a	65.2	3544	17

Figures:

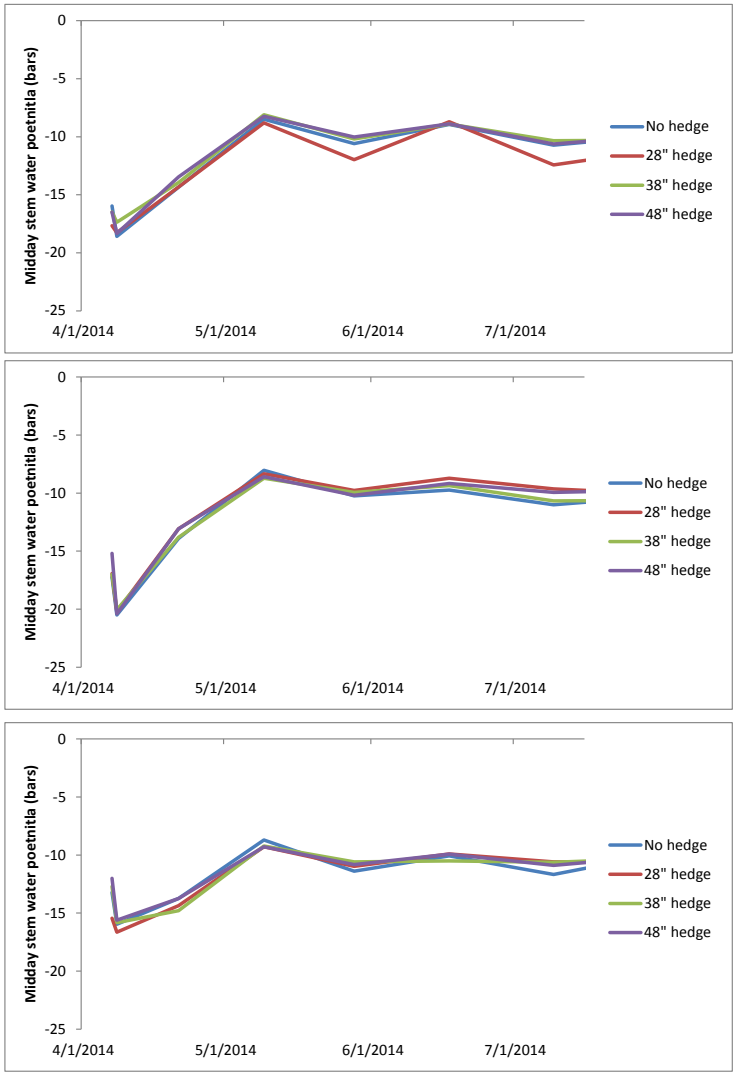

Figure 1. Midday stem water potential by hedging treatment over the 2014 season for Nonpareil, Monterey and Wood Colony. There were no significant differences among treatments on any date.

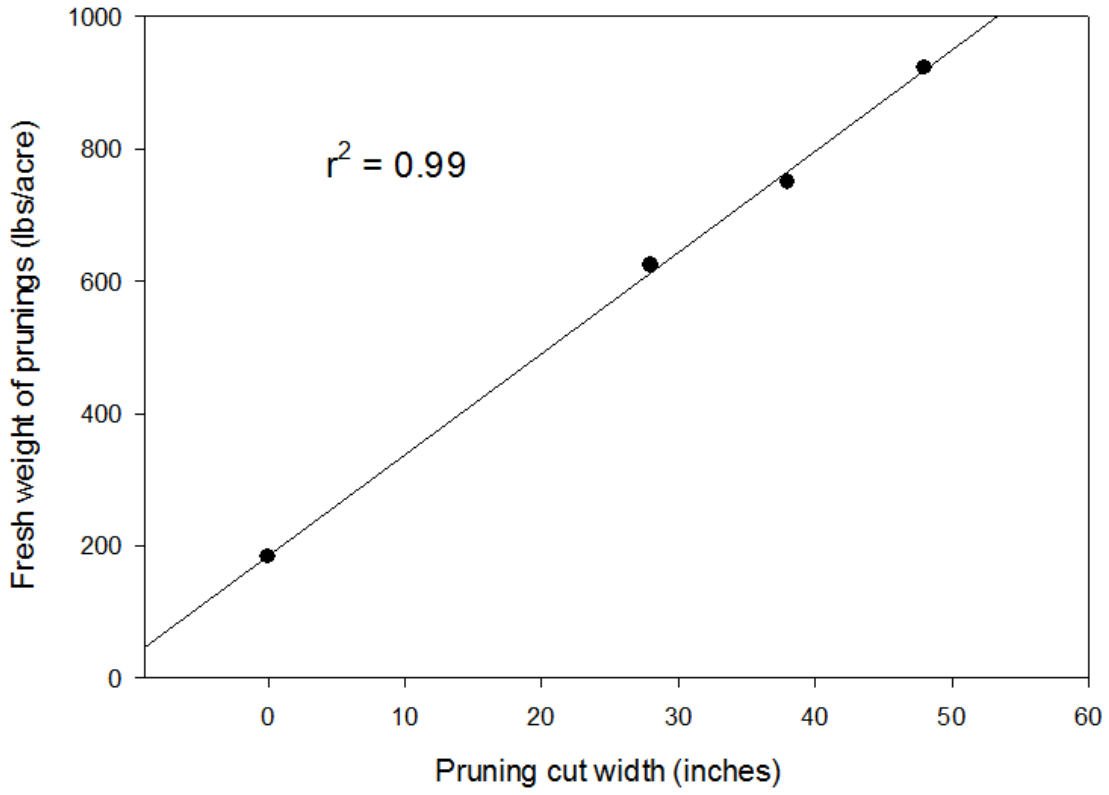

Figure 2. Pruning cut width versus fresh weight of prunings.

Acknowledgements

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