COMPARISONS BETWEEN MECHANICAL HEDGING TREATMENTS AND THE NON-HEDGED CHECK - 2003

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ABSTRACT

In this 18 year-old Chandler Orchard, where mechanical hedging has been the only method of pruning for the past 11 years, there was a significant yield differences between some treatments in 2003. A significant difference in accumulative yield was also observed between some of the five different hedging programs and the non-pruned trees. All treatments yielded between 2.9 and 4.1 tons per acre in 2003.

A trial was begun in 1992 in a 6 year-old Chandler walnut orchard (26' x 26' spacing) comparing three hedging and two hand-pruning techniques. Four years of evaluations were made on economics, yield and fruit quality in this trial.

The treatments for this first trial were:

1. Annually hedged alternate centers
2. Annually hedged alternate row sides
3. Annually hedged one tree quadrant/year
4. Alternate year hand pruning
5. Annual hand pruning

Accumulative yields after four years of treatments showed no clear trend in preferred hedging or pruning system, with all treatments producing between 12 and 13 tons/acre total over the four years.

Quality data indicated no significant difference in any quality parameter measured for any treatment. The only difference between treatments was the cost and time savings from the hedged treatments as compared to hand pruned treatments. This trial clearly showed that after 6 years of training by hand pruning, hedging can be used to successfully finish developing the tree at a minimum cost without sacrificing productivity.

Reported here are final results from a trial that began in 1996 comparing five hedging systems and a non-pruned system. Statistically different yields amongst the treatments were found for the first time after four years of hedging treatments in 1999. However, in 2000, 2001, and 2002 there was no statistical difference in yield between treatments. In 2003 there was again a significant yield effect between treatments. There was also a significant difference in accumulative yield between treatments in 2003. A new treatment of hedging for the first time after seven years of no hedging or pruning was added to the trial this year and produced a significantly lower yield than all other treatments. The non-pruned treatment had more dead wood per acre than the other treatments. The Cross-hedging treatment continued to break sprinklers. Nut quality data was taken but unavailable at time of publication.

OBJECTIVES

Once the trees were mature (10 years old) the trial was modified, as reported in 1995, to consider 5 hedging treatments and a non-pruned treatment. This new trial was continued for eight years to evaluate various hedging procedures as viable approaches to handling high density, standard design orchards. In the final year of the trial (2003) a new treatment of hedging for the first time after seven years of non hedging or pruning was also evaluated. Data collected includes: yield, nut quality, economics, tree performance, hedging procedures, amount of sunlight being intercepted by the tree and stem water potential.

PROCEDURES

The treatments established in 1995 were:

1. Hedge every other center each year (N-S)
2. Hedge every third center each year (N-S)
3. Hedge every fourth center each year (N-S)
4. Hedge one center each year (N-S; E-W)
5. Hedge one center every other year (N-S; E-W)
6. Non-Pruned (Check)

The treatment established in 2003 was:

7. Hedge centers for the first time (N-S) after seven years of no hedging/pruning

There are four replicates per treatment, each replicate consisting of 26 trees. The experiment was laid out in a randomized block design. The hedging operation was timed, yield and quality data was collected, dead wood and problems recorded, light interception and stem water potential was measured.

The hedging (H) treatment sequence for the measurement rows for the eight years of this trial is as follows:

	1996	1997	1998	1999
Treatment 1	H, N-S, 1st center	H, N-S, 2nd center	H, N-S, 1st center	H, N-S, 2nd center
Treatment 2	H, N-S, 1st center	H, N-S, 2nd center	SKIP	H, N-S, 1st center
Treatment 3	H, N-S, 1st center	H, N-S, 2nd center	SKIP	SKIP
Treatment 4	H, N-S, 1st center	H, E-W, 2nd center	H, N-S, 3rd center	H, E-W, 4th center
Treatment 5	H, N-S, 1st center	SKIP	H, E-W, 2nd center	SKIP
Treatment 6	NON-PRUNED	NON-PRUNED	NON-PRUNED	NON-PRUNED
Treatment 7	NON-PRUNED	NON-PRUNED	NON-PRUNED	NON-PRUNED
	2000	**2001**	**2002**	**2003**
Treatment 1	H, N-S, 1st center	H, N-S, 2nd center	H, N-S, 1st center	H, N-S 2nd center
Treatment 2	H, N-S, 2nd center	SKIP	H, N-S, 1st center	H, N-S 2nd center
Treatment 3	H, N-S, 1st center	H, N-S, 2nd center	SKIP	SKIP
Treatment 4	H, N-S, 1st center	H, E-W, 2nd center	H, N-S, 3rd center	H, E-W, 4th center
Treatment 5	H, N-S, 3rd center	SKIP	H, E-W, 4th center	SKIP
Treatment 6	NON-PRUNED	NON-PRUNED	NON-PRUNED	NON-PRUNED
Treatment 7	NON-PRUNED	NON-PRUNED	NON-PRUNED	H, N-S, 1st center

RESULTS

There was a significant difference between treatment yields per acre at the 10 % level of significance in 2003 with the four-year cycle and the non-pruned check out yielding all other treatments. There was also an accumulative yield difference after eight years of the various hedging or non-pruned treatments (Table 1).

The bar graph (Graph 1) shows the impact hedging had on annual production as compared to the non-pruned treatment. The first year of hedging most treatments had a reduction in productivity of about 2.2% compared to the non-pruned treatment. After the second year of hedging, yields were about the same as the non-pruned treatment (+/- 3%). All hedging treatments exceeded the non-pruned treatment yields in year three of this trial. When hedging was skipped in the second and third year of the trial yields exceeded the non-pruned treatment by 5 to 13 %. In the fourth year only the treatments that were not hedged exceeded the non-pruned check treatment in yield. Treatments hedged in 1999 had a 10 % yield reduction compared to the non-pruned treatment. Four out of the five treatments hedged in 2000 had a 2% to 5% yield reduction when compared to the non-pruned check. Treatment five (hedge one quadrant every other year) yielded approximately 1 % more than the non-pruned check in 2000. Two out of the three treatments hedged in 2001 had a 2% to 5% yield reduction when compared to the non-pruned check. Treatment three (hedged every fourth center each year (N-S)) yielded approximately 8.5 % more than the non-pruned check in 2001. In 2002

treatment three, which resulted in a skip hedging year, yielded 16.7% more than the non–pruned check. In 2002 all treatments outperformed the non–pruned check except for treatment five which yielded 3.2 % less**.** In 2003 only treatment three out yielded the non-pruned check and that by only 1.4 %. Other hedging treatment yields ranged from 85 to 91 % of the check. The new treatment that was hedged for the first time after seven years of no hedging/pruning yielded only 73 % as much as the non-pruned check.

The non-pruned check had significantly more dead wood on the ground after shaking the trees at harvest than all other treatments (Table 2).

Nut quality measurements were not available at time of publication.

Treatment four was cross hedged this year, cross hedging resulted in 1.1 % of the sprinklers to be broken, (Table 2).

Sunlight interception data and stem water potential data collected over the past three years is presented in Table 3. Light interception data is also graphed in Graph 2. In general, trees that were hedged on a more frequent schedule intercepted less light and trees that were hedged the previous winter intercepted less light the following growing season than non-hedged trees. The non-pruned check had the most light being intercepted. There are statistically significant differences between treatments. There are no statistically significant differences between treatments in terms of stem water potential.

This year, with cross hedging included, it took approximately 4.5 hours to hedge 18 acres of the trial or 4.0 acres/hr. The contract cost of hedging was $185/hr. or $46.25/acre. An economic analysis of the cost of hedging (Table 4) suggests that the four-year cycle (treatment 3) is the most economic and the quadrant hedging (one quadrant each year) is the least economical treatment.

Graph 1.

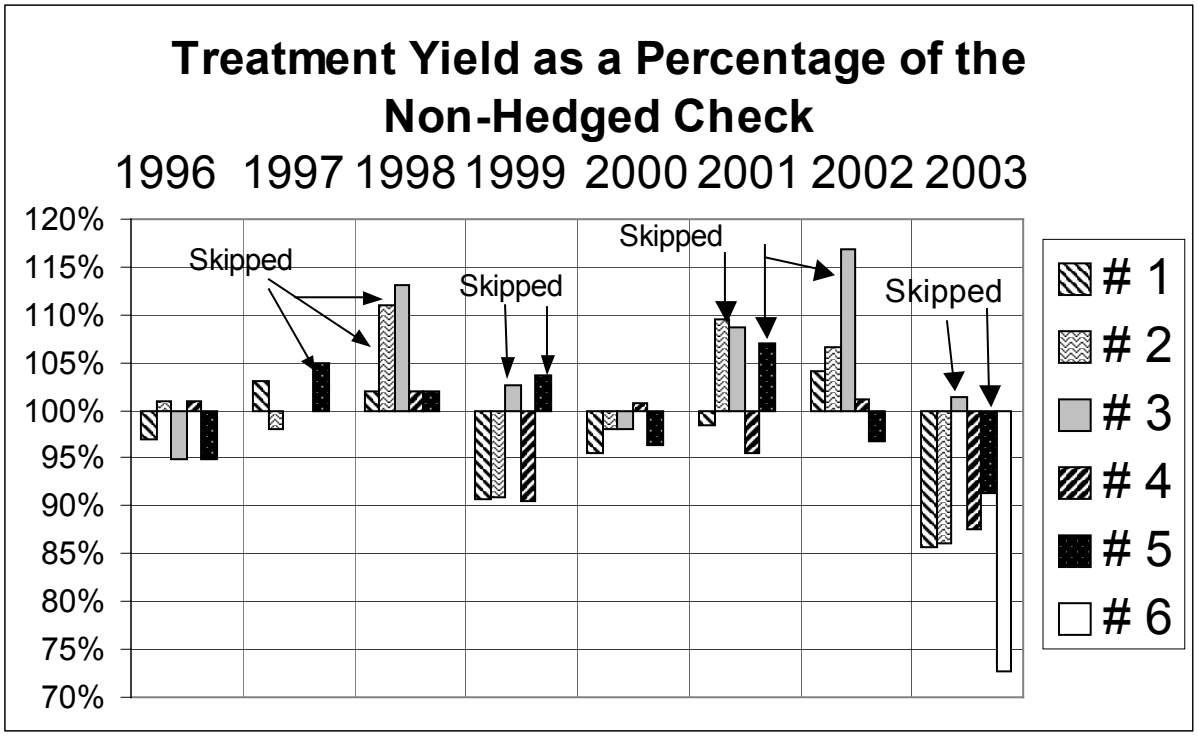

Table 1.

Treatment #	Hedging Treatment & Direction	1996 - 2003 Accum. Yield (Dry tons/A)*	2003 Yield (Dry Tons/A)**
# 1	Hedge every other middle each year	23.89 b	3.44 b
# 2	Hedge every third middle each year	24.63 ab	3.46 b
# 3	Hedge every fourth middle each year	25.83a	4.07 a
# 4	Hedge one quadrant each year	23.87 b	3.51 b
# 5	Hedge one quadrant every other year	24.65 ab	3.66 b
# 6	Non-pruned check	24.71 ab	4.02 a
# 7	pruned only in 2003	23.61 b	2.92 c

*****Means not followed by the same letter are significantly different at the 5 % level by Duncan's Multiple Range Test For Mean Separation.

****** Means not followed by the same letter are significantly different at the 10 % level by Duncan's Multiple Range Test For Mean Separation.

Table 2

Hedging Treatment & Direction	Number of Dead Branches > 3/4"	% Broken Sprinklers
Hedge every other middle each year	2.2 b	0 b
Hedge every third middle each year	2 b	0 b
Hedge every fourth middle each year	2 b	0 b
Hedge one quadrant each year	3.2 b	1.1 a
Hedge one quadrant every other year	1.2 b	0 b
Non-pruned check	6 a	0 b

Means not followed by the same letter are significantly different at the 5 % level by Duncan's Multiple Range Test For Mean Separation.

Table 3.

Pruning Treatment	July 5, 2001		June 21, 2002		August 11, 2003	
	Percent light intercept	Midday stem water potential (bars)	Percent light intercept	Midday stem water potential (bars)	Percent light intercept	Midday stem water potential (bars)
1-hedge every other middle every year	78.4 d	-6.9 a	76.7 b	-4.5 a	75.0 ab	-7.3 a
2- Hedge every 3rd middle every year	81.4 bcd	-6.2 a	78.0 b	-4.4 a	74.0 c	-6.7 a
3- Hedge every 4th middle every year	79.3 cd	-7.4 a	86.4 a	-4.4 a	83.6 a	-6.6 a
4- Quadrant hedge 1 quadrant per year	88.4 a	-6.8 a	82.0 ab	-4.7 a	80.4 ab	-6.0 a
5- Quadrant hedge 1 quadrant every other year	84.6 abc	-6.8 a	77.0 b	-4.9 a	79.6 abc	-6.9 a
6- Unpruned control	87.0 a	-9.8 a	87.7 a	-4.4 a	83.7 a	-7.1 a

Graph 2.

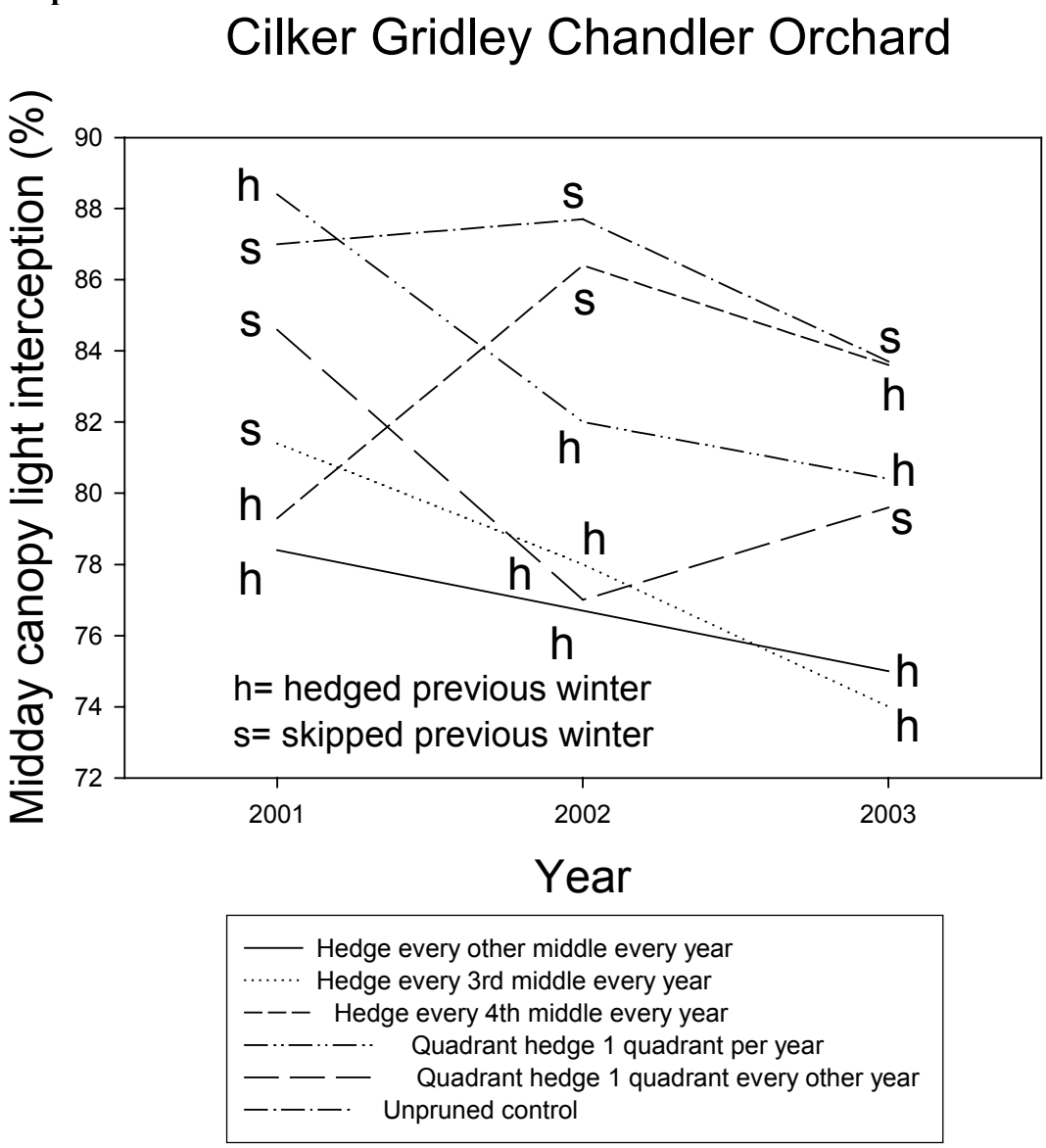
Cilker Gridley Chandler Orchard
Midday canopy light interception (%)
90
88
86
84
82
80
78
76
74
72
2001
2002
2003
Year
h= hedged previous winter
s= skipped previous winter
Hedge every other middle every year
Hedge every 3rd middle every year
Hedge every 4th middle every year
Quadrant hedge 1 quadrant per year
Quadrant hedge 1 quadrant every other year
Unpruned control

Table 4.

Economic Analysis of Treatments				
Treatment #	Hedging Cost/A	8-Year Accum. Hedging Cost/A	8-Year Accumulation Crop Value/A at $1400/Ton	Net Profit/A
1. Hedge every other middle each year	$41	$328	$33,446	$33,118
2. Hedge every third middle each year	$41	$246	$34,482	$34,236
3. Hedge every fourth middle each year	$41	$164	$36,162	$35,998
4. Hedge one quadrant each year	$46.25	$370	$33,418	$33,048
5. Hedge one quadrant every other year	$46.25	$158	$34,510	$34,325
6. Non-pruned check	$0	$0	$34,594	$34,594
7. Pruned only in 2003	$41	$41	$33,054	$33,054

DISCUSSION

Results from this trial indicate that hedging programs that incorporate skipping years of hedging boosts productivity the year hedging is skipped.

Although the 2003 data was not available at time of publication previous data suggest that hedging has a positive influence on nut size since the non- pruned check trees had the smallest size walnuts.

Hedging after seven years of no hedging/pruning resulted in the lowest production in 2003 and the lowest accumulative production. Hedging this infrequently is clearly a poor practice to follow. Hedging the same trees each year, either N-S or one quadrant per year resulted in some of the lowest accumulative production. These two hedging programs show no advantage. Cross-hedging damaged sprinklers every year it was preformed and showed no yield advantage. This should be a consideration for growers considering cross hedging especially when two one direction hedging treatments performed as well as, or better than, the treatments that incorporated cross-hedging.

This year the three year hedging cycle was intermediate in yield and ranked fourth in accumulative yield. Of the hedging treatments evaluated the four-year cycle had the most yield in 2003, the most accumulative yield and had the greatest accumulative economic return of any of the treatments. The treatment that was hedged only once after seven years of no hedging/pruning had one of the poorest accumulative economic returns.

The non-pruned check trees had the greatest light interception and, except for the four-year hedging cycle, the greatest yield.

Although it is disappointing that the non-pruned check treatment still yielded so well after eight years of no hedging/pruning, this is consistent with other short-term hedging/pruning trials. It obviously takes many years of non-pruning to impact productivity. Dead wood, however, was much more prevalent in the non-pruned check trees and this has an economic consequence with harvest delays.

Clearly, increased yields should not be the main motivation for adopting a hedging program. The motivation to adopt a hedging program should include: 1) creating ease of other cultural operations such as improved spray coverage and access to the orchard, 2) controlled tree size, 3) decreased amount of dead wood, 4) increased nut size, 5) amount of time required to achieve desired outcome and 6) keeping the tree "young" and perhaps extending the life of the orchard all at an economic cost. An infrequent, but scheduled hedging program (four year cycle) met these objectives best in this trial.