Project No. 91-S3 - Improving Almond Pruning Decisions

Project Leader: John Edstrom
Colusa County Cooperative Extension
P.O. Box 180
Colusa, CA 95932
(916) 458-2105

Cooperating Personnel: J. Connell, M. Freeman, (L. Hendricks, B. Beede), B. Krueger, W. Micke, M. Viveros

Objectives: The objective of this project is to develop research based information to answer five basic pruning questions: 1) What is the best method for pruning temporary trees in double-planted orchards and how are those trees best removed when they crowd? (Connell). 2) What is the best method for training and pruning a high density hedgerow orchard when maintaining it indefinitely? (Edstrom). 3) What is the best way to prune to invigorate low vigor varieties? (Freeman, Hendricks, Beede). 4) What is the impact of alternate year pruning versus annual pruning? (Krueger). 5) Is mechanical hedging and/or topping a viable alternative? (Viveros).

1. **REMOVING TEMPORARY TREES IN DOUBLE PLANTED ORCHARDS** (Connell, Micke, Yeager, Krueger)

This trial evaluates temporary tree removal through three pruning treatments: 1) gradual removal with thinning cuts, 2) quicker removal with larger chain saw cuts, and 3) effects of keeping "temporary" trees indefinitely or removing them later all at once.

Pruning treatments in winter 1990-91 were applied more severely as the permanent trees expand to fill the space in the orchard. Cuts on all permanent trees were confined to thinning out the centers and removing crowded or crossing limbs. Temporary trees in treatment 1 had upper limbs or centers thinned out wherever they crowded the permanent trees. In treatment 2, temporary trees had large chain saw cuts made from the ground to remove the tree center or to whisk back the sides wherever permanent trees were crowded. Trunk circumference measurements were taken to evaluate effects of pruning on tree growth.

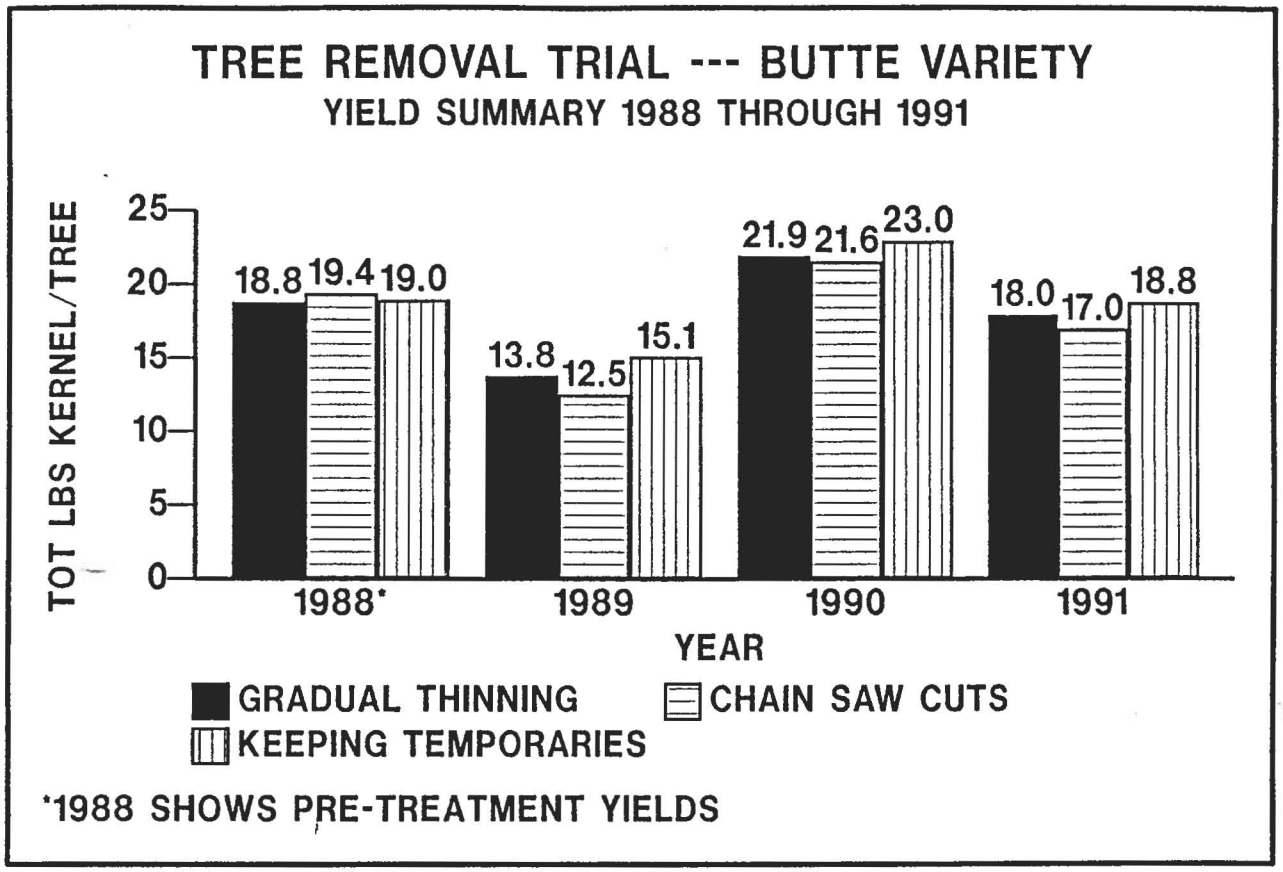
'Butte' yields are shown for the past four years in the following table. Yields are numerically lower as the severity of pruning increases. Permanent trees are expanding to fill the orchard space as temporary trees are gradually thinned. Chain saw pruning from the ground although easier, has resulted in a slight yield reduction.

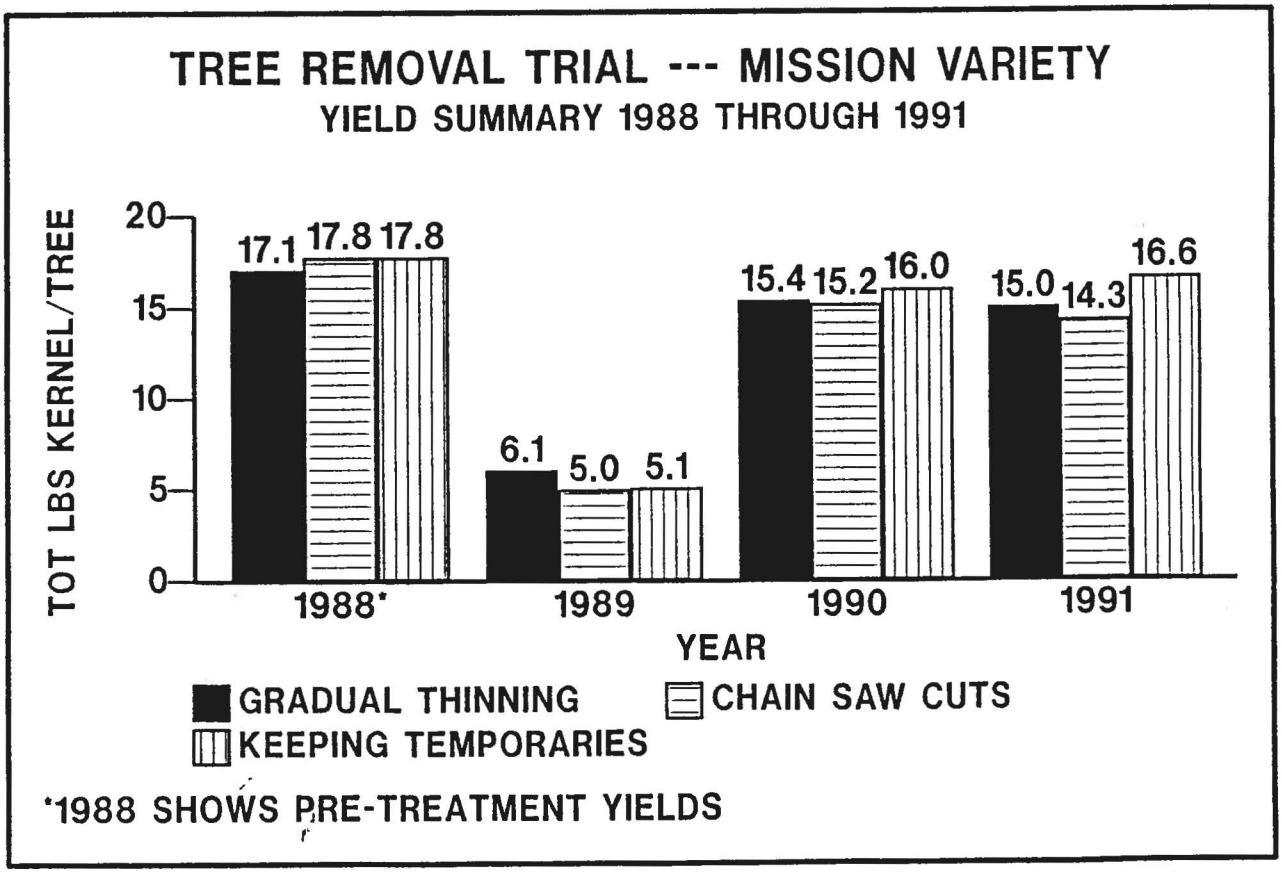
Butte Almonds - Average Meat Pounds Per Tree

Treatment	1988 Pretreatment	1989 After Thinning	1990 After Substantial	1991 Pruning
1. Gradual Thinning	18.8	13.8	21.9	18.0
2. Chain Saw Cuts	19.4	12.5	21.7	17.0
3. Keeping Temporaries	19.0	15.1	22.5	18.8

We expect temporary tree removal to begin either later this winter or a year from now depending on additional evaluation of data and discussions with our grower cooperator. This trial involves both 'Butte' and 'Mission' almond varieties. 'Mission' has a more upright growth habit than the 'Butte' and may not require removal as soon.

Plant for 1991-92 are to continue the tree removal program in the orchard and to make growth and yield observations.


TREE REMOVAL TRIAL --- BUTTE VARIETY
YIELD SUMMARY 1988 THROUGH 1991
TOT LBS KERNEL/TREE
25
20
15
10
5
0
18.8
19.4
19.0
13.8
12.5
15.1
21.9
21.6
23.0
18.0
17.0
18.8
1988*
1989
1990
1991
YEAR
GRADUAL THINNING
CHAIN SAW CUTS
KEEPING TEMPORARIES
*1988 SHOWS PRE-TREATMENT YIELDS


TREE REMOVAL TRIAL --- MISSION VARIETY
YIELD SUMMARY 1988 THROUGH 1991
TOT LBS KERNEL/TREE
20
15
10
5
0
17.1
17.8
17.8
6.1
5.0
5.1
15.4
15.2
16.0
15.0
14.3
16.6
1988*
1989
1990
1991
YEAR
GRADUAL THINNING
CHAIN SAW CUTS
KEEPING TEMPORARIES
*1988 SHOWS PRE-TREATMENT YIELDS

2. **SUSTAINING YIELDS IN HEDGEROW SYSTEMS** (Edstrom, Micke)

Four pruning/training strategies are being evaluated to sustain production in permanent hedgerow orchards:

1) Temporary: standard pruned on permanent trees, gradually whisked back temporary trees then removed at 9th year leaving a 14' x 22' spacing.

2) Permanent Hedge: standard pruned hedge maintained at 7' x 22'.

3) Two Scaffold Hedge: two primary limbs trained out into row middles - 7' x 22' hedge.

4) Unpruned Hedge: trained to three scaffolds on 7' x 22' then no further pruning.

Trees in the temporary hedge plots, now on a 14' x 22' spacing, continue to refill space created by alternate tree removal. However, most regeneration of fruitwood occurs on the south sides of trees with very little on north half. Trees in vigorous plots have now completely filled in and yields from these are among the highest. Trunk size is substantially larger on these permanent trees versus tightly hedged plots.

1991 yields showed no statistically significant difference between the four treatments due to high variability between plots.

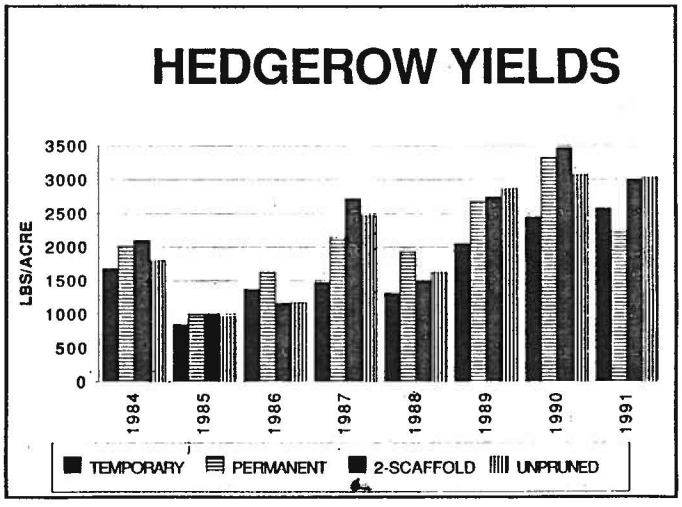
1991 Nonpareil Yields

Unpruned Hedge	3036 A
Two Scaffold Hedge	2992 A
Temporary	2576 A
Permanent Hedge	2254 A

However, the average yields continue to be lower in the temporary plot where trees were removed in 1986. Surprisingly the unpruned plots continue to sustain high yields. Yield levels in general were lower in 1991 but the trend for the hedge continues up.

Average Per Acre Yields 87-91

Two Scaffold Hedge	2685
Unpruned Hedge	2616
Permanent Hedge	2470
Temporary	1970



3. **PRUNING TO INVIGORATE LOW VIGOR ALMOND TREES** (Micke, Freeman, Beede, Hendricks, Yeager)

Problem:

Some precocious varieties (such as Merced, Carmel, and Harvey) often produce little vegetative growth once they reach full maturity. When using the conventional pruning technique of thinning out several one to three inch diameter limbs each year, these varieties are not usually invigorated. Also, it is often hard to find limbs to thin out when pruning such trees. Thus, methods of pruning to invigorate low vigor trees are needed.

Procedure:

A pruning trial was established during the winter of 1986-87 using 11-year-old Harvey trees that were healthy but making little or no new growth. The four pruning treatments being compared were 1) cutting back the entire tree to approximately six feet (dehorning); 2) moderately heading back all terminal branches on one scaffold, generally one-third of the tree, each year in a three year cycle (heading 1/3 of tree); 3) making approximately 20 small, one half to one inch in diameter, heading cuts per tree (heading); and 4) normal thinning out (control). These treatments were randomized over three rootstocks, Nemaguard, Lovell and almond seedling.

The control (thinning out) and heading treatments have been continued each year. The dehorned trees, after the severe pruning the first year, have been thinned annually. The heading 1/3 of tree treatment was continued for three years to complete the cycle and has since been thinned out annually.

Results and Discussion:

In 1987, dehorning drastically reduced production while the two heading treatments reduced yield moderately as compared to the control. However, tree vigor was improved by both heading treatments (heading 1/3 of tree mainly increased vigor on the headed scaffold); and as expected, dehorned trees responded with very vigorous growth.

In 1988 the control still had the highest yield. As compared to the control, production was reduced on the heading treatment by about 5%, the heading 1/3 of tree treatment by approximately 15%, and on the dehorned trees by nearly 50%. Only the difference between the control and dehorned trees was statistically significant.

By 1989 the heading and dehorning treatments out produced the control by 15% and 9%, respectively, although these differences were not statistically significant. However, the control significantly out yielded the heading 1/3 of tree treatment by 23%, probably because this latter treatment was the most severely pruned the previous winter.

In 1990 and 1991 there were no significant differences between any of the pruning treatments, except in 1990 the heading 1/3 of tree treatment had significantly less yield than the control and heading treatments but only on almond seedling rootstock. While other differences were not significant, there was a trend both years for the heading 1/3 of tree treatment to lag all other treatments in production and for the heading treatment to yield slightly more than the control.

Heading tends to improve growth in low vigor trees as compared to conventional thinning out. For most purposes dehorning appears to be too drastic unless a response in addition to invigoration is desired. Extending the moderately severe heading over three years (heading 1/3 of

tree) tends to prolong the yield reduction and, thus, may not be a practical treatment. An annual light heading appears to be the best approach of the treatments evaluated for invigorating low vigor but otherwise healthy trees. However, such heading is more time consuming and, hence, more costly than conventional thinning out.

4. ALTERNATE YEAR PRUNING OF ALMONDS (Krueger, Micke, Yeager)

Objectives:

Annual pruning is recommended procedure for mature almonds. Growers who prune every other year or even once every three years have observed no apparent deleterious effects to tree vigor or production. Alternate year pruning has been shown to be an acceptable practice with lateral bearing walnuts. This study was undertaken to compare the impact of alternate year pruning to that of annual pruning on mature almond production and kernel quality.

Procedure:

A mature uniform 20 acre block of almonds planted in 1978 located in Hamilton City was selected for the trial. The planting is a 1:1 planting with 50% Nonpareil, 25% Price and 25% Peerless and 70 trees per acre. Only Nonpareil was used for the pruning treatments. The ten acres of Nonpareil were divided into a randomized complete block with four treatments and five replications. Yield data was collected one year prior to assigning the treatments to make sure that there were no significant differences due to block location. The treatments were initiated during the winter of 1987-88 and were 1) annual pruning; 2) pruning prior to odd numbered years; 3) pruning prior to even numbered years; and 4) unpruned, starting prior to the 1988 crop. Pruning has been the same for all the pruned treatments and consisted of four, approximately 1.5 inch or larger cuts per tree or the equivalent. Average pruning weights have been collected following each pruning and have averaged between 37 and 53 pounds per tree. Trunk circumferences were measured and cross-sectional areas determined and divided into yields to determine yield efficiencies.

Results and Discussion:

After four years of differential pruning treatments there have been no significant differences in yield or accumulated yield between any of the treatments (Table 1). When yield per tree is divided by trunk cross-sectional area (yield efficiency) no significant differences are noted. In 1991, kernel weight was significantly greater for annually pruned compared to non-pruned and alternate year pruned not pruned prior to the 1991 crop. This was the first significant difference which has been noted in the four years of the harvest.

Pruning treatments had a significant effect on quality (kernel size) for the first time in 1991. Because kernel size has little effect on crop value and there has been no effect on total yield, there has been no effect on overall crop value to this point.

We expect that yield in the non-pruned trees will eventually decline due to lack of renewal of fruit wood. We would like to continue the trial until this occurs.

Table 1. Effect on Annual vs. Alternate Year and No Pruning

TREATMENTS	1991 Wt. g/Kernel	1991 Yield Lbs/Tree	1991 Yield Efficiency	Accum. Yield 1988-91 Lbs/Tree
Annual Pruning	1.26 A	26.23 A	3.50 A	120.72 A
Alt. yr prior to odd yr	1.17 AB	28.73 A	3.97 A	124.08 A
Alt. yr prior to even yr	1.14 B	30.60 A	4.22 A	126.87 A
Non-pruned	1.12 B	27.07 A	3.82 A	122.68 A

Numbers followed by the same letter not significantly different at the 5% level.

5. **MECHANICAL PRUNING OF ALMONDS** (Viveros)

Justification and Objectives:

Mechanical pruning (hedging and topping) is an alternative to the traditional hand pruning practice in many almond orchards. Many growers have used it without any information on yield data. Therefore, this project was established to determine the effects of mechanical pruning on almond yields.

Materials and Methods:

The test plot was established in a 14-year-old Mission-Nonpareil-Nonpareil-Merced orchard in 1987. There were four treatments:

1) Control (hand pruning)
2) Perpendicular hedging
3) Angle hedging
4) Hedging and topping

The hand pruning treatment was done in 1987 and it has been repeated every other year. The mechanical pruning treatments were done in 1987 and they have been followed by hand pruning every other year.

Results:

The test plot has been harvested for 4 years to determine the impact of mechanical pruning on yields. The results are in the following table.

	YIELD - MEAT POUND/ACRE				
TREATMENT	1988	1989	1990	1991	TOTAL
Control	2875	2300	2683	1734	9592
Hedging	1840	2482	2727	1800	8849
Angle Hedging	1590	2386	2671	1697	8344
Hedging & Topping	945	2948	2277	1536	7706

In 1988, the yields decreased proportionately to the amount of wood removed by pruning. The heavier the pruning the greater reduction in yields. The treatment with the most severe pruning was the hedged and topped and it was also where 1,930 meat pounds were lost.

In 1989, the hedged and topped treatment improved over all three treatments. However, the increase in yield was not big enough to overcome the yield losses of 1988.

There were no major differences among treatments in 1990 and 1991. However, the hedged and topped had the tendency for lower yields.

The total yield column shows that yield losses are proportionately to the amount of fruiting wood removed by the pruning. This column is very similar to the 1988 column. This means that the trees never recovered from the pruning done in 1987.

Discussion:

Four years of data shows that the yields of the hand pruning treatment are superior to any of the mechanical treatments. Therefore, we can conclude that mechanical hedging and/or topping is not a viable alternative to hand pruning.

The only area where mechanical pruning has made an impact is on mummy removal. There were less mummies on the hedging and hedging-topping treatments.