Project No. 94-S6 Improving Almond Pruning Decisions

Project Leader: Joseph Connell
U.C. Cooperative Extension
2279 Del Oro Ave., Suite B
Oroville, CA 95965
(916) 538-7201
FAX (916) 538-7140

Cooperating Personnel: John Edstrom, Warren Micke, Jim Yeager

Objectives: The objective of this project is to develop research based information to answer pruning questions for two different situations:

1) To develop methods to train Nonpareil almonds into a hedgerow configuration and develop pruning and/or tree removal systems capable of sustaining high yields in hedgerows. (Edstrom)
2) To determine the best method for removal of temporary trees in double planted orchards when they crowd. (Connell)

Results:

1) Sustaining Yields in Hedgerow Systems
John Edstrom, Warren Micke, and James Yeager

In 1979, a Nonpareil - Price (at a 1:1 ratio) almond block was planted 7' x 22' (270 trees/acre) at the Nickels Soil Laboratory in Arbuckle, California. The following four training treatments were used for this plot:

1) **Temporary Hedge** -- standard pruning for permanent trees, with temporary trees gradually whisked back and then removed after their 8th year (1986-87), leaving a 14' x 22' spacing.
2) **Permanent Hedge** -- trained to three scaffolds, standard pruned and maintained at 7' x 22'.
3) **Two Scaffold Hedge** -- a 7' x 22' hedge trained with two primary limbs growing out into the row middles and standard pruned.
4) **Unpruned Hedge** -- a 7' x 22' hedge trained to three scaffolds and then essentially unpruned since.

Nut production this season rebounded in all four training systems from last year's moderate crop. Yields in 1994 were among the highest in the eleven year life of this trial.

While statistically there was no difference in production between treatments due to the variability in this orchard, the Temporary Hedge continued to numerically trail all other treatments in production, as can be seen in the following table. Even though the permanent trees now appear to be filling-in quite well, it has taken longer than was expected on this class 2 soil, and perhaps tree removal after the 8th leaf was too early.

Table I.
Yields by Hedgerow System for 1987 - 94 and
Accumulative Yields Since Production Began in 1984.

Kernel Pounds per Acre
LeafYear

Treatment	9th 1987	10th 1988	11th 1989	12th 1990	13th 1991	14th 1992	15th 1993	16th 1994	Accum. 1984-94
2 Scaffold	2720	1498	2746	3470	2992	2079	1943	2835	24,522
Unpruned	2474	1626	2870	3072	3036	2471	1804	2799	24,089
Permanent	2149	1932	2680	3333	2254	2268	1189	2678	23,117
Temporary	1472	1308	2046	2450	2576	1739	1280	2448	19,206

Close spaced almond hedgerows appear to be quite forgiving with respect to pruning/training methods. Accumulative yields show no difference between trees pruned to Two-Scaffold, Permanent (3-scaffold) or left Unpruned (after scaffolds established).

However, accumulative yields for the Temporary Hedge through the 16th leaf lag approximately 5,000 pounds behind the other three treatments. The continued low yield from the Temporary Hedge treatment suggests that alternate tree removal may be a questionable practice, even in tightly spaced hedgerow almonds. However, the peculiarities of this test site should be considered when interpreting these yield figures. This two cultivar planting (Nonpareil and Price, 1:1) has developed on class II/III gravelly loam soils under a single hose drip irrigation system.

These limitations have resulted in a restricted root zone and have possibly restricted or delayed the growth of permanent trees into their expanded space (from 7' spacing to 14' spacing). Poor regrowth is evidenced in Table II. which shows only a moderate increase in trunk size for the remaining trees in the temporary Hedge, despite the opportunity of eight growing seasons since the alternate trees were removed. Additionally, the adjacent tightly spaced pollenizer rows created heavily shaded conditions, further inhibiting fruitwood regrowth on the 14' x 22' spaced Nonpareil plots. Given more favorable "regrowth" conditions, this hedge removal treatment may have regained high productivity and proven, over time, to be an economically viable system. Certainly under our conditions with nearly 5,000 lbs. in accumulated lost production, this is not an advisable hedge management strategy.

Table II.
TRUNK SIZE
CIRC. - CM

	Rep 1	Rep 2	Rep 3	Total	Mean
Permanent	69.9	63.2	66.5	199.6	66.5
Temporary	71.2	79.9	77.8	228.9	76.3
Two-Scaffold	64.2	67.8	66.8	198.8	66.3
Unpruned	63.6	66.4	63.8	193.8	64.6

We know of no other experimental data that shows unpruned almonds to produce yields equal to standard pruned trees over this length of time (16 years).

However, the sustained productivity in this test of the Unpruned Hedge merits consideration when planning a pruning strategy for almond hedgerows. Our savings, in pruning costs over the span of this trial (since 1981) were considerable.

2) Removing Temporary Trees in Double Planted Orchards

(Connell, Micke, Yeager, Krueger)

The objective of this trial is to evaluate temporary tree removal by comparing three pruning treatments:

1. Maintaining a hedgerow indefinitely.
2. Gradual removal of temporary trees through thinning cuts.
3. Heavy whisking of temporary trees with chain saw cuts made from the ground.

Methods:

Pruning in treatment 1 and on permanent trees in treatments 2 and 3 consists of removing crowded or crossing limbs by thinning out. Pruning temporary trees in treatment 2 consists of thinning out upper limbs when they crowd the permanent trees. Temporary trees in treatment 3 have chain saw cuts made from the ground to remove the tree center or whisk back the sides whenever branches compete with the permanent trees.

To chart tree growth, trunk circumference measurements are made each year. Pruning was not done in the 1992-1993 winter but was fairly severe in 1993-1994 since crowding was again becoming more significant.

Pruning back temporary trees has been proceeding gradually since 1989 allowing the permanent trees to fill in. By gradually phasing out the temporary trees we hope to minimize crop loss when the trees are completely removed.

Results:
Cumulative yields for 6 years from 1989 through 1994 show no statistically significant differences between the three treatments on either variety (table 1).

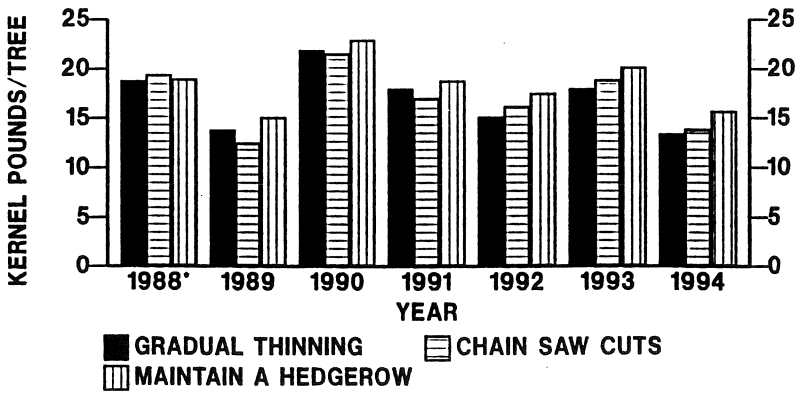
Table 1. Treatment	6 years accum. yield lbs/tree	6 year average yield lbs/acre	% of #1	Tot lbs/acre lost to tree removal over 6 years
Butte				
1. Maintaining hedgerow	110.3	2573	100	0
2. Gradual thinning	100.2	2338	91	1406
3. Chain saw whisking	100.2	2338	91	1409
Mission				
1. Maintaining hedgerow	81.2	1895	100	0
2. Gradual thinning	76.5	1786	94	657
3. Chain saw whisking	69.9	1631	86	1584

kernel pounds are calculated on a 140 tree per acre basis.

Although yield differences between treatments are not statistically significant at the 5% level, in Mission, cumulative yields are lower as the severity of pruning increases. Chain saw pruning from the ground, although easier, resulted in the numerically lowest yield. So far, yields are numerically highest where we continue to maintain the hedgerow at a 14 foot spacing. For the Butte variety, both pruning treatments reduced yields equally over the past six years.

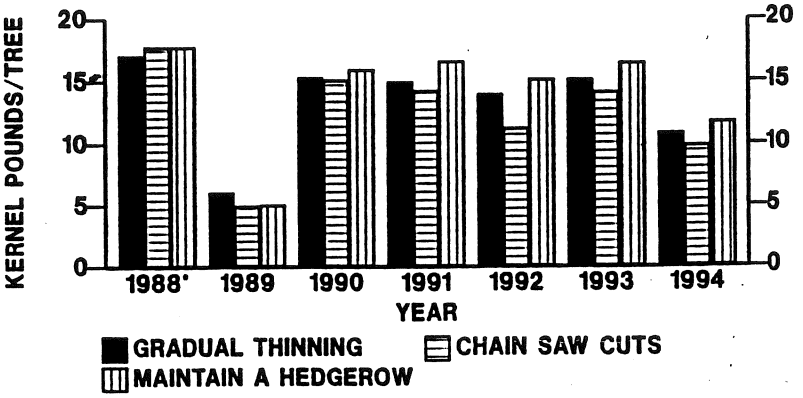
A yield summary of both the Butte and Mission varieties is shown in figures 1 and 2 respectively. Trend lines for cumulative yields are shown for Butte and Mission in figures 3 and 4 respectively.

FIGURE 1. YIELD SUMMARY, BUTTE ALMOND.
TREE REMOVAL TRIAL



*1988 shows pre-treatment yields.

FIGURE 2. YIELD SUMMARY, MISSION ALMOND.
TREE REMOVAL TRIAL



*1988 shows pre-treatment yields.

FIGURE 3. CUMULATIVE YIELD TREND, 'BUTTE'.
TREE REMOVAL TRIAL

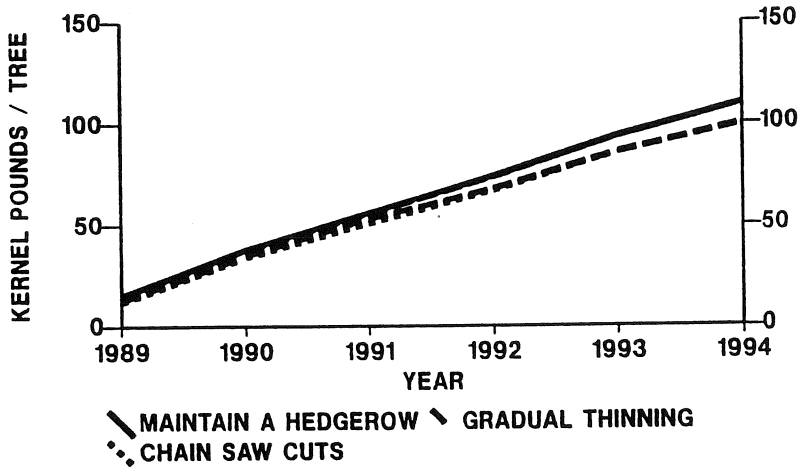
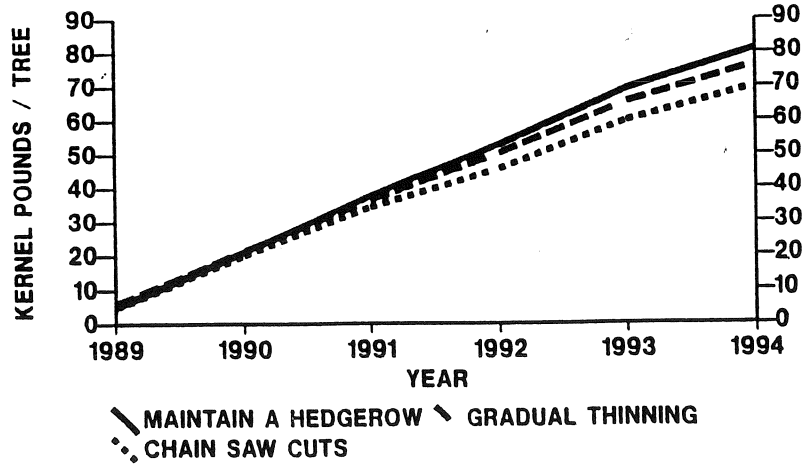


FIGURE 4. CUMULATIVE YIELD TREND, 'MISSION'.
TREE REMOVAL TRIAL



Conclusions:
Thinning out of the temporary trees has been done very gradually over the past five years to try and minimize the yield reduction that comes with tree removal. Yield differences betyween treatments are not statistically significant, suggesting the rate of tree removal is appropriate.

We have been managing sunlight so that the temporary trees don't inhibit the growth of the permanent trees. Wood in the lower canopy of the temporary trees that doesn't affect the permanent trees has been kept. The upper canopy of temporary trees has been thinned out to allow the permanent trees to spread and over grow the temporaries. The permanent trees are expanding to fill the orchard space as temporary trees are gradually thinned.

In spite of the fact that tree removal has been proceeding gradually, the process of removal has resulted in numerical reductions in yields (table 1). We intend to follow this project into the future to try and determine if and when the plots where trees are removed catch up to and exceed the yields of the crowded plots where the hedgerow is being maintained indefinately. I expect that the temporary Butte trees will be removed completely this spring. Mission tree removal will be re-evaluated at the same time. Ultimately, this project will help us determine whether tree removal is the best approach to deal with crowding in double planted orchards.

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