# Almond Board Report May 2002

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**Project Title:** Nickels Soil Lab Projects

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## 1) Pruning Trials for High Density Orchards

John Edstrom, Bill Krueger & Dr Bruce Lampinen

Almond tree training and pruning practices haven't changed much for decades. Traditional concepts stressed careful selection of primary and secondary branches to develop a strong evenly spaced framework capable of supporting heavy crops. Large trees developed during the 30-40 year life span especially at wide spacings. Yearly pruning was needed on old trees to increase light into the tall canopies, stimulate growth and replace unproductive fruitwood. Considerable time, equipment and expense are required to complete this type of pruning operation.

Today, however, tree densities have increased to 100+ trees/ac, twice what they used to be and many new orchards are planted on weaker ground. Both trends result in smaller sized trees, which don't need to support such heavy weight (crop) per tree to be productive per acre. Scaffold number, position, orientation, or strength become less critical without large expansive canopies. Younger trees, typical of more tightly spaced orchards are inherently more vigorous so yearly pruning is not as critical to maintain vigor. Shorter statured trees naturally allow more light to penetrate deeper into the canopy promoting fruit bud formation without much pruning to "open up the centers". Big cuts may not be necessary. Improvements in water management using microirrigation bring orchards into production fast (and impart vigor to older trees). Good yields are obtained in the 4$^{th}$ year compared to year 6 to 8 as in the past.

Many growers don't expect today's almond orchards to last longer than 20 years. Blocks will be replaced at a younger age simply to exploit new superior technology. These factors should all be considered when devising a profitable training/pruning strategy for today's high density orchards.

The **objective** of this field trial is to evaluate various tree training/pruning methods, which promote maximum early production while maintaining long-term orchard yield in tightly spaced almonds.

Four training systems were selected using 4 replicates of 33 trees using Nonpareil, Carmel, Monterey and Aldrich, microsprinkler irrigated and planted at 16'x22', 124 trees/acre:

1) **Standard Method** - Three primary limbs selected at 1st dormant, long pruned, secondaries selected 2nd dormant, centers kept open, limb tying/staking as necessary. Yearly traditional, moderate pruning continued.

2) **Unpruned** - Three Primary limbs selected at 1st dormant pruning then no additional pruning unless needed for equipment or wind damage, etc. Minimal staking as necessary.

3) **Mechanically Topped** - Same as unpruned, but, adding machine topping to remove half of prior seasons top shoot growth beginning at 2nd dormant with selective dormant thinning and topping in spring, if needed.

4) **Temporary Scaffolds** - Train limbs at 1st dormant to favor 3 permanent primary scaffolds, but also retain many other temporary branches below these on the trunk, removing only those which compete strongly with permanent scaffolds. Retain as much wood as possible. Temporary limbs scheduled for gradual removal during years 5-8 after producing some crop or sooner if they threaten primaries.

**Results**

Overall tree vigor has been quite good in this planting. This should allow a commercial test for the unpruned and other methods under strong growing conditions. The north end of the planting is more vigorous than the south, providing two distinct conditions to evaluate these training methods. In the previous evaluation at Nickels of the unpruned method, weak growing conditions complicated drawing meaningful conclusions.

This years yields (Table 1) show big differences between varieties with fair production from all pruning methods in this 5th leaf block. Carmel and Monterey production was good while Nonpareil and Aldrich was mediocre. This years treatment affects differed from last years. For 2001, all pruning systems yielded statistically the same. This held for all varieties. Yield variability was high this year and prevented significant differences despite the apparent production advantage of the unpruned system in Monterey.

**Table 1.**

**YIELDS - LBS./ACRE**

| Trial | Aldrich | Carmel | Monterey | Nonpareil | Sonora | *Mean |
|---|---|---|---|---|---|---|
| **Standard** | 1,271 | 1,890 | 1,621 | 1,201 | 984 | 1,414 |
| **Temporary Scaffold** | | 1,810 | 1,736 | 1,253 | 774 | 1,461 |
| **Mechanically Hedged** | 1,190 | 1,844 | 1,553 | 1,272 | 580 | 1,366 |
| **Unpruned** | 1,213 | 1,604 | 1,956 | 1,198 | 775 | 1,422 |
| **Mean** | 1,225 | 1,787 | 1,717 | 1,231 | 778 | N.S. |

* = Weighted Mean (considers reduced number of pollenizer trees)

**Observations**

Temporary limb concept

This method still holds promise but some temporary lower limbs are competing too strongly with the upper permanent ones. Many permanent scaffolds appear smaller and weaker, compared to those on standard pruned trees. Secondary limbs have flattened with much water sprout growth in this treatment. Many trees are now too open in the center. Nonpareil and Monterey are affected the most, while Carmel and Sonora appear to be OK. Due to this wider tree form, Carmel rows have filled in unusually well compensating for lower vigor of this variety. Some "temporary" limbs will now be maintained permanently mainly with Monterey as many limbs on this variety appear of equal vigor and show even development between all primary scaffolds. However, those that are too low on the trunk are being gradually removed to facilitate shaking. Careful training of competitive branches is critical to this method but properly training work crews is difficult. Again this winter, extra effort was made to favor the permanent primary and secondary scaffolds. Removal of strongly competing lower limbs and the vertical shoots arising from them was continued. The Aldrich variety proved too troublesome with the lower scaffold idea and this variety was eliminated from this treatment. Strong north wind damage during the second leaf was far less in this treatment and the "unpruned" compared to heavily damaged trees in "standard" pruned plots.

Unpruned Method

This method appears to have commercial potential. Within the weaker soil area, nearly all unpruned trees look acceptable. Nonpareil and Aldrich in the vigorous area appear a bit too dense in the upper canopy with more shading below, but a heavy crop has yet to be produced on these varieties, so they should open later. The 2002 crop set appears to be good and should provide the necessary weight. Some Monterey trees are misshapen and have "mushroomed" open but the Sonoras and Carmels look fine. Removal of twisted, crossing and rubbing limbs may be more practical and desirable in all varieties. However, any cuts will likely cause sucker growth and set up the demand for even more pruning. Trees receiving no pruning cuts grow more evenly without overly vigorous limbs and appear to allow enough light penetration to promote cropping. These trees are also somewhat shorter which helps promote light penetration. We plan to make light intensity measurements in the mid/low canopy of each pruning style this summer. There was no problem with crop removal at harvest despite the dense fruitwood, as the trees enlarge this may become a problem.

Mechanically Topped

All varieties in this treatment are shorter in height than in the other methods. Aldrich benefited some from topping with better branching forming a wider canopy, but still seems too dense in the center. In general, excessive shoot growth resulted from the dormant topping in 1998 .Too much was removed during that operation resulting in very vigorous growth the following spring. This dense upright growth of 3 to 8 feet was cut 1/2 during the May 2000 topping. However, this resulted in cutting into the prior year's wood which de-invigorated these trees and reduced tree height. Regrowth of top shoots after spring topping was only moderate. If any future spring

topping is performed the hedger will be set to remove mainly current shoot growth. The decision was made during dormant pruning 2001 not to hand prune this treatment to thin out the very dense wood. No hand pruning was done in 2002 either. Monterey and Nonpareil tree structure appears most affected by topping with heavily shaded interior. Aldrich trees appear more normal but are extremely dense.

Standard Pruning

These trees are the tallest of all treatments and also exhibit a standard, open canopy. However, our pruning here is best described as "minimum", as not enough wood has been removed to qualify as standard pruning. Primary scaffold development is good while some secondary limbs are bending out of position exaggerating the open center, especially on Nons. There appears to be less lower "hanger" fruitwood in this treatment. Sonoras look quite good. Dormant pruning was again increased this winter on "standard" trees to achieve a more commercial level of pruning.

**Summary**

At this stage, the "Unpruned "method seems to hold the most potential. Trees left unpruned (or at most with a few cuts to remove badly angled, twisted, and interfering branches) are as productive as pruned trees. The "Unpruned" system which was successful in the old test at Nickels for 20 years on weak soil is also performing here so far under much more vigorous conditions. The "Temporary "system also shows some promise. In hindsight, we should have tied the permanent scaffolds to help maintain their dominance and avoided so much extra training of temporary limbs. Some variant of the temporary limb system is under evaluation in many local orchards. In our test, yields in the next few years should tell if this system is economical given the expensive training involved. But longterm tree yield need monitoring to check any sustained productive advantage of this idea. Adding another system in this test, which maintained 6-8 scaffolds permanently, would have been instructive, although similar grower attempts have been troublesome in the long run.

## 2) Comparison of Microirrigation Systems for Almonds

John Edstrom, Dr. Larry Schwankl & Stan Cutter

A 22-acre field demonstration was established in 1990 to evaluate the major systems of microirrigation; Drip, Subsurface Drip (SDI) and Microsprinklers. This trial was designed with 36 1/2 acre plots to simulate commercial conditions using four almond varieties, Nonpareil, Butte, Carmel and Monterey. The systems under study include:

| | |
|---|---|
| 1. Surface Drip - single hose | 4 - 1 gph Netafim PC emitters/tree |
| 2. Surface Drip - double hose | 8 - 0.5 gph Bowsmith emitters/tree 4 ft. from rows |
| 3. Microsprinkler | 1 - 10 gph Bowsmith Fanjet between trees |
| 4. Microsprinkler double | 2 - 5 gph Bowsmith Fanjets around trees |
| 5. Microsprinkler double1.2 ET | 2 - 7.5 gph Bowsmith Fanjets around trees |
| 6. Subsurface Drip - double hose | 8 - 0.5 gph Geoflow emitters/tree, 4 ft. from rows |
| 7. Surface Drip double hose150% Et | 8 - 1 gph Netafim PC emitters at 4 ft. |
| 8. Subsurface Drip double New | 8 - 0.5 gph PC Geoflow emitters at 4 ft |

Subsurface drip treatments were established the first year with surface hoses and early in the 2nd year converted to SDI with the tubing installed at a depth of 15 inches. Previously, Netafim Ram tubing was evaluated as SDI but became extensively plugged by almond root intrusion. All of these lines were retrofitted, spring of 2000, with pressure compensating Geoflow trifluralin impregnated SDI placed at a depth of 8-10 inches directly above the abandoned Netafim hoses. This treatment is # 8 - New Geoflow double.

**Results**

Data for 2001 (Table1) show only minor yield differences between irrigation types. Statistically, micros were equal to drip and SDI across all varieties. However, when 120 % of ET was applied via micros yields increased over drip and SDI. This advantage is similar to past data and can also be seen in the larger kernel sizes in Butte and Carmel varieties this year. This season we kept water equal at 34 inches between systems but at the cost of stressing some plots. Measurements made for another trial using a pressure bomb indicated SWP values were -8 to -12 bars for 1.0 ET trees during high evaporative periods. Part of the difficulty is due to the experimental design. Our test block has micros and drip plots down the same tree rows. When middles are dried for mowing etc., irrigations are delayed and drip plots often suffer more stress than micros. This problem clearly indicates one advantage to applying larger volumes of water twice per week via micros versus nearly every day or two with drip i.e. more time for cultural operations with less stress on trees.

Installation of automated soil moisture probes in this test has been very helpful in irrigation scheduling. Microirrigation systems can easily meet ET, but may not be favoring deep root growth nor preserving deep moisture for summer stress periods and harvest.

**Table 1.**

**YIELDS - Lbs/Acre**

| System | Variety | | | | |
|---|---|---|---|---|---|
| | Nonpareil | Butte | Carmel | Monterey | Average |
| **Drip** | 2,505 b | 2,462 | 2,659 | 2,206 | 2,458 |
| **Drip Double** | 2,384 bc | 2,315 | 2,520 | 1,950 | 2,292 |
| **Micros** | 2,538 b | 2,445 | 2,471 | 2,102 | 2,389 |
| **Micros Double** | 2,670 ab | 2,532 | 2,510 | 2,173 | 2,471 |
| **Micros Double 120%** | 2,896 a | 2,965 | 2,956 | 2,412 | 2,808 |
| **Drip Double 150%** | 2,187 c | 2,465 | 2,717 | 1,775 | 2,286 |
| **Subsurface Drip:** | | | | | |
| **New Geoflow Double** | 2,466 bc | 2,359 | 2,494 | 1,689 | 2,252 |
| **Geoflow Double** | 2,574 b | 2,423 | 2541 | 1,789 | 2332 |
| | | ns | ns | | ns |

*Fishers Protected LSD P=0.05*
ns= not significant

**Kernel size gms.**

| System | Variety | | | | |
|---|---|---|---|---|---|
| | Nonpareil | Butte | Carmel | Monterey | Average |
| **Drip** | 1.18 | 0.93 ab | 1.16 cd | 1.29 | 1.14 |
| **Drip Double** | 1.20 | 0.93 ab | 1.17 bcd | 1.36 | 1.17 |
| **Micros** | 1.19 | 0.95 ab | 1.20 ab | 1.39 | 1.18 |
| **Micros Double** | 1.26 | 0.95 ab | 1.20 abc | 1.32 | 1.18 |
| **Micros Double 120%** | 1.23 | 0.96 a | 1.22 a | 1.36 | 1.19 |
| **Drip Double 150%** | 1.26 | 0.96 a | 1.20 ab | 1.34 | 1.19 |
| **Subsurface Drip:** | | | | | |
| **New Geoflow Double** | 1.23 | 0.92 bc | 1.16 cd | 1.37 | 1.17 |
| **Geoflow Double** | 1.18 | 0.89 c | 1.12 d | 1.37 | 1.14 |

*Fishers Protected LSD P=0.05*

The small yield advantage micros have over drip is dependant upon the availability of more

water. Given equal water, drip and micros have yielded the same in this test. Given more water, microsprinklers can outperform drip systems in yield and kernel size. Given the restricted rootzone at this site, applying more water via drip causes soil saturation problems while increased irrigation to micros spreads water over a much larger area avoiding saturation. Careful understanding of site specific conditions are required when evaluating any irrigation system. Here, the trees seem to respond to micros better than drip, at least when high water rates are used.

Geoflow SDI plots continue to yield the same as surface drip and show no signs of root intrusion after 11 years in the field. The original Geoflow SDI emitters installed were not pressure compensating so resulted in poorer uniformity. The New Geoflow SDI product is PC. Trees switched in spring 2000 to the New Geoflow from plugged SDI hoses have responded dramatically in shoot growth and yield. This indicates how responsive almonds are to sufficient irrigation and how soon yield can begin to repay costs of irrigation improvements. We are very interested in monitoring the newly installed (8 inch depth) double hose Geoflow PC SDI and almond yield/quality in the future.

## 3) Almond/Marianna 2624 Performance

John Edstrom and Stan Cutter

Marianna plum 2624 rootstock is the most useful rootstock for Oak Root Fungus sites and has become increasingly important in the expansion of almonds onto the heavier soils of the western Sacramento Valley

Mission, Ruby and Padre cultivars have shown excellent compatibility with M2624. Inconsistent field performance of Butte on M2624 has been common, yet Butte is the most desirable M2624 "compatible" variety. Evaluating the commercial potential of M2624 plantings however, requires closer spacings than typically used in almonds, resulting in more trees and higher investment expenses.

A test planting was established to check the productivity of four almond cultivars in a close planted hedgerow on M2624 rootstock. Butte trees were obtained as certified virus free (scion and root) to remove the virus affects. Commercially harvestable replications were designed into the test for yield data collection. Butte, Mission, Ruby and Padre almonds were planted March, 1989, under drip irrigation, as single N/S rows at 10' x 20' spacings for 218 trees/acre.

**Results**

Yield and kernel size data for 2001 are presented in the following table.

| Variety | Lbs./Acre | Gms/Kernel |
|---|---|---|
| **Padre** | 2,676 | 0.98 |
| **Butte** | 2,165 | 0.91 |
| **Mission** | 2,666 | 1.06 |
| **Ruby** | 2,059 | 1.17 |

Again, yields show a productive almond planting can be maintained into the 13th leaf using M2624 root. All four varieties produced respectable yields this year except for Ruby.

Important to the interpretation of this test is the soil which is quite shallow with a restricting clay layer at 24-36 inches. Shoot growth has been weak in recent years especially during heavy sets. Attempts have been made to invigorate this block. Three years ago, a second drip line was added to one of the reps. this change has not resulted in any measurable difference in production. During the 1999 winter a mechanical hedger (rotary saws) was used to prune one side of alternate rows to stimulate top and side shoot growth. An angled hedging cut was made on the shoulder of the canopy, positioned 2 feet from tree top center and angled 30 degrees down into the row middles. One side of all Ruby and Butte rows were cut that winter. During year 2000 all Padre and Mission rows were cut. Last winter the opposite side of Butte/Ruby rows was cut. Next year Mission/Padre will be cut on the other side thus, four years will be needed to complete this hedging plan. Mission regrowth last season was considerably less than other varieties after

winter hedging.

After the first winter hedging, Ruby trees produced 2-5 shoots at each saw cut, which grew 24-36 inches in length. Buttes grew 3-6 shoots at each cut, which grew 24-48 inches. The mechanical pruning appears to be invigorating the Buttes and Rubys, which have been the least vigorous of the four varieties. This is particularly instructive for Ruby given its' heavy crop load last year and for Butte given the questionable compatibility on M2624. However, this year the Ruby crop is down, maybe limited pollen or possibly carbohydrate reserves were heavily depleted last season after producing strong shoot growth while carrying a heavy crop. . Yields have been down slightly on varieties hedged the previous winter. Measuring overall orchard canopy expansion and/or yield enhancement will be started after the final hedging is completed winter 2002/03.

Kernels produced continue to be of high quality in all varieties. Surprisingly, Mission yield and kernel size were both exceptional this year.