Final Report to the Almond Board- May 2004

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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

The objective of this trial is to evaluate tree training/pruning methods for maximum early production while maintaining long-term yields in tightly spaced almonds.
In the spring of 1997 almonds on Lovell peach rootstock were planted on Marine Ave. at the Nickel's Soils Lab. The trees were spaced 16' X 22' with a north south row orientation. The soil was slipped plowed prior to planting and the trees were irrigated to meet ET with microsprinklers. The orchard planting design was 1:1 with Nonpareil rows alternating with pollinator rows of Monterey, Carmel, Aldrich and Sonora. Four training systems were selected and imposed on the trees beginning in the first dormant season. Each row served as replicate with all of the treatments randomized in the row. There were four replicates of Nonpareil, three of Monterey, two of Aldrich, two of Carmel and one of Sonora. Beginning in the fourth leaf, yield data has been collected, summarized and, where adequate replication allowed (Nonpareil), analyzed for statistical differences.

Treatments

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

2) **Unpruned** - Three primary limbs selected and left long at the 1st dormant pruning then no additional pruning unless needed to facilitate orchard operations or to remove broken limbs. Minimal staking as necessary.

3) **Mechanically Topped** - Same as unpruned, but with machine flat-topping to remove half of prior season's top shoot growth conducted during the 2nd dormant season and again in spring of the 4th leaf.

4) **Temporary Scaffolds** - Train limbs at 1st dormant to favor 3 permanent upright primary scaffolds, temporarily retain lower less dominant branches, removing only ones competing 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 good in this planting allowing a realistic evaluation of the unpruned method under strong growing conditions. Tree canopies are now closing in, forming a dense orchard canopy. Two thousand and three (7th leaf) Nonpariel yields ranged from approximately 2000 pounds per acre for the standard and temporary scaffold treatments to approximately 2500 pounds per acre for the unpruned and mechanically topped treatments(table 1). Yield variation in the plots prevented these differences from being statistically significant at the 5% level using Fisher's test..

Table 1.

	Aldrich		Carmel		Monterey		Nonpariel	
	7th Leaf		7th Leaf		7th Leaf		7th Leaf	
	2003	Accum.	2003	Accum.	2003	Accum.	2003	Accum.
Standard	2,566	8,121	1,600	7,035	1,935	7,413	2,032	6,885
Temporary Scaffold			1,377	7,695	1,847	7,610	2,067	7,254
Mechanically Hedged	2,676	7,899	1,969	7,867	1,784	6,938	2,549	7,348
Unpruned	2,525	8,176	802	6,085	2,525	9,106	2,501	7,630
Average (Mean)	2,589	8,065	1,437	7,170	2,023	7,768	2,287	7,278
							NS	

Discussion

Temporary limb concept

This method is probably not worth the extra effort. The only yield advantage (300 lbs/acre) came during the 4th leaf. During the 5th & 6th harvests, production was equal to the standard pruned trees. While not statistically significant on the Nonpareils the yield for the 7th leaf (2003) was approximately 500 pounds per acre less than the unpruned or mechanically topped trees. This was probably due to temporary scaffold removal. The pruning work required is difficult to prevent temporary lower limbs from competing too strongly with the upper permanent ones. Secondary limbs have flattened with much water sprout growth. Some "temporary" limbs will now be maintained permanently with Monterey as many limbs on this variety show even development between all main scaffolds. Many permanent scaffolds appeared to be smaller and weaker, compared to those on standard pruned trees during the training period. The training phase was completed last winter when the remaining temporary scaffolds were removed. Most of the trees appear to have a satisfactory framework for long-term production. On the positive side this treatment sustained much less damage from a strong wind storm that occurred in the second leaf than the standard pruned trees.

Unpruned

This method continues to demonstrate commercial potential. Nearly all unpruned trees look acceptable or very good. Nonpareil and Aldrich did appear too dense in the upper canopy with more shading below, but the heavy crops produced since 2002 opened the centers naturally. Some Monterey trees are misshapen and have "mushroomed" open, but the Sonoras and Carmels look good. Some thinning cuts could be made to open the trees and reduce crowding. 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 and facilitates most orchard operations There has been no problem with crop removal at harvest despite the dense fruitwood, as the trees enlarge this may become a problem. The long-term production of these trees is our only remaining concern.

Mechanically Topped

All varieties in this treatment are shorter in height than in the other methods and appear thicker and more crowded in the upper canopy. 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 in half during the May 2000 topping. This resulted in cutting into some prior year's wood, de-invigorating the trees and reducing tree height. As expected, 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. Since the forth season this treatment has received no pruning. Yields are now very similar to the unpruned treatment. Monterey and Nonpareil tree structure appears most affected by topping with heavily shaded interior. Aldrich trees appear more normal, but are very dense. However, the crowded upper canopy condition appears to be lessening with time.

Standard Pruning

These trees are the tallest of all treatments and also exhibit a standard, open canopy. However, pruning in this treatment in the past would best be described as "minimum", as not enough wood was removed in the early years to qualify as standard pruning. During the past two dormant seasons, in order to represent a more typical standard pruning, trees in this treatment were pruned more heavily, removing more crowded and crossing limbs. This heavier pruning was reflected in reduced production compared to the unpruned and mechanically topped treatments for 2003. 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.

Summary

The no pruning treatment continues to look promising. To date, accumulated yields for this treatment are as high as any in the trial and the trees appear well balanced with good to acceptable tree architecture, which should be capable of long term high production. The reduced pruning costs represent savings to the grower with no reduction in yield. Trees settle down more naturally, so far, without shading lower fruitwood. Consistent, heavy cropping has also moderated growth. Now, after 7 seasons, many Nonpareil and Sonora trees look dense, but very good and most are acceptable. Varieties like, Monterey, Carmel and Aldrich may require different methods. But the "unpruned" method continues to perform remarkably well, both in terms of production and tree framework. After selecting three primary scaffolds, trees left unpruned are as productive, or more, than pruned trees through the 7th leaf. This minimum system, which was successful for 20 years in a previous trial at Nickels on weak soil, is performing well here under much more vigorous conditions.

The "temporary" system looks questionable. Yields don't appear to justify the extra pruning efforts. Long-term yields could find mature yield gains to this idea when compared to the possible declining yields of the "unpruned" trees.

2. Comparison of Microirrigation Systems for Almonds

John Edstrom, Dr. Larry Schwankl, Stan Cutter and Bill Krueger

A 22-acre field demonstration began in 1990 to evaluate the three major types of microirrigation: Drip, Subsurface Drip (SDI) and Microsprinklers. This trial uses 36 one-half acre plots to simulate commercial conditions on four almond varieties, Nonpareil, Butte, Carmel and Monterey. The systems under study are:

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 replaced in the 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

Production in this trial was very good again this year with an average of 2480 pounds per acre for all plots compared to 2584 pounds per acre for 2002. Nonpareil and Butte yields showed no significant yield differences at the 5 % level using Fisher's test for any of the treatments.

No yield enhancement has been found for Micros Double verses Micros (single). Previously, soil moisture uptake measurements indicated that an advantage might be obtained from surrounding the tree canopy with wetted soil (Micro Double) verses a circular wetted area midway between trees (Micros). No advantages have been measured, however, more efficient frost protection may be obtained by applying water directly beneath canopies.

Evaluation of sub surface drip systems (SDI) suggests that the original deep placement of hoses at 15 inches maybe inferior to the newly installed SDI at 8 inches (Shallow verses Deep Geoflow). This might be explained by the shallow soil at this site (24"-48"). However, the new SDI emitters are pressure compensating, the old ones are not, so a fair comparison isn't possible. Root intrusion has not been a problem with the triflurilin herbicide product (Geoflow) as was found in the standard SDI emitters (Netafim). Overall, after 12 years in the field, the yields and performance from SDI in almonds continues to be promising.

Table 2.

	YIELDS - Lbs/Acre				
	Variety				Average
System	Nonpareil	Butte	Carmel	Monterey	
Drip	2,544	2,811	2,666	2,165	2,547
Drip Double	2,385	2,810	2,586	1,586	2,342
Micros	2,318	2,662	2,400	2,170	2,387
Micros Double	2,367	2,612	2,292	1,900	2,293
Micros Double 1.2 ET	2,245	2,891	2,203	2,116	2,363
Drip Double 150% ET	2,657	3,144	2,870	2,155	2,707
SDI Double:					
Shallow New Geoflow	2,738	2,989	2,562	1,954	2,561
Deep Original Geoflow	2,480	3,068	2,813	2,205	2,641
	NS	NS			

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. Mission, Ruby and Padre cultivars have shown excellent compatibility with M2624, but field performance of Butte has been troublesome. 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 cultivars in a close-planted hedgerow on M2624 rootstock. All 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 north south oriented rows with a 10' x 20' spacing or 218 trees/acre.

Results

Yields for 2002 were severely reduced due to frost and ranged from 500 to 800 pounds per acre for Padre, Butte and Mission. Ruby yields were somewhat better at around 1600 pounds per acre. The yields rebounded dramatically this year and ranged from over 2,700 pounds per acre per acre for Ruby to more than 4000 pounds per acre for Padre (table 3.).
A mechanical hedging program was initiated 5 years ago to stimulate growth to fill in the canopies. Alternate sides of alternate rows were cut each winter. This hedging program was completed during 2002/03 winter. Hedging greatly invigorated shoot growth resulting in a more angular upper canopy compared to a rounded canopy on the unhedged trees. Tree canopies in the uncut rows have now filled in the 20 foot row spacing. Hedged canopies, being more up-right, do not touch in the middles, but may bend down soon under the weight of denser fruitwood stimulated by the hedging.

Table 3.

Variety	Yield - Lbs/Acre
Padre	4,019 a
Butte	3,066 bc
Mission	2,827 bc
Ruby	2,729 c