Nickels Soil Lab Projects

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Organic Production Systems for Almonds

Objectives:

Evaluate the economics and productivity of USDA and California Certified Organic Farmers (CCOF) compliant organic almond production methods suitable for the Sacramento valley region in comparison to standard production methods.

Interpretive Summary:

Since planted in April of 2006 an 8-acre almond planting of Nonpareil/Fritz (75/25) has been evaluating three production systems; Conventional (Conv), Transitional (Trans) and Organic (Org). The conventional trees are produced using practices typical for almond production in the area. The transitional trees were grown conventionally for 3 seasons and then converted in September 2008 to organic practices. The organic trees are grown using practices approved for organic production by the USDA and CCOF. A partial list of contrasting cultural practices and the associated costs are shown in **Table 1**.

During the current season, measurements were taken for trunk circumference; canopy shaded area and intercepted light. These data indicate larger tree size for the Stan/Trans compared to the smaller Org trees. (**Table 2 & Table 3**). Stem water potential readings (SWP) measured in – bars by a pressure chamber indicate equal water status between treatments. However, if tree size between the systems differ significantly adjustments to the irrigation will be necessary.

During the three seasons of this trial, weed control has been the most challenging issue. While propane flaming in the tree row has been effective it is slow and expensive. At this age the young trees shade only 25% of the tree line strip providing nearly full sun for weed growth. As tree canopies enlarge and create more shade, weed pressure will

be dramatically reduced. Sections of the Org trees received a weed cloth barrier at planting which has prevented most weed growth in the 6 ft. wide tree line but at the considerable expense of $1,500/acre plus yearly repair expenses. The longevity of the cloth will determine ultimate cost/acre. If the cloth endures for 5 - 6 years, the cost will be comparable to current flaming expenses. However, there appears to be some advantage to tree growth from the weed cloth compared to propane flame weed control.

The surface drip system was replaced in October 2007 with a dual line subsurface drip system, primarily to reduce weed growth, seed emergence and associated weed control costs. This has reduced propane flaming expenses significantly compared to previous seasons. However, flaming is not effective during wet conditions and only marginally at cold temperatures. Given the 18 inches of rainfall in the Arbuckle area, weed growth gets ahead of the flamer in the winter requiring hand hoeing. This expense should also be reduced as canopies shade the soil surface.

Yields for Nonpareil were similar between the three treatments. Yields in general were low due to heavy pruning needed to restructure tree framework following high wind damage. Kernel quality evaluations measured the off grade as follows: Stan, NOW - 0.25 % and ant- 0%,Trans, NOW- 2.5% , ant 0.5% and Org NOW- 1.3 % and ant- 0.33%.

In general the leaf analysis results reflect the fertilizer programs. Higher mineral content in the Stan/Trans follow the higher levels of nutrients provided by commercial nitrogen, potassium, and zinc fertilizers. For the Org, it is difficult to estimate the nutrition provided by the compost applications. Lab analysis of the compost shows 1.5% nitrogen that converts to 120 lbs N/acre (4T x 2000 lb x 0.015) applied broadcast per acre. Soil results show only 9 ppm NO_3 level in the root zone and only 2.25% N in the leaves. These levels suggest that nitrogen mineralization of the applied compost has been insufficient and in general, nitrogen is not optimal in the Org trees. The level of zinc is also low in the Org trees. Other elements are adequate. However, we do expect the amount of available nitrogen to increase as more if the compost is mineralized. Compost applications should also improve the potassium and zinc levels. Although copper was applied in the dormant spray, the leaf level isn’t higher than the Stand where copper was not applied suggesting the copper rate was insufficient to affect tree nutrition.

Stan/Trans tree nutrition also appears a bit low in N and zinc. The elevated chloride is likely a result of potassium chloride applications that are omitted in the Org trees.

Standard Organic

Table 1. Production Costs per Acre- 3rd leaf

Field Practice	Standard	$	Organic	$
Nutrition				
- nitrogen	CAN-17 30 lb N/ac	30	sodium nitrate 30 lb N/ac	56
	UN-32 60 lbs N/ac	43	Agrolizer 6-2-0@30 lb N/ac	120
- boron spray	Solubor @ 2.5 lbs/ac	6		
- potassium	140 lbs K2O/ac	95		
- zinc spray	Zinc sulfate 10 lb/ac	25		
- compost			4 tons/acre	120
Weed control				
- herbicides	Glyphosate/Goal	40		
	pre-emerge	50		
- propane			50 gal @ $3.50	175
			10 flamings @ 0.5 hr	90
- hoeing			2 times @ 2 hrs @ $12	48
- mowing	5 times @ $7	35	5 times @ $7	35
Insects				
- dormant			2 gal veg oil + 1 lb cu	50
- mites	Agrimek @12 oz	40		
- PTB	Dimilin @ 12 oz	35	Entrust @ 2.5 oz 2x	105
Disease				
- blossom	Vanguard @ 5 oz	30	(1 lb/ac dormant copper)	
- leaf	Abound @ 12 oz	45		
TOTAL COSTS		**$474**		**$799**

Table 2.

System	Intercepted light PAR	SWP bars
Standard	22.1 a	-8.5 a
Transitional	21.1 a	-9.1 a
Organic	14.9 a	-9.6 a

Duncans MRT alpha 0.05

Midday canopy light interception measured 12:30-13:30 hrs.
100 measurements were taken in an area between two tree rows.

Table 3.

System	Yield lbs/plot	Trunk circ. Cm
Standard		31.8 a
Transitional		30.9 a
Organic		27.1 b
Org & weed cloth		29.1

Duncans MRT Alpha 0.05

Compost Analysis

Percent							PPM			
N	P_2O_5	K_2O	S	Mg	Ca	Na	Mn	Cu	Zn	B
1.4	0.5	1.1	0.26	0.78	2.0	0.09	412	91	240	70

Leaf Analysis

	N	P	K	S	B	Ca	Mg	Cl	Zn	Mn	Fe	Cu
	%	%	%	ppm	ppm	%	%	%	ppm	ppm	ppm	ppm
Standard	2.34	0.12	2.19	1925	39	4.16	0.87	0.10	16	124	288	4.5
Trans	2.44	0.12	2.21	1970	37	4.11	0.91	0.09	16	147	316	5.4
Organic	2.25	0.13	1.94	1853	37	3.96	0.91	0.05	12	143	339	4.6

Soil Analysis

	pH	OM	NO3	P Olsen	K	ZN DTPA	Mn DTPA	Cu DTPA
		%	ppm	Ppm	ppm	ppm	ppm	ppm
Standard	6.6	0.8	19	9	105	0.8	217	0.1
Organic	6.0	0.7	9	10	80	0.6	216	0.1

Composite samples taken 11/07 from berm area @ 6"-12" depth.

Minimum Pruning Systems for Almonds

John Edstrom, Bill Krueger & Stan Cutter

Objectives:

The objective of this trial is to evaluate tree training/pruning methods for maximum early production while maintaining long-term yields in tightly spaced (16' x 22') almonds.

<u>Treatments</u>

1) <u>Standard</u> - Three primary limbs selected at 1st dormant, tipped but long pruned, secondaries selected 2nd dormant, centers kept open, limb tying/staking as necessary. Yearly traditional, light pruning continued.
2) <u>"Unpruned"</u> - Three primary limbs selected, tipped 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 during the 2nd dormant season and again in spring of the 4th leaf. No additional pruning.
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 gradually removed during years 5-8 after producing some crop and adding to tree size.

Interpretive Summary:

The yield results of this field trial continue to question the need for pruning to maintain almond production once the primary scaffolds have been selected. Yields for Standard and Unpruned trees in this 12th leaf orchard reached record levels of 3800 lbs. per acre. (**Table 1.)** Trees receiving the Temporary scaffold technique and the Mechanical topping program also produced comparably. As in the past two seasons, the Aldrich variety produced somewhat lower yields in the unpruned trees while Unpruned Monterey produced the highest. Average yields across all varieties for 2008 and accumulative production figures for all varieties (yrs. 3 - 11) also show no yield reduction in the unpruned trees. (**Table 2.**) Kernel size continues to be equal for all pruning types. Although the Unpruned trees appear to be losing lower fruitwood, the total yields of the canopy remain the same as the Standard pruned trees. Possibly the upper canopy has compensated for the loss of lower fruitwood as was seen in the prior Unpruned trial conducted at Nickels in the 1980 - 1990s.

Trees in each pruning treatment are monitored for hull rot, stick-tights, shaker injury and various other diseases and none of these parameters differs between the pruning types. Soil moisture probe readings show that the micro-sprinkler irrigation system maintained deep soil moisture close to harvest and met or slightly exceeded Etc requirements. Despite ample water the only summer leaf disease found in the past was leaf rust seen sporadically throughout the plot in 2006. Leaf nitrogen levels are maintained at 2.6 % - 2.7% N while leaf potassium levels fluctuate around 2%. The soil at this site is a Class II gravelly, sandy loam underlain with clay at 30-50 inch depth. Deep slip plowing and land leveling operations have improved the profile, but this orchard exhibits moderate vigor when compared to the strongest young almond orchards found today. This might be reducing the negative effects of shading on fruitwood longevity and ultimately yield. However, near 4000 lbs per acre yields certainly show high productivity for most any site.

The relevance of these trial results to other soils/growing conditions is unknown. However, similar tests in central and southern San Joaquin Valley vigorous orchards have supported these findings. The validation of the minimum pruning concept will require 3 - 5 more years to assess the peak productivity period during the typical life span of an almond orchard.

Past results have shown that 1) Minimally pruned trees and temporary scaffold trees out yield standard trees in the early years, 2) Temporary limb training is expensive and probably uneconomical, 3) Production between all treatments leveled out at the 6th year 4) Accumulated cost savings of $ 600-900 per acre to the 12th year are possible with minimum pruning methods, 5) Aldrich growth habit is incompatible with the temporary limb method 6) Some minimal amount of secondary and inside branch removal may be beneficial under minimum pruning, 7) It appears that Nonpareil is most compatible with minimum pruning followed to Monterey, Aldrich and Carmel in decreasing order of compatibility, 8) No increase in disease or sticktights was found for minimum pruning, and 9) Tree height appears shorter with minimum pruning.

The central questions concerning minimum pruning are: 1) the number of primary limbs to select, 2) the necessity of heading primaries, 3) the feasibility of retaining multiple scaffolds, 4) the need for limb tying, 5) the shading of fruitwood and eventual yield decline, and 6) the range of varieties and growing conditions/vigor amenable to minimum pruning.

Table 1. Pruning Test Results

Kernel lbs/acre

	Aldrich		Carmel		Monterey		Nonpareil	
	accum	***2008***	*accum*	***2008***	*accum*	***2008***	*accum*	***2008***
Standard	20,848	**3,775**	19,021	**3,791**	18,933	**2,982**	19,854	**3,464**
Temp Scaffold	---	**---**	18,754	**3,187**	19,513	**3,296**	20,229	**3,482**
Mech hedged	20,589	**3,807**	19,810	**3,396**	18,725	**3,117**	19,583	**3,177**
Minimum/ Unpruned	19,049	**2,653**	16,576	**3,295**	22,515	**3,939**	21,064	**3,821**

No statistical difference between treatments

Table 2.

	AVERAGE YIELDS ALL VARIETIES 2008	CUMULATIVE (YEARS 3-11)
Standard	**3,503**	**19,664**
Temp Scaffold	**3,322**	**19,499**
Mech hedged	**3,374**	**19,677**
Minimum/ Unpruned	**3,427**	**19,801**