Nickels Soil Lab Projects

Project No.: **10-HORT6-Edstrom**

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Organic Production Systems for Almonds

Objectives:

Evaluate the economics and productivity of USDA and CCOF compliant organic almond production methods suitable for the Sacramento valley region in comparison to standard production methods.

Interpretive Summary:

For the past 5 years we have been evaluating an 8-acre almond planting of Nonpareil/Fritz (75/25) by comparing 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 list of contrasting cultural practices and the associated product and applicatioin costs are shown in **Table 1**. Other costs common to both systems i.e. irrigation, harvest, overhead etc., are not included.

During the five seasons of this trial, weed control and nitrogen fertility have been the most challenging issues. While propane flaming in the tree row has been mostly effective it is slow and expensive. At this age the young trees shade only 50-60% of the tree line strip providing ample 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 $1500/acre plus yearly repair expenses. Weeds are still a menace along the edges of the cloth were mowers can't operate. 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. 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 should also be reduced as canopies shade the soil surface. One immediate advantage of the switch to SDI irrigation is a reduction in harvest time tree water stress by running SDI hoses during harvest without wetting the crop significantly.

The fertility levels are reflected in the tree size measurements (trunk circumference) that indicate larger tree size for the Stan/Trans compared to the smaller Org trees. (**Table 2**). Canopies of the ORG trees also appear thinner.

In general the leaf analysis results also reflect the fertilizer programs. Higher mineral content in the Stan follow the higher levels of nutrients provided by commercial nitrogen, potassium, and zinc fertilizers. For the Trans/Org, it is difficult to estimate the nutrition provided by the compost applications. Lab analysis of the compost shows 2.0% nitrogen that converts to 200 lbs N/acre (5 T x 2000lb x 0.02) applied broadcast per acre presumably, the typically slow rate of nitrogen mineralization of the applied compost has resulted in the 2.4% leaf N level somewhat below the 2.8 % N level found in the Stan trees. Leaf potassium levels (1.7% K) are being well maintained by both the compost and KCL fertilizers. The level of zinc is lower in the Org trees. Other elements are adequate. The cost of this season's organic nitrogen fertility program is now comparable to our standard program and leaf levels are within adequate levels although lower than those in the Standard trees. Hopefully we can maintain adequate levels as production increases and as more of the compost N is mineralized and other nutrients become more available.

Yields for Nonpareil show a 1,100 lb/acre advantage in the conventional production system over organic and a 800 lbs advantage over the transitional trees. Kernel size (22/oz) and quality were excellent for all three systems, virtually no worm or ant damage was found. Again, leaf burn was noted only on the Fritz pollinizer trees that received propane weed applications combined with 2 foliar spays of wettable sulfur. Apparently the heat from the propane applications activated the burn potential of foliar residues of sulfur and desicated lower hanging foliage. Foliage on trees above the sections with weed cloth (where no propane was applied but, received sulfur) did not show leaf damage. No leaf damge was found on any Nonpareil foliage.

For the second consecutive season, significant amount of precipitation fell in the spring; 1.25 inches during bloom and 4.25 inches during leaf emergence. No significant blossom disease resulted from rain but, heavy leaf rust infections developed during mid to late summer as seen in photos. Leaf rust appeared to impact leaf retention more on the Organic trees than Standard trees despite higher Nitrogen levels in Standard. The application of Pristine at petal fall may have given some protection from rust to the Standard trees, but rust activity has not been proven for Pristine and the application timing wasn't appropriate for rust. We expect the disease pressure to increase substantially in future years.

Trial Planting Design
75% Nonpareil/25% Fritz

	N		F		N					
F		N		N		N				
	N		N		F					
N		F		N		N				
	N		N		N					
N		N		F		N				
	F		N		N					
N		N		N		F				
	N		F		N					
F		N		N		N				
	N		N		F					
N		F		N		N				
	N		N		N					

Organic- Rust Defoliation

Standard - Rust Defoliation

Mushroom Compost Analysis

Percent							ppm			
N	P_2O_5	K_2O	S	Mg	Ca	Na	Mn	Cu	Zn	B
2.0	1.37	2.4	1.9	0.78	7.0	0.3	290	169	131	25

Table 1. **Production Costs per Acre- 5th leaf**

Field Practice	Standard	$	Organic/Trans	$
NUTRITION				
nitrogen	UAN 200 lbs N/ac	100	sodium nitrate 40lb.N/ac	80
boron spray	Solubor @2.5lbs/ac	25		
potassium	100 lbs K2O/ac + KNO3 @ 30 lbs	95		
zinc spray	Zinc sulfate 10lb/ac	30		
compost			5 tons/acre	175
WEED CONTROL				
herbicides	Glyphosate + Goal 3 x @ $15	50		
	Matrix + Rely	75		
propane			80 gal @ $3.00	240
			8 flamings @ .75 hr	100
hoeing	weedeater		5 times @ 0.5hrs @ $12	60
mowing	5 times@ $6	30	5 times @ $6	30
INSECTS				
dormant			2.5 gal veg oil + 10 lb cu Nordox	90
mites	Agrimek @12 oz	70		
PTB				
NOW	Asana @ 9 oz	30		
DISEASE				
blossom	5 oz Vanguard	38	2x Wettable sulfur @ 10 lbs	64
leaf	Pristine @ 12 oz	60	+ Thermx @ 6 oz	
PF + 4 wks	Ziram @ 8lbs	40	2x Actinovate @ 12oz + ThermX @ 6oz	180
TOTAL COSTS	Includes applic costs	**$643**	Includes application costs	**$1,019**

Table 2.

System	Yield lbs/Ac	Kernels/oz	Trunk circ.cm
Standard	1,917	22	48.2
Transitional	1,087	21	46.8
Organic	822	22	45.6
Org & weed cloth	833	22	46.6

Leaf Analysis

	N %	P %	K %	Ca %	Mg %	S ppm	B ppm	Zn ppm	Mn ppm	Fe ppm	Cu ppm
STANDARD	2.82	0.13	1.72	4.17	0.82	2360	31	444*	92	263	6.2
TRANS	2.58	0.13	1.59	4.00	0.86	1687	32	17	78	223	7.9
ORGANIC	2.43	0.13	1.73	4.03	0.81	1610	34	16	67	250	7.6

* Ziram residue

Minimum Pruning Systems for Almonds

John Edstrom, Stan Cutter & Bill Krueger

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.

Treatments

1) **Standard** - 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) **"Unpruned"** - 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, from then on standard pruning.

Interpretive Summary:

The **yield results from this field trial continue to question the need for regular pruning** to maintain almond production once the primary scaffolds have been selected. Yield results for Nonpareil and Monterey show no difference in production between Pruned and Unpruned trees. Nonpareil out-produced all other varieties in this 13th leaf orchard but fell short of last season's record. (**Table 1**) Average yields across all varieties for 2009 and accumulative production figures for all varieties (yrs. 3-13) also show no yield reduction in the unpruned trees. (**Table 2.**) Kernel size continues to be equal for all pruning treatments, 22/oz. for this season. **Although the Unpruned and Mechanically Topped trees appear to be losing more lower fruitwood each year, the total yields remain the same as the Standard pruned trees.** (Standard pruned trees have open centers with significant light penetration into the lower canopy.) Possibly the upper canopy of unpruned trees has compensated for the loss of lower fruitwood.It is noteworthy to mention that this same phenomenon was observed in the original Unpruned trial conducted at Nickels in the 1980-1990s. However, continuation of this compensatory fruiting habit is uncertain and remains our primary concern.

Again, we did not see any difference between treatments for hull rot, stick-tights, or any other disease but, shaker damage appears to be more prevalent in both the Unpruned and Mechanically topped (also unpruned) trees. Despite ample water the only summer leaf disease found has been leaf rust seen sporadically throughout the plot since 2006. This site does not

experience stagnant humid air conditions during the summer and thus far, no Alternaria has been found. Drying conditions in the windrows at harvest adequately dry the crop for hulling.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 limiting the negative affects of shading on fruitwood longevity and ultimately yield. July leaf samples show adequate to optimal levels of leaf minerals: Nitrogen-2.7 %, Phosphorus-0.12%, Potassium-2.5%, Sulfur-2250ppm, Boron- 46ppm, Calcium-3.2%, Magnesium-0.85%, Manganese-105ppm, Iron-455ppm, Copper- 9ppm.

So far, this test has produced yields comparable to the best in the Arbuckle area. The relevance of these trial results to other growing regions is unknown, but similar tests in central and southern San Joaquin Valley vigorous orchards have supported these findings. The validation of the minimum pruning concept will require a few more years to determine the total production over the life of the orchard and to track the possible accelerated yield decline over the 20-22 year expected life span of this orchard.

Results and Discussion:

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 6^{th} year 4) Accumulated cost savings of $ 800-1100 per acre to the 14^{th} 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 by 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 10) No problems drying crop on orchard floor. 11) Lack of pruning resulted in a higher % of leaning trees.

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, growing conditions/vigor and tree spacings amenable to minimum pruning without resulting in undesirable consequenses.

Table 1.

PRUNING TEST YIELDS
Kernel lbs/acre

	Aldrich		Carmel		Monterey		Nonpareil	
	accum	***2009***	*accum*	***2010***	*accum*	***2010***	*accum*	***2010***
Standard	22,863	**2,015**	23,972	**2,549**	23,585	**2,468**	25,740	**2,610**
Temp Scaffold	---	---	22,835	**2,251**	23,859	**2,287**	26,217	**2,582**
Mech hedged	22,900	**2,311**	24,560	**2,436**	22,833	**2,183**	25,334	**2,609**
Minimum/ Unpruned	21,032	**1,983**	20,407	**2,009**	27,482	**2,502**	27,195	**2,627**

No statistical difference between treatments

Table 2.

	AVERAGE YIELDS ALL VARIETIES 2009	ACCUMULATIVE (YEARS 3-12)
Standard	2,483	22,133
Temp Scaffold	2,441	21,940
Mech Hedged	2,423	22,099
Minimum/Unpruned	2,445 ns	22,244 ns

Recent Publications:
Annual report of the Nickels Soil Laboratory, May, 2010