Nickels Soil Lab Projects

Project No.: **11-HORT6-Niederholzer**

Project Leader: Franz J.A. Niederholzer
UC Cooperative Extension
P.O. Box 100
Colusa, CA 95932

Project Cooperators and Personnel:
John Edstrom, UCCE - Colusa Co. (emeritus)
Stan Cutter, Nickels Soil Lab
Bill Krueger, UCCE - Glenn Co.
Bruce Lampinen, Department of Plant Science, UC Davis
Gabriela Ritokova, Almond Board of CA/UC ANR intern

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 conventional production methods.

Interpretive Summary:

For the past 6 years we have been evaluating an 8-acre almond planting of Nonpareil/Fritz (75/25; see **Figure 1** for tree layout) by comparing three production systems; Conventional (Conv), Transitional (Trans), and Organic (Org). The Conv 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 costs are shown in **Table 1**. Other costs common to both systems; i.e. irrigation, harvest, overhead etc., are not included. This trial is not replicated due to the limited space available. However, this side-by-side comparison is intended to be a valid case study of differing almond management systems.

The yield differences between Conv and Org Nonpareil production further increased in 2011. The Conv Nonpareil yields showed an 1800 lb/acre and a 1452 lb/acre advantage over the Org and Trans productions systems, respectively. Kernel size (21-24/oz) and quality were excellent for all three systems. Virtually no worm or ant damage was found. Again, as in past years, leaf burn was noted only on the Fritz pollinizer trees that received propane weed applications combined with 2 foliar spays of wettable sulfur. It appears that heat from the propane flame desiccated low hanging leaves and fruit. Foliage on trees above the sections with weed cloth (where no propane was applied but, received sulfur) did not show leaf damage. No leaf damage was found on any Nonpareil foliage.

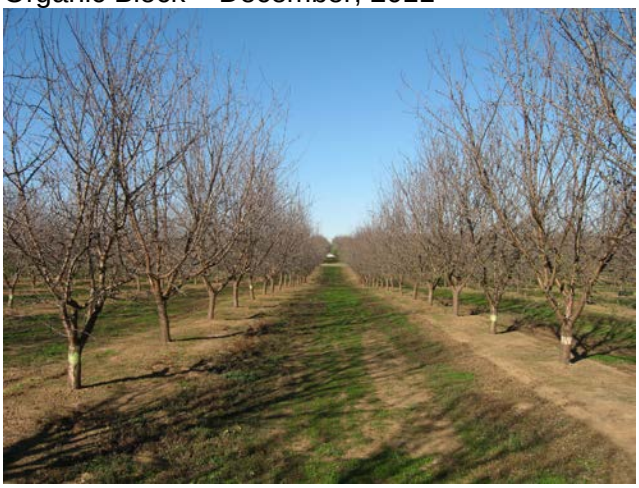
During the six seasons of this trial, disease management, weed control and nitrogen fertility have been the most challenging issues.

- Weed Control: While propane flaming in the tree row has been mostly effective, it is slow and expensive. 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. Weeds are still a menace along the edges of the cloth were mowers can't operate. The weed cloth was removed at the end of the 2011 after annual maintenance became too expensive and time consuming to continue. 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 was a reduction in harvest time tree water stress by running SDI hoses during harvest without wetting the crop significantly.
- Fertility: In 2011, the nitrogen fertility program in the organic/transitional trees was changed to include more organic fertilizer. Yard waste compost was not broadcast this year. Instead, an additional 50 lb N/acre was applied through the irrigation system using 4-0-2 organic liquid fertilizer. This was done in an effort to improve leaf N and canopy size.
- Disease control: Rust was again a problem in the organic blocks and to a lesser degree in the Conv planting. For the third consecutive season, significant amount of precipitation fell at bloom and into the summer; 3.5 inches in the last half of February, 6.18 inches during March, 0.2 inches in April, 1.57 inches in May, and 2.11 inches in June. No significant blossom disease was observed, but, heavy leaf rust infections developed during mid to late summer. Leaf rust appeared to impact leaf retention more on the Org and Trans trees than Conv trees despite higher Nitrogen levels in Conv block. The application of Pristine at petal fall and Tebuzol in late May provided rust protection to the Conv trees for up to 2 weeks after each application, but none of the trees were sprayed before or after a significant rain in late June. The Org and Trans treatments received no fungicides after 2 weeks after petal fall.

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

Figure 1. Trial Planting Design
75% Nonpareil/25% Fritz

Organic Block – December, 2011



Conventional Block -- December, 2011

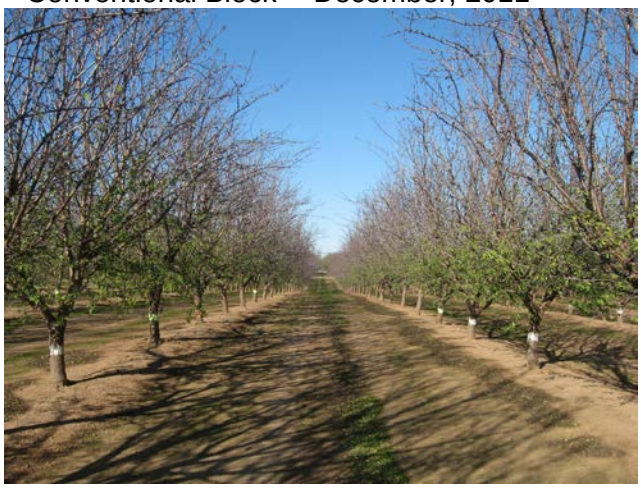


Table 1. Production Costs per Acre- 6th leaf. (Application costs are not included)

Field Practice	Conventional	$/a	Organic/Trans	$/a
NUTRITION				
nitrogen	CAN17 (100 lb N/acre) + UAN32 (150 lb N/acre)	191	sodium nitrate 40 lb N/ac + 4-0-2 (50 lbs N/acre)	826
potassium	0-0-12 (150 lbs K_2O/ac)	122	4-0-2 (25 lbs K_20)	
boron	Solubor @2 lbs/ac	3		
zinc spray	Zinc sulfate (36%) 20lb/ac	16		
WEED CONTROL				
herbicides	Chateau + Prowl + Poast	83		
	Glyphosate + Goal + surfactant	4		
propane			80 gal @ $3.00	240
Labor for propane flaming			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 gallons oil and 10# Nordox 75	100
Peach Twig Borer (bloom)	Intrepid (16 oz)	34		
Spider mites	Agrimek (12 oz)	92		
Navel orange worm (hull split)	Altacor (4oz)	41		
DISEASE				
Pink bloom (1/2 spray)	Vanguard (5 oz)	10	Regalia (2 qt)	28
Full bloom	Rovral (1 pt)	21	Regalia (2 qt)	28
Petal fall	Pristine (12 oz)	38	Regalia (1 qt), Trilogy (12 oz) and Thermix (8 oz)	17
2 WAPF	Ziram (6 lb)	26	Trilogy (1 gal)	37
Late May	Tebuzol (8 oz)	9		
TOTAL COSTS	Doesn't include application costs	**$720**	Doesn't include application costs	**$1,466**

Table 2. 2011 Yield / Kernel Size / Tree Size

System	2011 Nonpareil yield lbs/Ac	Kernels/oz	Trunk circ.cm	July leaf %N
Conventional	2,621	21	55.7	2.69
Transitional	1,169	23		2.60
Organic	822	24	52.2	2.58
Org & weed cloth	833	23		

Minimum Pruning Systems for Almonds

Franz Niederholzer, John Edstrom, Bill Krueger, Stan Cutter and Gabriela Ritokova

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:

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.

"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.

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.

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 15th leaf orchard. (**Table 1**) Average yields across all varieties for 2011 and cumulative production figures for all varieties (yrs. 3-15) 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. **Yields of unpruned Carmel appear to be declining compared to Standard pruned Carmels.**

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 effects of shading on fruitwood longevity and ultimately yield. July leaf samples show adequate to optimal levels of leaf nutrients: Nitrogen-2.9 %, Phosphorous-0.13%, Potassium-2.6%, Sulfur-2270ppm, Boron- 38ppm, Calcium-2.9%, Magnesium-0.76%, Manganese-83ppm, Iron-161ppm, Copper- 6ppm.

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.

Past results:
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) Cumulative cost savings of $ 800-1100 per acre to the 15th year are possible with minimal 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) Number of primary limbs to select, 2) Necessity of heading primaries, 3) Feasibility of retaining multiple scaffolds, 4) Need for limb tying, 5) Shading of fruitwood and eventual yield decline, and 6) Range of varieties, growing conditions/vigor and tree spacings compatible to minimum pruning without resulting in undesirable consequences.

Table 1. Pruning Test Yields. 2011 (Kernel lbs/acre)

	Aldrich	Carmel	Monterey*	Nonpareil*
Standard	2,167	2,455	2,139	3,262
Temp Scaffold	---	2,236	2,351	3,032
Mech hedged	2,020	1,833	2,115	2,987
Minimum/unpruned	1,890	2,197	2,610	3,168

*No statistical difference between treatments

Table 2.

	AVERAGE YIELDS ALL VARIETIES 2011	CUMULATIVE (YEARS 3-15)
Standard	2,439	29,270
Temp Scaffold	2,583	25,825
Mech Hedged	2,385	28,626
Minimum/Unpruned	2,577	30,922

Recent publications:

Annual report of the Nickels Soil Lab, May, 2012