University of California
Agriculture and Natural Resources

Organic Almond Production System

Nickels Soil Lab Project

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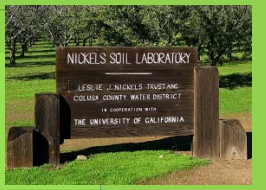

Objectives:

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.

Conventional trees, Dec. 5, 2011 →

Organic trees Dec. 5, 2011 ←

Field Test Results - five years experience

- Trees planted in 2006 on Lovell rootstock. 66% Non-pariel, 33% Fritz. Every third tree in every row is a Fritz. Transitional trees farmed conventionally for three years and then shifted to organic production.
- Tree canopies well developed but less dense for organic (see photos @ lower left).
- Weed control biggest challenge- propane expensive and ineffective in winter requiring hand hoeing/weed eater use multiple times/season.
- No significant disease problems except more leaf rust defoliation in Organic trees. More focus on summer disease control will be focus of 2012 season.
- Yields in Organic are one third of those in Standard (5th leaf)
- Production cost $ 700/acre higher (100%) for Organic methods vs. Standard.
- Added organic liquid fertilizer (4-0-2) in 2011.

Organic vs. Conventional: Yield, and tree size, and summer leaf nitrogen (N) levels, 2011

System	Yield lbs/Ac*	Kernels/gms	Trunk circ. (cm)	% leaf N
Standard	2,621	1.341	**55.7**	2.69
Transitional	1,169	1.215		2.60
Organic	819	1.200	**52.2**	2.58
Org & weed cloth	746	1.248		

*Yields in this report are calculated from small lots. They do not include deduction from huller/cracker loss and assume solid orchards with no missing trees. Therefore, the numbers are approximately 5-10% higher than expected commercial block yields.

Production Cost Comparison

Conventional	Notes	Cost/acre	Organic	Notes	Cost/acre
Nutrition					
100# N/acre as CAN-17		106.47	40# N/acre Sodium nitrate	April/May (20#/20#)	120.00
150# N/acre as UN-32		84.84	50# N/acre and 25# K (4-0-2 liquid)	June	706.25
150#K2O as 0-0-12 (KCL)		122.50			
20#/acre zinc sulfate 35.5%		16.33			
Solubor (2#/acre)		3.00			
Weed Control					
Chateau (12 oz/acre)	February	39.91			
Prowl H20 (6 qts/acre)	February	37.17			
Poast (1 pint/acre)	February	6.22			
Glyphosate (20 oz/acre)		1.52			
Goal (5 oz/acre)		1.84			
R-11 (64 oz/100 gal)		0.94			
			propane	8 flamings	240.00
			labor for flaming		100.00
			hoeing (weed eating)	5 times	60.00
mowing	5 times	30.00	mowing	5 times	30.00
Insects/Mites					
Agrimek (12 oz/acre)	Late May	92.50	2.5 gallons oil and 10# Nordox 75/acre		100.00
Intrepid (16 oz/acre)	At bloom	34.39			
Altacor (4 oz/acre)	Hull split	40.64			
Disease					
Vanguard (2.5 oz/acre)	Pink, every other row	9.88	Regalia (2 qt/acre)	Pink bud	27.47
Rovral (1 pt/acre)	Full bloom, every row	21.26	Regalia (2 qt/acre)	Full bloom	27.47
Pristine (12 oz/acre)	Petal fall, every row	38.40	Regalia (1 qt/acre), Trilogy (12 oz), Thermx (8 oz)	Petal fall	17.25
ziram (6#/acre)	2 WAPF, every row	25.68	Trilogy (1 gal/acre)	2 WAPF	37.46
Tebuzol (8 oz/acre)	Late May, every row	9.27			
Total costs	Does not include application costs	**722.75**		Does not include application costs	**1465.90**

Special thanks to Ubaldo Salud, Gerry Hernandez, and Leslie Clark Pingrey

Improving spray coverage & managing drift: a progress report.

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Introduction

Navel orange worm (NOW) is a key pest in almonds. While effective control begins with careful winter orchard sanitation, a hull split spray can be a vital part of an effective NOW control program.

Every spray application is unique. Orchard air temperature, relative humidity, wind speed and direction, sprayer fan size and speed, ground speed, nozzles, targets (leaves and nuts), pesticide selection and adjuvant(s) influences the outcome of grower investment in pest control.

How should pesticides be applied to almonds for the best possible pest control at the least cost to the grower, the applicator and the environment?

New pesticides offer the potential of NOW control with less disruption of beneficial insects and mites; however, excellent coverage is critical to effective NOW control with new materials.

Efficient application that increases spray deposition on the target and reduces off-target pesticide movement is key to sustainable almond production.

In the past two years, research to improve coverage and increase efficacy and efficiency of hull split sprays for NOW control has been evaluated in commercial almond orchards. This is report discusses the progress of this research.

Experiment 2: Spraying tall almonds late spring, 2011. Air-O-Fan GB36 PTO sprayer; 110 gpa; 150 psi; 2 mph; micronutrients in sprayer as tracer. Question: Will using many, small droplets (2x nozzles) deposit more spray material in the tree tops? Answer: NO.

General field tests

- Multiple tests were conducted in commercial orchards in the Sacramento and San Joaquin Valleys. Here, we are primarily reporting on Almond Board supported work in the Sacramento Valley. USDA (Siegel) and Paramount Farms (Higbee) have conducted extensive spray coverage/pest control testing in the San Joaquin Valley over the past several years Their work is continuing.
- Spray coverage was measured with water sensitive paper and non-toxic tracer deposits measured on leaves, leaf punches, nuts, and/or mesh cylinders hung in trees.
- Spray volumes applied varied from 50-100 gals per acre.
- Ground speeds ranged from 1.8-2.4 MPH.
- PTO sprayers were used with a John Deere 5105 tractor. In 2010, we used a TurboMist S30 from Slimline Manufacturing. In 2011, we used a GB36 from Air-O-Fan.
- Drift was measured by collecting spray fallout on metal plates, cellulose sheets, and/or water sensitive paper on the orchard floor or outside the orchard, but within 75' of the orchard.
- NOW control was measured by:
  - Collecting nuts from low (5-7') and high (16-20') sections in sprayed trees at 1 and 14 days after spraying, exposing those nuts to newly hatched NOW larvae and counting the surviving NOW after 6 weeks.

Experiment 1: Hull split spray, 2010. TurboMist S30 PTO sprayer; 150 psi; 2 mph; Brigade WSB @ 1.5#acre Question: Will spray volume differences (50 gpa vs 100 gpa) effect NOW control? Answer: NO.

Progress to date

- Regardless of pesticide sprayed, % of NOW control dropped between 1-14 days after spraying (see Table 1).
- Lower tree canopy was consistently over-sprayed compared to what was needed for excellent NOW control (see Table 1).
- Upper tree canopies of tall trees (16-20') are hard to cover. Slow ground speed is preferred with the standard airblast sprayers available. 2.0 MPH gave significantly better NOW control in the tops of trees vs 2.5 MPH using a PTO sprayer with 36" fan.
- Optimum nozzle size for coverage and efficiency at hull split appear, at this time, to be in the medium range (Teejet D4-5 or similar nozzle size). Smaller nozzles produce less spray deposit in tree tops compared to these nozzles. Big drops (D6-8) do not provide quality (uniform) coverage.
- Good NOW control is possible at 50 gallons of spray material per acre. Pesticide selection and orchard vigor and shape may affect how this approach works in specific orchards.
- Larger droplets (D4-5/25) produce more fallout onto the ground within or near the orchard compared to smaller droplets (D1.5/25). This means less pesticide drift* and less potential applicator exposure to pesticides with smaller nozzles (producing smaller droplets) compared to larger nozzles. <u>However, if smaller droplets produce less spray deposition on leaves in tree tops and less fall out on orchard floor, where does the remaining pesticide end up?</u>
- Water sensitive paper (WSP) appears to be as good a tool as we currently have for measuring pest control potential. Total tracer deposit is not closely linked to NOW control in 2011. Current target is 500-1000 drops/cm^2 on WSP for good NOW egg control based on work in the San Joaquin Valley.
- Current preferred sprayer set up for hull split spraying in almonds (to be checked in 2012) with a standard air blast hydraulic nozzle PTO or engine drive sprayer is:
  - Slow tractor speed (1.8-2 MPH)
  - Every row spraying
  - 70-75% of spray output from the top 50% of nozzles (D4-D5 or similar nozzles)
  - 25-30% of spray volume in the lower 50% of nozzles (D2-D3 or similar GPM hollow cone nozzles)

*This statement works if you define pesticide drift only as what lands on the ground at certain distances from the spray site. This definition does not include airborne pesticide from the spray floating above the measurement sites. Some drift lands miles away.

Experiment 3: Spraying almonds during hull split 2011 Air-O-Fan GB36 PTO sprayer; 100 gpa; 150 psi; Altacor (4 oz/acre), micronutrients in sprayer as tracer. Question: Will directing more pesticide towards the tree tops and driving faster (2.5 mph) give the same NOW control as the usual nozzle set up (2/3 of pesticide through top half of nozzles) and slower tractor speed (1.8 mph)? Answer: NO.

Coverage differences between upper and lower canopies shown by water sensitive paper placed in the upper (A) and lower (B) canopy during Experiment 2. Droplet patterns were similar with each nozzle treatment.

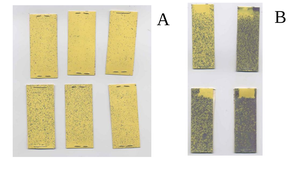

Table 1. Study details and NOW control results, 2010 and 2011.

Year	Location	Tractor speed	Pesticide & rate	Spray volume	Canopy location	Nozzle arrangement*	Day 1 survival	Day 14 survival
2010	Sutter	2.0 mph	Brigade 1.5 lb/a	50 gpa	5-7'	50/50	0.0%	0.2%
2010	Sutter	2.0 mph	Brigade 1.5 lb/a	50 gpa	16-20'	50/50	0.5%	5.3%
2010	Sutter	2.0 mph	Brigade 1.5 lb/a	100 gpa	5-7'	50/50	0.0%	0.0%
2010	Sutter	2.0 mph	Brigade 1.5lb/a	100 gpa	16-20'	50/50	0.1%	10.7%
2011	Arbuckle	1.8 mph	Altacor 4 oz/a	100 gpa	5-7'	66/33	1.1%	3.7%
2011	Arbuckle	1.8 mph	Altacor 4 oz/a	100 gpa	16-20'	66/33	1.1%	3.7%
2011	Arbuckle	2.4 mph	Altacor 4 oz/a	100 gpa	5-7'	75/25	1.5%	4.2%
2011	Arbuckle	2.4 mph	Altacor 4 oz/a	100 gpa	16-20'	75/25	1.5%	12.8%

*% spray volume output from upper half of nozzles / % spay volume output from lower half of nozzles.

Thanks *to the Almond Board of California, George Arroyo (Raub Orchards) , Stan Cutter and Ubaldo Salud (Nickels Soils Lab), Shannon McDonald (Air-O-Fan), Henry Miller, Jr. (Valley Truck and Tractor), and Trustees of Nickels Soils Laboratory*

Pruning Systems for High Density Orchards

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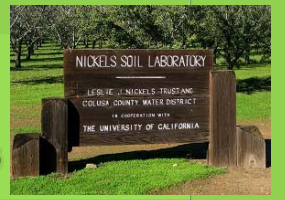

Objectives

To evaluate tree pruning methods for maximum production while maintaining long-term yield in 16'x22'spaced almonds.

Methods

- 15th season evaluating minimum pruning methods (planted in 1997)
- 16'x22' spacing, north and south on Lovell
- Microsprinklers, irrigated 2x per week to meet Etc
- Sandy loam with clay at 26-60''
- Orchard design is 1:1, Nonpareil alternates with Monterey, Carmel, Aldrich
- Replicates: 4 Nonpareil, 3 Monterey, 2 Aldrich, 2 Carmel

Nonpareil

Pruned

Unpruned

Pruning treatments

- **Standard** - 3 primary limbs selected at 1st dormant, secondaries selected 2nd dormant. Balanced canopy wit opened centers. Yearly pruning.
- **Unpruned** - 3 primary limbs selected, tipped and left long at 1st dormant pruning, then no additional pruning unless required for operations, wind etc.
- **Mechanically Topped** - Same as unpruned plus machine topping, cut ½ previous yr growth in winter after 2nd year, then spring 4th leaf.
- **Temporary Scaffolds** –Train limbs at 1st dormant to favor 3 primary scaffolds. Keep temporary branches lower on trunk, removing only ones competing with permanent scaffold. Temp limbs removed yr 4-8 after cropping.

Average Yields of All Varieties

No statistical difference between treatments

Pruning Method	2000	2001	2002	2003	2004	2006	2007	2008	2009	2010	2011	Accumulative yield (yrs 3-15)
Standard	1,185	1,414	2,613	2,033	1,928	2,140	2,843	3,503	2,483	2,542	**2,439**	**29,270**
Temp Scaffolds	1,406	1,461	2,677	1,764	1,945	2,045	2,698	3,322	2,441	2,373	**2,583**	**25,825**
Mech Topped	1,060	1,366	2,660	2,244	1,890	2,060	2,788	3,374	2,423	2,409	**2,385**	**28,626**
Unpruned	1,374	1,422	2,801	2,260	2,042	2,009	2,698	3,427	2,445	2,379	**2,577**	**30,922**

Yields in this report are calculated from small lots. They do not include deduction from huller/cracker loss and assume solid orchards with no missing trees. Therefore, the numbers are approximately 5-10% higher than expected commercial block yields.

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