Almond Orchard and Culture Management

Project No.: **14-HORT3-Gradziel**

Project Leader: Tom Gradziel
Department of Plant Sciences
UC Davis
One Shields Ave.
Davis, CA 95616
530.752.1575
TMGRADZIEL@UCDAVIS.EDU

Project Cooperators: Franz Niederholzer, Farm Advisor, UCCE – Colusa County
David Doll, Farm Advisor, UCCE - Merced County
Brent A. Holtz, Farm Advisor, UCCE – San Joaquin County
Gurreet Brar, Farm Advisor, UCCE- Fresno & Madera Counties

Project Objectives:

Farm advisors conduct numerous projects addressing local issues in their counties. Many of these issues are addressed with small projects that may not require major support to conduct and complete the work. This project is designed to provide local support for county Farm Advisors' general extension research programs related to almond production.

Interpretive Summaries:

Project #1. Nematicide Trial in a First Leaf Orchard Infested with Plant Parasitic Nematodes

Project goals were to determine the impacts of three commercially available post-plant nematicides and one experimental product on populations of parasitic nematodes of almond roots. The plot is located on a sandy loam soil, previously cropped to alfalfa, with confirmed presence of ring nematode (*Mesocriconema xenoplax*). There were no observed differences in measured variables in the first year of this study for growth, nematode counts, and DSRs. We plan to continue this study for two more years to determine if there is any longer term benefit from these treatments.

Project #2. Navel Orangeworm Efficacy Trial

Project goals were to evaluate sequential treatments of Altacor® (Rynaxypyr), Cyazypyr (HGW86), Intrepid (methoxyfenozide), Intrepid + Delegate (spinetoram), Asana (Esfenvalerate), Proclaim (Emamectin benzoate), Athena (Bifenthrin + Abamectin), Gladiator (Zeta-cypermethrin + Abamectin), Brigade (Bifenthrin), Hero (Bifenthrin + Zeta-cypermethrin), Belt (Flubendiamide), and a DuPont experimental product in tank mixtures for control of Navel Orangeworm (NOW) at hull-split in Nonpareil almond. Vigilant (Bifenazate) was added to treatments that were not mixed with horticultural oil to suppress spider mite populations. The first harvest on August 6th, 21 days after the second hull split spray, was considered the commercial harvest. Third and Fourth hull split applications and second and third harvest were performed with the hope that NOW populations would increase and greater product efficacy would be observed. NOW populations did not increase but the data is presented.

Project #3. Can Early Spring Foliar N + K Sprays Increase Almond Yield in the Sacramento Valley?
Project goals were to determine if foliar N, K, and/or seaweed extract applications early in the season improve yield of young, vigorous almond trees in the Sacramento Valley. Results showed no measureable yield or nutritional benefit following spring applications of liquid seaweed concentrate (LSC), specialty N and LSC, specialty N and K foliar fertilizer and/or combinations of LSC with foliar N for the healthy, well-managed and productive almond trees used in the two years of this study.

Project #4. Managing Salinity Issues in Almonds – Year 1
The objective of this sampling study was to understand the variability in salt uptake among different almond cultivars and the accumulation of sodium and chloride within different tree parts. The results showed that in all three locations sampled, the leaf sodium (Na) concentration in Aldrich and Monterey trees was significantly higher than Nonpareil. The rootstock samples were generally similar in terms of sodium concentration, except one site (Cantua Creek). Leaf chloride concentrations were significantly higher in Monterey trees at Sanger site while in Kerman orchard, Aldrich had significantly higher leaf Chloride levels as compared to Nonpareil and Monterey.

1. Nematicide Trial in a First Leaf Orchard Infested with Plant Parasitic Nematodes

Project Leader: David Doll
Farm Advisor - UCCE Merced County
2145 Wardrobe Avenue
Merced, CA 95341-6445
209.385.7403
dadoll@ucdavis.edu

Project Personnel and Cooperators:
Andrew Ray and Matt Jones, Staff Research Associates, UCCE – Merced County

Objectives:

This experiment will determine the impacts of three commercially available post-plant nematicides and one experimental product on populations of parasitic nematodes of almond roots. The plot is located on a sandy loam soil, previously cropped to alfalfa, with confirmed presence of ring nematode (*Mesocriconema xenoplax*).

Methods and Materials:

The trial was established in a newly planted almond orchard with a double line drip irrigation system in March of 2014. Initial nematode sampling and trunk diameter measurements were taken prior to treatment. The orchard has alternating rows of ‘Nonpareil’ and ‘Independence’ almond varieties. Treatments included May/September foliar sprays with Movento® at 9 fl. oz./acre, a May/June application of a unregistered Bayer product at 6.84 fl. oz./acre, a May/September application of an unregistered Bayer Product at 6.84 fl. oz./acre, a May/June/September application of MeleCon® (Certis®) at 64 oz./acre, May/September application of MeleCon® at 64oz/ac, a May/June/September application of DiTerra (Valent®) at 80 oz./acre, and a control (**Table 1**). The plot includes four blocks, with one row randomly selected for each of the seven treatments in each block, totaling 28 rows. Two blocks were in the 'Nonpareil' and two blocks were in the 'Independence' rows. The unregistered Bayer® product, MeleCon® and DiTerra products were injected into the individual irrigation line at the riser using a Mazzei® injector.

Data collection included disease severity ratings (DSRs), nematode samples, and growth measurements. DSRs were taken in the summer of 2015 by rating each tree on a scale of 0-5, 0 meaning no symptoms of stunting from plant parasitic nematodes, 5 meaning the tree was dead from disease. Trunk diameters were measured in the late fall of 2014. Nematode samples were taken in October 2014 by sampling soil between the depths of 12"-18". Samples were submitted to a commercial laboratory for analysis.

Results and Discussion:

There were no observed differences in measured variables in the first year of this study for growth, ring nematode counts, and DSRs (**Figures 1, 2,** and **3**, respectively). We plan to continue this study for two more years to determine if there is any longer term benefit from these treatments.

Table 1. List of the 7 different treatments in the trial and the timing of their applications. The same application schedule will be followed for all three years of the experiment.

Product (Timing #)	Application Method	First Application	Second Application	Third Application
Movento®	Foliar	May	September	-
Bayer® (#1)	Injection	May	June	-
Bayer® (#2)	Injection	May	September	-
MeleCon® (#1)	Injection	May	June	September (.5)
MeleCon® (#2)	Injection	May	September	-
DiTerra®	Injection	May	June	September
Control	N/A	-	-	-

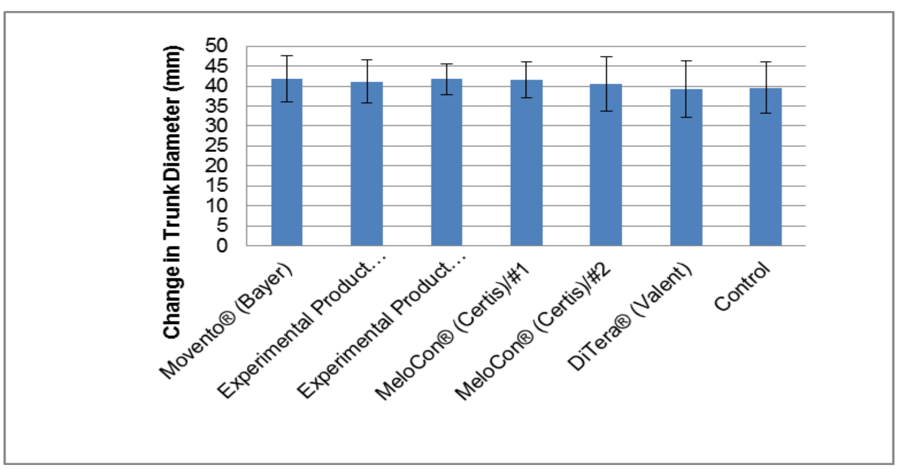

Figure 1. Average seasonal growth for each treatment. None of the differences shown are significantly different ($p<0.05$).

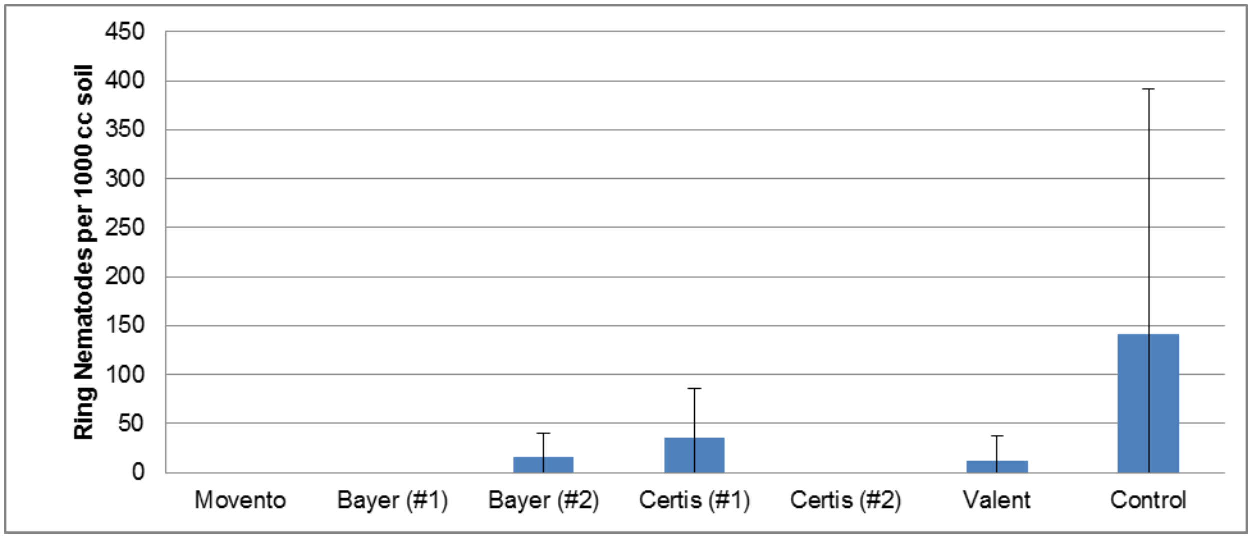

Figure 2. Average ring nematode counts from samples taken October 2014. None of the differences shown are significantly different (p<0.05).

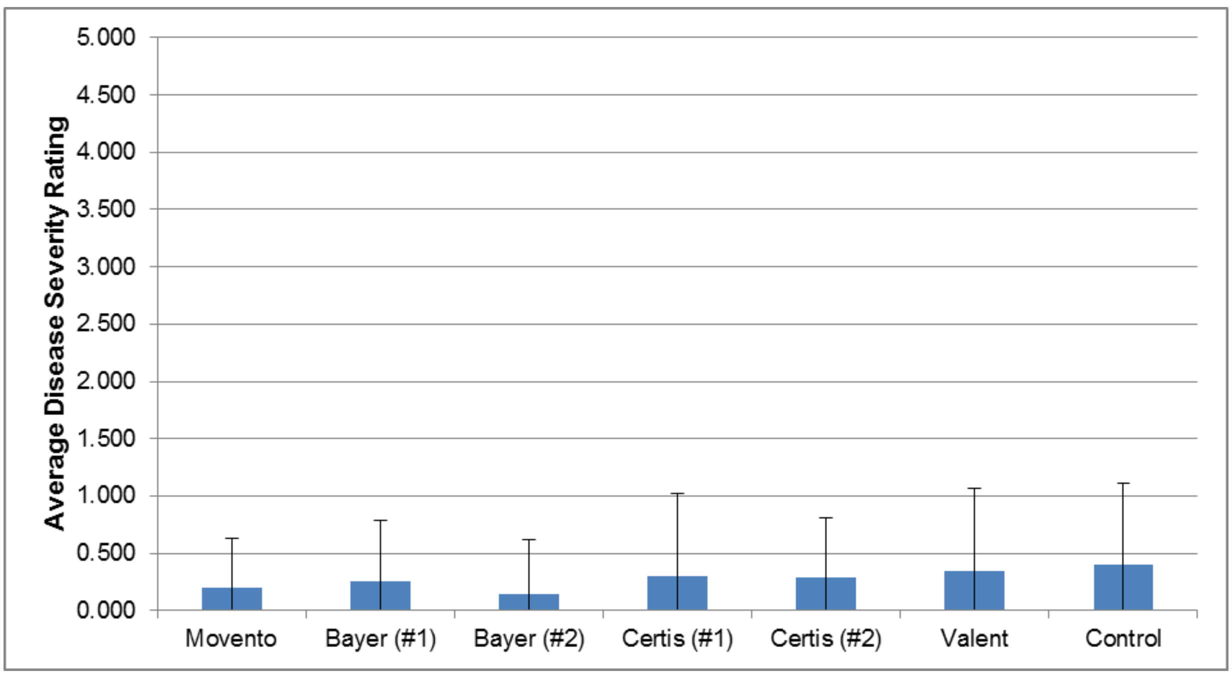

Figure 3. Average disease severity ratings observed in July 2015. None of the differences shown are significantly different (p<0.05).

2. <u>Navel Orangeworm Efficacy Trial</u>

Project Leader: Brent A. Holtz, Ph.D.
Farm Advisor and County Director
UCCE - San Joaquin County
2101 E. Earhart Ave., Ste. 200
Stockton, CA 95206
209.953.6124
baholtz@ucdavis.edu

Project Personnel and Cooperators:

Cheryl S. Gartner, UCCE – San Joaquin County
Stephen F. Colbert, Ph.D., DuPont Crop Protection, Escalon, CA
Alistair McKay, Ph.D., Dow AgroSciences LLC, Clovis, CA

Objectives:

To evaluate sequential treatments of Altacor® (Rynaxypyr), Cyazypyr (HGW86), Intrepid (methoxyfenozide), Intrepid + Delegate (spinetoram), Asana (Esfenvalerate), Proclaim (Emamectin benzoate), Athena (Bifenthrin + Abamectin), Gladiator (Zeta-cypermethrin + Abamectin), Brigade (Bifenthrin), Hero (Bifenthrin + Zeta-cypermethrin), Belt (Flubendiamide), and a DuPont experimental product in tank mixtures for control of Navel Orangeworm (NOW) at hull-split in Nonpareil almond. Vigilant (Bifenazate) was added to treatments that were not mixed with horticultural oil to suppress spider mite populations.

Methods and Materials:

Target Pests. Navel orangeworm (*Amyelois transitella*), Peach twig borer (*Anarsia lineatella*), and Web Spinning Mite (*Tetranychus pacificus*) populations were recorded if present.

Application timing and nut harvest. The first application was timed at approximately 1-5 % hull-split, on June 28th, followed-by a second application at approximately 60% hull split, on July 16th. Nuts were collected for the first harvest on August 6th, 21 days after the second application. A third application was made on August 6th after nuts were collected for the first harvest. Nuts were collected for the second harvest on August 27th, 21 days after the third application. A forth application was made on September 18th and nuts were collected for the third harvest 21 days later, on October 9th.

Target Pest Stage at Application. Eggs and early larval stages.

Application Methods. Treatments were applied by ground application equipment, 100 gallon spray tanks, 200 gallon per acre rate, at approximately 1.65 gallons per tree, 200 psi, hand-held spray gun. Approximately 1.5 gallons of water is in the spray hose and was considered in our calculations. Calculations were based on 7 trees per treatment, 1 tree was considered extra and one tree spray volume was determined to be contained in the hose. Nozzle orifice was 45.

Orchard. The experimental orchard at the Kearney Research and Extension Center contains Nonpareil, Butte, and Carmel almond varieties at 20 ft x 18 ft spacing, 121 trees per acre, 360 sq. ft per tree. Only the Nonpareil rows were treated (counting from north to south 2, 5, 8, 11, 14, 17, & 20). The Carmel (3, 6, 9, 12, 15, 18, & 21) and Butte (1, 4, 7, 10, 13, 16, & 19) rows were not treated.

Results and Discussion:

The first harvest on August 6th, 21 days after the second hull split spray, should be considered the commercial harvest. Third and Fourth hull split applications and second and third harvest were performed with the hope that NOW populations would increase and greater product efficacy would be observed. NOW populations did not increase but the data is presented.

2014 Navel Orangeworm Efficacy Trial

Treatments, Rates per acre, Application Timings[1, 2, 3, 4]	
1	DuPont Exp 100 g / hectare + Vigilant 24 fl oz
2	DuPont Exp 200 g / hectare + Vigilant 24 fl oz
3	DuPont Exp 300 g / hectare + Vigilant 24 fl oz
4	DuPont Exp 400 g / hectare + Vigilant 24 fl oz
5	Cyazypyr (HGW86) 20.5 fl oz + Vigilant 24 fl oz
6	Altacor® (Rynaxypyr) 4.0 oz/ac + Vigilant 24 fl oz
7	Intrepid 16.0 fl oz + Vigilant 24 fl oz
8	Asana 12.8 fl oz + Vigilant 24 fl oz
9	Intrepid/Delegate Mix 10.0 fl oz + Vigilant 24 fl oz
10	Intrepid/Delegate Mix 12.0 fl oz + Vigilant 24 fl oz
11	Proclaim + Dyne-Amic, 4.5 oz + 0.25%
12	Athena 19.2 fl oz + Hort oil 1 gal
13	Gladiator 19.0 fl oz + Hort oil 1 gal
14	Brigade WSB 18 oz + Hort oil 1 gal
15	Hero EW 11.3 fl oz + Hort oil 1 gal
16	Belt SC 4 fl oz + Hort oil 1 gal
17	Untreated Control
18	Untreated Control

1 The first application was made at approximately 1-5 % hull-split on June 28th.
2 The second application was made at approximately 60% hull split on July 16th.
3 The third application was made on August 6th after nuts were collected for the 1st harvest. The second harvest was performed on August 27th, 21 days after the third application.
4 The fourth application was made on September 18th, and nuts from the third harvest were collected 21 days later on October 9th.

2014 Navel Orangeworm Efficacy Trial
Nonpareil Variety- 1st Harvest, August 6th

2013 Treatments		% NOW[a]		Data Transformed[b]
16	Belt SC 4 fl oz + Hort oil 1 gal	0.0	0.0	a
11	Proclaim + Dyne-Amic, 4.5 oz + 0.25%	0.0	0.0	a
15	Hero EW 11.3 fl oz+ Hort oil 1 gal	0.0	0.0	a
13	Gladiator 19.0 fl oz + Hort oil 1 gal	0.0	0.0	a
7	Intrepid 16.0 fl oz + Vigilant	0.0	0.0	a
12	Athena 19.2 fl oz + Hort oil 1 gal	0.0	0.0	a
10	Intrepid/Delegate Mix 12.0 fl oz + Vigilant	0.1	0.0141539	ab
8	Asana 12.8 fl oz + Vigilant	0.1	0.0141539	ab
9	Intrepid/Delegate Mix 10.0 fl oz + Vigilant	0.1	0.0141539	ab
3	DuPont Exp 300 g / hectare + Vigilant	0.2	0.0283079	abc
6	Altacor® (Rynaxypyr) 4.0 oz/ac + Vigilant	0.2	0.0283079	abc
5	Cyazypyr (HGW86) 20.5 fl oz + Vigilant	0.2	0.0283079	abc
14	Brigade WSB 18 oz + Hort oil 1 gal	0.5	0.0425334	abc
2	DuPont Exp 200 g / hectare + Vigilant	0.5	0.0425334	abc
1	DuPont Exp 100 g / hectare + Vigilant	0.6	0.0483414	bc
4	DuPont Exp 400 g / hectare + Vigilant	0.7	0.0625668	c
18	Untreated	1.2	0.109214	d
17	Untreated	1.3	0.110534	d

[a] Treatments were applied to single tree replications and each treatment was replicated 5 times. Two hundred nuts were collected and cracked out from each replication, repeated 5 times per treatment. Percent worm damage of both hull and kernel were determined per 1,000 nuts. Data was transformed (ArcSin(sqrt(x)).

[b] For analysis by ANOVA with means separated by Fisher's Protected LSD ($\alpha = 0.05$) test. Means followed by the same letter are not significantly different. All treatments significantly reduced the percent NOW infestation when compared to our two untreated controls.

2014 Navel Orangeworm Efficacy Trial
Nonpareil Variety- 2nd Harvest, August 27th

2013 Treatments		% NOW[a]		Data Transformed[b]
8	Asana 12.8 fl oz + Vigilant	0.0	0.0	a
7	Intrepid 16.0 fl oz + Vigilant	0.0	0.0	a
14	Brigade WSB 18 oz + Hort oil 1 gal	0.0	0.0	a
3	DuPont Exp 300 g / hectare + Vigilant	0.0	0.0	a
15	Hero EW 11.3 fl oz+ Hort oil 1 gal	0.0	0.0	a
12	Athena 19.2 fl oz + Hort oil 1 gal	0.1	0.0141539	a
6	Altacor® (Rynaxypyr) 4.0 oz/ac + Vigilant	0.1	0.0141539	a
16	Belt SC 4 fl oz + Hort oil 1 gal	0.1	0.0141539	a
11	Proclaim + Dyne-Amic, 4.5 oz + 0.25%	0.1	0.0141539	a
10	Intrepid/Delegate Mix 12.0 fl oz + Vigilant	0.2	0.0200335	ab
4	DuPont Exp 400 g / hectare + Vigilant	0.2	0.0283079	abc
13	Gladiator 19.0 fl oz + Hort oil 1 gal	0.3	0.0341874	abc
9	Intrepid/Delegate Mix 10.0 fl oz + Vigilant	0.4	0.0387105	abc
5	Cyazypyr (HGW86) 20.5 fl oz + Vigilant	0.5	0.04459	abc
1	DuPont Exp 100 g / hectare + Vigilant	0.6	0.0670184	bcd
2	DuPont Exp 200 g / hectare + Vigilant	1.2	0.0769387	cd
17	Untreated	1.3	0.11238	d
18	Untreated	1.3	0.113737	d

[a] Treatments were applied to single tree replications and each treatment was replicated 5 times. Two hundred nuts were collected and cracked out from each replication, repeated 5 times per treatment. Percent worm damage of both hull and kernel were determined per 1,000 nuts. Data was transformed (ArcSin(sqrt(x))).

[b] For analysis by ANOVA with means separated by Fisher's Protected LSD (α = 0.05) test. Means followed by the same letter are not significantly different.

2014 Navel Orangeworm Efficacy Trial
Nonpareil Variety- 3rd Harvest, October 9th

2013 Treatments		% NOW[a]		Data Transformed[b]
15	Hero EW 11.3 fl oz+ Hort oil 1 gal	0.0	0.0	a
8	Asana 12.8 fl oz + Vigilant	0.1	0.0141539	ab
14	Brigade WSB 18 oz + Hort oil 1 gal	0.1	0.0141539	ab
16	Belt SC 4 fl oz + Hort oil 1 gal	0.1	0.0141539	ab
13	Gladiator 19.0 fl oz + Hort oil 1 gal	0.2	0.0200335	abc
7	Intrepid 16.0 fl oz + Vigilant	0.2	0.0283079	abc
12	Athena 19.2 fl oz + Hort oil 1 gal	0.2	0.0283079	abc
6	Altacor® (Rynaxypyr) 4.0 oz/ac + Vigilant	0.3	0.0341874	abcd
1	DuPont Exp 100 g / hectare + Vigilant	0.4	0.0387105	abcd
9	Intrepid/Delegate Mix 10.0 fl oz + Vigilant	0.4	0.0424618	abcd
10	Intrepid/Delegate Mix 12.0 fl oz + Vigilant	0.4	0.0483414	abcd
2	DuPont Exp 200 g / hectare + Vigilant	0.5	0.0548501	bcde
11	Proclaim + Dyne-Amic, 4.5 oz + 0.25%	0.5	0.0624953	bcdef
3	DuPont Exp 300 g / hectare + Vigilant	0.7	0.0728979	cdef
4	DuPont Exp 400 g / hectare + Vigilant	0.8	0.0859797	def
5	Cyazypyr (HGW86) 20.5 fl oz + Vigilant	1.0	0.103191	ef
17	Untreated	1.1	0.103334	ef
18	Untreated	1.3	0.113737	f

[a] Treatments were applied to single tree replications and each treatment was replicated 5 times. Two hundred nuts were collected and cracked out from each replication, repeated 5 times per treatment. Percent worm damage of both hull and kernel were determined per 1,000 nuts. Data was transformed (ArcSin(sqrt(x)).

[b] For analysis by ANOVA with means separated by Fisher's Protected LSD (α = 0.05) test. Means followed by the same letter are not significantly different.

3. Can Early Spring Foliar N + K Sprays Increase Almond Yield in the Sacramento Valley?

Project Leader: Franz Niederholzer
UCCE Farm Advisor, Colusa and Sutter/Yuba Co
P.O. Box 180
Colusa, CA 95932

142A Garden Hwy
Yuba City, CA 95991
530.218.2359
fjniederholzer@ucanr.edu

Project Personnel and Cooperators:

Stan Cutter, Nickels Soil Lab, Arbuckle, CA
Bruce Lampinen, UCCE Specialist, Davis, CA

Objectives:

Determine if foliar N, K, and/or seaweed extract applications early in the season (bloom, March, and April) improve yield of young, vigorous almond trees in the Sacramento Valley.

Materials and Methods:

This study was conducted in a commercial almond orchard located at the Nickels Soil Lab, about 5 miles southwest of Arbuckle in Colusa County, California. The trees are spaced 20' x 12'. The orchard, planted in 2008, is 33% Nonpareil, 33% Aldrich, and 33% Fritz varieties. The Aldrich and Fritz are planted on M2624 plum rootstock. The Nonpareil are planted on two rootstocks, Krymsk 86 (K86) or Padre interstem on M2624 plum, each alternating down the row. The orchard is irrigated by double line drip and weeds are controlled by herbicide applications in the tree rows and with weeds controlled by herbicides (pre- and post-emergent) and mowing in the centers.

The study began in 2013 to evaluate the potential for bloom and/or post-bloom spray treatments of liquid seaweed concentrate (LSC) with or without additional foliar nitrogen (N) and potassium (K) to improve yield of well maintained (nutrients, pests and water) almond trees. Additional treatments tested post-bloom foliar N, K, or N and K, without LSC.

This report covers the second year of this study, with the same treatments applied to the same trees in 2014 as 2013, with two small exceptions. In 2014, K was not applied with the LSC and the N source was changed from a 26-0-0 to 28-0-0 material, which, based on content and label differences, resulted in a 15% increase in N applied per spray.

A randomized complete block design experiment was established in February, 2013 in the Nonpareil on K86 trees with seven treatments (**Table 1**) with one replicate per block. Blocking was done by tree size, measured by trunk diameter at 12" above the graft union. There were no significant yield differences between treatments in 2013. There were differences in yield between the largest and the smallest trunk diameter blocks.

Orchard management met industry standards and production was excellent in 2013. All trees in the study were treated with moderate to high levels (225 lbs. N/acre) of nitrogen (fertigated UN32) in three applications in 2013. All trees received 200 lbs. K_2O/acre in fall, 2013 as a band of dry fertilizer on each side of the tree row and within the wetting zone of the double-line drip irrigation. All trees also received 2.5 lbs. Solubor (0.5 lbs. boron) and 2.5 lbs./acre 36% zinc sulfate in an October, 2013 foliar application. Nonpareil yield in this block was 2360 kernel lbs. per acre in 2013 – the sixth leaf.

In 2014 as in 2013, spray applications were evenly applied around the entire tree using a Stihl 420 motorized backpack sprayer applying spray volume equivalent to 100 gallons per acre. The amount of spray material to be applied to each tree was separately measured and applied to each tree to ensure that each tree received the same amount of material. Treatments and timings were as presented in **Table 1**. Foliar N applied equaled 7% of total annual N budget for treated trees.

In 2014, as in 2013, the study orchard was carefully managed to support the high yield per acre. Excellent strength bee hives (10-12 frames/hive) were rented and placed in the orchard ahead of bloom. Soil-applied N fertilization (UN32) began on March 23 (45 lbs. N/acre) and included two additional applications by mid-June for a total of 195 lb. N/acre. Fungicide and miticide/insecticide treatments were carefully timed to protect the crop and reject levels were below 1%. No leaf drop occurred prior to harvest. Nonpareil production in this block averaged

2643 kernel lbs. per acre with the majority of the crop produced by the Krymsk rooted trees – based on the observation of tree size and per tree yield during this study.

On July 18, 2014, mid-day PAR interception per tree was measured by Sam Metcalf from the Lampinen lab (Bruce Lampinen, UCCE Extension Specialist, UC Davis Plant Sciences Department) using the light bar/mule equipment developed by Bruce and others at UCD. On August 3, 50 leaves from non-bearing spurs on each tree were sampled, dried, weighed, and submitted to the UC Davis Plant Sciences Analytical lab for determination of N, P, K, Ca, Mg, S, Zn, Fe, Cu, Mn, Cl and Na.

Harvest was carefully conducted to measure per tree yield as closely as possible. At harvest, the shaker went through the block and dropped all the M2624 rooted crops. These nuts were immediately raked into a 3' wide band perpendicular to the tree rows and directly under the plum rooted trees. Later that day, the study trees were shaken and those nuts raked away from the nuts from the M2624 rooted trees. The two-stage shaking allowed as great a separation of individual tree nuts as possible, given the vigorous growth of these trees on a 12' down-the-row planting.

Nuts were allowed to dry and then raked into piles and hand-processed across a series of screens to remove trash and rocks. Total field weight was then measured and a 4 lb. subsample taken for later crack-out. These subsamples were stored in a freezer until crack-out, when all nuts in the 4 lb. sample were counted and 50 nuts randomly selected for kernel crack-out, oven drying and then weighing. From these measurements, a per tree kernel weight was determined. Tree production per percent light interception was calculated from per tree yield and PAR interception data. Percent light interception per tree ranged from 60-80%.

Statistical analysis was done using general linear model (GLM) with mean separation using Tukey HSD process (Statgraphics Centurion XVI, Statpoint Technologies, Warrenton, VA). Homogeneity of variance (Levene's Test) and normal distribution (Shapiro-Wilks) were determined for each analysis.

Results and Discussion:

No measureable yield or nutritional benefit was measured following spring applications of liquid seaweed concentrate (LSC), specialty N and LSC, specialty N and K foliar fertilizer and/or combinations of LSC with foliar N for the healthy, well-managed and productive almond trees used in the two years of this study.

Significant pattern of variation in yield across the blocks existed (**Figure 1**) again confirming the use of tree size based on trunk diameters in early, 2013 as the blocking factor in this experiment. Crop yield (kernel lbs./tree) differed significantly among blocks ($p=0.0004$), with trees in Blocks 1 significantly -- $p \leq 0.05$ -- more crop than those in Blocks 6&7.

There was no significant treatment difference ($p \leq 0.05$) in yield per tree, whether presented as in kernel yield per tree ($p=0.5521$) or kernel yield per tree per unit PAR interception ($p=0.9238$). Kernel yield per tree results are presented in **Table 2**.

Leaf samples revealed no significant treatment differences in N and K levels (**Table 2**). Of all the eleven other nutrients analyzed, only one – sodium -- showed any significant ($p \leq 0.05$) treatment differences. Leaves from untreated trees contained measurably less sodium than those from trees treated with 4x liquid seaweed concentrate plus additional N and K (**Table 2**). These differences have no obvious/apparent biological significance and are two orders of magnitude less than toxic levels (0.25% Na).

Table 1. Materials and timings for spring, 2014 study testing the yield impact of foliar application of nutritional materials on Nonpareil almond trees on Krymsk 86 rootstock. N source was 28-0-0 (liquid urea and triazole) and K source was 2-0-25 (urea and potassium acetate). LSC is a liquid seaweed concentrate (0.1-0-5).

Treatment/spray	Feb 5*	March 18**	Mar 13	April 9
Untreated control	Feb 21*	March 1**	Mar 15	April 19
7.8 lb. N & 4 lb. K_2O/a			X	X
7.5 lb. N/a			X	X
4 lb. K_2O/a			X	X
LSC (2 qt/a)	X	X	X	X
LSC (2 qt/a) + 7.5 lb. N/a	X	X	X	X
LSC (2 qt/a) + 7.5 lb. N/a			X	X

* Pink-bud
** Petal fall

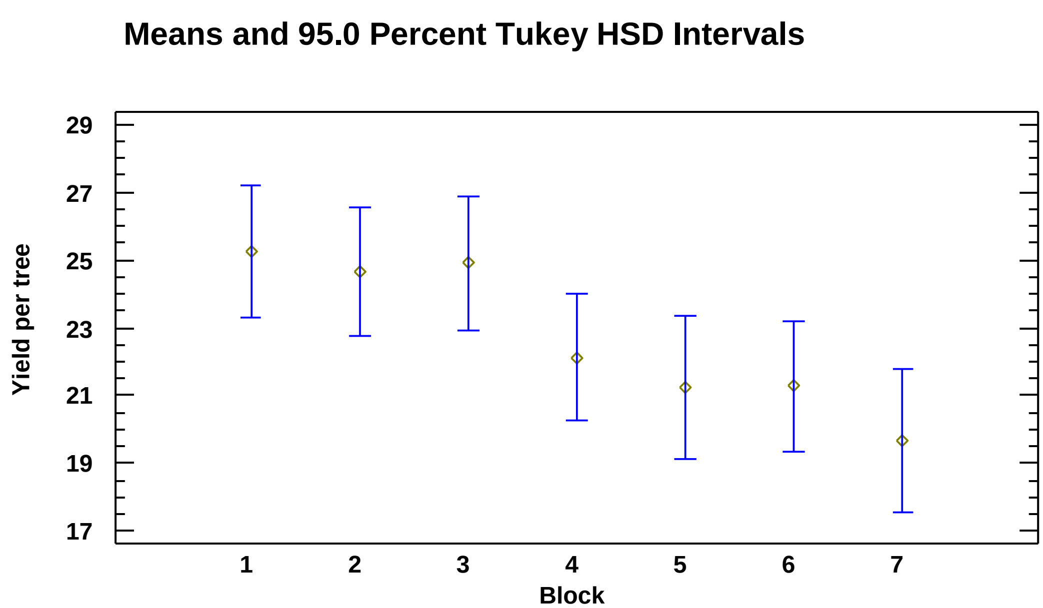

Figure 1. Mean block yield per tree (kernel lbs.) and 95% confidence intervals (Tukey HSD) for seven blocks in this experiment. Block 1 had the largest and Block 7 the smallest trunk diameters.

Table 2. Influence of spring foliar treatments (see **Table 1** for materials and timing) on Kernel pounds yield per tree as well as leaf N, K, and Na levels sampled on August 3, 2014. Data with the same letters are not significantly different from others in the same column at the 5% level (Tukeys HSD). Leaf N medians (means presented) are not significantly different (p=0.99).

Treatment	Kernel yield (lb./tree)	%Leaf N	%Leaf K	Leaf Na (ppm)
Control	23.9 a	2.50	2.17 a	47.7 a
7.8 lb. N & 4 lb. K_2O/a (2x)	22.1 a	2.53	2.20 a	55.8 ab
7.5 lb. N/a (2x)	23.2 a	2.51	2.34 a	54.0 ab
4 lb. K_2O/a (2x)	22.0 a	2.51	2.14 a	57.5 ab
LSC (2 qt/a) (4x)	22.2 a	2.49	2.11 a	57.4 ab
LSC (2 qt/a) (4x) + 7.5 lb. N & 4 lb. K_2O/a	22.2 a	2.49	2.09 a	55.1ab
LSC (2 qt/a) (2x) + 7.5 lb. N & 4 lb. K_2O/a	23.5 a	2.51	2.26 a	58.7 b

4. Managing Salinity Issues in Almonds – Year 1

Project Leader: Gurreet Brar.
Farm Advisor, UCCE – Fresno/Madera Counties
550 E. Shaw Ave., Suite 210
Fresno, CA 93702
559.241.7526
gurbrar@ucanr.edu

Project Personnel and Cooperators:
Bill Chandler, Almond Grower, Fresno County
Rod Yraceburu, Almond Grower, Fresno County

Objectives:

The objective of this sampling study in the first year was to understand the variability in salt uptake among different almond cultivars and the accumulation of sodium and chloride within different tree parts.

Methods and Materials:

Sampling Procedures:

- Three sites were selected in Fresno County, for tissue sampling. These were located near Sanger, Kerman & Cantua Creek (**Figure 1**).

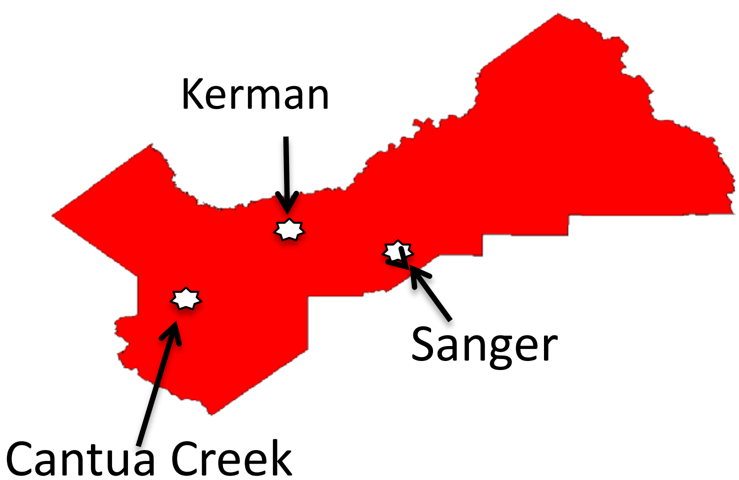

Figure 1. Location of the orchards used for this sampling study within Fresno County

- Soil types were Delhi loamy sand (Sanger), Hanford sandy loam (Kerman) & Ciervo Clay (Cantua Creek).
- Latest soil & water test reports were taken from growers' records.
- Three cultivars - Nonpareil, Aldrich (**Figure 2**) and Monterey were selected.
- All trees were on Nemaguard rootstock.
- Number of replicate trees in each cultivar was 3.
- At least 30 leaves were sampled randomly from each tree canopy for leaf tissue analysis.
- Trunk & rootstock tissues were sampled by drilling 1" deep holes. Outer bark shreds were discarded.
- Sufficient volumes of tissue were collected by drilling several holes on the side of the tree trunks.

Figure 2. Aldrich row at Sanger location.

Results and Discussion:

The results showed that in all three locations sampled, the leaf sodium (Na) concentration in Aldrich and Monterey trees was significantly higher than Nonpareil. The rootstock samples were generally similar in terms of sodium concentration, except one site (Cantua Creek). Leaf chloride concentrations were significantly higher in Monterey trees at Sanger site while in Kerman orchard, Aldrich had significantly higher leaf chloride levels as compared to Nonpareil and Monterey.

It was observed in all three locations that leaf sodium concentration in Aldrich and Monterey trees was significantly higher than Nonpareil (**Figure 3**). In terms of total sodium concentration, Kerman location was worst among all three sites. The site conditions in Kerman were: Hanford Sandy Loam, with silt substratum, a soil pH of about 7.5 and an EC less than 1.4. In this site soil samples taken from two areas (one with healthy looking and other with badly affected trees) were also analyzed. The saturation percentage of the soil was in the lower 20's indicating sandy soil. The irrigation water at this site has high pH (8.1) and contains high levels of sodium and chloride ions (2.7 and 1.1 meq/L, respectively).

The rootstock samples were generally similar in terms of sodium concentration, except Cantua Creek site. At this site, rootstock tissue in case of Nonpareil trees showed significantly higher accumulation of sodium below the graft union. This generates further interest as to how different scions vary regarding accumulation of salts below the graft union.

Leaf chloride concentrations were significantly higher in Monterey trees at Sanger site while in Kerman orchard, Aldrich had significantly higher leaf chloride levels as compared to Nonpareil and Monterey (**Figure 4**). Rootstock chloride levels were generally similar among all cultivars at all sites, with no significant differences.

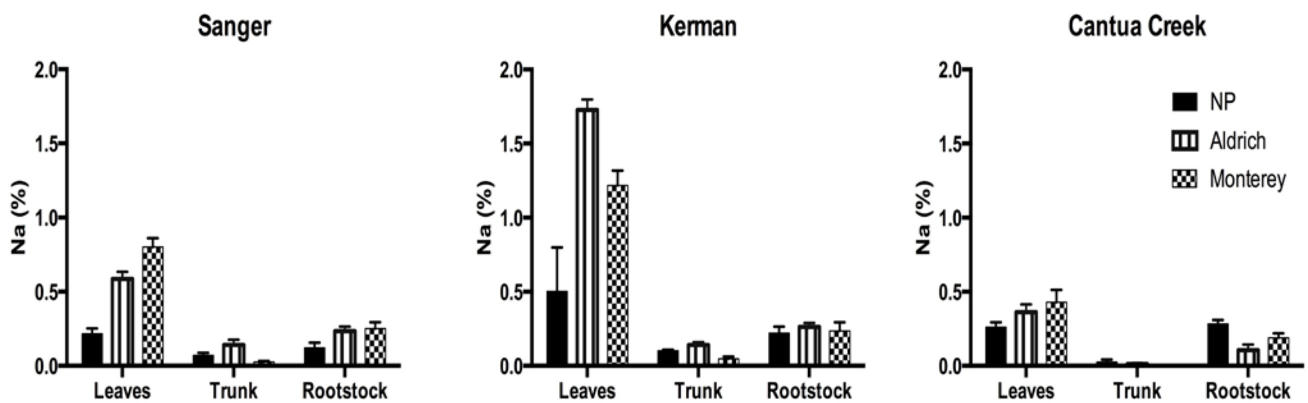

Figure 3: Concentration of sodium in different tree parts in three almond cultivars. n=3

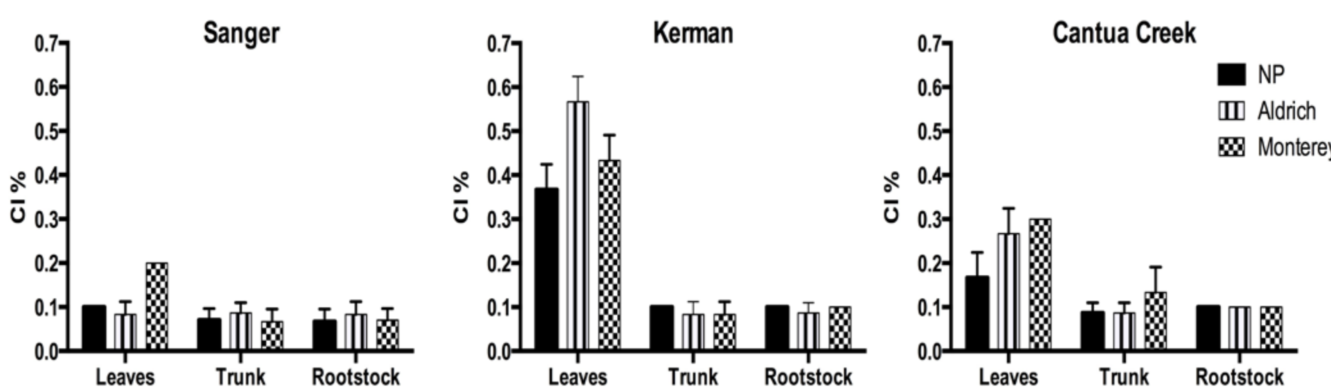

Figure 4. Concentration of chloride in different tree parts in three almond cultivars. n=3

Similar observations regarding varietal differences among different cultivars were also reported during 2014 by various UC Cooperative Extension Farm Advisors across the state.

The effect of salinity on the growth of almond trees is an important topic to be researched. However, there are many factors that could influence the uptake and accumulation of salts within the orchards, other than the rootstocks and scions, for example, cation exchange capacity of the soil, interaction with other cations present in the rootzone, pattern of exposure of the trees to salt conditions (continuous application of saline water & soil over a long period of time versus occasional irrigation with high salinity water). With these factors in mind, this study will be continued in the coming years with specific emphasis on studying the underlying causes & effects of salt stress and on developing strategies for amelioration of such stresses.