Almond Board of California
Almond Report
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Project No.: 96-BF5- Almond Culture and Orchard Management

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Objectives:

1. To compare two types of drip irrigation systems (above ground and buried) in a 9-year-old almond orchard and to determine the effects of irrigation strategies on nut removal and hull rot. Similar trials will be conducted in micro-sprinkler irrigated orchards.

2. To evalute training methods and to develop pruning systems to maintain the productivity of almonds in tightly spaced hedgerows.

3. To evaluate temporary tree removal in double planted orchards.

4. To determine if *Monilinia laxa* is developing fungicide resistance in Madera County or if disease outbreaks are due to inadequate fungicide coverage.

5. To evaluate effectiveness and any phytotoxicity of liquid lime sulfur with or without oil for spring disease control. To compare the effectiveness of Spinosad, a new biological pesticide, with other insecticides for peach twig borer control.

6. To determine the timing and number of zinc sprays to correct deficiency symptoms on vigorously growing almond trees.

7. To determine if potassium fertilizer may be more efficiently applied between trees within the tree row rather than between rows.

Procedures, Results and Discussion: See Attached

COMPARISON OF ALMOND NUT REMOVAL AND HULL ROT UNDER VARIOUS DRIP IRRIGATION MANAGEMENT

Wilbur Reil, Yolo/Solano Farm Advisor

OBJECTIVES

Farmers continue to strive to improve irrigation efficiency because of both the increasing cost of water and power and the availability of only limited amounts of water. Drip irrigation is increasingly becoming popular. This trial is designed to compare two types of drip irrigation systems (above ground and buried) in a uniform almond orchard. It is also designed to compare nut removal at harvest and hull rot in the different irrigation blocks.

PLANS AND PROCEDURES

Three irrigation systems were installed in a 6 year-old almond orchard on the Nonpareil rows (every other row)in 1992. The systems are (1) above ground drip of a single hose designed to apply 100% ET until first hull split then be reduced to 50% ET for one to four weeks; (2) buried drip with a hose buried on each side of the tree 5 feet from the tree row and 12 inches deep to apply the same amount of water as treatment 1; and (3) an above ground drip to apply the same water as 1 and 2 until early hull split, then apply twice the water or 100% ET of the other two systems.

Two additional experiments were established in two microsprinkler irrigated almond orchards. Both experiments were conducted on Nonpareil rows with one trial in a Lovell peach rootstock block and the second in a peach almond (Brights hybrid) block. The orchard age was 7 and 6 years respectively. The canopy was estimated at approximately 70% cover in the peach and 80% in the hybrid block. Both trials contained either the wet treatments where water was maintained at the current irrigation rates or the dry treatment where the rate was reduced to 50% rate approximately one week before anticipated hull split and maintained at this level for one month. Thus there was 2 treatments of 3 trees replicated 3 times.

RESULTS:

Data for 1992 was primarily to get the system up and running and to obtain preliminary hull rot data. While treatment 1 and 2 are applying the same amount of water the buried drip system has no surface moisture and no evaporation, therefore, more of the water is available to the tree than in treatment 1 and it is estimated at approximately 60 to 65% ET rather than 50%.

Table 1. Evaluation of Nonpareil nuts remaining on tree after shaking under three irrigation management systems. The same quantity of water was applied to trees until 1% hull split when different rates were then applied.

Type System:	Surface	Surface	Buried
Irrig. Rate:	100% ET	50%* ET	50%* ET
Year			
1996	391	89	91
1995	280	99	91
1994	312	63	44
1993	118	28	16
1992	683	282	205

*For at least 2 weeks at early hull split.

Table 2. Nonpareil Shoots killed by hull rot under three drip irrigation management systems at early hull split. The same quantity of water was applied to trees until 1% hull split when different rates were then applied.

Type System:	Surface	Surface	Buried
Irrig. Rate:	100% ET	50% ET	50% ET
Year			
1996	22.0	4.5	6.8
1995	12.7	5.2	2.3
1994	8.2	1.7	0.9
1993	3.6	0.5	0.5
1992	12.2	0	1.8

Table 3. Micro-irrigation Trial on Nonpareil Almonds

Irrigation	Peach Rootstock	Peach/Almond Rootstock
Wet	1239	570
Dry	1284	352

Table 4. Micro-irrigation Trial on Nonpareil Almonds

Irrigation	Peach Rootstock	Peach/Almond Rootstock
Wet	11.4	4.57*
Dry	11.4	1.90

*Significant @ .05

Table 3 and 4 show the results obtained from the first year of the trials under micro-irrigation. The trees on peach rootstock did not respond to the treatment the same as the drip and the peach almond only gave marginal response. Hull split on the peach rootstock trees occurred about one week after the water differentiation treatment approximately two weeks earlier than on the peach almond rootstock. Moisture measurements on the trees (pressure bomb tests) conduced at peach almond early hull split showed no differences in tree moisture on peach but a slight difference on the peach almond.

After further analysis it was felt that there probably was no stress in the peach root trees and indeed the nuts remaining and hull rot showed no differences. There was probably some stress on the peach almond although readings indicated only a slight amount of stress occurred. Next year closer attention needs to occur on irrigation quantity being applied so that a definite stress will occur in both trials.

CONCLUSIONS:

Table 1 and 2 suggest reduced moisture in the tree during the hull split period may reduce the incidence of hull rot and improve nut removal at harvest. Both the above ground drip that had the water reduced to 50% ET at early hull split and the buried drip that also had the amount of water reduced in half had less nuts remaining on the tree after shaking than the trees maintained at 100% ET. Trees under adequate or luxurious moisture status such as the 100% ET during hull split had a higher amount of hull rot in all years. The surface was wet approximately the same length of time as the 50% ET treatment. The humidity in the tree canopy was low in all systems suggesting that humidity may not affect hull rot whereas the moisture status within the tree itself may be the cause.

The higher number of nuts left on the tree after shaking in the system receiving 100% ET throughout hull split also suggests that nut abscission may be enhanced by some stress during the maturation process. Some moisture is needed to stimulate hull split but perhaps intermediate or approximately 50% ET may provide sufficient moisture for proper hull split while enhancing nut removal.

SUSTAINING YIELDS IN HEDGEROW ALMONDS
J.P. Edstrom, W.C. Micke, J. Yeager

Methods: In 1979, a Nonpareil - Price (1:1) block was planted 7' x 22' (270 trees/acre) at the Nickels Soil Laboratory in Arbuckle. The following four treatments were used to evaluate pruning strategies capable of sustaining production in tightly spaced hedgerows.

1) **Temporary Hedge** - standard pruning for permanent trees, with temporary trees gradually whisked back and then removed after their 8th year (1986-87), leaving a 14' x 22' spacing.
2) **Permanent Hedge** - trained to three scaffolds, standard pruned and maintained at 7' x 22'.
3) **Two Scaffold Hedge** - a 7' x 22' hedge trained with two primary limbs growing out into the row middles and standard pruned.
4) **Unpruned Hedge** - a 7' x 22' hedge trained to three scaffolds and then essentially unpruned since.

Results: Long term yield figures continue to be taken from this tightly spaced Nonpareil - Price hedgerow.

Production figures for 1996 show a dramatic improvement over last years low yields. All comparisons produced over 2,000 lbs./Ac with the three permanent hedge treatments statistically equal at 2,624 - 2,963 lbs./Ac.

Again in 1996 the temporary hedge yielded far less (600 - 900) lbs./Ac) then all three permanent hedges. (Table I)

TABLE I.

	YIELDS LBS/AC
2Scaffold	2,968
Unpruned	2,833
Permanent	2,624
Temporary	2,076

Ten years time has passed since the alternate trees were whicked back and then removed completely in the winter of 1986. Over 6,000 lbs. Of accumulated yield has been lost overall when compared to the three permanent hedge treatments.

TABLE II. Yields by Hedgerow System for 1987 - 96

Kernel Pounds per Acre
Leaf/Year

Treatment	9th 1987	10th 1988	11th 1989	12th 1990	13th 1991	14th 1992	15th 1993	16th 1994	17th 1995	18th 1996	Accum.[1] 1984-96
2 Scaffold	2720	1498	2746	3470	2992	2079	1943	2835	1598	2968	29,088
Unpruned	2474	1626	2870	3072	3036	2471	1804	2799	1215	2833	28,137
Permanent	2149	1932	2680	3333	2254	2268	1189	2678	1297	2624	27,048
Temporary	1472	1308	2046	2450	2576	1739	1280	2448	1079	2076	22,361

1. Accumulative Yields Since Production began in 1984.

Regrowth of the permanent trees has filled in the 14' x 22' spacing but productivity has not returned to the high levels attained by the 7' x 22' hedge treatments. It appears unlikely that this thinned hedge will ever regain comparable productivity.

Accumulative yields for the Temporary Hedge through the 18th leaf lag approximately 6,000 pounds behind the other three treatments. The continued low yield from the Temporary Hedge treatment suggests that alternate tree removal may be a questionable practice, even in tightly spaced hedgerow almonds. However, the peculiarities of this test site should be considered when interpreting these yield figures. This two cultivar planting (Nonpareil and Price) has developed on Class II/III gravelly loam soils under a single hose drip irrigation system. These limitations have resulted in a restricted root zone and have possibly reduced or delayed the growth of permanent trees into their expanded space (from 7' spacing to 14' spacing). Additionally, the adjacent tightly spaced pollenizer rows created heavily shaded conditions, further inhibiting fruitwood regrowth on the 14' x 22' spaced Nonpareil plots. Given more favorable "regrowth" conditions, this hedge removal treatment may have regained high productivity and proven, over time, to be an economically viable system. Certainly under our conditions with nearly 6,000 lbs. in accumulated lost production, this is not an advisable hedge management strategy.

Close spaced almond hedgerows appear to be quite forgiving with respect to pruning/training methods. Accumulative yields show no difference between trees pruned to Two-Scaffold, Permanent (3-scaffold) or left Unpruned (after scaffolds established).

We know of no other experimental data that shows unpruned almonds to produce yields equal to standard pruned trees over this length of time (18 years).

However, the sustained productivity in this test of the Unpruned Hedge merits consideration when planning a pruning strategy for almond hedgerows. Our savings, in pruning costs over the span of the trial were considerable.

Cropping continues to move progressively into the tops of this heavily shaded orchard, particularly in the unpruned trees. Although no counts were made it appeared that the hulls on unpruned trees were greener at harvest than those on pruned trees and that more mummies remained after harvest in the unpruned trees.

As seen in Table III, kernel sizes were similar for all four comparisons, while the number of nuts per tree is equal for the three permanent hedge treatments and only 50% higher for the larger trees in the temporary hedge. Given equal sized kernels a doubling of kernel number per tree will be needed for the wider spaced trees to equal the yield of the permanent hedge.

TABLE III.

	KERNEL WTS - GMS	TREES/AC	NUTS PER TREE
2 Scaffold	1.23	270	4,437
Unpruned	1.21	270	4,316
Permanent	1.19	270	4,060
Temporary	1.23	135	6,236

Removing Temporary Trees in Double Planted Orchards
Joseph H. Connell, Warren Micke, and Jim Yeager.

Problem and Objectives:

When a double planted orchard crowds, extra trees are commonly thinned and then removed. Reasons given for tree removal include: improved light penetration, fruitwood renewal, and maintaining the orchard's future productivity. The objective of this trial is to evaluate temporary tree removal by comparing two treatments:

1. Maintaining a hedgerow indefinitely with standard pruning.
2. Removal of temporary trees after whisking back by gradual pole saw thinning or large chain saw cuts.

Methods:

For seven years, 1989 through 1995, we attempted to minimize crop loss following temporary tree removal by gradually cutting back the temporary trees. We managed sunlight so that the temporary trees didn't inhibit the growth of the permanent trees. Wood in the lower canopy of the temporary trees that didn't affect the permanent trees was kept. The upper canopy of temporary trees was thinned out to allow the permanent trees to spread and overgrow the temporaries. The permanent trees expanded to fill the orchard space as temporary trees were gradually thinned.

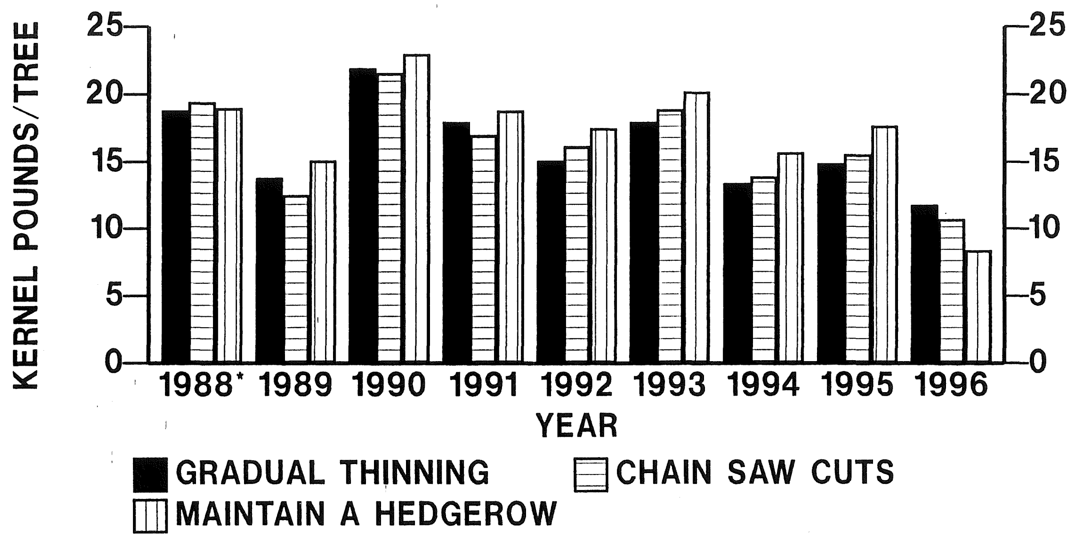
The temporary trees were removed following the 1995 harvest. Yield data collected in 1996 and in the future will document if and when plots with trees removed will catch up to or exceed the yields of the crowded plots where the hedgerow is maintained indefinitely. The effect of tree removal on remaining tree size will also be assessed.

Results:

During each of the seven years, there were no statistically significant crop reductions from cutting back the temporary trees suggesting an appropriate rate of tree removal. However, in real terms, the <u>accumulated</u> seven year yield reduction due to gradual pole saw tree thinning amounted to 1805 kernel pounds of Buttes per acre and 707 kernel pounds per acre of Missions. Chain saw whisking reduced Butte yields by 1702 kernel pounds per acre and Mission yields by 1590 kernel pounds per acre over the seven years. Although thinning out of the temporary trees was done very gradually, the accumulated yield reductions were substantial.

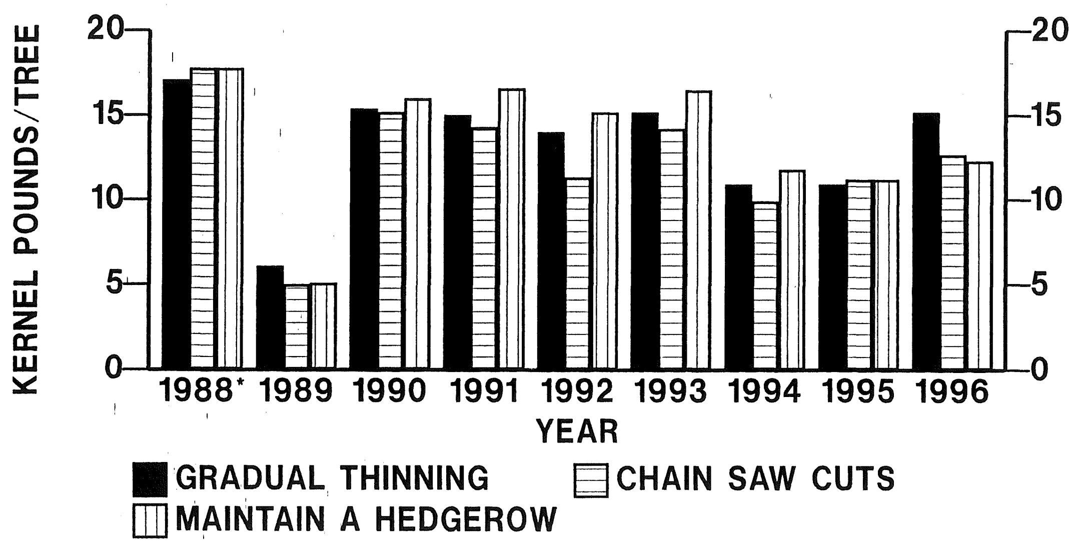
A yield summary of both the Butte and Mission varieties is shown in figures 1 and 2 respectively. The permanent trees grew larger and filled more space as the temporary trees were gradually thinned or chain saw whisked. The 1996 yield was highest on a per-tree-basis in both treatments where temporary trees were cut back and then removed in 1995 because the remaining trees were larger. This increase in yield per tree was not

FIGURE 1. YIELD SUMMARY, BUTTE ALMOND.
TREE REMOVAL TRIAL



*1988 pre-treatment yields, trees removed in Fall 1995.

FIGURE 2. YIELD SUMMARY, MISSION ALMOND.
TREE REMOVAL TRIAL



*1988 pre-treatment yields, trees removed in Fall 1995.

sufficient to make up for the fact that there were only half as many trees left in these treatments compared to the treatment where all trees were kept and the hedgerow was maintained. For both varieties, per acre yields are highest where we continue to maintain the double-planted hedgerow.

We had hoped that 1996 yields would not be seriously reduced by the 1995 tree removal since the temporary trees had already been cut back for seven years. This was not the case. Average yields for the three treatments expressed in kernel pounds are shown in the following table:

1996 Yield per acre* following the 1995 post-harvest removal of temporary trees in the gradually thinned and chain saw whisked treatments.

Treatment:	Butte	% of #1	Mission	% of #1
1. hedgerow maintained	1182	100	1734	100
2. gradually thinned	831	70	1068	62
3. chain saw whisked	755	64	890	51

*per-acre yields are calculated on a 140 tree/acre basis where the hedgerow is maintained and on a 70 tree/acre basis for the other two treatments.

Yield reductions in the year following removal of half of the trees ranged from 30 percent to nearly 50 percent in the gradually thinned and chain saw whisked treatments, respectively. Reductions were greater in treatments applied to the Mission variety compared to the results when the treatments were applied to Buttes.

Conclusions:

Currently, under the conditions in this trial, "temporary" tree removal has not yet provided any benefits in this hedgerow orchard even when done very gradually. Tree removal resulted in a substantial reduction in the amount of kernel pounds produced per acre both during the years that trees were cut back and following the tree removal. Whether these losses can be made up over the remaining life of the orchard remains to be seen as this trial progresses.

So far, it appears that double planting is appropriate when early returns are absolutely necessary to develop an orchard. Once done, it appears that the trees should be kept for the life of the orchard. Ultimately, we expect to determine conclusively if "temporary" tree removal should be considered once an orchard has been double planted.

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EVALUATION OF FUNGICIDE RESISTANCE AND SPRAY COVERAGE

Brent A. Holtz, U.C. Farm Advisor in Madera County

Objective:

To determine if *Monilinia laxa* is developing fungicide resistance in Madera County or if disease outbreaks are due to inadequate fungicide coverage.

Procedures

Fungicide spray coverage for the control of brown rot blossom blight, caused by *Monilinia laxa*, was evaluated on the susceptible NePlus almond variety at the S & J Ranch in Madera County. Brown rot sprays included a pink bud spray of Rovral (50W, 1.0 lb/acre) and oil (Omni Supreme 1%) and a full bloom spray of Benlate (SP 1.5 lb/acre) and Ziram (76W, 8 lb/acre). The treatments included ground sprayed (100 gal/acre), air sprayed (20 gal/acre), and unsprayed trees. Percent blossom blight was recorded in late February/early March by determining the percentage of blighted blosoms per 200 flowers counted per tree. Isolates of *Monilinia laxa* were obtained from blighted blossoms from by transfering condia from sporodochia to acidified potato dextrose agar (APDA).

Results and Discussion:

In the non-sprayed plot 62.8 % of the blossoms were blighted compared to 41.1 % in the ground sprayed and 44.7 % in the air sprayed plots. There was significantly more blossom blight in the non-sprayed plots when compared to the ground and air sprayed plots. There was not a significant difference between the ground and air sprayed treatments, though the air sprayed trees had more disease. In 1995, the non-sprayed plots had 7.8 % blossom blight compared to 3.2 % in the ground sprayed and 2.1 % in the air sprayed. The increase in blossom blight this year was most likely due to more precipitation during the NePlus bloom and additional blossom blight caused by *Botrytis cinerea*.

Forty-three isolates of *Monilinia laxa* were obtained from blighted blossoms from orchards traditionally sprayed with Benlate and from locations within these orchard which were not sprayed, such as under power lines. These isolates were tested for resistance to benomyl by comparing radial growth on fungicide-amended and non-amended potato-dextrose agar (PDA). Only 50 % of the isolates obtained from "non-sprayed" locations grew on PDA amended with 1 μg benomyl. In contrast, 92 % of the isolated obtained from "sprayed" locations grew, at least marginally, on PDA amended with 1 μg benomyl. Of the "non-sprayed" isolates which did survive on benomyl amended media, their growth was significantly less (23.25 ± 14.7 mm) when compared to isolates from traditionally sprayed locations (36.75 ± 12.62). These results suggest that benomyl resistance is developing among *Monilinia laxa* populations found in orchards at the S&J Ranch traditionally sprayed with Benlate.

LIQUID LIME-SULFUR TREATMENTS IN ALMOND-1996

Principal Investigators:
Lonnie C. Hendricks, Farm Advisor, Merced County
Everett Younce, Lab and Field Technician, Merced County
Cooperators:
Faith H. Potter, Product Development, Best Sulfur Products
Ray Eck, Hilmar, CA
Walt Bentley, Area IPM Advisor, Kearney Ag Research Center
Beth Teviotdale, Ext. Plant Pathologist, Kearney Ag Research Center

Situation:
Little has been known about possible phytotoxicity on almond from dormant sprays combining oil with liquid lime-sulfur (calcium polysulfide 29.0%) (LLS), or following oil with LLS at a close interval in time, such as 7-14 days. This field experiment was conducted to determine whether phytotoxicity with liquid lime-sulfur is a problem in almond.

Procedures:
Several applications of LLS and Omni oil were made to test possible phytotoxicity and to measure San Jose scale and European red mite egg survival. Scab infections were also to be rated if they occurred. Old Nonpareil and Carmel almonds at Morimoto Farms on Schaffer Road in Atwater were sprayed with several LLS treatments in January and February 1996. Applications were made by high pressure sprayer at 300-400 gpa to five trees per variety in a randomized complete block. The following treatments were applied:

TREATMENT	RATE/100 GAL	APPLICATION DATES
LLS (calcium polysulfide 29.0%)	4 gal/100 gal @ 3.5 gal/tree	1/27/96,2/8/96*
DORMANT OIL (Omni Oil)	2 gal/100 gal	1/27/96
LLS + OIL	4 gal + 2 gal/100	1/27/96
OIL DORMANT + LLS Later	2 gal + 4 gal/100	OIL-1/27 + LLS-2/9/96
CHECK	none	none

*LLS mistakenly re-applied 2/8/96.

Results:
All reps of both varieties were inspected on March 4th and 13th for bud damage, flower damage, leaf burn, and twig killing. No damage was found in any treatment or check.. Buds were normal in all treatments. Leaf tips were inspected as they emerged, and no leaf tip burn was detected. Flowers opened and bloomed normally in all treatments. On 3/13/96 the initial nut set appeared normal and equal in all treatments. No evidence of twig killing or other phytotoxicity has been detected through the spring and summer. Overall tree appearance is equal in all treatments. No scab, mite eggs, or scale were found in this orchard in 1996.

Conclusions:

No phytotoxicity could be detected in this experiment. This was true for straight LLS applications (applied twice), for oil applications followed by LLS, and even for a combination of oil and LLS. Phytotoxicity from LLS, even when applied close to an oil application, appears unlikely. These applications were made as a dilute application at 300 to 400 gallons per acre. Concentrate applications of 100 gpa or less may give different results.

LIQUID LIME-SULFUR TREATMENTS FOR SPRING DISEASE CONTROL IN ORGANICALLY GROWN ALMONDS

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Everett Younce, Lab and Field Technician, Merced County

Cooperators:

Faith H. Potter, Product Development, Best Sulfur Products
Ray Eck, Hilmar, CA

The Situation:

Growers of organic almonds have almost no tools for disease control. The primary bloomtime diseases are brown rot, shot hole, jacket rot, and scab. Liquid lime-sulfur (calcium polysulfide 29.0%) (LLS) at low rates during and soon after bloom may give some control of these diseases. Some control of scale and spider mite eggs may also be possible with LLS. Little is known about possible phytotoxicity from LLS when used repeatedly during bloom. This field experiment tested LLS for disease control and phytotoxicity in an organically managed almond orchard.

Procedures:

Carmel trees in an orchard of mature Nonpareil and Carmel almonds at Ray Eck's orchard on Williams Ave in Hilmar, CA were sprayed with two rates of LLS at several timings during and after bloom. The following treatments were made:

<u>BLOOMTIME APPLICATIONS:</u>

COLOR	RATE	DATES	BLOOM STAGE
ORANGE	1.5 g/100=1.5 qt in	2/15	POPCORN
	25 gal @ 3 gal	2/22	FB-10% PF
	per tree	3/7	PF
		3/19	PF+2WKS
YELLOW	0.9 g/100g	2/15	POPCORN
	1.0 g/100g	2/22	FB-10% PF
	1.0 g/100g	3/7	PF
	1.0 g/100g	3/19	PF+2WKS
WHITE	CHECK	-	-

Observations on March 7, 1996 at petal fall indicates that flowers are normal on all sprayed and unsprayed trees. There is no indication of any flower or leaf damage from LLS. Some shot hole was beginning to show on March 7, but no brown rot was evident yet. Tree appearance and condition of bloom was equal in the sprayed and unsprayed trees.

On March 19, PF plus 2 weeks, there was very little brown rot showing, and some shothole was developing but it was minor at that date.

LIQUID LIME-SULFUR EXPERIMENT RATINGS 4/9/96

TREATMENT	NUTS/100 SPURS	SHOT HOLED LEAVES/25 lvs	SHOT HOLE* VISUAL RANK	BROWN ROT STRIKES/TREE
WHITE 1	46	12	3	1
WHITE 2	28	17	2.5	0
WHITE 3	26	16	2.5	0
WHITE 4	8	23	4	0
WHITE 5	13(REPLANT)	21	3	0
TOTAL	121	89	15	1
AVG.	**24**	**18**	**3**	**0**
YELLOW 1	30	15	3	0
YELLOW 2	22	8	3	0
YELLOW 3	16	18	3	0
YELLOW 4	17	13	3	0
YELLOW 5	16	17	3	0
TOTAL	101	71	15	0
AVG.	**20**	**14**	**3**	**0**
ORANGE 1	20	11	2.5	0
ORANGE 2	43	10	2	0
ORANGE 3	61	17	3	0
ORANGE 4	29	12	3	0
ORANGE 5	18	18	3	0
TOTAL	171	68	13.5	0
AVG.	**34 ns**	**14 ns**	**2.7**	**0**

* 0=no shot hole, 2=moderate, 3=severe, 5=defoliation

Rating Summary

TREATMENT	NUTS/100 SPURS	SHOT HOLED LEAVES/25 lvs	SHOT HOLE VISUAL RANK*	BROWN ROT STRIKES/TREE
Check	**24**	**18**	**3**	**0**
1 gal / 100 gal	**20**	**14**	**3**	**0**
1.5 gal / 100 gal	**34 ns**	**14 ns**	**2.7**	**0**

* 0 = no shot hole, 2 = moderate, 3 = severe, 5 = defoliation

Conclusions:

No phytotoxicity was seen from four bloomtime sprays of liquid lime-sulfur at 1 gallon or 1.5 gallons per 100 gallons of water at a 300 gallon per acre rate. Almost no brown rot was seen in even the unsprayed trees. Shot hole was severe in sprayed as well as unsprayed trees, and there is no difference between treatments.

Nut set per 100 fruiting spurs showed no statistical difference between treatments, because there was too much variability between reps. But there seemed to be a trend toward better set of nuts, possibly as a result of treatment with the 1.5 gallon LLS per 100 gallons treatment. This may warrant checking again next year with more reps. No disease was evident in the check treatment to indicate why the treatment might have higher set.

EVALUATING SPINOSAD FOR PTB CONTROL IN ALMOND

Principal Investigators:
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Everett Younce, Lab and Field Technician, Merced County

Cooperators:
Arnold Farms, Atwater, CA
Barat Bisabri, DowElanco
Peter Yu, DowElanco
Craig Plunkett, Abbott Labs

Introduction:

The peach twig borer, *Anarsia lineatella* is a major pest of almonds in California and can be an especially severe pest in Merced County. The PTB is usually controlled by dormant sprays of oil plus insecticide or with a bloomtime spray of *Bacillus thuringiensis* (Bt). The use of dormant sprays are being questioned because OP insecticides are being found in local rivers. These contaminants are probably resulting from dormant OP applications to orchards. Some other pesticides used in the dormant applications may cause summer mite population increases. SPINOSAD (DowElanco), is the common name for a product derived from the fungus *Saccharopolyspora spinosa.* Spinosad appears to be control a number of insect pests while having low toxicity to beneficials.

Procedures:

Second leaf (planted '95) Nonpareil and Fritz almond trees at Arnold Farms in Atwater, California were used to evaluate peach twig borer control with SPINOSAD (DowElanco), Dipel (Abbott), Lorsban (DowElanco) plus dormant spray oil, and dormant oil alone. Each treatment was applied to 15 trees in Nonpareil and Fritz varieties in a randomized complete block design. Applications were made with a high pressure sprayer at approximately 1.5 qt. per tree. Total trees are 120 (15 Reps X 8 Treatments). Treatments were applied at the following timings:

INSECTICIDE	RATE/100 GAL	TIMING	RATE/10 GAL	COLOR CODE
DORMANT OIL PLUS LORSBAN	1 GAL 1 PT	DORMANT 1/27/96	0.1 GAL = 13 OZ 0.1 PT = 1.6 OZ	RED+BLACK
DIPEL 2X	1 LB	2/22 FB, PF	0.1 LB	PINK
DIPEL ES	1 PT	2/22 FB, PF	1.6 OZ	P+BLK(SO END)
SPINOSAD	3/4 OZ + Kinetic	DORMANT 1/27	21 ml OF MIX* 10 ml	BLUE
SPINOSAD	1 1/2 OZ + Kinetic	DORMANT 1/27	42 ml 10 ml	RED
SPINOSAD	3/4 OZ + OIL	DORMANT 1/27	21 ml + 13 OZ	YELLOW+BLK
SPINOSAD	1 1/2 OZ + OIL	DORMANT 1/27	42 ml + 13 OZ	ORANGE
DORMANT OIL	1 GAL	DORMANT 1/27	0.1 GAL = 13 OZ	BLACK
CHECK	-	-	-	WHITE
CHECK	-	-	-	YELLOW

*Diluted mixture: used 21 ml/10 gal for low rate(3/4 oz) and 42 ml/10 gal for higher rate(1.5 oz).

Results:

Evaluation of the treatments was done by counting the number of peach twig borer, *Anarsia lineatella* strikes per tree. This count was conducted on April 4, 1996 by Barat Bisabri, Lonnie Hendricks and Everett Younce.

Evaluation of treatments on April 4, 1996. PTB strikes per tree.

INSECTICIDE		Fritz									Nonpareil						Avg.
OIL/LORSBAN 1 gal+1pt	R/BLK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPEL 2X 1 lb.	PINK	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0.07
DIPEL ES 1 pt	P/BLK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPINOSAD .75 oz+Kinetic	BLUE	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0.07
SPINOSAD 1.5 oz+Kinetic	RED	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.13
SPINOSAD .75 oz+Oil	Y/BLK	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0.07
SPINOSAD 1.5 oz+Oil	ORANGE	X	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0.14
DORMANT OIL 1 gal	BLK	0	0	0	0	0	0	3	0	0	3	5	0	0	0	0	0.73
CHECK	WHITE	1	0	0	0	2	0	0	0	0	5	3	2	0	0	0	0.87
CHECK	YELLOW	0	0	2	0	0	0	0	0	0	1	3	0	0	0	0	0.40

Treatment	**Strikes per 15 trees**
Oil+Lorsban	0 B
Dipel 2X	1 B
Dipel ES	0 B
Spinosad 0.75 oz	1 B
Spinosad 1.5 oz	2 B
Spinosad 0.75 oz + oil	1 B
Spinosad 1.5 oz + oil	2 B
Dormant oil	11 A
Check #1	13 A
Check #2	7 AB

Conclusions:

The peach twig borer population was very low in this orchard, even though no dormant spray was applied. The dormant oil alone, and one check had statistically higher numbers of twig borer strikes per tree. The second check had numerically high numbers, but did not break out statistically higher than the treatments. Spinosad at either the 0.75 oz or 1.5 oz per acre rate gave effective control, and the addition of oil did not alter the effectiveness. The standard treatments of oil plus Lorsban, and both formulations of Dipel provided good PTB control. All treatments were statistically equally effective, and all of the treated trees had very low PTB numbers.

Correction of Zinc Deficiency Symptoms in Young Almond Trees

By: Mario Viveros, Farm Advisor, UCCE, Kern County

Purpose: To determine the timing and number of zinc sprays to correct deficiency symptoms on vigorously growing trees in Kern County

Justification: Zinc deficiency symptoms are common in vigorously growing trees in Kern County. Trees in their first, second, third and fourth leaf show the most severe symptoms. However, the severity of the symptoms varies from orchard to orchard depending on soil texture and amount of tree vigor.

Material and Method: A first leaf Nonpareil orchard in sandy soil was selected early this summer and seven treatments were established in a uniformed part of the orchard. Different zinc fertilizer materials were selected for the experiment. They were selected to match to proper spray timing. Zinc chelate was used for spring and summer. Zinc sulfate was used for fall spray and soil application. The basic zinc sulfate was used for winter spray.

Treatments were selected randomly and replicated five times in the selected area. A leaf sample was taken from each treatment and replication. The treatments were the following:

1. Control
2. Spring spray
3. Summer spray
4. Summer + Fall spray
5. Summer + Fall + Winter spray
6. Summer + Fall + Winter sprays + soil application
7. Summer + Fall + Winter + Spring sprays

The foliar tissue levels from June - July samples were the following:

Treatment	Zinc Levels
	(ppm)
Control	11
Spring spray	11
Summer spray	13
Summer + Fall spray	12
Summer + Fall + Winter spray	14
Summer + Fall + Winter sprays + soil application	12
Summer + Fall + Winter + Spring sprays	13

The above results show no difference among and between treatments. There shouldn't be any difference since the leaf sample was taken before any treatment was applied. A respond to the zinc sprays should be present in the 1997 June - July leaf samples.

Potassium Fertilizer Placement Study

Annual Report (First Season)

Roger A. Duncan
UC Cooperative Extension, Stanislaus County

This is a report of the first season's results. The study will continue for at least two more years.

Objective: To determine if potassium fertilizer (sulfate of potash) may be more efficiently placed closer to the trees in the tree row rather than the typical placement where soil may be compacted from tractor traffic.

Introduction: Potassium is an essential nutrient in almond production. Deficiencies may lead to smaller nuts and lower yields. Potassium is very immobile in the soil and must be maintained in a dilute soil solution at the surface of the roots for uptake. Because potassium is held tightly to the negatively charged soil particles, potassium fertilizers (i.e. sulfate of potash) are typically applied at high rates in concentrated bands. The conventional practice is to place these bands 5-7 feet from the trees on both sides of the tree rows. Unfortunately, this area of soil is often compacted from farm equipment traffic, especially under no till farming systems. Soil compaction can result in reduced water penetration and perhaps less fertilizer movement deep into the rootzone. Potassium fertilizers may be more efficiently placed closer to the trees in the herbicide strip where tractor traffic does not occur and roots may be more concentrated, closer to the surface, and less affected by soil compaction.

Many growers typically apply 500-1200 pounds of potassium fertilizer per acre to the soil every 1-3 years. The current cost of the most common soil applied potassium fertilizer (sulfate of potash) is about $290 per ton. This translates to approximately $75-$175 per acre plus application costs. If placing the potassium fertilizer closer to the trees proves to be more efficient, it is possible lower rates of potash could be applied with substantial cost savings to the grower.

Methods and materials: The trial was conducted in an 18 year-old almond orchard in Stanislaus County. The orchard is a 2:1 planting (Nonpareil:Carmel) on a 24' x 24' spacing and flood irrigated. The soil type is sandy loam. The trial is arranged in a randomized complete block design with five replications of the following treatments:

1) Sulfate of potash @ 1200 lb. per acre in conventional placement (5'-7' from tree row)
2) Sulfate of potash @ 600 lb. per acre in conventional placement
3) Sulfate of potash @ 1200 lb. per acre banded approximately 1' from tree row in herbicide strip
4) Sulfate of potash @ 600 lb. per acre banded approximately 1' from tree row in herbicide strip
5) No potassium fertilizer applied.

Sulfate of potash fertilizer (0-0-51-17) was applied in bands to three adjacent Nonpareil trees in each replication in January, 1996. Data was collected from the center tree in each replication. On August 6, 1996, leaf samples (50 leaves per replication) were sampled from non-fruiting spurs and sent to the DANR analytical laboratory at UC Davis and analyzed for leaf potassium levels. Due to miscommunication with the grower, yield data (meat weight, total yield) could not be obtained as anticipated in 1996.

Results: Leaf potassium levels for the various treatments are listed in Table 1 below. Unfertilized trees had a mean leaf potassium level of 1.8%, well above the published "adequate" level of 1.4%. No trends were detected in leaf potassium levels between 600 or 1200 pounds of potassium sulfate per acre nor between application techniques. Although leaf potassium levels were numerically higher in trees that received potassium fertilizer, levels were not statistically different than unfertilized trees ($P<0.05$). More time may be necessary for significant differences in potassium leaf levels to develop.

A second, similar trial was initiated in February 1997 in an almond orchard with leaf potassium levels below 1.4% .

Table 1.	**Total leaf potassium (%)**
1200 lb. - conventional placement	2.2 a
600 lb. - conventional placement	2.1 a
1200 lb. in herbicide strip	2.0 a
600 lb. in herbicide strip	2.1 a
No potassium fertilizer	1.8 a

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March 28, 1997

APR 02 1997

Chris Heintz
Research Director
Almond Board of California
1104 - 12th Street
Modesto, CA 95354

Dear Chris,

Enclosed is the annual report for our project "Almond Culture and Orchard Management". Please contact me if you have any questions.

Sincerely,

Warren C. Micke
Extension Pomologist

WCM:kk

cc: J. Connell
R. Duncan
J. Edstrom
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