Correct Project Number: 98-WM-o1

Project No.: **98-WM-01 – Almond Culture and Orchard Management**

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Objectives:

1. To compare stress and no stress at early hullsplit on nut removal and hull rot in a microsprinkler irrigated almond orchard.

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

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

4. To compare the effectiveness of Success®, Asana®, and diazinon for dormant control of peach twig borer and San Jose Scale.

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

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

7. To determine the effect of chipping prunings on their decomposition and their effect on soil organic matter.

Procedures, Results, and Discussion: See attached report for each objective.

COMPARISON OF NUT REMOVAL AT HARVEST AND HULL ROT UNDER MICROSPRINKLER 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 and microsprinkler irrigation are increasingly becoming popular. These trials are designed to compare nut removal at harvest and hull rot from trees with differing irrigation management at hull split.

PLANS AND PROCEDURES

Experiments conducted between 1992 and 1996 showed improved nut removal at harvest and reduced hull rot on drip irrigated trees that were moisture stressed for a 2 to 3 week period at early hull split. The same results were not obtained in a microsprinkler irrigated block in 1996. It was postulated that the stress may not have occurred at the correct time to be beneficial.

Two experiments were established in two microsprinkler irrigated almond orchards in 1997 and continued in 1998. Both experiments were conducted on Nonpareil rows with one trial in a Lovell peach rootstock block and the second in a peach almond block. The orchard age was 8 and 7 years respectively. The canopy was estimated at approximately 80% cover in the peach and 90% 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 two weeks before anticipated hull split and maintained at this level for one month. It was estimated that the no stress block was irrigated at 120% ET during June and July whereas the stress block received 70% ET in 1997. In 1998 the moisture was maintained at 100% ET vs. 50% ET. There was 2 treatments of 3 trees replicated 3 times.

RESULTS:

Trials in both 1997 and 1998 in a microsprinkler orchard were designed to create a mild stress during June and July compared to a well irrigated orchard (70% ET compared to 120% ET in 1997, 50% ET compared to 100% ET in 1998) on two different rootstocks (Titon Peach/Almond and Lovell peach). Data is summarized in the following table. Significant differences occurred between the No stress and the Stress treatments for nuts remaining on the tree in both 1997 and 1998. Although the probability was reasonably high at 0.12 and 0.09 there was not a significant difference at 0.05% for hull rot in either rootstock in 1997 but there was in 1998.

Number of Nonpareil nuts remaining on tree after normal harvest shaking:

Rootstock	Peach/Almond		Peach	
Year	1997	1998	1997	1998
Treatment				
No stress	17.7	131.3	79.7	654.0
Stress	5.3	41.0	17.9	195.0
Probability	0.049	0.020	0.038	0.038

Number of hull rot strikes per tree as identified by dead spurs with nuts and dead leaves still attached

Rootstock	Peach/Almond		Peach	
Year	1997	1998	1997	1998
Irrigation Treatment				
No stress	1.33	19.3	2.56	43.3
Stress	0.33	4.3	0.22	8.0
Probability	0.12	0.038	0.09	0.014

CONCLUSIONS:

These data suggest reduced moisture in the tree during the hull split period may reduce the incidence of hull rot and improve nut removal at harvest. Trials with 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 in trials conducted between 1992 and 1996. 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.

From these data it appears that stress occurring before and during hull split will promote better nut removal at harvest and may reduce the incidence of hull rot in drip and microsprinkler orchards. The stress should occur at very early hull split. This requires reducing the water perhaps two weeks before hull split in micro-irrigated orchards to allow for some depletion of the stored water in the root zone whereas the stress response in a drip irrigated orchard occurs within days of decreasing water.

The higher number of nuts left on the tree after shaking in the system receiving full ET throughout hull split 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% to 70% ET may provide sufficient moisture for proper hull split while enhancing nut removal. Hull rot was also reduced with the stressed treatment.

SUSTAINING YIELDS IN HEDGEROW ALMONDS

J. Edstrom, J. Yeager, S. Cutter

In 1979, a Nonpareil - Price (1:1) orchard was planted 7' x 22' (270 trees/acre) at the Nickels Soil Laboratory in Arbuckle. The soil series is Class II - Class III Arbuckle gravelly loam; irrigation is by single hose drip. The following four training treatments were used for this plot:

1) **Temporary Hedge** -- trained to three scaffolds, standard pruning for permanent trees, with alternate trees gradually whisked back and then removed after their 8th year (1986), 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.

Yield declined somewhat this year in the Unpruned Hedge compared to other 7' x 22' spacing treatments. We have not found this difference before since we began collecting data in 1981. Lack of pruning for 17 years did not depress yield until this season (see table). Data show that the Unpruned tree yield is close to the typically low yielding Temporary Hedge. Production from the Two-Scaffold and Permanant Hedge treatments (7' x 22') continues to exceed the Temporary Hedge (14' x 22') where alternate trees were removed in 1986. These 14' x 22' trees have never replaced the fruitwood lost from past alternate tree removal. Accumulative yields continue to favor the permanantly spaced trees. The alternate tree removal scheme has resulted in an accumulative production loss of 7000 lb./Ac. No differences in kernel size were found between treatments. Shaded tree canopies continue to result in loss of lower fruitwood especially in the unpruned trees. Yield monitoring and observations will continue in this trial to track the economic lifespan of the hedgerow and the effects of the spacing and training treatments.

YIELDS BY HEDGEROW SYSTEMS

Kernel Pounds per Acre
Leaf/Year

Treatment	11th 1989	12th 1990	13th 1991	14th 1992	15th 1993	16th 1994	17th 1995	18th 1996	19th 1997	20th 1998	Accum.[1/] 1984-98
2 Scaffold	2746a	3470	2992	2079	1943	2835	1598	2968	2953a	2296a	34,337
Unpruned	2870a	3072	3036	2471	1804	2799	1215	2833	2680a	1958ab	32,775
Permanant	2680a	3333	2254	2268	1189	2678	1297	2624	2498a	2494a	32,040
Temporary	2046 b	2450	2576	1739	1280	2448	1079	2076	2081 b	1757 b	26,199

[1/] Accumulative Yields Since 1984.

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

Extra trees are commonly thinned and then removed when double-planted trees begin to crowd. Reasons given for tree removals include improved light penetration, fruitwood renewal, and maintaining the orchard's future productivity. In this trial, we evaluated temporary tree removal by comparing two treatments: 1) Maintaining a hedgerow indefinitely with standard pruning, and 2) Removing temporary trees that had been whisked back by gradual thinning or by heavier chain saw cuts. For seven years, 1989 through 1995, we attempted to minimize crop losses following temporary tree removal by gradually cutting back the temporary trees. The temporary trees were removed following harvest in 1995.

Results:

During these seven years (1989-95), crop reductions from thinning out the temporary trees were not statistically significant suggesting an appropriately gradual rate of tree removal. However, in real terms, the seven year accumulated yield reduction on a per acre basis due to tree thinning amounted to 1805 kernel pounds of Buttes and 714 kernel pounds of Missions. Chain saw whisking reduced seven year accumulated Butte yields by 1702 kernel pounds and Mission yields by 1596 kernel pounds (Tables 1 & 2). It's clear that removing temporary trees was costly due both to increased pruning costs and to yield losses over the years when the trees were being pruned back.

Table 1. Accumulated Butte yields (lbs. kernel/acre) over seven years of tree thinning.

Treatment	Pre-Treatment Yield 1988	Cumulative Yield 1989-1995	Yield Loss* Cumulative	Yield Loss* Avg./year
Maintain Hedgerow	2660	17,923	0	0
Gradually Thinned	2632	16,118	1805	258
Chain Saw Whisked	2716	16,221	1702	243

*overall average loss related to thinning or whisking was 250 lbs. kernel / acre / year.

Table 2. Accumulated Mission yields (lbs. kernel/acre) over seven years of tree thinning.

Treatment	Pre-Treatment Yield 1988	Cumulative Yield 1989-1995	Yield Loss* Cumulative	Yield Loss* Avg./year
Maintain Hedgerow	2491	12,950	0	0
Gradually Thinned	2393	12,236	714	102
Chain Saw Whisked	2498	11,354	1596	228

*overall average loss related to thinning or whisking was 165 lbs. kernel / acre / year.

Following the 1995 tree removal, yield was substantially reduced again even though the temporary trees had already been cut back annually for seven years.

Over the past three years where the temporary trees were removed, additional accumulated yield losses averaged 2071 pounds per acre for the Butte variety, (Table 3), and 2179 pounds per acre for the Mission variety, (Table 4), compared to maintaining the double planted hedgerow. Butte yield per tree was significantly greater in 1998 in the plots where temporary trees had been removed in 1995 (on a per acre basis, not as far behind the maintained hedgerow) since these trees were larger and filled more space in the orchard. However, this increase did not make up for the fact that there were only half as many trees per acre in those plots compared to the maintained hedgerow (70 vs. 140).

Table 3. Butte yield history following 1995 tree removal (lbs. kernel/ acre).

				Cumulative Yield	
Treatment	1996	1997	1998	1996-1998	Loss*
Maintained hedgerow	1182	3064	1732	5,978	0
Gradually thinned then removed	831	1626	1271	3,728	2250
Chain saw whisked then removed	755	2050	1282	4,087	1891

* overall average loss related to tree removal was 690 lbs. kernel / acre / year.

Table 4. Mission yield history following 1995 tree removal (lbs. kernel /acre).

				Cumulative Yield	
Treatment	1996	1997	1998	1996-1998	Loss*
Maintained hedgerow	1734	2700	1138	5,572	0
Gradually thinned then removed	1068	1671	662	3,401	2171
Chain saw whisked then removed	890	1701	794	3,385	2187

* overall average loss related to tree removal was 726 lbs. kernel / acre / year.

Conclusions:

High-density hedgerows are an acceptable strategy both for achieving earlier returns when an orchard is being established and for maintaining it's long term productivity. This training and tree removal trial was followed in this orchard for the past 17 years. It's now clear that once a high-density hedgerow orchard is planted it should be farmed that way for the life of the orchard. Trees planted at higher densities tend to dwarf one another and the crowding that occurs does not seem detrimental.

Conversely, plots with trees removed continue to have reduced yields. The day when they will equal or exceed the yields of the maintained hedgerow will most likely be far into the future. Yield losses incurred while waiting for this to occur prohibit this approach. Removing "temporary" trees has shown no benefits in this trial even when done very gradually. This report concludes our work on this project.

Acknowledgement:

I greatly appreciate Sam Lewis Jr. of Durham for his outstanding cooperation over many, many years that allowed this project to continue, and, the Almond Board of California for their financial support. My sincere thanks are extended to both.

A comparison of the responses of peach twig borer, San Jose scale and the scale parasitoid, *Encarsia perniciosi* to dormant sprays in almond

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Introduction:

The peach twig borer (PTB), *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 is being questioned because organophosphate (OP) insecticides are being found in local rivers. These contaminants probably originate from dormant OP applications to orchards.

Dormant sprays of oil plus insecticide are also applied to almonds for control of San Jose Scale (SJS) *Quadraspidiotus perniciosus*. There is a possibility that dormant sprays could adversely impact beneficial arthropods, resulting in increased problems with San Jose scale and web-spinning summer mites. This experiment was designed to test the control of PTB and San Jose scale with several dormant sprays and to monitor the scale parasitoid, *Encarsia perniciosi*. Web spinning mites were also monitored.

Procedures:

A young, bearing almond orchard with Nonpareil, Carmel and Sonora varieties in Livingston, CA was chosen to test dormant pesticide applications. SUCCESS® (Dow AgroSciences), a product derived from *Saccharopolyspora spinosa* was tested with diazinon and Asana® in dormant treatments. Each treatment was applied to three replicates of 9 to 12 trees by 13 rows with a PTO driven Aerofan sprayer pulled by a Heston hydrostatic 80-66 tractor at 2.4 mph. Tree spacing is 21' X 18' with 101 trees/ac. Asana® and Success® sprays were applied on January 21, 1998, and the diazinon treatment was applied on January 22, 1998. All treatments were applied at 100 gpa.

Treatments:

1) diazinon 4EC @ 2 qt/ac + supreme oil @ 5 gpa + 8 # Kocide 101
2) Success®* 2SC @ 6 oz/ac + supreme oil @ 5 gpa + 8 # Kocide 101
3) Asana® XL @ 10 oz/ac + supreme oil @ 5 gpa + 8 # Kocide 101
4) Untreated Control

* spinosad derived from *Saccharopolyspora spinosa*

Two PTB traps, 2 NOW traps and 2 San Jose Scale pheromone traps were placed in each treatment replication in March (six per treatment). Traps were monitored and read weekly through August. Twospotted mite *Tetranichus urticae*, the European red mite *Panonychus ulmi* and the Western orchard predator mite *Metaseiulus occidentalis* were also monitored weekly.

Samples of nuts were taken from the windrows at harvest, cracked and evaluated to determine the reject levels for NOW, PTB, ants and other causes.

Results:

All insecticide treatments reduced PTB catches in pheromone traps by nearly 2/3 in the first flight, but did not affect the second flight catches. PTB catches in the check on May 8th were highly significantly different from all other treatment catches for that date. See **Figure 1**. The first flight of PTB began April 25th and ended July 3rd. The second flight began July 13th and ended August 21st. PTB damage in 'Nonpareil' nut samples collected from harvest windrows was 0.9% in the untreated check, 0.6% for diazinon, 0.5% for Success®, and 0.3% for Asana®. PTB reject levels were significantly lower in the Asana® and Success® treatments as compared to check. See **Figure 2**.

Shrivel was also a very common reason for rejects in 1998. Shrivel was unrelated to the dormant spray treatments, and caused much greater losses than insects in this orchard. See **Figure 3**.

All insecticide treatments reduced San Jose scale male counts in pheromone traps by 80% or more in the 1st flight in late March, and had no apparent effect on the very small August flight. Check counts of SJS males were highly significantly greater on March 27th compared to all treatments. See **Figure 4**. However, San Jose scale has not become a problem even in the unsprayed check.

Trap counts of *Encarsia perniciosi* were very sharply reduced by the Asana® spray throughout the trapping period from March to September. Success® and diazinon showed almost equal, moderate reductions of *Encarsia perniciosi* as compared to the catches in the unsprayed check as seen in **Figure 5**. *Encarsia* peak numbers were significantly higher in the check on April 24th, but not significant at the August 30th peak. **Figure 6** compares season long total catches of SJS males with *Encarsia* catches. Note the sharp reduction in total numbers of *Encarsia* in the Asana® treatment.

Navel orangeworm was almost nonexistent on the NOW egg traps, but we did find 0.3% to 0.7 % kernel damage in the samples which we attributed to NOW. The highest level was in the untreated check, which probably means that NOW was found in nuts which had been damaged initially by PTB.

Twospotted mite suddenly increased to high levels in early July. Western orchard predator mite was not prevalent at that time. The orchard was sprayed to prevent damage, and no evaluation could be made between treatments. Spider mite numbers were very similar across treatments and check before the orchard was sprayed.

Conclusions:

Dormant treatments reduced PTB catches in the pheromone traps in the first flight, because overwintering larvae were killed and the total population was reduced. This trap response was surprising, since pheromone traps are not usually a good tool by which to estimate population size. Dormant spray effects did not modify the second flight catches. PTB damage in the harvest samples from windrowed 'Nonpareil' nuts was significantly higher at 0.9% in the untreated check than in the Success® (0.5%) or the Asana® (0.3%) treatments. Diazinon (0.6%) was not statistically better than check nor worse than the Success® and Asana® treatments.

All insecticide treatments reduced SJS male catches in the 1st flight, but had no apparent effect on the August flight. The SJS pheromone traps did seemingly reflect population size. *Encarsia* seems to be controlling the San Jose scale in the unsprayed Check.

Trap counts of the SJS parasitoid *Encarsia perniciosi* were very sharply reduced by the Asana® spray throughout the trapping period from March to September. This indicates a possible problem with disruption of biological control of SJS in an orchard in which SJS has become a major pest. Growers and PCAs should carefully consider this possible problem when choosing a pesticide for dormant application. Success® and diazinon showed almost identical, moderate reductions of *Encarsia perniciosi* as compared to the catches in the unsprayed Check.

Navel orangeworm is only a minor pest in this orchard at this time and these dormant sprays did not seem to be a factor with the web spinning mite populations.

Figure 1. PTB MOTH CATCHES 1998

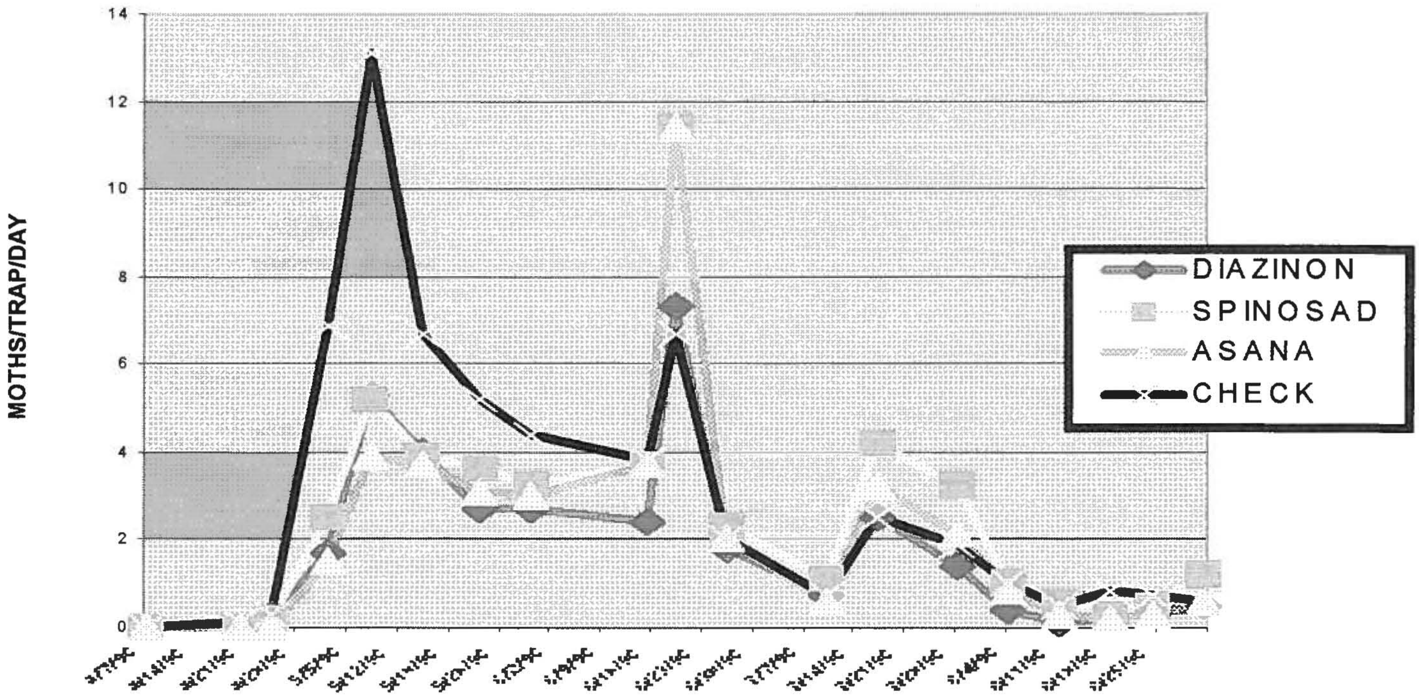


Figure 2. PERCENT PTB-DAMAGED NUTS AT HARVEST

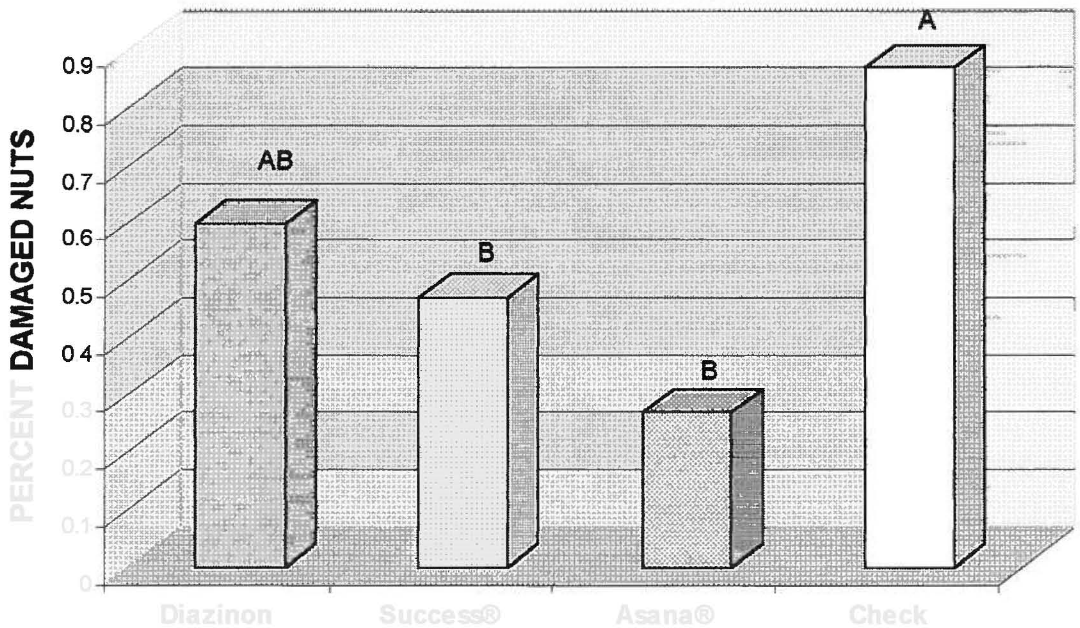


Figure 3. ALL INSECT DAMAGE AND SHRIVEL IN DORMANT TREATMENTS

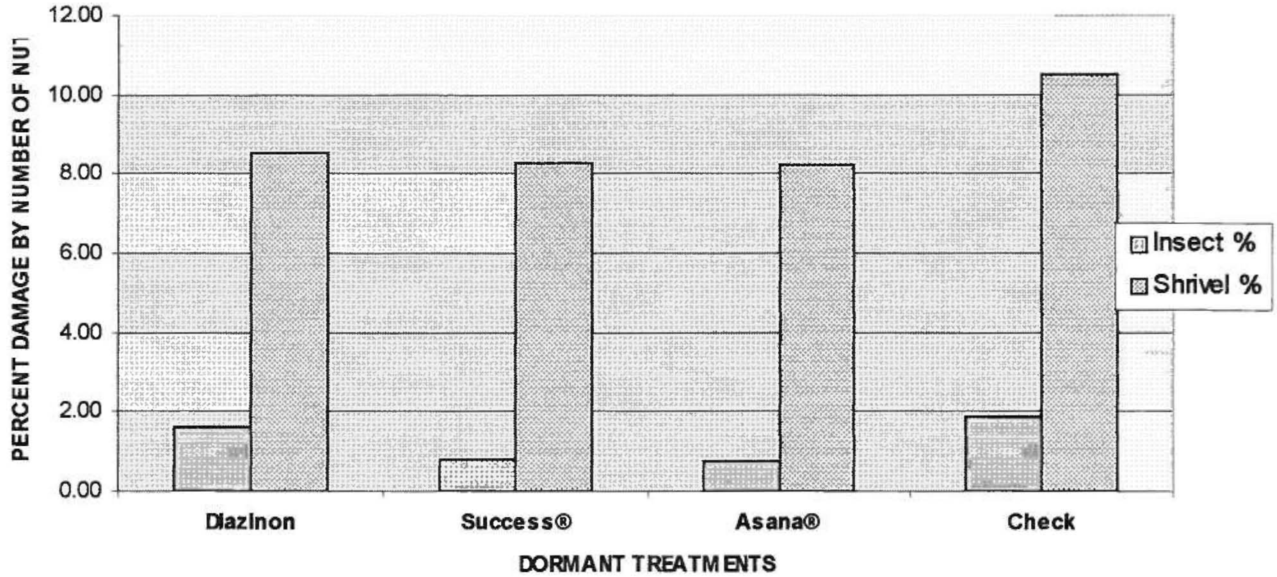


Figure 4. SAN JOSE SCALE CONTROL EXPERIMENTS - 1998

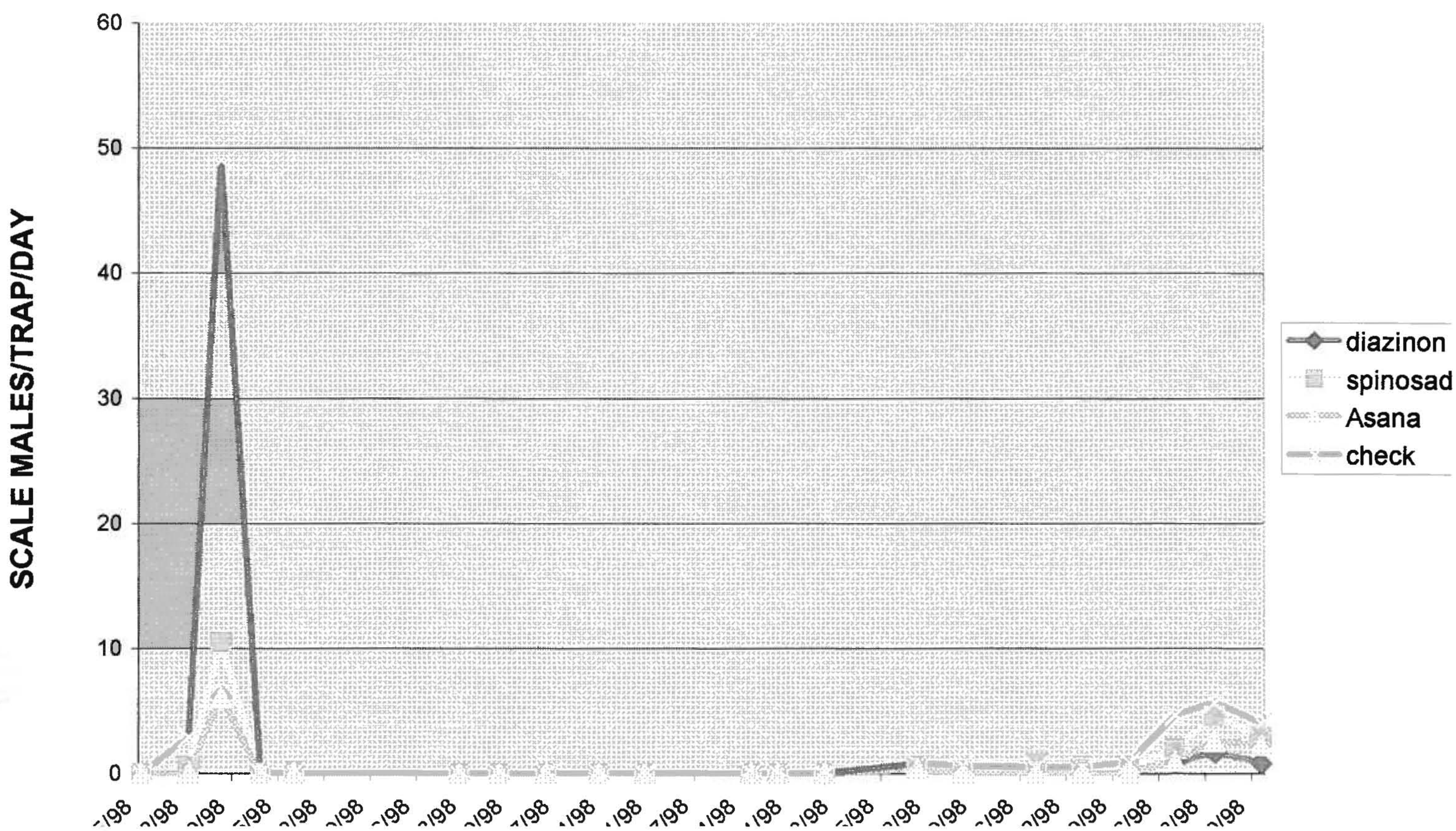


Figure 5. DORMANT SPRAY EFFECTS TO ENCARSIA

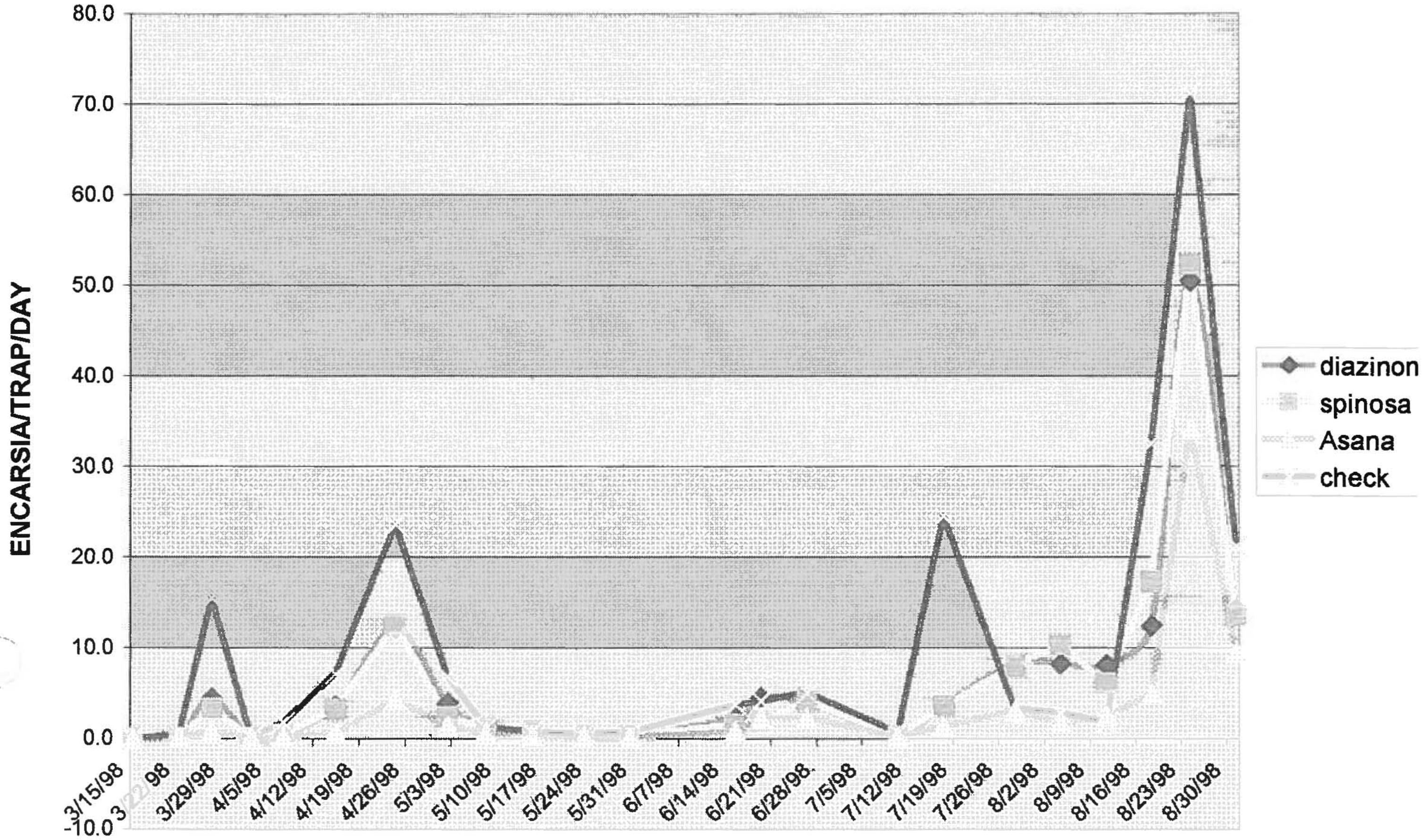
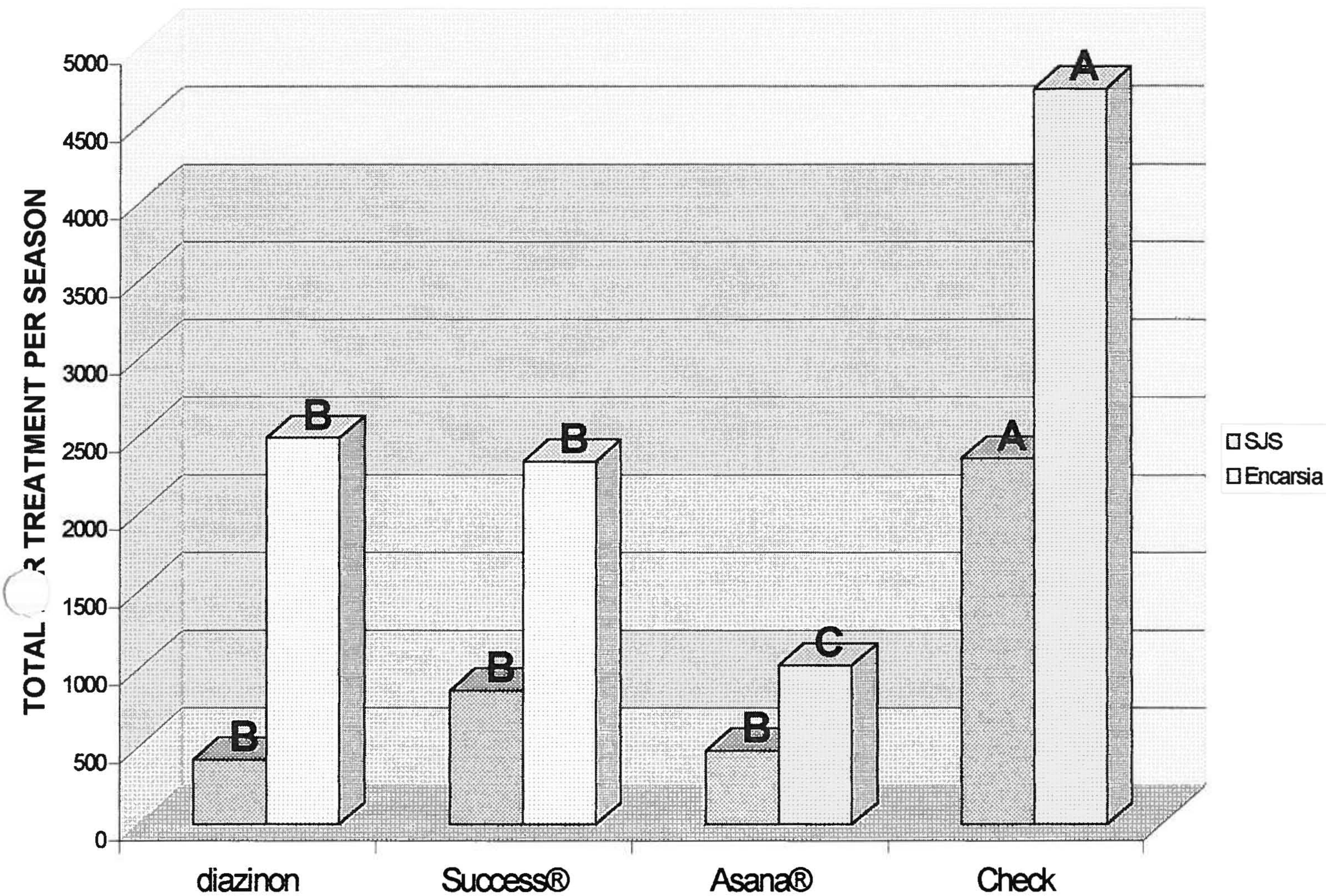


Figure 6. DORMANT SPRAY EFFECTS 1998



Correction Of Zinc Deficiency Symptoms In Young Almond Trees

Mario Viveros, U.C. Farm Advisor
Kern County

Zinc deficiency symptoms are common in vigorously growing almond trees in Kern County. Trees most affected by zinc deficiency symptoms are those in their first, second, third and fourth growing seasons. The degree of zinc deficiency varies from orchard to orchard depending on soil type and tree vigor.

A first leaf Nonpareil orchard in a sandy soil was selected in the 1998 spring. The following treatments were selected, randomized and replicated: 1) untreated control, 2) spring, 3) spring and summer, 4) spring, summer and fall, 5) spring, summer, fall and winter. A leaf sample was taken in the spring to determine the tree's zinc levels before any treatments were applied. The leaf samples were processed and sent to our laboratory at UC Davis.

The results were the following:

Spray Timings	Concentration (ppm)
Control	13
Spring	12
Spring + Summer	12
Spring + Summer + Fall	12
Spring + Summer + Fall + Winter	12

The concentration of zinc didn't show any significant differences. All the treatments and all the replications were the same. In fact, this concentration is deficient. Adequate zinc concentrations should be above 15 ppm. Even though the zinc concentrations were below 15 ppm, no zinc deficiency symptoms were visible at the end of the 1998 growing season.

We have continued with our treatments in the 1998-1999 growing season. A leaf sample will be taken in June-July, 1999 and zinc concentrations will be determined at our DANR Davis laboratory.

Potassium Fertilizer Placement Study

Roger Duncan, UCCE Farm Advisor, Stanislaus County

Final Report to the Almond Board - Year three of three year study.

Abstract:
Two trials were established in mature almond orchards in Stanislaus County to accomplish two objectives: 1) Determine if potassium fertilizer can be applied more efficiently in the herbicide strip where roots may be more concentrated, closer to the surface, and less affected by soil compaction; 2) Revisit current University of California recommendations for "adequate" potassium leaf levels. After three years of study, results show there was no increase in leaf potassium levels or yield in trees with potassium fertilizer applied in the herbicide strip as compared to conventional placement. Due to errant fertilizer applications by the grower, mean leaf potassium levels were $\geq$ 1.8% in "unfertilized" control trees. Additional potassium fertilizer did not increase leaf potassium or yield in test areas.

Materials and Methods:
Trials were established in two, mature almond orchards (cvs. Nonpareil & Carmel) in Stanislaus County to meet the above stated objectives. Trial A was established in 1996 in the Hickman area of Stanislaus County; Trial B was established in 1997 near the town of Empire. The soil type in both locations is classified as a sandy loam. In Trial A, sulfate of potash (0-0-51-17) was applied in January 1996 at rates of 0, 600, or 1200 pounds per acre. In Trial B, sulfate of potash was applied in February 1997 at rates of 0, 250, 500, or 1000 pounds per acre. Both plots compared applying potassium fertilizer in the conventional manner (in two bands 6-8 feet from the trees) to applications in two bands between trees in the herbicide strip. Both trials were arranged in randomized complete block designs with six replications per treatment and three treated trees per replication. Leaf samples were collected in July and sent to the UC DANR laboratory for analysis of potassium content.

Three to four days after trees were commercially shaken at harvest, all almonds from the data trees were hand raked, collected and weighed in the field. Field weights included almond meats, shells, hulls, and some vegetative orchard floor debris. Five-pound samples of the field weighed material were collected for calculation of actual meat weights per tree and determination of percent doubles and shriveled meats. Harvest data was collected only for the Nonpareil variety.

Results:
Leaf potassium levels, almond kernel size, and yield per tree for the various fertilizer treatments are shown in Table 1 below. Due to miscommunication with the grower, yield data from plot A was not available in 1996. There were no consistent effects of fertilizer rate or placement on leaf potassium levels, nut sizes, or final yields in either trial in any year. Applying sulfate of potash fertilizer in the herbicide strips did not prove more efficient than the conventional placement. In fact, trees with potassium fertilizer banded in the strip sometimes had numerically lower (although not statistically significant at $P \leq 0.05$) levels than conventional banding placement. There was no clear relationship between leaf potassium level and yield of individual trees. Although trees that received the highest rates of potassium fertilizer sometimes had numerically higher leaf potassium levels, differences were not statistically different ($P \leq 0.05$) due to high

variability between trees. In both trials, trees had average leaf potassium levels of 2.0% or greater, well above the established critical level of 1.4% for a July leaf sample. It is possible that increasing leaf potassium levels in trees already above 2.0% will have no effect on yield.

In Trial B, pretreatment leaf analyses indicated a potassium deficiency in the orchard (< 1.0%) at the onset of the trial. However the grower inadvertently applied a large dose of potassium fertilizer in the test area after the trial had been initiated, bringing potassium levels in "untreated" trees above 2.0%. In addition, analyses of July sampled leaves in Trial B were not meaningful due to a foliar application of potassium nitrate for mite control a few days before leaf collection.

Summary:
Results from these trials indicate no advantage in banding potassium fertilizer in the herbicide strip. Application in this fashion would be more difficult than current application techniques in flood irrigated orchards.

Both orchards had leaf potassium levels of 1.8% or greater in untreated trees. Additional potassium fertilizer applications did not result in larger almond meats or increases in total yield. The current minimum threshold published by the University of California for potassium levels in July sampled almond leaves is 1.4%. However, there is a strong feeling throughout the California almond industry that the threshold should be increased to at least 2.0%. The lack of yield response in these trials supports the current University of California's published value. Additional, more comprehensive research is needed in almond orchards with leaf potassium levels beginning at less than 1.4%.

Table 1. Summary of leaf potassium levels and yield as influenced by rate and placement of potassium sulfate fertilizer.

	July Leaf potassium (%)			Weight per 100 nut meats (g)			Yield (lb./tree)		
Hickman Plot	**1996**	**1997**	**1998**	**1996**	**1997**	**1998**	**1996**	**1997**	**1998**
600 lb. potash, conventional placement	2.1	2.2	2.8		104.2	128.6	-	31.4	23.5
1200 lb. potash, conventional placement	2.2	2.5	3.0		114.8	130.9	-	33.6	22.7
600 lb. potash, between trees in strip	2.1	2.0	2.7		107.4	127.9	-	28.8	21.2
1200 lb. potash, between trees in strip	2.0	2.3	2.8		106.9	131.5	-	32.4	20.1
Unfertilized	1.8	2.0	2.7		113.6	134.4	-	39.4	25.3
Empire Plot									
250 lb. potash, conventional placement			2.0		143.3	137.7	-	33.5	25.1
500 lb. potash, conventional placement			2.2		132.7	135.4	-	38.3	19.8
1000 lb. potash, conventional placement			2.2		135.8	136.1	-	33.6	25.2
250 lb. potash, between trees in strip			2.1		139.0	132.8	-	31.9	20.4
500 lb. potash, between trees in strip			2.1		139.3	138.9	-	32.4	22.3
1000 lb. potash, between trees in strip			2.1		136.1	135.0	-	36.2	24.3
Unfertilized			2.0		144.3	138.9	-	35.3	20.0

Wood Chipping to Reduce Air Pollution and Build Soil Organic Matter
Brent A. Holtz, Madera County

The wood chipping of almond prunings instead of burning as a method to reduce air pollution and return organic matter to soils could become an important orchard practice for almond growers. Wood chipping could provide an alternative to burning which would not contribute to PM-10 pollution while at the same time add valuable organic matter to soils. The success of wood chipping will depend on whether the chips decompose quickly and are incorporated into the soil, or whether they are harvested with the nuts and increase foreign material and industrial waste. Wood chippers and shredders have both been used and their products can be quite variable. Chips from a Brush Bandit wood chipper were compared to shreddings from a Rears Shredder. Size (area), weight, and rate of decomposition were examined. Soil analysis between chipped and non-chip soils is not yet completed.

Average chip weight was 0.683 ± 0.11 g while average shreddings were significantly larger at 3.63 ± 0.48 g (dry weight). Average chip size (area) was 2.1 ± 0.42 cm^3 while shreddings were significantly larger at 8.12 ± 1.83 cm^3. Chips and shreddings (300g samples) were placed in nylon mesh sacks, with soil, and placed on the floor of an almond orchard in order to examine their rate of decomposition. After 9 months total chip weight was reduced by 23.73 % while total shreddings were reduced by 44.71 %. The greater decomposition rate observed in the shreddings may be related to their larger initial size. In an orchard where shredding was compared to no-shredding, 20 ft wind-row segments were examined for woody material. The shredded segments had significantly more wood (1225 ± 43 g) when compared to non-shredded segments (475 ± 88). Shredded vs. wood-chipped wind-rows were not compared.

Potassium Fertilizer Placement Study

Roger Duncan, UCCE Farm Advisor, Stanislaus County

Final Report to the Almond Board - Year three of three year study.

Abstract:
Two trials were established in mature almond orchards in Stanislaus County to accomplish two objectives: 1) Determine if potassium fertilizer can be applied more efficiently in the herbicide strip where roots may be more concentrated, closer to the surface, and less affected by soil compaction; 2) Revisit current University of California recommendations for "adequate" potassium leaf levels. After three years of study, results show there was no increase in leaf potassium levels or yield in trees with potassium fertilizer applied in the herbicide strip as compared to conventional placement. Due to errant fertilizer applications by the grower, mean leaf potassium levels were $\geq$ 1.8% in "unfertilized" control trees. Additional potassium fertilizer did not increase leaf potassium or yield in test areas.

Materials and Methods:
Trials were established in two, mature almond orchards (cvs. Nonpareil & Carmel) in Stanislaus County to meet the above stated objectives. Trial A was established in 1996 in the Hickman area of Stanislaus County; Trial B was established in 1997 near the town of Empire. The soil type in both locations is classified as a sandy loam. In Trial A, sulfate of potash (0-0-51-17) was applied in January 1996 at rates of 0, 600, or 1200 pounds per acre. In Trial B, sulfate of potash was applied in February 1997 at rates of 0, 250, 500, or 1000 pounds per acre. Both plots compared applying potassium fertilizer in the conventional manner (in two bands 6-8 feet from the trees) to applications in two bands between trees in the herbicide strip. Both trials were arranged in randomized complete block designs with six replications per treatment and three treated trees per replication. Leaf samples were collected in July and sent to the UC DANR laboratory for analysis of potassium content.

Three to four days after trees were commercially shaken at harvest, all almonds from the data trees were hand raked, collected and weighed in the field. Field weights included almond meats, shells, hulls, and some vegetative orchard floor debris. Five-pound samples of the field weighed material were collected for calculation of actual meat weights per tree and determination of percent doubles and shriveled meats. Harvest data was collected only for the Nonpareil variety.

Results:
Leaf potassium levels, almond kernel size, and yield per tree for the various fertilizer treatments are shown in Table 1 below. Due to miscommunication with the grower, yield data from plot A was not available in 1996. There were no consistent effects of fertilizer rate or placement on leaf potassium levels, nut sizes, or final yields in either trial in any year. Applying sulfate of potash fertilizer in the herbicide strips did not prove more efficient than the conventional placement. In fact, trees with potassium fertilizer banded in the strip sometimes had numerically lower (although not statistically significant at $P \leq 0.05$) levels than conventional banding placement. There was no clear relationship between leaf potassium level and yield of individual trees. Although trees that received the highest rates of potassium fertilizer sometimes had numerically higher leaf potassium levels, differences were not statistically different ($P \leq 0.05$) due to high

variability between trees. In both trials, trees had average leaf potassium levels of 2.0% or greater, well above the established critical level of 1.4% for a July leaf sample. It is possible that increasing leaf potassium levels in trees already above 2.0% will have no effect on yield.

In Trial B, pretreatment leaf analyses indicated a potassium deficiency in the orchard (< 1.0%) at the onset of the trial. However the grower inadvertently applied a large dose of potassium fertilizer in the test area after the trial had been initiated, bringing potassium levels in "untreated" trees above 2.0%. In addition, analyses of July sampled leaves in Trial B were not meaningful due to a foliar application of potassium nitrate for mite control a few days before leaf collection.

Summary:
Results from these trials indicate no advantage in banding potassium fertilizer in the herbicide strip. Application in this fashion would be more difficult than current application techniques in flood irrigated orchards.

Both orchards had leaf potassium levels of 1.8% or greater in untreated trees. Additional potassium fertilizer applications did not result in larger almond meats or increases in total yield. The current minimum threshold published by the University of California for potassium levels in July sampled almond leaves is 1.4%. However, there is a strong feeling throughout the California almond industry that the threshold should be increased to at least 2.0%. The lack of yield response in these trials supports the current University of California's published value. Additional, more comprehensive research is needed in almond orchards with leaf potassium levels beginning at less than 1.4%.

Table 1. Summary of leaf potassium levels and yield as influenced by rate and placement of potassium sulfate fertilizer.

	July Leaf potassium (%)			Weight per 100 nut meats (g)			Yield (lb./tree)		
Hickman Plot	**1996**	**1997**	**1998**	**1996**	**1997**	**1998**	**1996**	**1997**	**1998**
600 lb. potash, conventional placement	2.1	2.2	2.8		104.2	128.6	-	31.4	23.5
1200 lb. potash, conventional placement	2.2	2.5	3.0		114.8	130.9	-	33.6	22.7
600 lb. potash, between trees in strip	2.1	2.0	2.7		107.4	127.9	-	28.8	21.2
1200 lb. potash, between trees in strip	2.0	2.3	2.8		106.9	131.5	-	32.4	20.1
Unfertilized	1.8	2.0	2.7		113.6	134.4	-	39.4	25.3
Empire Plot									
250 lb. potash, conventional placement			2.0		143.3	137.7	-	33.5	25.1
500 lb. potash, conventional placement			2.2		132.7	135.4	-	38.3	19.8
1000 lb. potash, conventional placement			2.2		135.8	136.1	-	33.6	25.2
250 lb. potash, between trees in strip			2.1		139.0	132.8	-	31.9	20.4
500 lb. potash, between trees in strip			2.1		139.3	138.9	-	32.4	22.3
1000 lb. potash, between trees in strip			2.1		136.1	135.0	-	36.2	24.3
Unfertilized			2.0		144.3	138.9	-	35.3	20.0

Wood Chipping to Reduce Air Pollution and Build Soil Organic Matter
Brent A. Holtz, Madera County

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