Almond Board of California Final Report - May 2002
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OBJECTIVES:
1) Slip plow tillage effects in almonds
2) Wood chipping to reduce air pollution and build organic matter
3) Survival and growth of fall transplanted potted almond nursery trees compared to spring transplanted bare root trees
4) Dormant and spring-time sprays for the control of oblique-banded leaf roller in almonds
5) Correcting zinc deficiencies in young almond trees

REPORTS:

1) Slip Plow Tillage Effects in Almonds

John P. Edstrom, UCCE Farm Advisor & Stan Cutter, Nickels Soils Lab

Expansion of orchard plantings in California has exhausted the supply of prime orchard ground forcing new plantings onto poorer soils. These are often characterized by stratified layers of clay, hardpan or gravel and shallow topsoil.

To overcome soil limitations, substantial new almond acreage has been established using deep tillage slip plows at considerable expense - $300-500/acre. At the same time, adoption of microirrigation has allowed growers to supply tree roots with a more optimal and continuous supply of moisture. Soil physical characteristics have to some extent been overcome by the use of microirrigation, especially under close tree spacings.

A trial at the Nickels Soil Lab in Arbuckle is evaluating the effects of slip plow soil modification on three varieties of almonds: 'Nonpareil', 'Carmel' and 'Aldrich' planted in 1997 at 16' X 22'. Prior to planting, replicated areas of this 20 acre block received a commercial slip operation on a 10 foot grid to a depth of 6 feet in a north/south direction and with a diagonal pass (SE-NW) to a 5 ft. depth. The planting receives irrigation via microsprinklers. Trees are planted to Lovell rootstock.

Results: Tree performance for 'nonpareils' between slipped and non-slipped areas was evaluated by measuring trunk size and by determining crop yield and kernel size. The 2001 data represents the second commercial harvest. Although a numerical difference is evident for yield, statistically, there was no difference between slip @ 9.9 lbs/tree and non-slip, 8.6 lbs/tree. Kernels sizes were also equal. The test area consists of trees planted on Lovell peach and peach/almond hybred rootstocks. No differences were measured for either rootstock area. Measurements taken this season reveal no differences in trunk circumference between slip and non slip trees. Now after the 5th growing season, there are no detectable differences between trees planted in slip plowed and non slip areas. Yields in this block are, so far, only moderate so have not fully tested the yield capacity of the treatments.

	Kernel - Lbs./Tree					
	Rep					
	1	2	3	4	Total	Mean
Slip Plow	9.03	7.13	8.63	9.46	34.25	8.56
No Slip Plow	10.58	9.21	9.65	10.38	39.82	9.95
						NS

	Weight - gms/Kernel					
	Rep					
	1	2	3	4	Total	Mean
Slip Plow	1.311	1.332	1.329	1.301	5.273	1.318
No Slip Plow	1.313	1.248	1.311	1.324	5.195	1.299
						NS

Slip Plot Prop 2000.doc

2) Wood Chipping to Reduce Air Pollution and Build Soil Organic Matter

Brent A. Holtz and Michael V. McKenry, UCCE 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 nuts and increase foreign material and industrial waste.

An experiment was established where wood chips were mixed with soil and placed in 35 gallon plastic containers, with a single almond tree per container, in order to quantitatively examine the effect of wood chips on soilborne organisms living within the root zone (fungi, bacteria, and nematodes), and to study the effects of the woodchips on tree growth and nutrient availability.

Tissue analysis was performed on leaf petioles to determine whether the wood chips were effecting nutrient availability. After the first year, trees growing with wood chips had significantly less nitrogen, zinc, and manganese while phosphorus was increased. After the second year, trees with wood chips no longer had significantly less nutrient levels while phosphorus levels were still significantly increased. Soil analysis after the second year showed significantly higher levels of zinc, copper, organic matter, phosphorus, potassium, ammonium, calcium, and magnesium. The pH in the chipped soils were significantly decreased while the electrical conductivity was significantly increased.

When nematode populations were analyzed there were significantly less ring (*Criconemella* sp.) and stubby root nematodes (*Trichodorus* sp.) and significantly more *Bunonema*, Doryleimida, and free living nematodes in the chipped soils. Of the free living nematodes, there was a higher percentage of fungal feeders in the chipped soils while the non-chipped soils had a higher percentage of bacterial feeding nematodes.

3) Survival And Growth Of Fall Transplanted Potted Almond Nursery Trees Compared To Spring Transplanted Bare Root Trees Survival And Growth Of Fall Transplanted Potted Almond Nursery Trees Compared To Spring Transplanted Bare Root Trees

Wilbur Reil, UC Farm Advisor for Yolo and Solano Counties

Almond trees on peach/almond hybrid rootstock have been difficult to transplant and grow if the bare root trees are planted in mid to late spring from nursery trees stored in cold storage. In some cases losses have been 20 to 40 %. Many years on loam and silty clay loam soils the ground is too wet to plant earlier than late spring. There are also times that growers do not complete ground preparation in the preceding year to have an ideal planting bed. Therefore, sometimes the ground must dry out in the spring to complete soil preparation before planting. One nursery currently has been growing nursery trees in containers and selling the potted trees for transplant into the orchard at any time of the year. I started a trial 3 years ago to evaluate planting potted tree transplants in the fall compared to winter or spring planted bare root nursery trees.

The trial is on class 1 silty clay loam in Yolo County. The orchard site previously was planted to almonds. The experimental design is a randomized complete block of five replicates of four trees per replicate. There are two treatments (potted vs. bare root trees) and three varieties (Nonpareil, Sonora, and Butte). The five month old growing potted trees were planted on September 18, 1998 and the bare root 5/8 inch dormant trees were planted in late January, 1999. All trees were headed at 36 to 38 inches.

At the end of the first growing season the length of the three longest shoots that were selected for the primary scaffolds of the tree was measured. Results are shown in Table 1.

Table 1. Average length of each of the 3 longest scaffolds at the end of the first year of growth.

	Potted		Bare root	
Nonpareil	164.3 cm.	4.6 feet	134.5 cm.	4.4 feet
Butte	135.2	4.4	136.2	4.5
Sonora	131.2	4.3	125.8	4.1
Average	135.2	4.4	132.2	4.3

During the winter following the first, second and third growing seasons the trunk circumference was measured at 14 inches above the ground. The measurement was then converted to trunk cross sectional area. Results are shown in Table 2. No yield was taken in 2001 because of a very light crop on all trees.

Table 2. Average square centimeters of trunk cross sectional area measured approximately 14 inches above ground level at the end of the first, second and third year of growth.

	Potted			Bare root		
	1999	2000	2001	1999	2000	2001
Nonpareil	17.8	59.7	110.3	15.1	55.2	103.6
Butte	14.9	63.2	121.1	14.6	62.0	121.2
Sonora	18.3	66.8	130.4	13.1	56.5	110.9
Average	17.0 *	63.3*	120.6	14.3	57.9	111.9

* Statistically significant - LSD .05

Growth measurements in October 1999 showed no statistical differences between the potted trees and the bare root trees in shoot length. The total length of the 3 longest scaffold limbs showed that the potted trees had grown and average of 406 cm. (13.3 feet total or an average of 4.4 feet per limb) compared to 397 cm. (13.0 feet total or an average of 4.3 feet per limb) for the bare root trees. Average Trunk cross sectional area in 1999 was statistically significant at 17.0 sq cm. for the potted trees compared to 14.3 sq. cm. for the bare root trees showing that the potted trees had attained a larger trunk thickness. Trunk cross sectional area was also significantly larger for the potted trees (63.3 square centimeters) in 2000 compared to the bare root trees (57.9 square centimeters). In 2001 the trunk cross sectional area showed no significant differences between the potted and bare root trees (120.6 vs. 111.9 square centimeters). Both Nonpareil and Sonora trees planted as potted trees were slightly bigger although not statistically than the trees planted as bare root. The Butte trees were equal.

Growth and height of the potted and bare root trees look the same. You cannot view the trial and separate the nursery potted trees from the bare root trees.

One bare root tree died whereas no potted tree died due to transplanting. The bare root trees were not placed in cold storage. Planting of the bare root trees occurred shortly after digging from the nursery. Originally the trial was set up to compare the potted trees planted in September to bare root trees that were going to be planted in late March or April after the bare root trees were dug and placed in cold storage. There was a window in January, 1999 where weather was ideal for planting so the trial was modified to take advantage of the good planting conditions. This window does not occur every year in Yolo Co.

On an adjoining block the grower planted several rows of potted nursery trees and also several rows of bare root trees that had been in cold storage approximately 3 weeks until they were planted in mid March. Survival was observed on a random 200 trees in each section. While it is not a replicated trial the observation showed that 4 trees out of 200 died in the bare root section (2%) and no trees died in the potted tree section.

4) Dormant and Spring-time Sprays for Control of Oblique-Banded Leaf roller in Almonds

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Frank Zalom, UC Statewide Integrated Pest Management Program
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Barat Bisabri, DowElanco, Rod and Connie Hooker, Brent Stout, growers

Oblique-banded leaf roller (OBLR) has emerged over the past 3-4 years as a potentially serious pest in some Northern San Joaquin Valley almond orchards. The most damaging generation is the over-wintering generation which feeds on developing nuts in early spring. This results in a direct loss of yield as these damaged nutletts shrivel and fall from the trees. At high OBLR populations, yield loss may be significant. The later generation of OBLR larvae appears to feed primarily on the hull or between the hull and the shell. However, some of these larvae have been observed feeding on kernels. This late feeding directly increases rejects at harvest as well as indirectly by making these nuts more susceptible to navel orangeworm damage.

It is unclear why OBLR has become problematic in some Northern San Joaquin Valley almond orchards. The increase in OBLR has occurred at the same time many growers have stopped applying dormant sprays. In fact, OBLR problems are found primarily in almond orchards where dormant sprays have not been applied for a few years. However, some growers have had high OBLR populations even after dormant spraying.

<u>Goals</u>:

1. Determine the efficacy of several insecticides on over-wintering OBLR larvae.
2. Compare dormant-applied with spring-applied insecticide applications for efficacy on over-wintering OBLR larvae.

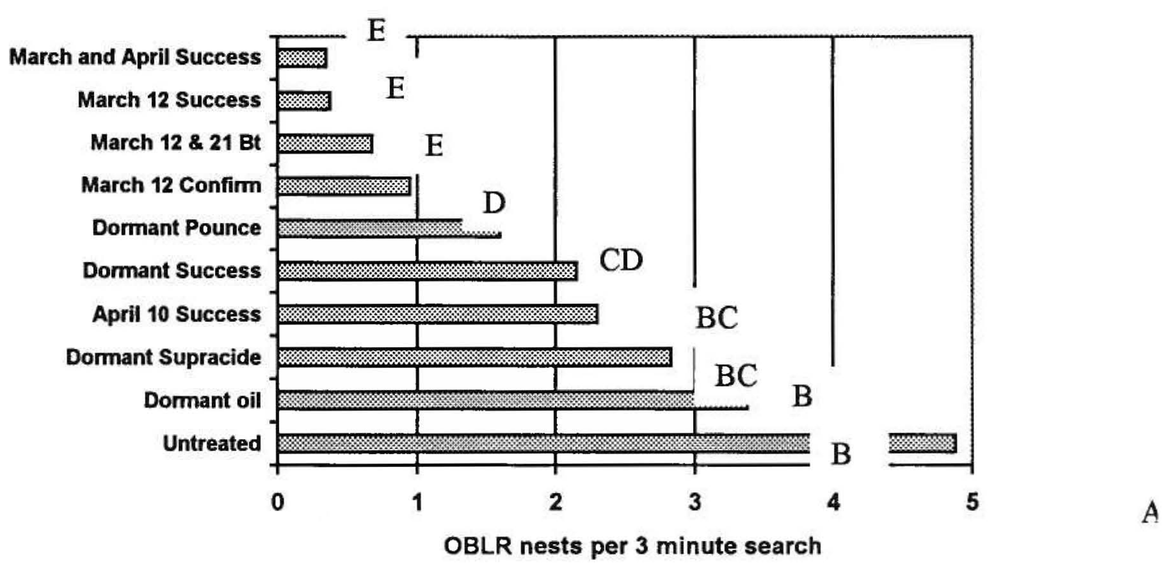
Procedure:
The trial was conducted in a 75-acre almond orchard (cvs. Butte, Mission and Ruby) in eastern Stanislaus County that had very high OBLR populations the previous two seasons. The orchard had not been dormant sprayed for several years and OBLR populations appeared to be increasing annually. Using a commercial speed sprayer, the following treatments were applied:

1. Untreated
2. Dormant oil (Gavicide Super 90) @ 6 gallons
3. Dormant organophosphate (Supracide 25-W) @ 6 lb. + oil
4. Dormant pyrethroid (Pounce 3.2 E) @ 8 oz + oil
5. Dormant spinosad (Success) @ 6 oz + oil
6. March 12 Success (6 oz)
7. March 12 Confirm (20 oz + 8 oz surfactant)
8. March 12 & March 21 Bt (Deliver) @ 1 lb.
9. April 12 Success (6 oz)
10. March 12 & April 12 Success (6 oz)

All materials were applied with a commercial air blast sprayer at ca. 100 gallons per acre. Dormant materials were applied January 23 & 25, 2001. Most spring materials were applied March 12, which was about Butte petal fall and also coincided with approximately 25% peach twig borer emergence. The goal of the March 12th application was to determine if a spray timed to control peach twig borer would also reduce OBLR. A second Bt spray was applied March 21 (~ 80% PTB emergence).

Trees were examined for OBLR larvae or "nests" on April 30. A team of seven people performed three-minute searches of treated trees, looking for OBLR larvae or "nests" of leaves webbed to nuts. The results are shown in Figure 1 below.

Figure 1. Efficacy of dormant and spring-time insecticide sprays on the over-wintering larvae of oblique-banded leaf roller in almonds.



Although OBLR populations were much lower in 2001 than the past two seasons in this orchard as well as throughout the San Joaquin Valley, we did obtain significant treatment effects. All treatments reduced populations significantly compared to untreated controls. In general, March 12 applications were more effective than dormant applied sprays in reducing over-wintering OBLR. The April 10 application of Success was not as efficacious as the March 12 date, but was comparable to a dormant application of Success. The combination treatment of a March 12 application and the April 10 application was no different than the March 12 application alone.

Discussion. These data show that a petal fall application timing is effective for controlling the most damaging generation of OBLR. Although dormant sprays reduce numbers, they do not work as well as a well-timed spring spray. It is possible an earlier (delayed dormant or full bloom) spray may have worked as well or better than the petal fall spray, but we would have sacrificed PTB control. Materials such as Success, Confirm or Bt can be included in a grower's regularly scheduled petal fall fungicide spray to control OBLR as well as PTB. This should fit very well into normal cultural practices as more and more growers move away from dormant applied insecticides. In addition, waiting until spring to spray allows the grower an opportunity to scout an orchard for OBLR larvae during bloom to determine if treatment is warranted.

5) Correction of Zinc Deficiency Symptoms in Young Almond Trees

Mario Viveros

Zinc deficiency symptoms are common in vigorously growing trees in Kern County. The trees are most susceptible to zinc deficiency when they are in their first, second, third and fourth leaf. The degree of zinc deficiency varies from orchard to orchard depending on soil type and tree vigor.

Post research has shown that zinc spray applications are the most effective treatments for correcting zinc deficiency in almonds. A dormant, spring, summer and fall spray treatments are effective in the control of zinc deficiency symptoms. The question growers ask is when is the best time to spray and how many times one should spray young almond trees? To answer this question, two experiments were established in Nonpareil orchards in sandy soils. The first was established in 1998 with the following treatments: 1) untreated control; 2) spring spray; 3) spring and summer spray; 4) spring, summer and fall spray; 5) spring, summer, fall and winter spray.

The spring and summer sprays were done using one quart of zinc chelate (Helena's tracite® Zn 10%) in 100 gallons of water. The fall and winter sprays were done using 10 pounds of zinc sulphate (33%) in 100 gallons of water. The trees were sprayed to a dripping stage. There were five replications in a randomized block design. Each treatment plot included five trees. The leaf samples were taken from the middle three trees.

A pre-treatment leaf sample was taken from all treatment plots to determine the zinc levels in the leaves. Ten shoots (in each data tree) were flagged at the terminal ends. This was done to avoid sampling sprayed leaves.

The pre-treatment zinc levels in Table 1 show no significant difference among all treatments. The spray treatment zinc levels are 12 ppm and the control is 13 ppm. These levels are considered deficient. The adequate zinc level should be 15 ppm.

Table 1. **Zinc levels (ppm) in June-July leaf samples due to multiple spray Applications.**

Application	Pre-Treatment (zinc-ppm)	Post-Treatment (zinc- ppm)
Spring	12.0 a*	29.5 b
Spring, summer	12.0 a	31.8 b
Spring, summer and fall	12.0 a	32.5 b
Spring, summer, fall, winter	12.0 a	32.5 b
Untreated control	13.0 a	15.8 a
* Values followed by the same letters are not statistically different as measured by the least significant different test at $P < 0.5$.		

The post-treatment column does show an increase in zinc levels among all treatments. The spring, spring-summer, spring-summer-fall and spring-summer-fall-winter treatments show a significant increase in zinc levels over the control. Furthermore, there were no significant differences in zinc levels among any of the spray treatments. From these results, we can conclude that after the spring spray, there is no significant increase in zinc levels due to multiple zinc applications.

The second experiment was established in 2000. The purpose was to validate the efficacy of the spring zinc spray versus a summer, fall and winter spray application of zinc. The experiment was established in a Nonpareil orchard in sandy soil. The experiment consisted of the following treatment sprays: 1) spring, 2) summer, 3) fall, 4) winter, 5) all seasons and 6) control. The spring and summer spray applications were done using one quart of zinc chelate (Helena's tracite® Zn 10%) in 100 gallons of water. The trees were sprayed to a dripping state. There were five replications in a randomized block design. Each treatment plot consisted of five trees but only the middle three trees were used for leaf samples.

A pre-treatment leaf sample was taken from all treatment plots to determine the zinc levels in the leaves. Ten shoots (in each data tree) were flagged at the terminal ends. This was done to avoid sampling sprayed leaves.

The data from this experiment is found in Table 2. The pre-treatment column shows variability among the treatment plots. The summer and control treatments show less than 15 ppm. This means that they are in the deficient range. However, these levels were not significant different from any other treatment plots.

Table 2. Zinc level (ppm) in June-July leaf samples due to spray application done in spring, summer, fall and winter.

Application	Pre-Treatment	Post-Treatment
Spring	17.6 a*	23.8 a
Summer	13.0 a	49.5 c
Fall	18.0 a	44.2 bc
Winter	15.0 a	47.3 bc
All seasons	20.4 a	29.2 ab
Untreated control	13.6 a	28.2 ab
* Values followed by the same letters are not statistically different as measured by the least significant different test of $P < 0.5$.		

The post-treatment column shows all zinc levels to be in the adequate range. These are, however, significant differences among the different treatments. There are no significant differences among fall, winter, all seasons and untreated control. They are considered the same because they have the same letters. The summer spray treatment is significantly superior to any of the other treatments and the spring spray treatment is least effective zinc spray treatment.

The data from this experiment does not make sense because the leaf zinc levels from the all seasons spray treatment should be higher than any of the other treatments. The only explanation may be due to tree development and zinc availability in the soil. During the first and second growing seasons, the trees may have developed enough roots allowing them to forage for zinc in the soils.