Almond Culture and Orchard Management

Project No: **02-BK-01** Correct Project Number: 02-JE-02
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Sub Project Leaders: **Roger Duncan, Mark Freeman, Brent Holtz, Mario Viveros**

Objectives:

1) Evaluate the response of almonds to deep slip plow tillage.
2) Evaluate wood chipping to reduce air pollution and build soil organic matter.
3) Evaluate controls for Tenlined June Beetle.
4) Investigate pellicle inking in Sonora.
5) Re-evaluate established critical leaf potassium values.

Results:

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 'Nonpareil' almonds 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 on Arbuckle series gravelly loam Class II soil.

Results: The 2002 data represents the third commercial harvest on these 6th leaf trees. Yield results in the table show no difference in production between slip plowed areas and non-slip areas. Production in this orchard was high this season at about 2700 lbs per acre providing for a more demanding test. Kernels sizes were also about equal at 1.2 gms/kernel or 24/ounce. The test area consists of trees planted on Lovell peach and peach/almond hybrid rootstocks. Frost damage in March affected production of the P/A hybrid root section of the orchard. No evaluation was possible here. Three consecutive years of yield evaluations have found no difference between trees planted in slip plowed and non-slip areas. However, a complete evaluation of slip plowing in almonds should consider surface/subsurface drainage patterns during wet winters and ultimately the possible advantage to tree survival. This test site has this potential given a wet winter.

	Kernel lbs/acre	Weight gms/kernel
Slip Plow	2725	1.177
No Slip Plow	2761	1.215
	NS	NS

2) Wood chipping almond brush and its effect on the almond rhizosphere, soil aggregation, and soil nutrients

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Keywords: *Prunus dulcis*, rhizosphere, free-living nematodes, soil aggregating basidiomycetes, petiole and soil nutrients

The wood chipping of almond (*Prunus dulcis*) prunings could provide an alternative to burning that would not contribute to air pollution and add valuable organic matter to soils. The success of wood chipping depends on whether the wood chips delete the soil of critical nutrients necessary for tree growth. An experiment was established where wood chips were mixed with soil and placed in containers, each with an almond tree, in order to quantitatively examine the effect of wood chips on soil nutrients, soil aggregation, and the rhizosphere microbial community. Control trees were planted in containers without wood chips. Tissue analysis was performed on leaf petioles to determine whether the wood chips had an effect on nutrient availability. After the 1st year, trees growing with wood chips had less N, Zn, and Mn while P was increased. After the 2nd year, trees with wood chips no longer had less N levels while P and K were significantly increased, but Zn was decreased. Soil analysis after the 1st year showed significantly higher levels of Ca, Mg, Zn, Cu, P, and K with wood chips. The % carbon, NH_4-N, cation-exchange-capacity (CEC), electrical conductivity (EC), and % organic matter (OM) were increased. The soil pH and NO_3-N levels were decreased. Similar results were obtained the 2nd year except that Mn and Fe levels were decreased in wood chipped soils while B and Na were increased. The CEC was no longer higher in wood chipped soils. When nematode populations were assayed after the 1st year there were less *Criconemella* and more *Bunonema*, *Doryleimida*, and free-living bacterial and fungal feeding nematodes in wood chipped soils. Similar results were obtained after the 2nd year except that root lesion was reduced in wood chipped soils. More basidiomycetes were counted in wood chipped soils and detected at higher levels with ELISA. Larger soil aggregates were found in wood chipped soils. Undisturbed wood chipped soils had more soil aggregates than disturbed wood chipped soils.

3) <u>Evaluation and Control of Tenlined June Beetle Damage in Almonds</u>

Mark Freeman and Richard Coviello (UCCE Fresno County), Marshall Johnson (UCR Entomology), Walt Bentley (UC IPM), Robert VanSteenwyk (UCB Entomology)

We are finding increasing amounts of tree damage and death resulting from the feeding of the Tenlined June Beetle larva, *Polyphylla decemlineata* (Say) on roots of almond trees. Previous research (about 15 years ago) done with almonds on sandy soil in San Joaquin County found that most insect larvae are found in the top 14 inches of soil, that the adult females do not fly, and that two soil insecticides suppressed larval populations. In addition, researchers found larva in the soil were always associated with almond roots.

We held a field meeting in July on the problem and produced a color pamphlet with pictures of the insect and damage. Currently, we are conducting field surveys of affected orchards. Preliminary results indicate that damage is worse on the sandy soils, on nemaguard rootstock, and with pressurized irrigation (drip and micro-sprinkler) systems. The larva feed mostly on the larger diameter roots and on roots of mature trees. We are also looking at factors such as almond varieties, ground floor management, irrigation scheduling, fertilization programs, and neighboring crop types. Feeding damage from larva has been found on cherry, apple, peach, plum, walnut, and grape roots. There is evidence that larva move vertically in response to fluctuating soil moisture levels.

A few "black light" traps were established to attract adult beetles that were flying, and only males were caught. We are investigating technology that can deliver synthetic insecticides to the soil larva. We are also investigating possible biological control methods with a parasitic wasp that is found in the Fresno area, and using biological pesticides.

4) <u>Pellical Inking in Sonora</u>

Mario Viveros, Deciduous Tree Fruits and Nuts Advisor, Kern County

The Sonora almond variety, in some years, has shown inking or discoloration on the pellical. This consists of brown to dark brown spots, which can vary from small pin size dots to areas that cover more than 50% of the nut surface. Both growers and handlers have been concerned about this problem, which is exclusive of the Sonora variety.

There is no information on the cause of inking, therefore, we decided to do the following: a) surveyed Sonora orchards under flood, micro-sprinkler, single hose drip, double hose drip and sub-surface drip irrigation systems; b) the surveys will be done pre-pit hardening, post pit hardening and during hull split; c) samples will be taken from "Hull Rot" disease and healthy nuts and, d) boron determinations in hulls from each of the irrigation systems.

The nut samples were collected from all the irrigation systems at pre-pit hardening, post pit hardening and during hull split. "Hull Rot" and healthy nuts were also taken from the drip irrigated orchard. Hull samples were sent to our laboratory at UC Davis.

At this time, we are in the process of cracking and analyzing nut samples. The results should be ready for the Annual Almond Research Conference.

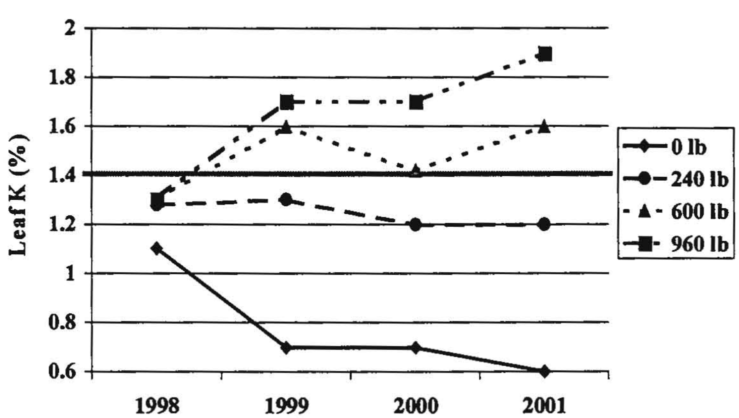
5) Leaf Potassium Critical Values as Related to Long-term Yield in Almond.

Roger Duncan, UCCE Farm Advisor, Stanislaus County; Steven Weinbaum, Ted DeJong, Richard Heerema, and Edwin Reidel, Dept. of Pomology, UC Davis.

The currently accepted potassium (K) critical value of 1.4% in July-sampled almond leaves appears to be based primarily on leaf symptomology and orchard surveys rather than experimentally determined values that associate inadequate K availability with yield reduction. Our objectives, therefore, were to reassess the validity of the critical value and determine how K deficiency impacts yield as well as the time frame over which that impact occurs. A trial was initiated in 1998 in which a range of leaf potassium values (0.6% - 1.9%) were established through differential potassium fertilization. Work conducted in 1999 and 2000 indicated that percentage fruit set and kernel weight were not reduced by K deficiency. Thus, during the onset year of K deficiency, yield is not likely to be impacted. We also reported that survival of fruiting spurs was much lower than that of non-fruiting spurs and was further reduced by K deficiency. In 2001, we measured a 40% reduction in spur renewal per tree on low K trees while shoot growth per tree declined by about 20%. Thus, yield reduction due to potassium deficiency appears to take at least two years to materialize and yield losses will be long-term.

Fig. 1 shows leaf potassium dynamics during four years of differential fertilization. All plots started the experiment with leaf K levels of 1.1 – 1.3%. Leaf K values steadily fell to an average of 0.6% in plots receiving no potassium. Trees fertilized annually with 240 lb. of potash (K_2O) maintained approximately even levels of leaf K or perhaps showed a slight decline, while 600 and 960 pounds of K_2O applied annually increased leaf K levels 0.3% and 0.6%, respectively. Trees in this experiment yielded an average of ca. 2600 meat pounds per acre over the duration of this experiment.

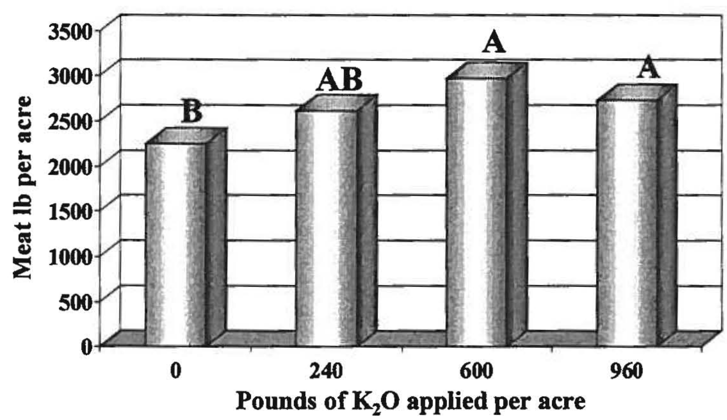
Fig. 1. Leaf Potassium Dynamics Over Four Years of Differential Potash Fertilization



In 2000, trees that had not received potassium fertilizer since 1997 had significantly lower yields than fertilized trees. In 2002, unfertilized trees again had significantly lower yields than trees fertilized with

600 or 960 pounds of K_2O annually (reductions of 23.5% and 16.4%, respectively). Trees fertilized with 240 lb. K_2O had yields numerically between the higher fertilizer rates and unfertilized trees (Fig. 2).

Fig. 2. 2002 Yield of Nonpareil Almond Trees After Four Years of Differential Potash Fertilization



The relationship between leaf K values and yield was examined using average leaf potassium data from 1999 through 2001 and comparing these data to 2002 yield. There was a significant, positive correlation between leaf K and yield when leaf values at or below 1.4% were examined. Leaf levels higher than 1.4% were not associated with higher yields (Fig.3). Results from this experiment do not indicate that the current potassium critical value of 1.4% should be modified at this time.

Fig. 3. 2002 Almond Tree Yields Related to Leaf K Values Above and Below 1.4%

Leaf K values are 3-year averages from 1999 - 2001