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ANNUAL REPORT TO THE ALMOND BOARD OF CALIFORNIA

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# Nitrogen on Drip Irrigated Almonds

by

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Objectives: (1) To evaluate the effects of different nitrogen rates applied at two water levels on growth, nutrient concentrations in leaves and twigs, and nut yields of almonds. (2) To assess the extent of soil acidification from nitrogen application under drip emitters. (3) To develop recommendations for nitrogen, irrigation and soil management for use in the establishment of almond orchards. (4) Evaluate changes in nutrient movement in drip zone as a result of acidification, leaching and nutrient uptake.

Problem and its Significance: Drip irrigation is a unique method of providing water to trees which makes for a number of challenging management situations. Having a relative small volume of soil being used as the reservoir for water and nutrient uptake which is saturated a high percent of the time during the summer provides a setting for several unusual chemical reactions in the soil. The use of an acidifying nitrogen fertilizer such as urea may increase the solubility of toxic elements like manganese and aluminum. Denitrification may also be occurring at a rather rapid rate which could result in reduced nitrogen efficiency by the crop. Because the answers to a number of these questions are still unknown this project was initiated and the continuing challenges will allow for the development of solutions so that growers can manage fertilizer application through drip irrigation systems to achieve profitable almond production.

Interpretive Summary: The orchard was planted on the Nickels Trust Ranch in the spring of 1981 to three almond varieties--Butte, Carmel and Nonpareil on a 12' X 18'spacing (202 trees/A). In the spring of 1982, five-5 tree plots were selected from each of the four-28 tree rows of each variety to which the two replications of the ten treatments were assigned. The ten treatments included two water levels-0.6 and 1.0 of evapotranspiration (ET) each with five nitrogen rates-0, 0.5, 1.0, 1.5 and 2.0 oz/tree in 1982; 0, 0.8, 1.7, 3.5 and 7.0 oz/tree in 1983; 0, 2, 4, 8 and 16 oz/tree in 1984; 4, 8, 16, 24 and 32 oz/tree in 1985; 6, 12, 24, 36 and 48 oz/tree in 1986; 8, 16, 32, 48 and 64 oz/tree in 1987 and 1988. Rates planned for 1989 are 6, 12, 24, 36 and 48 oz/tree. Urea is the nitrogen fertilizer source and it is applied on a monthly basis is six equal increments beginning April 1st. The 1.0 ET irrigation level is based on climatic data and visual observation to maintain active tree growth. The 0.6 ET treatments receive 60% of the water quantity of the 1.0 ET treatments.

Yields during 1988 were somewhat lower than the exceptional high yields recorded in 1987. The average yield was about 1400 kernel pounds per acre for the 8 oz/tree nitrogen rate and increased to approximately 2400 for the three highest nitrogen rates (Figure 1). Little or no difference between the two irrigation levels was observed. Four individual plot yields were greater than 3000 meat pounds per acre with the highest being 3102. As has been the case in the past, the Butte and Carmel varieties recorded the highest yields with the highest water and nitrogen rates whereas the Nonpareil variety showed little difference between water levels and reached its peak yields at the lower nitrogen rates. The five year total accumulated kernel yields for all varieties and both irrigation levels are 5060, 6993, 8911, 9487 and 10453 pounds per acre for the five nitrogen rates respectively. The highest yielding individual plot, which has received both the highest nitrogen and water rates, produced 13,145 kernel pounds per acre during the five years.

Evaluating the individual year or accumulative yields to arrive at nitrogen rates might at first glance suggest the use of the highest rate but more careful study indicates that in 1988 and to a lesser extent 1987 the three highest nitrogen rates gave nearly the same yields. This suggests that high nitrogen rates can be utilized by almonds during the growth and development of the tree which also has a varying need for nitrogen to produce large kernel yields. After the tree structure has been developed the need for nitrogen may not be as large with the major portion going into the kernels and a lesser portion going into the development of new fruiting wood. Since the kernel yields have been very similar for the three highest nitrogen rates during 1988, plans for 1989 are to reduce all rates by 25% to 6, 12, 24, 36 and 48 oz N/tree or 75, 150, 300, 450 and 600 lbs N/A.

The seasonal changes in leaf nitrogen, phosphorus and potassium for 1987 are shown in Figures 2 through 4 respectively. Note that the nitrogen concentration for the two lowest nitrogen rates is similar and remained slightly above 2% for the July 1st sample date. Observe as well that the three highest nitrogen rates resulted in similar leaf nitrogen concentrations and that kernel yields were nearly the same. This would suggest that leaf nitrogen levels should be near 2.5% at the July 1st sample date to achieve near maximum yields. Leaf phosphorus and potassium concentrations are much lower for the higher nitrogen rates during the early sample dates with potassium concentrations remaining lower for the entire sampling season. Early season results for 1988 continue to indicate this trend and plans are underway to apply both nutrients on selected plots to evaluate the response. All other nutrient levels are in adequate supply and the higher concentrations of manganese have stabilized in the 300 to 450 ppm range. Twig nitrogen concentrations have continued to show good correlations with meat yields.

Soil samples taken the fall of 1986 from six treatments, the low, intermediate and highest nitrogen rates each of the two water levels, indicate the severity of pH change with the higher nitrogen rate had not changed significantly since the previous sampling in the fall of 1984. Plans are to resample the sites chosen in 1984 to evaluate changes that have occurred. Sampling will be done to a greater soil depth and to a greater distance from the drip emitter.

The nitrogen source trial was initiated in 1986 with ten treatments: (1) calcium nitrate annually, (2) calcium nitrate alternated yearly with urea, (3) urea-ammonium nitrate solution 32 annually, (4) Nphuric (urea-sulfuric acid) annually and (5) through (10) urea annually with different ameliorative treatments such as lime after acidification of the soil. Soil samples taken the summer of 1988 indicated that the degree of soil acidification was nearly the same for all sources of nitrogen fertilizer used. This could be due in part to the earlier use of urea (prior to 1986) which had acidified the soil to a large extent. More extensive soil sampling to assess differents between nitrogen fertilizer sources and the application of different lime treatments is planned during the coming year.

Plans for 1989 include continuing to take bloom and set counts, monthly leaf samples, nut yields, relative kernel, shell and hull weights, dormant season twig sampling and trunk diameter measurements. Extensive soil sampling of this trial and the nitrogen source-acidification experiment are planned to determine pH, calcium, magnesium, ammonium and nitrate-nitrogen movement and distribution in the drip zone to gain a better understanding of the fate of the higher nitrogen rates being used.

Figure 1. Almond meat yields in 1988 as influenced by nitrogen rate and water applied through drip system. Nickels Ranch.

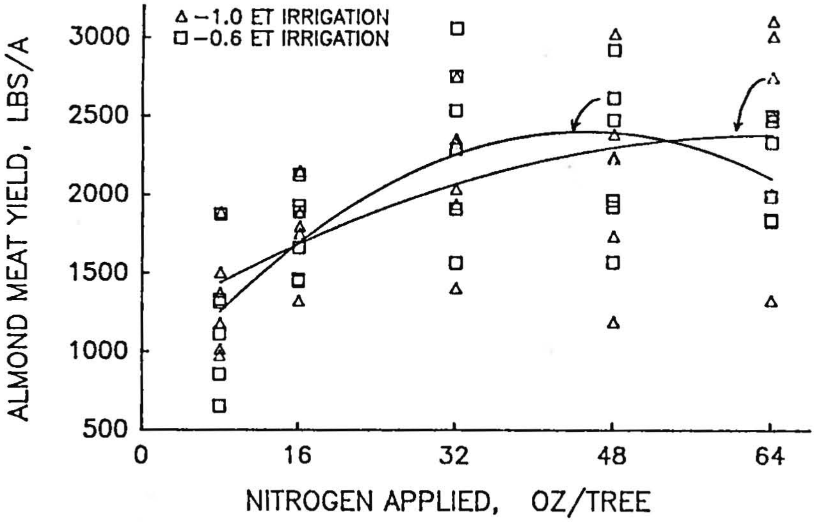


Figure 2. Almond leaf total nitrogen throughout 1987 for five rates of drip irrigation applied nitrogen. Nickels Ranch.

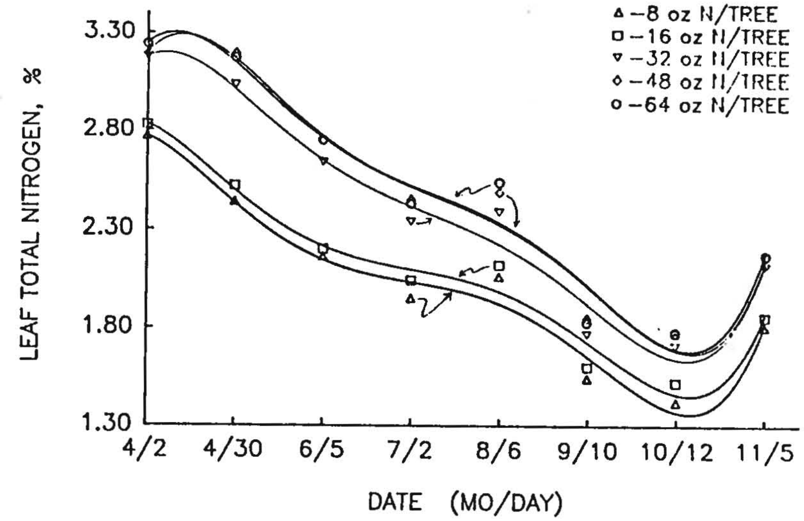


Figure 3. Almond leaf total phosphorus throughout 1987 for five rates of drip irrigation applied nitrogen. Nickels Ranch.

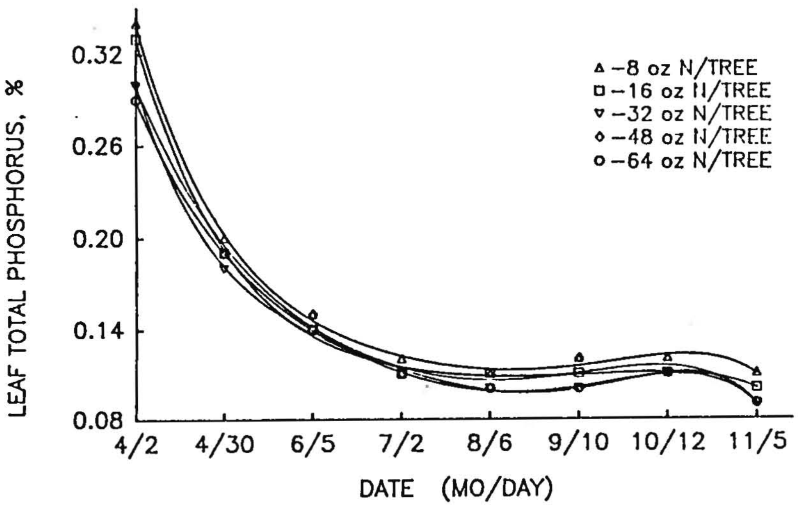


Figure 4. Almond leaf total potassium throughout 1987 for five rates of drip irrigation applied nitrogen. Nickels Ranch.