Project No. 93-Q12 - Tree and Crop Research - Nitrogen on Drip Irrigated Almonds

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Objectives:

1. To evaluate the effects of different N 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 N application under drip emitters and its effect on tree productivity.
3. To evaluate changes in nutrient movement in the drip zone as a result of nutrient uptake, leaching of nitrates, and acidification.
4. To evaluate the effects of two rates of K on growth, nutrient concentrations in leaves and nut yields.
5. To develop recommendations for nitrogen, irrigation and soil management for use during the establishment and early maturity stages of almond orchards.

Results: Yields in 1993 were slightly higher than in 1992 with four plots having yields greater than 3000 and 21 plots (out of 60) greater than 2500 meat lbs/A. The lowest plot yield was 1020 and the highest was 3286. Average yields for the three varieties Butte, Carmel and NonPareil (20 plots each) were 2085, 2170 and 2544 meat lbs per acre respectively. There was an increase in yield from the lowest nitrogen rate (0 oz/tree) to the fourth rate (16 oz/tree) with a trend for a decrease at the highest rate (32 oz/tree) at the 1.0 ET irrigation level. At the 0.6 ET irrigation level there was no yield increase across the five N rates. The yield differences between the 0.6 and 1.0 ET irrigation levels were 200 to 400 meat lbs/A across the five nitrogen rates. Meat yield re-

sponses for the three varieties to nitrogen rate at the two water levels were as follows: Butte - yield increase at both water levels up to the 16 oz/tree N rate with trend for decline at the 32 oz/tree rate, Carmel - No N response at 0.6 ET level with good (500 meat lb) increase from the 0 to 16 and 32 oz/tree rates, NonPareil - decrease in yield at the 0.6 ET water level with higher rates of N and at the 1.0 ET water level an increase up to the 16 oz/ tree rate with decline at the 32 oz/tree rate.

The orchard was planted in the spring of 1981 to three almond varieties--Butte, Carmel and Nonpareil on a 12' X 18' spacing (202 trees per acre). 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 fives 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; 6, 12, 24, 36 and 48 oz/tree in 1989 and 4, 8, 16, 24 and 32 oz/tree in 1990, 1991 and 1992. Rates applied in 1993 were 0, 4, 8, 16 and 32 oz/tree on two timing schedules; 1) one third each on 4/1, 5/1 and 7/1, and 2) one third each on 6/1, 8/1 and 9/1. Urea is the nitrogen fertilizer source and it was applied on a monthly basis in six equal increments (five in 1990, 1991 and 1992) beginning April 1st. The 1.0 ET irrigation level is based on CIMIS 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. In a second experiment different nitrogen sources have been used for several years. They are: urea, calcium nitrate, urea-calcium nitrate in alternating years, UN 32, N-phuric and 5 additional urea treatments to which different soil pH amendment materials will be added.

Tree trunk circumference measurements were taken in December and cross-sectional area was calculated to monitor tree growth for the 1992 growing season (299 trees). The data indicated there was a trend for the high water level to result in slightly greater increases in tree growth. There was no discernible effect of nitrogen rate on the tree trunk growth increases. These growth increases are somewhat different from earlier years when nitrogen rate was the more dominant factor in influencing trunk growth. A trend was observed for the Nonpareil variety to have a slightly larger increase in growth than the Butte variety which had only a marginally greater increase than the Carmel variety.

Twig samples from each of the 60 plots were taken twice, early dormancy-December 17-18, 1992 and late dormancy-February 26, 1993. Significantly higher twig total nitrogen (N), calcium (Ca), sulfur (S), zinc (Zn), manganese (Mn) and boron (B) concentrations were associated with higher applied N rates

for both sample dates. Water level had no effect on nutrient levels. At the early sampling date, significantly lower concentrations of potassium (K) were present at the higher N rates. No significant differences were observed in twig total phosphorus for the nitrogen rate-water level treatments. Higher concentrations in total N, P and K, slightly lower total Ca and nearly the same total S, Zn, Mn and B were observed in the late versus the early dormancy samples. It was also noted that at both sample dates the ranking for the three varieties from highest to lowest was Carmel > Butte > Nonpareil for the nutrients total P, S, Zn and B. The ranking was the same in the early sample date only for total N and K. For total Ca, the ranking was Butte > Nonpareil > Carmel on both sample dates. No differences between varieties was observed for either sample date for total Mn.

Leaf samples were taken on April 2 and 5, May 3, June 2, July 6 and 7, August 5 and October 1 and 4, 1993. Only the results for total potassium (K) of the May and June sample date are available at this time. On both sample dates total K concentration was reduced with higher rates of applied nitrogen. No water level effect on leaf total K was observed and there was no difference in total K between the three varieties. The total leaf K concentration was increased significantly in the applied K treatments in the June sampling with a strong trend indicated in the May sampling.

Soil samples were taken during the October through December 1992 period from several of the nitrogen rate-water level treatments. Samples were taken immediately under and at various distances from the emitters to various depths to assess nitrate and other nutrient movement. Very little nitrate or ammonium nitrogen was present in the samples from the two lowest N rate treatments with only small accumulations in the middle rate. At the two higher N rate treatments, both nitrate and ammonium nitrogen concentrations were higher, particularly with the lower water level treatment.

Soil samples are currently being taken from plots where several different nitrogen fertilizer sources have been applied. Samples are being collected from immediately under and at various distances from the emitters to a depth of about six feet or more to learn the degree of nitrate movement below the root zone. Earlier sampling has indicated a slightly greater acidification effect when the more acid forming materials were applied. Complimentary funding from the Fertilizer Research and Education Program of the California Department of Food and Agriculture has provided more extensive sampling of nitrogen rate-water level treatments and the fertilizer source treatments. This funding will provide the opportunity to evaluate pH, nitrate, ammonium and other cation distribution under the emitter basins.