Project No. 93-ZC4 - Optimizating Nitrogen Fertilization

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Objectives:

Overall:

1. Develop management guidelines to maintain almond productivity while reducing the leaching of fertilizer N below the root zone in almond orchards growing in coarse-textured soils.

2. Relate nitrate leaching in mature almond orchards growing in coarse-textured soils in "Nitrate Sensitive Areas" to leaf N concentration, tree yield and the rate of fertilizer N applied.

3. Evaluate the need for annual applications of fertilizer N in mature almond orchards growing in coarse-textured soils characteristic of Nitrate Sensitive Areas.

4. Assess the relationship between differential fertilizer N application rates and the percentage recovery of fertilizer N by mature almond trees using isotopically labeled fertilizer.

5. Reassess the validity of the currently accepted N critical values for almonds.

1993:

1. Continue establishment of tree N and soil nitrate differentials as a result of differential fertilizer N application rates.

2. Continue monitoring leaf N concentration (tree N status), soil nitrate levels, and productivity (i.e. individual tree yields).

3. Measure soil hydraulic conductivity and water fluxes below the root zone.

4. Apply istopically labeled fertilizer in the Salida orchard during late summer.

Results:

Two research plots were established in nitrate-sensitive areas of Stanislaus County in 1990. The orchards (located in Ceres and Salida) were planted in 1980, and the soils of both are classified as Hanford sandy loams. Differential rates of N fertilization (0, 125, 250, and 500 lbs. actual N per acre) have been applied as a 1/3 and 2/3 (of the annual application) split between April and October, respectively. The presence of high residual levels of nitrate in the soil and the utilization of high nitrate irrigation water (33 ppm nitrate in Salida and 44 ppm nitrate in Ceres) delayed yield reduction in unfertilized trees until 1993. In the Ceres orchard, tree yields did not differ significantly among the 125, 250, and 500 lbs N/A/Yr treatments in 1993, but the yields of the unfertilized trees were reduced. Similar results were obtained in the Salida Orchard. The lack of significant yield reduction in unfertilized trees over a 3 year period indicates that annual fertilization is not necessarily required to maintain productivity.

Leaf N concentrations decreased annually in all treatments and in both orchards between 1990 (pretreatment) and 1992 with the greatest decrease in leaf N concentration occurring among the unfertilized trees. Leaf N concentrations (including those trees receiving no fertilizer N), exhibited higher leaf N concentrations in 1993 than in 1992. Currently, almond trees are considered N deficient at leaf N concentrations below 2.0%, and leaf N concentrations between 2.2 and 2.5% are considered adequate. However, the experimental validitation of these guidelines and the relationship between tree productivity and leaf N concentrations remains questionable. After 3 1/2 years without supplemental fertilizer N, the unfertilized trees averaged about 2.28% and 2.37% in the Salida and Ceres orchards, respectively.

Our data suggest that tree yields are reduced when leaf N concentrations dip below 2.2%. Preliminary analyses also suggest that tree yields may even be reduced at leaf N concentrations between 2.2% and 2.3% Additional analyses next year may further clarify those relationships. Flower number per acre determines the yield potential in almond, and flowers begin development 6 months prior to bloom and a year before fruit maturity and harvest. We believe, therefore, that leaf N concentrations determined in July may be linked more directly to yield in the subsequent year than in the current year.

Soil hydraulic conductivity has been determined, and nitrate leaching, as a function of the level of applied fertilizer N, is being measured from June, 1993 until May, 1994. Isotopically labeled ammonium sulfate was applied to seventeen trees in the Salida orchard on October 2, 1993 following harvest. The effect of tree N status (as influenced by the rate of applied fertilizer N) on the recovery of isotopically-labeled fertilizer N in blossoms (February) and fruit (August) will be determined 1994. We anticipate achieving all project objectives and submitting a final report by June 1995.