Project No. 88-R2 - Tree and Crop Research
Root Zone Acidity and Chemistry

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Objectives: Determine the effects of nitrogen (N) fertilization on soil and rhizosphere (root zone) pH and the tree response consequences of this acidity. Acid soils are normally high in aluminum (Al), manganese (Mn) and hydrogen (H) and low in calcium and other bases and phosphorus. this project will quantify the Al, Mn and H levels associated with root zone acidity generated by nitrogen fertilization and contrast the bulk soil conditions with that of soil surrounding fine roots.

Interpretive Summary:

The orchard used for this project is located near Arbuckle and was planted in 1981 and nitrogen fertilization began in 1982. The highest nitrogen application rate was 2, 7, 16, 32, 48, 64 and 64 oz per tree in 1982, 1983, 1984, 1985, 1986, 1987 and 1988 respectively. Low nitrogen levels were 0, 0, 0, 4, 5, 8 and 8 oz. per tree over the same period. Rates of 64 oz. per tree are equivalent to 800 lbs N/per acre. The high urea applications have acidified the drip zone and lowered soil pH.

Because low pH could affect growth and tree nutrition, this project has been investigating properties of bulk soil and rhizosphere soil (soil in very close proximity to the roots) in the acid drip zone. Leaf samples were taken in March and September to assess increases in Mn noted in earlier years. Samples of rhizosphere and bulk soil were collected from high and low N treatments in the Nonpareil plots in March 1988 to contrast with those collected in November 1987. These samples showed that extractable nitrogen was very high in the high N treatments and was low in the low N treatments. Based on tree appearance and extractable soil levels, the low N treatments supply less nitrogen than necessary for good tree growth. In one of the high nitrogen plots extractable ammonium was very high and nitrate was low. This indicates that the applied urea was not being converted to nitrate and generating acidity. The less acid nature of these soil samples is in agreement with such a suggestion. The most likely explanations is that the high water content of the drip zone was limiting nitrification and lowering acid production. Extractable Mn in this plot was high indicating poor aeration which could limit nitrification. Fertilizer reactions in drip zones can be different than those found in other irrigation methods. In the low N treatments, pH varied from about 5 to over 7, while the high N treatments had pH levels from 3.8 to about 7. In both nitrogen treatments the surface is less acidic and pH decreases with depth. Rhizosphere pH follows the same pattern as bulk soil pH, but the rhizosphere was less acid that the bulk soil in high N treatments. The rhizosphere was more acidic than bulk soil in the less acidic low N treatments. As acidity increased with depth, extractable Al increased in the bulk and rhizosphere samples, but rhizosphere samples had less extractable aluminum than the bulk soil and more organic matter. Thus the rhizosphere in the more strongly acidic samples is presumed to be more amenable to root growth than the bulk soil.

Manganese was higher in tissue samples from the more acidic high N treatments sampled in the fall of 1987. In March of 1988, tissue Mn was lower than in fall of 1987 but increased in the September 1988 samples. For example, Mn was 125 ppm in the high N tissue in March 1988 and increased to 343 ppm by September. While elevated these levels do not appear to be toxic. Extractable Mn increased with depth in some plots to values as high as 125 ppm. This is most likely a response to poor aeration. The orchard is well supplied with Zn judging by leaf levels in March samples which averaged about 40 ppm. Phosphorus levels were adequate but lower in the high N treatment tissue, most likely because of better growth and dilution.

Observations indicated that there are fewer roots in strongly acidic drip zones. Whether this is true, awaits further investigation in the coming year. In all treatments roots are more abundant in the surface which is less acidic. Surface samples from Butte and Nonpareil plots had twice as much organic matter in the rhizosphere as in the bulk soil in both varieties and N treatments.

In the next year root distribution in relation to the drip zone and soil acidity as well as further investigations of soil aluminum and nutrient availability are planned.

16TH ANNUAL ALMOND RESEARCH CONFERENCE, DECEMBER 6, 1988, SACRAMENTO

Project 88-S9 - Tree and Crop Research
Fumigation, Sealing and Concealed Damage Studies

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<u>Objectives</u>: (1) Determine minimum lethal fumigation conditions of phosphine for navel orangeworm larvae, pupae and eggs. (2) Determine depletion of organic bromide from shelled and inshell almonds treated with methyl bromide at different temperatures and rates and under varying aeration conditions. (3) Determine the permeability of varous test sealants to phosphine. (4) Investigate the potential of a photometer as a means of electronically sorting almonds with concealed damage.

<u>Interpretive Summary</u>:

1. Phosphine/Navel Orangeworm Fumigation Study

Fumigation tests were conducted for control of NOW eggs, the most resistant stage, in inshell almonds at 60, 70, 80 or 90^{o}F using a constant dosage of 30g/1000 ft^{3} phosphine gas generated from aluminum phosphide pellets. Phosphine fumigation at 60^{o}F for 8 days resulted in a mean egg mortality of 99.8% with an ending mean gas concentration of 33 ppm. Treatment at 70^{o}F for 4 days resulted in 100% mortality with an end gas concentration of 62 ppm. Fumigation at 80^{o}F for 3 days or 90^{o}F for 2 days resulted in 100% mortality of NOW eggs, with an ending gas concentration of 48 ppm in each case. In our tests we have found that the length of the exposure period in relation to treatment temperature are more critical elements than dosage rate in obtaining complete kill with phosphine gas. However, it is essential that the phosphine gas is held by the fumigation