Project No. 93-AC3 - Salinity & Boron Effects on Almond under Trickle Irrigation

Project Leader: Dr. Patrick Brown
University of California
Department of Pomology
Davis CA 95616
(916) 752-0929

Cooperating Personnel: Nening Hu, Rawia El-Motaium, Bob Hutmacher

Objectives:

1. To determine the effect of boron and salinity on root growth and tree productivity in irrigated almonds.
2. To follow the accumulation of B, Na, Cl and other elements in plant and soil as influenced by irrigation volume, salinity (EC_e) and B concentration.
3. To identify the symptoms of B toxicity in almond and to identify the soil and plant B levels at which yield will be reduced.
4. Determine the relative susceptibility of various almond, peach, plum and hybrid rootstocks for use with almond in salinity and B sensitive areas.

Results:

Significant yield reduction as a result of root-zone and tissue accumulation of B, Na and Cl was observed in almond in the 1991 and 1992 season. Yield depression was correlated with a marked accumulation of B in the hull and stem tissue, and of Na and Cl in leaf tissue of almond. The lack of B accumulation in leaf tissue suggests that standard leaf sampling techniques are insufficient to quantify B accumulation in Prunus species. Almond responds to Na and Cl accumulation with a characteristic leaf burn, this can be distinguished from B toxicity which results in the death of young stem tissue with no significant leaf symptomology.

A two year pot study of six rootstocks used for almond, suggests a great diversity in salinity and B tolerance exists amongst these common rootstocks. The peach rootstocks Nemared, Nemaguard and Levell and the plum rootstock "Marrianna" are uniformly sensitive to high B as well as saline conditions, the combination of Band salinity results in the greatest impact on plant growth. In contrast, the plum rootstock Myrabolan, are quite tolerant of saline

conditions (up to 8 $ds.m^{-1}$) while only Myrabolan is tolerant of both high B and saline conditions. Peach x almond hybrid rootstock was tolerant of high B and saline conditions as well as of saline conditions alone, but was relatively sensitive to high B stress alone. Grafting studies and tissue elemental analysis indicates that tolerance to high B and salinity is associated with an exclusion of the toxic elements from the above ground organs.

PROJECT CONCLUSIONS:

Boron Toxicity can significantly impact yield

It takes several years for B toxicity to impact yield. In circumstances were the irrigation water is the only significant B source, the short term (1-2 years) use of moderately B water (1-2ppm) can be tolerated if followed by a period of low B water (<1 ppm). Soils high in native B will ultimately impair the growth of Almond.

The best indicator of B toxicity is the B content of almond hulls at early hull split

B concentrations in excess of 200 ppm in the hull indicate a potential problem, particularly if Na is present in excess.

B toxicity symptoms include

- Appearence of dark spots on young stem tissue and leaf midribs
- Formation of gummy deposits on stems
- Gummy nuts
- New growth may suddenly collapse, resulting in the death of isolated branches (young tissue only). Leaves on affected stems may dry completely, resembling severe wate stress or Verticillium damage.

***NOTE: Other nutrient deficiencies and diseases may cause similar symptoms, analysis of hulls should be performed to verify the presence of excess B.

Rootstocks differ in their tolerance of High B and Na

- Peach Rootstocks -"Nemared, Nemaguard and Lovell" and the plum rootstock- "Marrianna" are sensitive to excess B and Na
- Peach x Almond hybrid rootstocks (only "Brights" hybrid was tested in these experiments), are tolerant of high B and Na together, or high Na by itself but were sensitive to high B when present alone.
- The plum rootstock "Myrabolan" was tolerant of high Na and B.

***NOTE: Selection of rootstock should not be based on Na and B tolerance alone. Factors such as precocity, growth form, disease tolerance and graft compatibility (amongst others) should always be considered in selecting a rootstock.