The Physiology and Management of Salinity Stress in Almond: Influence of Rootstock, Scion, and Supplemental Nutrition on Tree Growth, Ion Toxicity and Water Relations

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PROJECT SUMMARY

Objectives:

- Compare the salinity tolerance of selected rootstocks and cultivars in different combinations
- Measure the net Na and Cl uptake rates of different rootstocks at different salinity levels
- Investigate the interactions between the mineral nutrients N and K and the toxic ions Na and Cl
- Quantify the effect of saline conditions on nitrate uptake kinetics of almond
- Understand how non-uniform salinity affects water, nutrient, and salt uptake to devise improved salt management strategies

Background and Discussion:

Salinity is increasing in some almond-growing regions of California due to low rainfall, high evapotranspiration rates, and use of saline water. Salinity may impose water stress on plants and the accumulation of the salt ions Na and Cl in tissues causes toxic effects. Due to their cumulative nature, ionic toxicities tend to be more important for perennials than for annuals crops.

To address the above objectives, experiments were conducted in 2015 which were repeated in 2016 with additional rootstocks and modified salinity treatments. Detailed plant performance and saline ion monitoring for 2016 are underway and analysis will be completed in December.

There is substantial variation among almond cultivars and rootstocks in salinity tolerance. Nemaguard, the most common rootstock used for almond production in California, appears to be the most salt-sensitive among the tested ones; while Empyrean-1 and Viking exhibit superior tolerance. Other important rootstocks are under investigation for their salinity tolerance. Among cultivars, Nonpareil is particularly salt-tolerant, whereas Mission and Fritz are very sensitive. At practically relevant EC levels (2-4 dS/m), well-irrigated almonds may not be significantly affected by salt-induced water stress. Specific ion toxicities are mainly responsible for salt damage to almond. Cl accumulates significantly faster to toxic levels in leaves. In contrast, Na toxicity is less acute but more cumulative as woody tissues store significant levels of Na. In-season recovery treatments with high-quality water may minimize the carry-over effects of salinity in the next growing season.

Salt-tolerant rootstocks limit the amounts of Na and Cl that reach the scion. Interestingly, the Na and Cl exclusion capabilities of rootstocks seem to correlate. The salinity tolerance variation among the cultivars is mainly accounted for by the Na-storage capacities of the genotypes. Cl appears to be primarily responsible for the toxicity symptoms which accumulate in leaves at much faster rate than Na. Excessively high levels of K aggravated Cl toxicity and caused severe necrosis and defoliation compared to NaCl treated trees. Na_2SO_4 treated trees showed no stress or toxicity symptoms even though they received the same level of Na as the NaCl.

Split-root experiments with non-uniform salt treatments showed that rootstocks limit their water uptake from the saline zone and absorb more water from the non-saline zone. This substantially reduces the total salt uptake of rootstocks. These findings may have important implications for salinity management in almond orchards.

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For More Details, Visit

- Poster location 37, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2017) at Almonds.com/ResearchDatabase
- 2015 - 2016 Annual Reports CD (15-HORT20-Brown/Grattan); or on the web (after January 2017) at Almonds.com/ResearchDatabase
- Related projects: 16-HORT23-Drakakaki (COC); 16-HORT4-Duncan; 16-HORT10-Gradziel; 16-HORT16-Aradhya/Kluepfel (COC)