Determination of Root Distribution and Physiological Parameters of Nitrogen Uptake in Almonds to Optimize Fertigation Practices

Project Leader: Patrick Brown
Department of Plant Sciences, University of California, Davis, One Shields Ave., Davis, CA 95616
(530)752-0929; phbrown@ucdavis.edu

PROJECT SUMMARY

Objectives for current year:

- Determine almond root growth and phenology, and characterize root distribution and activity as influenced by soil and tree nitrogen status.
- Determination of the patterns and biological dynamics (K_m, V_{max}, C_{min}) of root nitrogen uptake and the relationship to tree phenology and demand.
- Determine the optimal fertigation method based on N demand and N application

Background and Discussion:

To optimize nutrient use efficiency in fertigated almond orchards it is essential that fertilizers injected into irrigation system are provided at the optimal concentration, time and place to ensure that deposition patterns coincide with maximal root nutrient uptake. In order to optimize fertigation practices in almond orchards, information on the spatiotemporal distribution and activity of nutrients and roots in the soil profile, and knowledge of seasonal crop nutrient demand patterns is required. The overall goal is to combine information derived from this project (root phenology and root uptake), with information from associated projects (tree demand and N movement in soils) to improve the design of fertigation systems and to optimize the application (volume, distribution pattern, rate, timing etc.) of fertilizers.

Preliminary results show that the uptake of nitrate (NO_3) by roots is strongly influenced by the prior nitrogen status of the tree. Thus trees grown under low N conditions exhibited a higher NO_3 uptake capacity than those grown under high N treatments when exposed to low or moderate concentrations of NO_3 in the root media. This result suggests that N starved trees up-regulate N uptake and can access N from lower NO_3 concentrations than trees with sufficient N content. Trees grown under high N application had very limited ability to access NO_3 when present at low concentrations. At high NO_3 concentration ranges however, low N trees exhibited lower uptake capacity than high N status trees. These findings have relevance for the timing and distribution of the application of nitrogen during fertigation events.

Preliminary results from soil solution extraction at different soil depths and times, in trees provided either with continuous N applications (applied in every irrigation event) or episodic N fertigations (same quantity of N but applied 4 times in a season) showed that continuous fertigation practices result in reduced concentration of N-NO_3 in the soil solution at any depth at any time in comparison with the standard practice (namely episodic fertigation).

Data on root uptake of NO_3, the impact of plant nitrogen status on root uptake and the movement of NO_3 through the soil under continuous and episodic N application will be used to help optimize the efficiency of N use in Almonds.

Project Cooperators and Personnel: Andres Olivos, UC Davis; Blake Sanden, UCCE-Kern County; Paramount Farming Company

For More Details, Visit

- Poster location 27, Exhibit Hall A & B during conference; or on the web (after January 2012) at www.almondboard.com/researchreports
- 2011.2012 Annual Report CD (11.PREC5.Brown); or on the web (after January 2013.) at www.almondboard.com/researchreports
- Related projects: 12.HORT2.Brown;12.HORT11/11A.Sanden/Shackel; 12.HORT13.Lampinen; 12.AIR2.Smart; 12.HORT15.Hopmans