Optimization of Water and Nitrate Use Efficiencies for Almonds Under Micro-Irrigation

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PROJECT SUMMARY

Objectives:

- Collect a full range of data, from both ongoing field tests and other sources, as inputs for evaluating the computer-based HYDRUS-2D simulation model as an optimization tool applicable to almond research and management.
- To determine optimal irrigation and fertigation practices for micro-irrigation (drip and micro-sprinkler) systems for almond using the HYDRUS tool for a range of soil types.
- Refine and orchard test the tool, piggybacking on existing fertigation rate trials, minimizing leaching rates.

Background:

This multiyear project is premised on a dictum formulated by Tom Bruulsema and colleagues that optimal fertigation practice can be realized only by focusing on the "4 R's"—the right source, right rate, right place, and right time.

The goal of this research project is to optimize management practices for various micro-irrigation systems, minimizing losses of water (leaching and evaporation) and nitrogen (leaching and denitrification), by using a computer-based modeling methodology for operating micro-irrigation systems in almond orchards.

To refine the modeling tool, additional field data on soil hydraulic properties, soil texture, and soil layering were obtained, and different types of soil-water-plant-atmosphere sensors were installed allowing for continuous monitoring of soil moisture, soil water potential gradients below the rooting zone, temperature, salinity, and nitrate concentration.

The model is to encompass all of the complexities associated with the dynamic interactions of water, nutrients, soil, air, and root systems. It will provide orchard managers with management guidelines for tracking—and also predicting—the flow and transport of water and nutrient at any time and location throughout and below the rooting zone.

Another anticipated advantage of using this multifaceted tool will be in the form of resource conservation. It will help to minimize the loss of water from leaching and evaporation, of nutrients from leaching and denitrification, and of yield loss from water stress and salinity stress.

Further, the tool will minimize the loss of time and other resources, thanks to its predictive capacity, which is likely to enhance problem solving. In addition, it has the potential to prove useful in helping growers and the almond industry deal with emerging regulations.

This year of study focused on the analysis of field-measured soil data, with the ultimate goal to assess and evaluate leaching rates of nitrates across the irrigation season for both irrigation treatments. We tentatively conclude that (a) leaching rates are largely controlled by irrigation type and soil heterogeneity (texture, layering), with irrigation frequency and applied water being the same; and (b) automated tensiometers are critical sensors in assessing magnitude of water and associated nitrate leaching rates.

Supported jointly by the Almond Board of California, the Pistachio Research Board, and the U.S. Department of Agriculture, this model development hopes to provide a valuable and specialized information and management tool.

Project Cooperators and Personnel: Maziar M. Kandelous, Patrick Brown, and David R. Smart, University of California, Davis

For more details, visit

- Poster location 25, Exhibit Hall A & B during conference; or on the web (after January 2013) at www.almondboard.com/researchreports
- 2011.2012 Annual Report CD (11.HORT15.Hopmans); or on the web (after January 2013) at www.almondboard.com/researchreports
- Related projects: 12.PREC2.Brown; 12.PREC5.Brown; 12.HORT11A.Sanden/Shackel; 12.HORT13.Lampinen; 12.AIR2.Smart; 12.PREC1.DeJong