Evaluating Nitrogen Management Strategies to Minimize Greenhouse Gas Emissions from California Almond Orchards

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PROJECT SUMMARY

Objectives:

- Assess soil nitrous oxide (N_2O) emissions in almond using two forms of nitrogen (N) fertilizer application: 1) low frequency high N and 2) high frequency low N for drip fertigation (HFLN).
- Evaluate N fertilizer type in limiting N_2O-forming soil N transformations.
- Identify microbial factors that control soil N_2O emissions; namely, nitrification and denitrification.
- Acquire data in 3-D over short term time scales for linking soil N_2O emissions to the Hydrus model.
- Use isotopic tracers to help estimate orchard fluxes of nitrogen (NH_4^+, NO_3^-, NH_3 gas, NO_x and N_2O).
- Assist with parameterization of the DeNitrification DeComposition (DNDC) and Hydrus models for use in a decision support framework.

Background and Discussion:

Offsite transport of reactive N from agriculture is facing increased regulatory scrutiny. Thus, one critical challenge facing California almond growers can be summed up in a two-word question: "Whither nitrogen?"

In an ideal world, the answer would be that N is fully taken up from soils by the tree, where it contributes to both growth and nut production. But in the real world, almond orchards are somewhat leaky. Some of the N is released in various gaseous forms to the atmosphere and some NO_3^- leached below the root zone where it might get into subsurface well waters.

Understanding nitrogen leakage and how much is leaking represent two interlocking questions being examined collaboratively by several research teams trying to unlock the complexities of what happens when water, nitrogen, and soil microbes interact in the orchard under varying conditions.

Their collective ultimate goal is to improve nitrogen use efficiency (NUE) in almond production, and thereby both maximize yield economically and minimize the offsite loss of reactive forms of nitrogen — especially N_2O, a potent greenhouse gas (GHG) and NO_3^-, to lessen contamination of groundwater.

This ongoing project, being coordinated with several other researchers, is focused on a comparative study of soil N_2O emissions and NO_3^- leaching using two methods of applying a given total of N fertilizer: comparing fewer but higher N applications targeted to tree demand (current practice) versus applying a small concentration of N with each irrigation ("spoon feed"). Nitrogen use efficiency (NUE), here defined as N assimilated by the tree as a percent of applied N is intensively monitored. The overall objective is to increase nitrogen into the tree and reduce reactive forms of N mobilized (NH_4^+, NO_3^-, NH_3, NO_x and N_2O).

The results are expected to provide practical management tools for growers to improve NUE for both almonds and pistachio. An important aspect of the project is to provide reliable information for regulators.

Project Cooperators and Personnel: Christine M.Stockert, Patrick Brown, and Michael Wolff, UC Davis; Blake Sanden, UCCE - Kern County; Franz Niederholzer, UCCE - Yuba County; ATB Growers, Paramount Farming Co.

For More Details, Visit

- Poster location 61, Exhibit Hall A and B during conference; or on the web (after January 2015) at http://www.almonds.com/growers/resources/research-database
- 2013.2014 Annual Report CD (13-AIR2-Smart); or on the web (after January 2015) at http://www.almonds.com/growers/resources/research-database
- Related Projects: 14-PREC5-Volder (Brown); 14-PREC4-Hopmans;14-STEWCROP4-Kimmelshue; 13-PREC2-Brown; 13-HORT11A-Sanden