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 (mainly NH_4^+, NO_3^- 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 is what causes and what can reduce offsite N movement.

In an ideal world, the applied N fertilizer is fully taken up from soils by the tree (NUE=100%), where it contributes to both growth and nut production. But in the real world, almond orchards, as are all crops, are somewhat leaky. Some of the N is released in various gaseous forms to the atmosphere and some as nitrate (NO_3^-) leached below the root zone.

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

The ultimate goal is to identify Best Management Practices (BMPs) with superior nitrogen use efficiency (NUE) in almond production, and maximize yield economically while minimizing offsite transport of reactive forms of N — primarily N_2O, a potent greenhouse gas (GHG), and NO_3^-, to lessen contamination of groundwater.

This ongoing project, is focused on a comparative study of soil N_2O emissions and NO_3^- leaching using two methods of applying 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, here defined as N assimilated by the tree as a percent of applied N is intensively monitored. A long term overall objective is to increase N that gets into the tree and lessen the totality of reactive N forms 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. A further aspect of the project is to provide reliable information on N2O emissions for regulatory agencies.

Project Cooperators and Personnel: Christine M. Stockert, Patrick Brown, Shahar Baram, and Sharon Dabach, UC Davis; Blake Sanden, UCCE - Kern County; Franz Niederholzer, UCCE – Colusa/Yuba/Sutter Counties; ATB Growers, Madera.

For More Details, Visit

- Poster location 63 Exhibit Hall A + B during the Almond Conference; or on the web (after January 2016) at Almonds.com/ResearchDatabase
- 2014 - 2015 Annual Reports CD (14-AIR2-Smart); are on the web (after January 2016) at Almonds.com/ResearchDatabase
- Related projects: 15-PREC5-Volder; 15.STEWCROP-Gaudin; 14-PREC4-Hopmans; 14-STEWCROP4-Kimmelshue; 13-PREC2-Brown; 13-HORT11A-Sanden