Evaluating Nitrogen Management Strategies to Minimize Reactive Nitrogen Mobilization from California Almond Orchards

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PROJECT SUMMARY

Objectives:

- Assess GHG emissions (N_2O, CH_4 and CO_2) from an orchard under computer controlled very high frequency low nitrogen (N) and low water applications (HFLN).
- Evaluate temporal variability of GHG emissions with respect to environmental factors such as volumetric water content and seasonal temperature variation.
- Identify microbial factors that control soil N_2O emissions; namely, nitrification and denitrification.
- Assess NO_3^- movement below the root zone from an orchard under computer controlled very high frequency low N and low water application.
- Assemble annual carbon footprint offset GHG budgets (N_2O, CH_4 and CO_2) and NO_3^- leaching budgets.
- Develop metrics for NO_3^- movement from below the root zone to first encounter with groundwater in a Hydrogeolotically Vulnerable Area (HVA).

Background and Discussion:

Offsite transport of reactive N (NH_4^+, NO_3^-, NH_3, NO_x and N_2O) from agriculture is facing increased regulatory scrutiny. Thus, one critical challenge facing California almond growers is what causes and what can reduce offsite reactive N loss.

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 N leakage represents 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^-, into groundwater.

This ongoing project, is focused on a comparative study of soil N_2O emissions and NO_3^- leaching using computer assisted irrigation and fertigation. Our experience with BMPs trials has indicated that limiting water and N to the root zone and increasing its residence time and targeted to tree demand (current practice) may enhance the “spoon feed” practice. Our experience has led us to the conclusion the most effective way to achieve spoon fed water and N is through computer assisted applications which ease the operational demands on growers. Nitrogen use efficiency, here defined as N assimilated by the tree as a percent of applied N plus mobilized reactive N (N_2O and NO_3^-), will be 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.

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 objective information on N_2O emissions and NO_3^- leaching dynamics for regulatory agencies.

Project Cooperators and Personnel: Christine M. Stockert, Patrick Brown, Jan Hopmans, and Thomas Harter, UC Davis; and Laura Hess of Stanford

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
- 2015 – 2016 Annual Report CD (15-AIR2-Smart; 15-PREC6-Smart)
- Related projects: 16-WATER-Horwarth/Dahlke; 14-PREC4-Hopmans; 13-PREC2-Brown;