Evaluating Mitigation Options of Nitrous Oxide Emissions in California Cropping Systems

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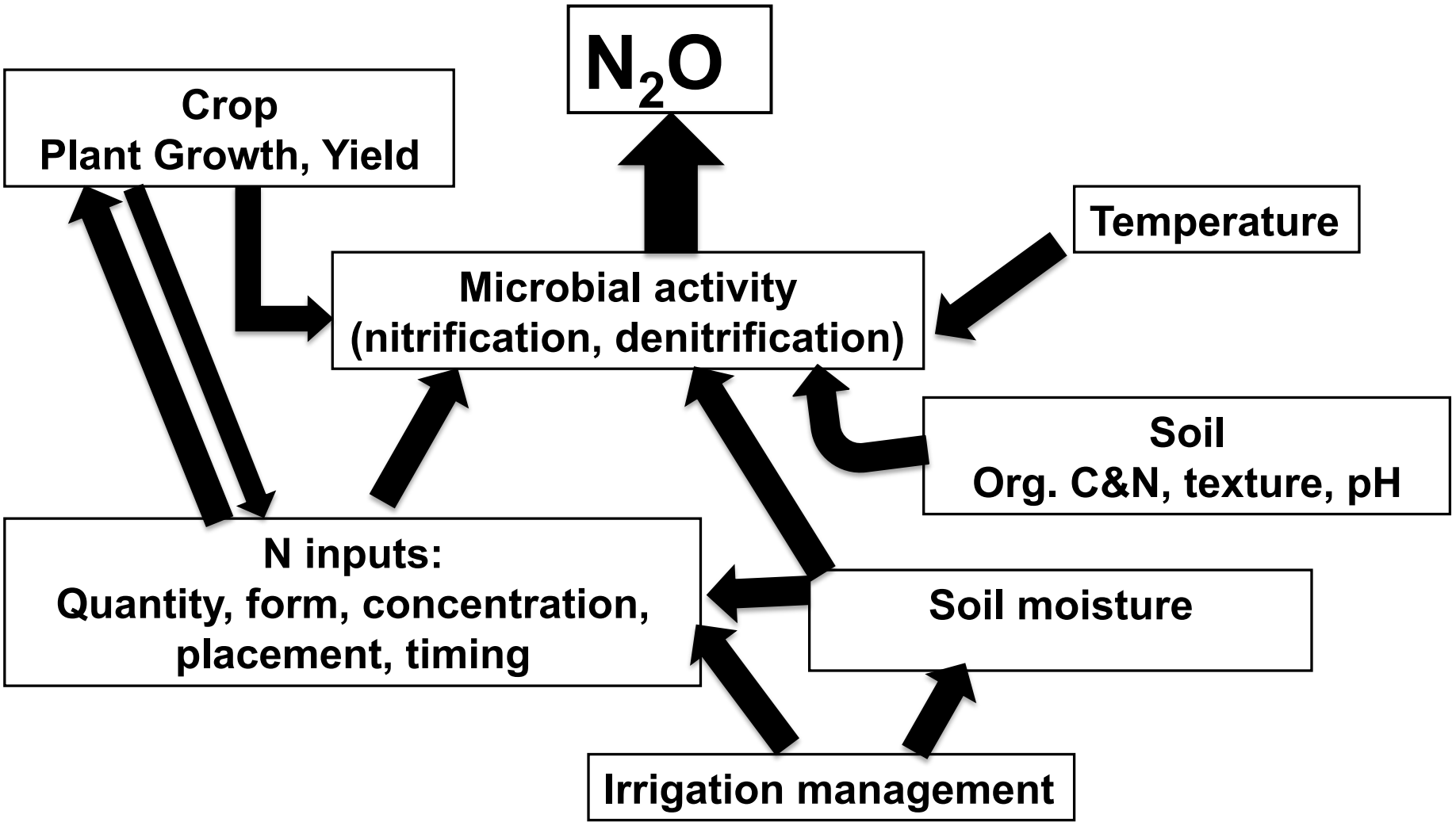
Objectives

- Systematic investigations of management practices that potentially mitigate N_2O emissions
- Management practices must maintain or enhance yield potential
- Evaluate practices in terms of nitrogen (N) use efficiency
- Consider total greenhouse gas emissions associated with each management practice

Controls on N_2O Emissions from Agricultural Soil



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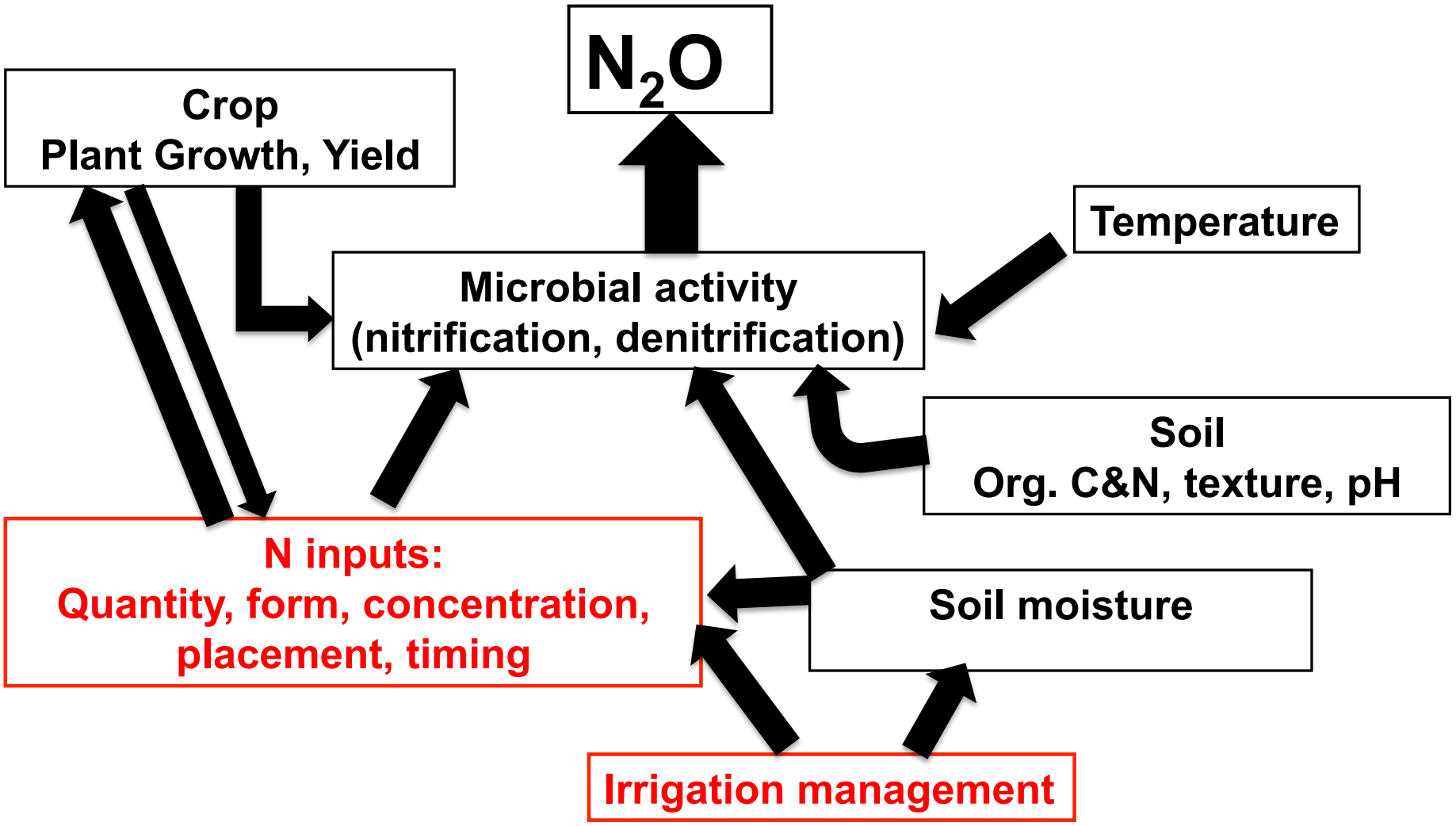


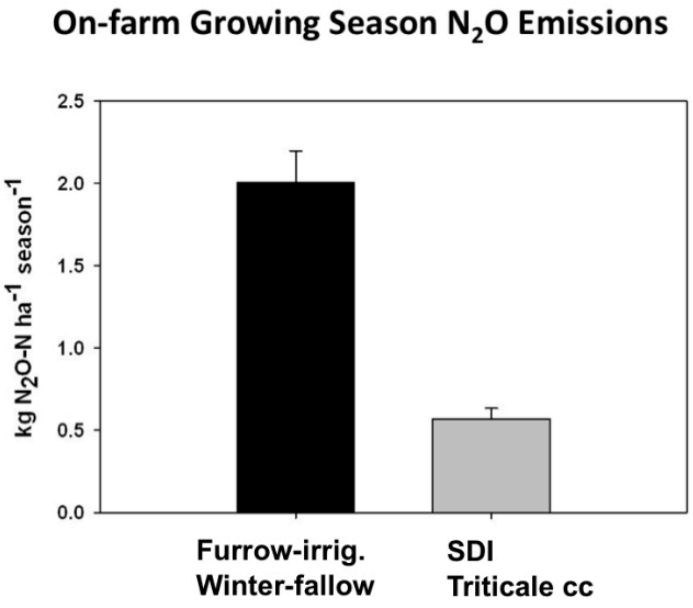
Irrigation and N Input Management Options to Mitigate N_2O Emissions

- **Subsurface drip irrigation (SDI)**
- **Nitrification inhibitors**
- **Decrease N fertilizer concentration**

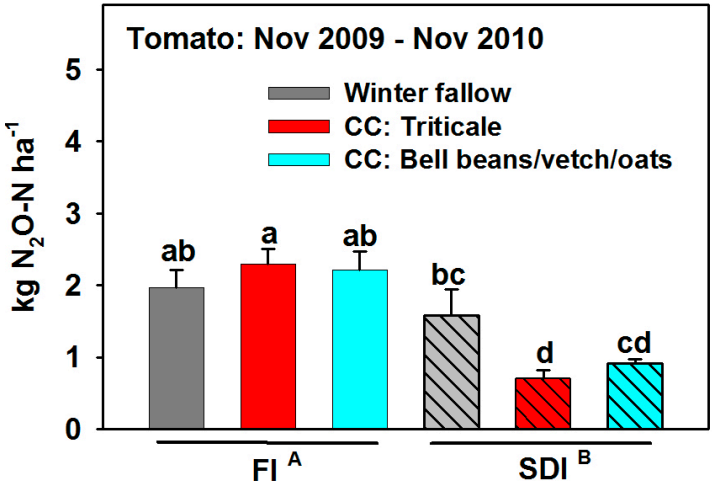
Irrigation and N Input Management Options to Mitigate N_2O Emissions

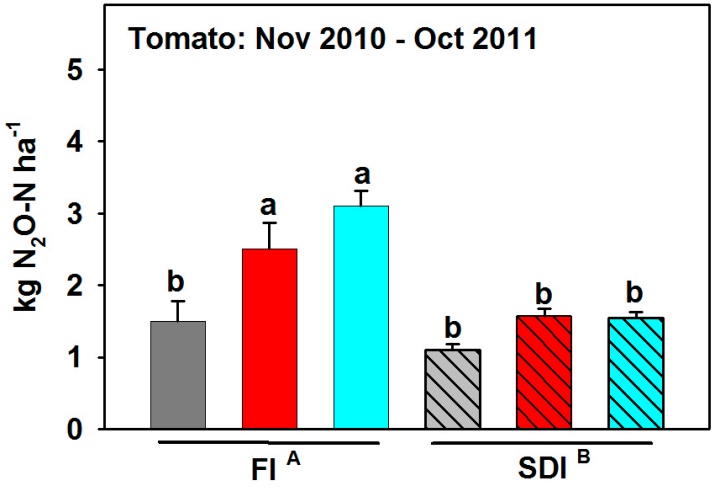
- **Subsurface drip irrigation (SDI)**
  - Incremental application of N fertilizers according to plant demand
  - Smaller volume of soil with high moisture compared to furrow irrigation

Irrigation and N Input Management Options to Mitigate N_2O Emissions



Kennedy et al., in prep.

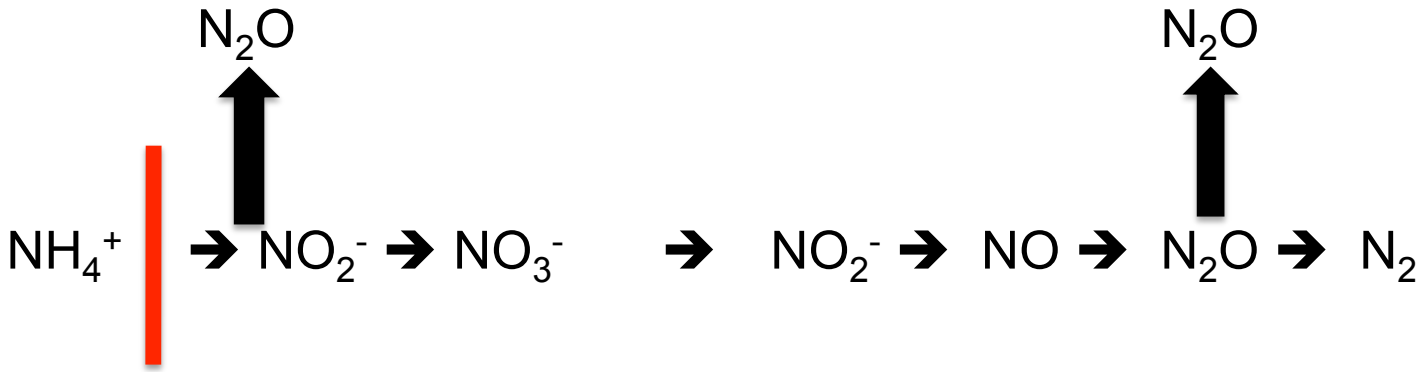




Burger et al., in prep.

Irrigation and N Input Management Options to Mitigate N_2O Emissions

- **Nitrification inhibitors**
  - Lowered N_2O emissions by 35% (-45% to -31%) according to a meta-analysis of 35 studies (Akiyama *et al.,* 2010)
  - Slow down conversion of ammonium to nitrate:



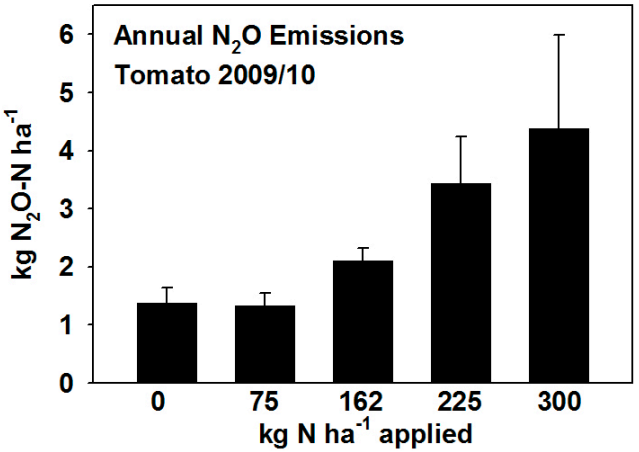
Irrigation and N Input Management Options to Mitigate N_2O Emissions

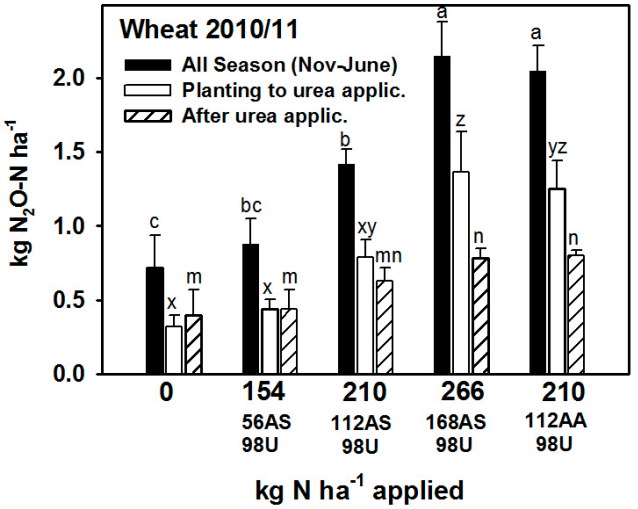
- **N fertilizer concentration:**
  - Fertilizer N application rate
  - Lower N concentrations of fertilizer material has lower N_2O emission potential:

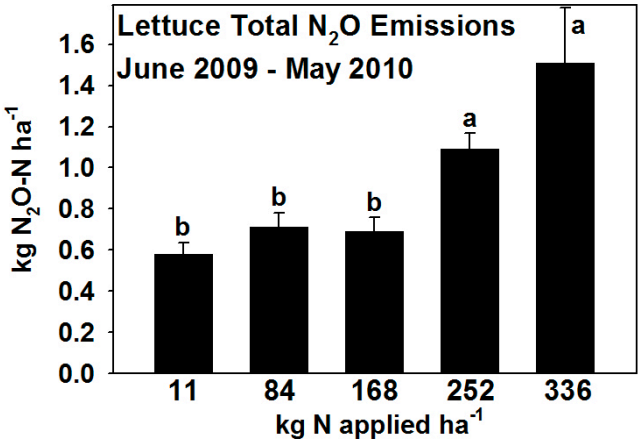
Organic N fertilizers	2-6% N
Calcium nitrate	9% N
Aqua ammonia	20% N
Urea ammonium nitrate	32% N
Urea	46% N
Anhydrous ammonia	82% N

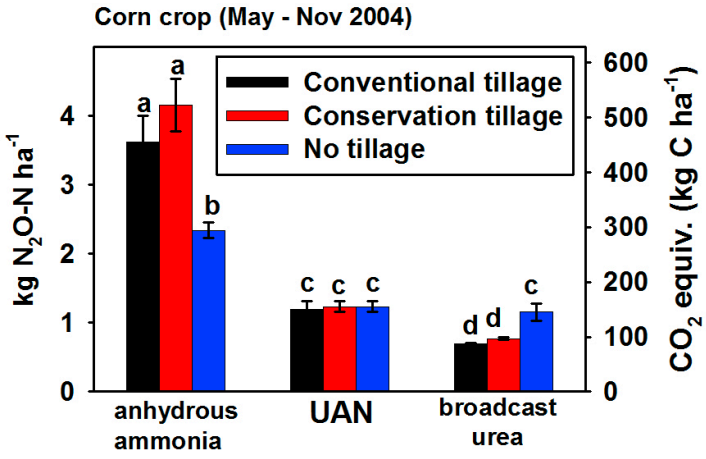
  - Placement of N fertilizer affects the concentration

Irrigation and N Input Management Options to Mitigate N_2O Emissions









Venterea et al., 2005

Cropping Systems

	Acres	Irrigation
• Tomato	290,000	>50% SDI
• Corn	550,000	furrow, flood, drip
• Lettuce	300,000	sprinkler, drip (35%), sprinkler/drip combination

Experimental Approach

Tomato on-farm trials

1. Use of urease and nitrification inhibitors (AgrotainPlus™) with UAN fertilizer applied incrementally via SDI.
   Control: UAN without inhibitors.
2. Organic management: N supplied by soil and organic amendments to the soil, legume cover crops.
   Furrow irrigation.
3. Effects of other types of nitrification inhibitors (charge, mobility) and fertilizers (UAN32, CAN-17) on N_2O emissions will be tested next season (2013).

Experimental Approach

Corn

- Three types of fertilizers:
  - UAN with/without nitrification inhibitors
  - Aqua ammonia with/without nitrification inhibitors
  - Calcium nitrate
- Furrow irrigation, 5 ft-beds, UCD research site

- Reduced tillage or no-till
  - Placement of fertilizer, i.e. spacing of N fertilizer bands
  - Flood irrigation, on-farm

Experimental Approach

Lettuce

- Pre-plant & side-dress application of N fertilizer, sprinkler irrigation

vs.

- Fertigation, SDI

Measurements

- N_2O flux
  - static chamber technique
  - sample collection by hand & automated system
  - gas chromatography
  - intensive sampling after N applications and irrigation/rainfall events
- Soil moisture
- Soil, ambient air, and chamber temperatures
- Soil inorganic N pools (NH_4^+, NO_2^-, NO_3^-)
- Yields & total biomass
  - N uptake

Evaluation of Management Options

- N_2O emissions
  - Time-integrated N_2O emission estimates
  - Mitigation potential of management practices
  - Yield-scaled N_2O emissions of management practices
- Total greenhouse gas emissions
  - including major emission sources (energy use for irrigation, farm equipment) associated with each management practice
- N use efficiency:
  - Fertilizer N applied / N removal by crops

Timeline

On-farm tomato experiments, started ✔	2012 – spring 2014
Corn UCD research site, starting ✔	2012 – spring 2014
Corn, reduced tillage, on-farm	
Lettuce, USDA research site, grower fields in Salinas	2012 – spring 2014


Thank You !