Minimizing Nitrogen Losses to the Environment

Patrick K. Nichols, Rebekah Davis, Sharon Dabach, Shahar Baram, Christine M. Stockert, David R. Smart

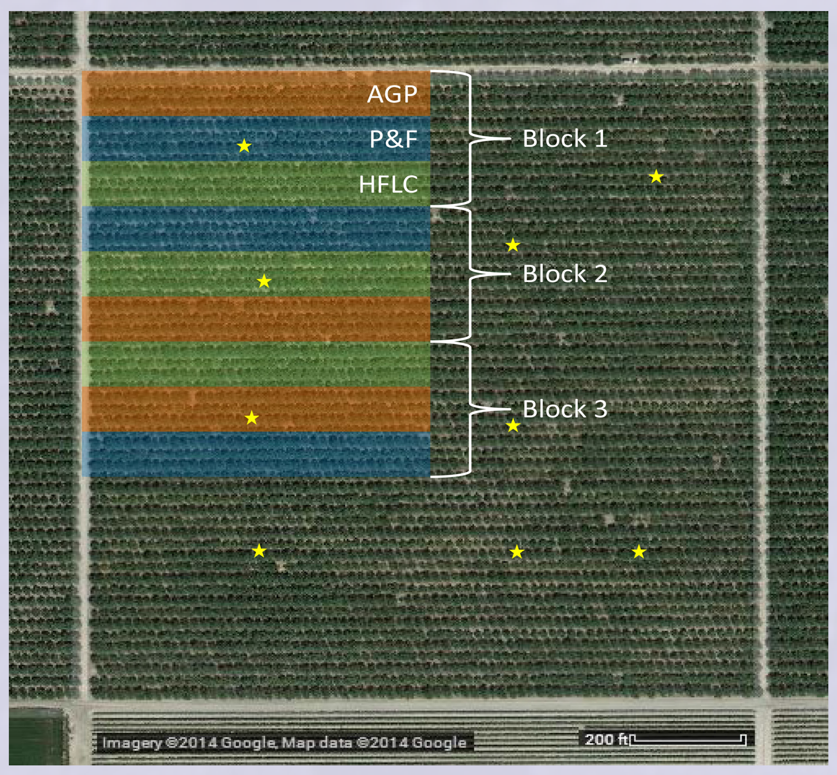
University of California, Robert Mondavi Institute for Wine and Food Science, Davis, CA 95616,

Objective

- Elucidate nitrogen (N) fate and dynamics under three fertigation management strategies.
- Develop annual yield-response potential for these fertigation practices.

Methods

- Three fertigation management schemes:
  - AGP – Advance Grower Practice
  - P&F – Pump and Fertigate
  - HFLC – High Frequency Low Concentration
- Fertilizer: UAN32 (Urea Ammonium Nitrate - 32% N)
- AGP followed the best management practices guidelines of 3-4 applications during the growing season following uptake curve.
- P&F subtracted groundwater N which calculated to 30% reduction of UAN32.
- HFLC application of 12 kg ha^{-1} was applied at each irrigation event.
- Static gas chambers were placed at the head of a fan jet micro irrigation system, at distances: 0cm, 50cm, 100cm, 150cm, and 200cm.
- Vadose zone monitoring setup installed at 8 sites across the orchard representing different soil profiles



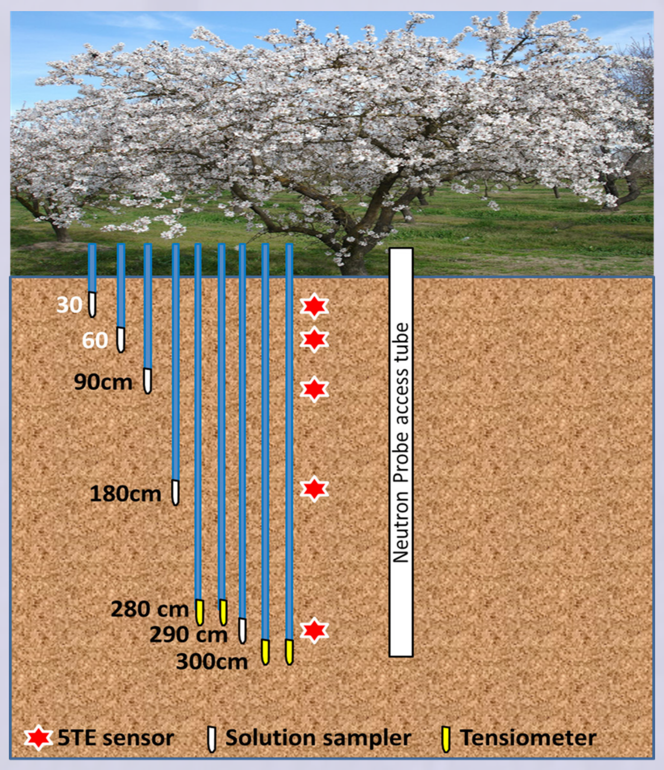


Figure 1 (left) Site map showing experimental block design with treatments and locations of vadose zone soil monitoring stations (stars). **Figure 2 (right)** Soil solution instrumentation setup at vadose zone soil monitoring stations.

Conclusions

- Using high frequency low N fertigation management decreases N_2O emissions significantly without reducing N rate and almond yields.
- Spatio-temporal variability was extremely high across the orchard in N concentration at depth of 290 cm and it is questionable whether any clear conclusions can be drawn from Figure 1.
- Mass balance (N input minus N output) provides good proxy for estimating N loads into the groundwater at the orchard scale (~ 40 acre).

Introduction

Almonds are considered to be a nitrogen (N) intensive crop with up to 426 Kg ha^{-1} of N applied per year and with a planted area of over 380,000 ha which has been increasing every year. With an estimated 0.9% of applied N lost as N_2O-N (IPCC, 2007), these orchards represent a major potential contributor to greenhouse gas (GHG) emissions. Additionally, leaching of N applied to agricultural land below the effective root zone is of great concern to groundwater quality worldwide. Best management practices for fertilizer application involve splitting applications into three or more events to optimize N uptake by the trees. The fertigation N management may have effects on loss of N through NO_3^- leaching and N_2O emissions.

Results

Nitrate Leaching

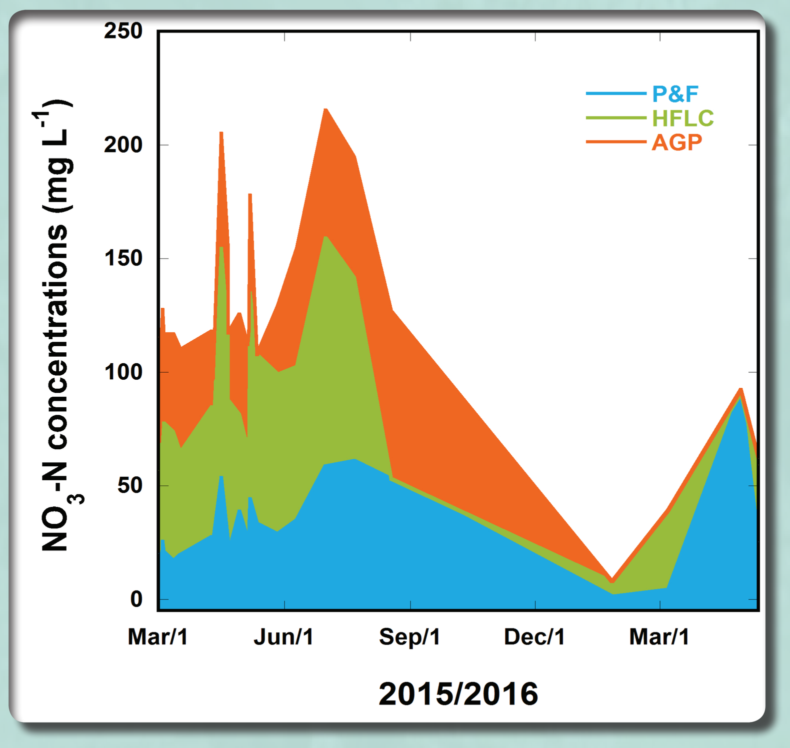


Figure 3. Concentration of Nitrate-N in the soil pore water below the effective root zone, 290 cm below the surface.

Yield

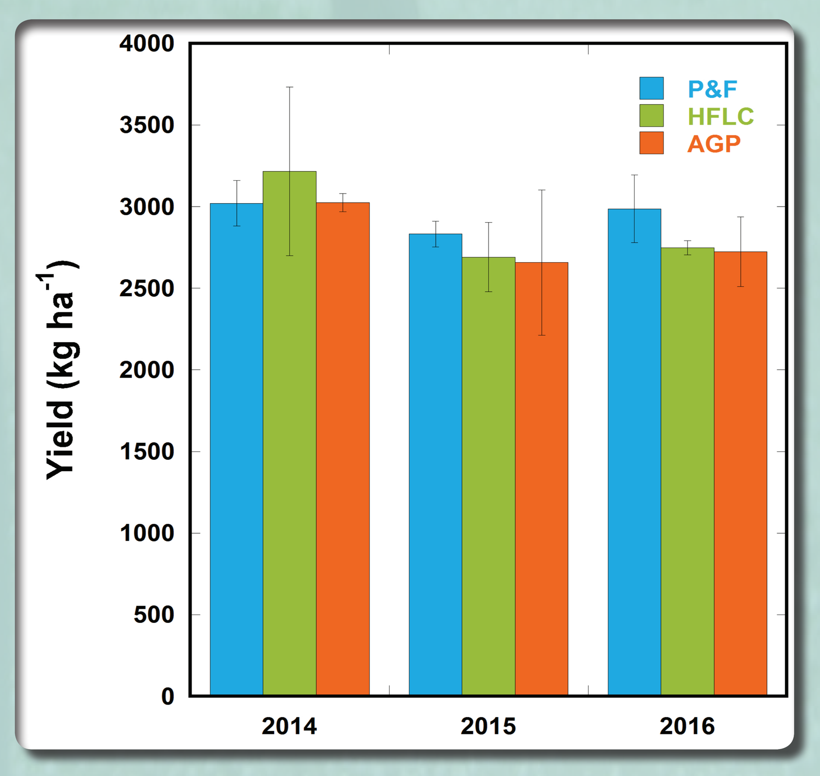
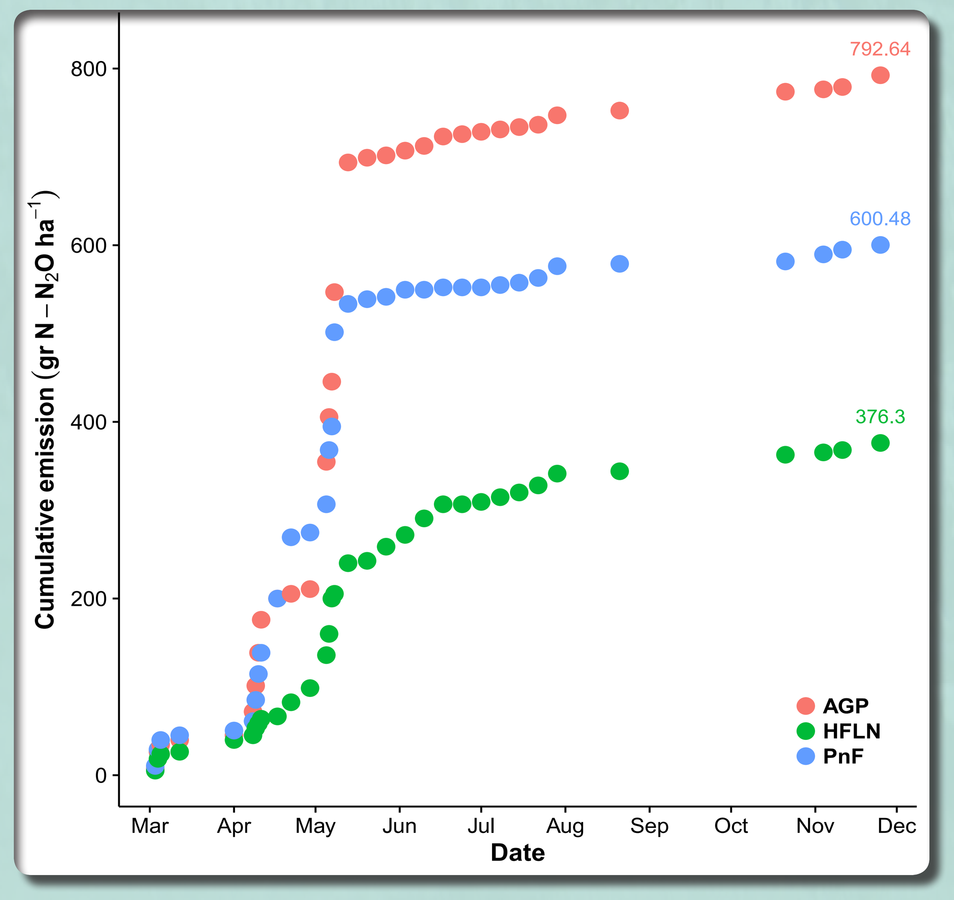


Figure 4. Kernel yield by treatment over two years in a Madera Almond Orchard.

N_2O Emissions

2015



2016

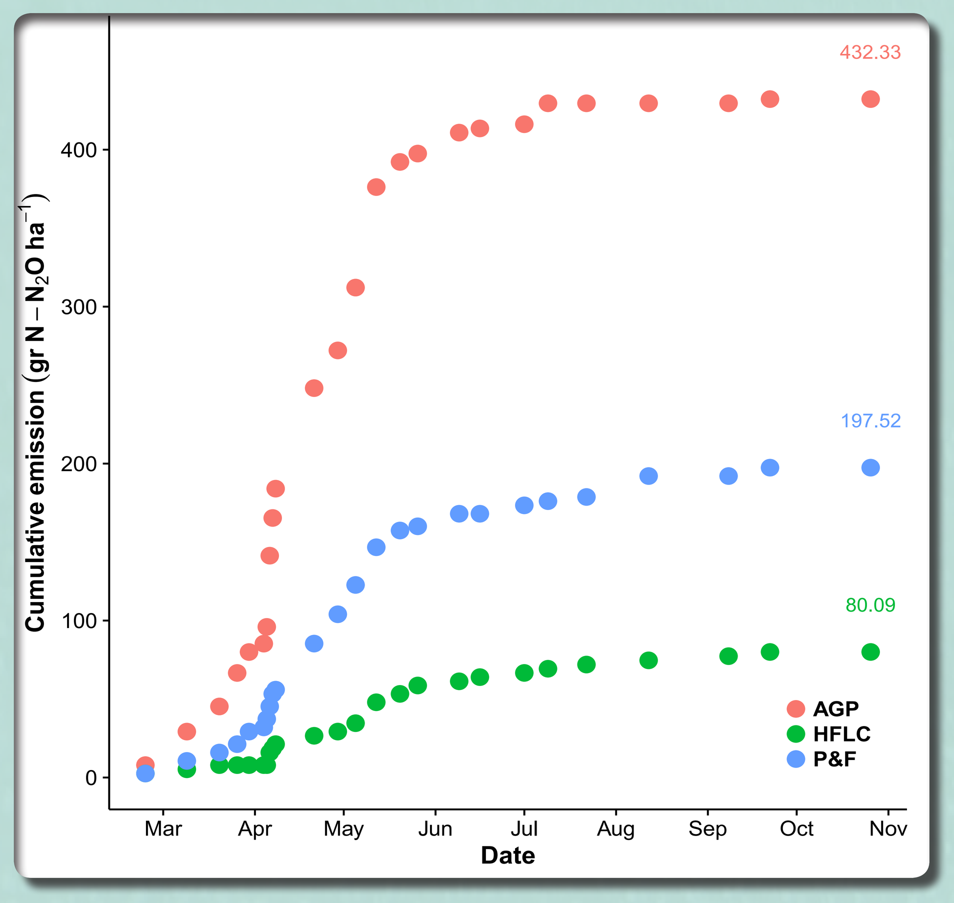


Figure 5. Cumulative annual N_2O emissions in an almond orchard for 2015 and 2016 using three fertigation management practices. The lines represent fertigation events

Nitrogen Balance

	P&F 2014	P&F 2015	P&F 2016	HFLC 2014	HFLC 2015	HFLC 2016	AGP 2014	AGP 2015	AGP 2016
Inputs									
Fertilizer	291	201	224	324	201	222	324	257	334
Compost	45	45	0	45	45	0	45	45	0
Output									
N in kernal	126	124	135	146	118	114	133	116	108
N in wood	28	28	28	28	28	28	28	28	28
Hull and shell	76	71	122	80	67	109	76	66	96
Loss	107	23	0	114	33	0	132	91	101
NUE	**0.68**	**0.91**	**>1**	**0.69**	**0.87**	**>1**	**0.64**	**0.70**	**0.70**

Table 1. Averaged N mass balance for each treatment for 2015 and 2016. Inputs and Outputs in kg N ha^{-1}

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