Managing Processing Tomatoes for Greenhouse Gas Reduction

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Recent research at UC Davis in collaboration with Yolo County processing tomato growers shows that switching to subsurface drip irrigation can reduce greenhouse gas emissions from tomato fields while bringing a number of other benefits to farmers.

This study suggests that:

- N_2O can be reduced without a yield penalty by adopting the integrated system.
- Improved use of fertilizer and water through subsurface drip irrigation with N fertigation can result in better matching of N availability & crop demand and can reduce N loss via N_2O emissions.

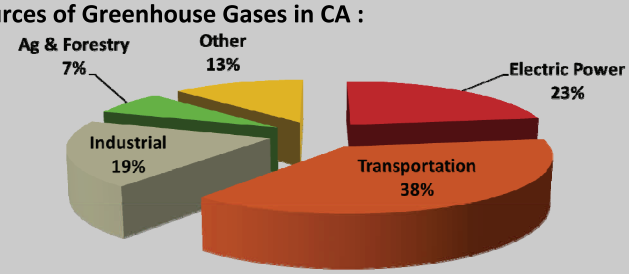
Nitrous Oxide (N_2O)—Why is it Important?

- N_2O destroys the ozone layer
- 300X more potent greenhouse gas than carbon dioxide (CO_2)
- 75% of global N_2O emissions comes from agricultural soils

Factors that influence N_2O Production:

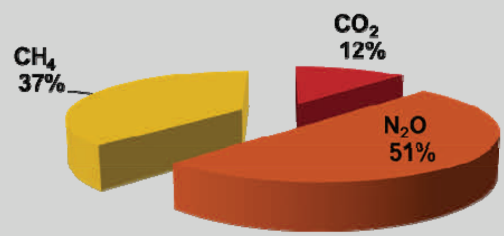
- Mineral Nitrogen (N)—**FERTILIZATION**
- Soil Moisture—**IRRIGATION**
- Soil Organic Carbon—**TILLAGE**

Sources of Greenhouse Gases in CA :



California Air Resources Board, 2009

Composition of GHGs from Agriculture:



California Air Resources Board, 2009

Drip irrigation yields multiple benefits to farmers:

Increased Fertilizer Use Efficiency · Increased Water Use Efficiency · Improved Crop Yields · Reduced N_2O and CO_2 emissions

In general, management practices that improve use of fertilizer are permanent—N that is taken up by the plant cannot be converted to N_2O, regardless of subsequent management.

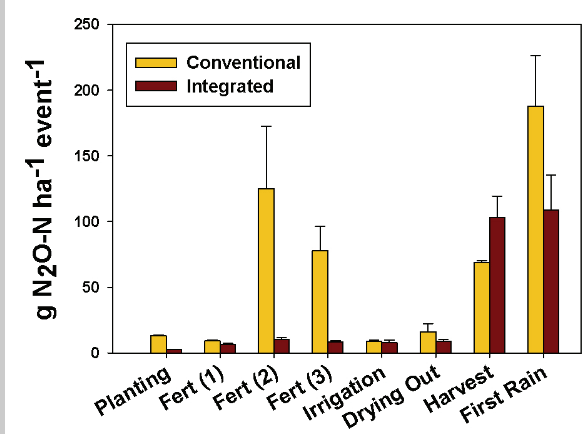
Case Study: Tomato Management and N_2O Emissions

In an on-farm study, greenhouse gas emissions were monitored for one year, from two fields managed by two different growers.

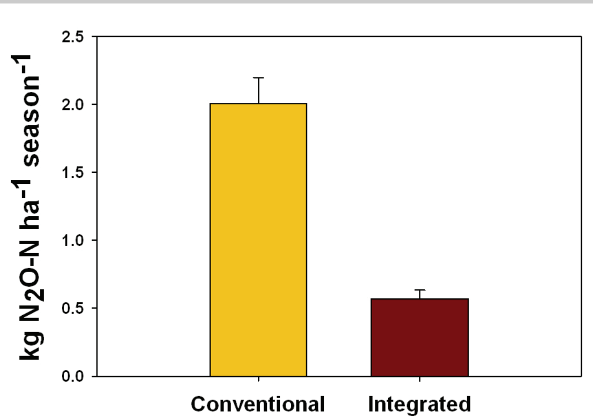
	CONVENTIONAL	INTEGRATED
Tillage method	Conventional Tillage	Reduced Tillage
Irrigation Method	Furrow Irrigation	Subsurface Drip Irrigation
Winter treatment	Winter Fallow	Cover Crop: *Triticale trios*
Fertilizer schedule	Starter, Planting, Sidedress N, & 3 H_2O runs	Starter & 6 Fertigations
Fertilizer type	8-24-6; 3-18-18; 28-0-0; CAN-17	8-24-6; UN-32
Tomato cultivar	AB2	AB2
kg N ha^{-1} / lb N acre^{-1} applied	*237 / 211*	*205 / 182*
# of N Fertilizations X Rate (*kg N ha^{-1} / lb N acre^{-1}*)	1 X (*146 / 130*); 5 X (*5 to 25 / 3 to 22*)	1 X (*75 / 67*); 6 X (*6 to 30 / 5 to 26*)
Yield (*ton ha^{-1} / ton acre^{-1}*)	*86 / 35*	*131 / 53*
Nitrogen use efficiency	37%	58%

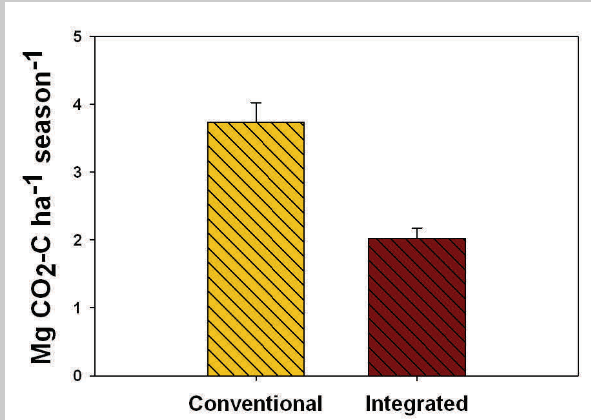
Additional case study results

In the conventional system, N_2O fluxes were highest following fertilizations and the first rain. High emissions at harvest in the integrated system were likely due to the use of a vine shredder at harvest (right).



Drip Irrigation (Integrated) significantly reduced N_2O emissions (Below, left) and CO_2 emissions (below, right) in comparison to furrow irrigation (Conventional) (Kennedy et al., *in prep*).





Management Effects on N_2O

- N_2O emissions increase as fertilizer rates increase, however the response is not always linear.
- When N availability exceeds plant demand, N_2O emissions increase dramatically.
- It is not fertilizer rate alone that determines the production of N_2O – other factors also play a role:
  - crop N uptake
  - fertilizer management (rate & timing)
  - irrigation strategy (furrow vs. drip)

N_2O Emissions are Event Related

- Agricultural management events play a critical role in N_2O emission patterns.
- Management events that increase soil moisture, N, and C levels cause a pulse of N_2O.
- N_2O fluxes are often highest after fertilizations, harvest, and the first rain.

"We were very excited to see the results of two years of cooperation with UC Davis on a greenhouse gas emissions study in our drip-irrigated tomatoes. We saw a 60% reduction in N_2O releases to the atmosphere as a result of drip irrigation vs. furrow."

"Subsurface drip systems require increased energy use and a high level of maintenance, but result in higher processing tomato yields, reduced greenhouse gas emissions, water conservation, and reduced tractor and diesel costs."

— Tony Turkovich, Button & Turkovich Farm

Research partially funded by:
the David & Lucile Packard Foundation

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