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:
- N₂O 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 N₂O emissions.

**Nitrous Oxide (N₂O)—Why is it Important?**
- N₂O destroys the ozone layer
- 300X more potent greenhouse gas than carbon dioxide (CO₂)
- 75% of global N₂O emissions comes from agricultural soils

**Factors that influence N₂O Production:**
- Mineral Nitrogen (N)—FERTILIZATION
- Soil Moisture—IRRIGATION
- Soil Organic Carbon—TILLAGE

**Sources of Greenhouse Gases in CA :**

<table>
<thead>
<tr>
<th>Source</th>
<th>Ag &amp; Forestry</th>
<th>Others</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Power</td>
<td>23%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>38%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

California Air Resources Board, 2009

**Composition of GHGs from Agriculture:**

<table>
<thead>
<tr>
<th>Gas</th>
<th>CO₂</th>
<th>N₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12%</td>
<td>51%</td>
</tr>
</tbody>
</table>

California Air Resources Board, 2009

**Drip irrigation yields multiple benefits to farmers:**
- Increased Fertilizer Use Efficiency
- Increased Water Use Efficiency
- Improved Crop Yields
- Reduced N₂O and CO₂ emissions

In general, management practices that improve use of fertilizer are permanent—N that is taken up by the plant cannot be converted to N₂O, regardless of subsequent management.

**Case Study: Tomato Management and N₂O Emissions**

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

| 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 H₂O runs | Starter & 6 Fertilizations | 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% |
N2O Emissions are Event Related

Agricultural management events play a critical role in N2O emission patterns.

Management events that increase soil moisture, N, and C levels cause a pulse of N2O.

N2O fluxes are often highest after fertilizations, harvest, and the first rain.

In the conventional system, N2O 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 N2O emissions (Below, left) and CO2 emissions (below, right) in comparison to furrow irrigation (Conventional) (Kennedy et al., in prep).

Management Effects on N2O

- N2O emissions increase as fertilizer rates increase, however the response is not always linear.
- When N availability exceeds plant demand, N2O emissions increase dramatically.
- It is not fertilizer rate alone that determines the production of N2O – other factors also play a role:
  - crop N uptake
  - fertilizer management (rate & timing)
  - irrigation strategy (furrow vs. drip)

"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 N2O 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

Additional case study results