Managing fertility in drip-irrigated processing tomatoes
How are drip-irrigated tomatoes different?

✓ Higher yield expectations = higher nutrient removal

Each ton of fruit contains about:
- 3 lb N
- 1 lb $P_2O_5$ equivalent
- 5 lb $K_2O$ equivalent
How are drip-irrigated tomatoes different?

- Roots feed in a limited zone of soil
Nutrient uptake is predictable:

Weekly N uptake (lb/acre)

Week after transplanting
Nutrient uptake is predictable:

![Graph showing nutrient uptake](image)

- **N**, **P2O5**, and **K2O** uptake over weeks post-transplanting.
Nutrient uptake is predictable:
Nutrient uptake by processing tomato:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>total (lb / acre)</th>
<th>in fruit (lb / acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>240 - 280</td>
<td>160 - 200</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>80 - 100</td>
<td>50 - 70</td>
</tr>
<tr>
<td>K₂O</td>
<td>300 - 450</td>
<td>250 - 350</td>
</tr>
</tbody>
</table>
Nutrient budget for processing tomato:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>total lb/acre</th>
<th>in fruit lb/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>220 - 280</td>
<td>160 - 200</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>80 - 100</td>
<td>50 - 70</td>
</tr>
<tr>
<td>K₂O</td>
<td>300 - 450</td>
<td>250 - 350</td>
</tr>
</tbody>
</table>

Lower fertilizer rates = soil ‘mining’
What is a reasonable N fertigation template?

<table>
<thead>
<tr>
<th>Growth stage</th>
<th>Duration (weeks)</th>
<th>N fertigation rate (lb/acre/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 weeks post-transplant - early fruit set</td>
<td>2-3</td>
<td>10</td>
</tr>
<tr>
<td>early fruit set - full bloom</td>
<td>3-4</td>
<td>30-35</td>
</tr>
<tr>
<td>full bloom - early red fruit</td>
<td>2-3</td>
<td>20-25</td>
</tr>
<tr>
<td>early red fruit - harvest</td>
<td>4-5</td>
<td>not usually necessary</td>
</tr>
</tbody>
</table>

* Not all plant N uptake comes from fertilizer
Sources of non-fertilizer N:

✓ Soil residual NO$_3$-N:

Post-thinning soil NO$_3$-N in Valley tomato fields:

![Bar chart showing Soil NO$_3$-N (lb/acre) for 0-12 inches and 12-24 inches for Tomato field 1 to 10.]

✓ Soil organic N mineralization:

≈ 1-2% of soil organic N is mineralized during a summer season
≈ 30-60 lb N/acre in soil with 1% organic matter

Bottom line:
seasonal N application of 160 – 200 lb N/acre should be sufficient
What is the problem with overfertilization?
How often to fertigate?

✓ no more than weekly should be required
Does the form of N matter?

- At summer temperature urea, and NH$_4$-N convert rapidly to NO$_3$-N
- In 2008 UCD trial, fruit yield, N uptake, leaf N and petiole NO$_3$-N were similar whether fertilized with UN-32 or calcium nitrate
Does the form of K matter?

At normal fertigation rates KCl and K$_2$SO$_4$ have performed similarly in research trials.
P and K management:
Soil testing is the foundation, but remember to...

Soil sample where the roots are!
Interpreting soil tests

For P (Olsen extraction):
less than 10 PPM - crop response guaranteed
10 - 20 PPM - crop response likely
Interpreting soil tests

For P (Olsen extraction):
- less than 10 PPM - crop response guaranteed
- 10 - 20 PPM - crop response likely

For K (ammonium acetate extraction):
- less than 150 PPM - yield response likely
- 150 - 250 PPM - yield response possible if K is < 2% of cation exchange
Applying P:
When:
   with appropriate preplant management, in-season application should not be necessary
How:
   get at least some P close to the transplant to support early growth
How much:
   soil test between 10-20 PPM - crop removal rate (50-70 lb P₂O₅/acre)
   soil test < 10 PPM – more than crop removal rate
Applying K:
When: during fruit set
How: fertigation
How much: first 100 lb/acre will be the most effective *

* Anything less than what is removed with fruit reduces long-term soil K supply
In-season nutrient monitoring:

Soil NO₃-N testing may be useful before fertigation begins, but is problematic after that.
Tissue testing:

Petiole sampling for $\text{NO}_3\text{-N}$, $\text{PO}_4\text{-P}$ and $\text{K}$:

- can change rapidly over a few days
- can be affected by weather conditions
- useful as a spot check on your fertility plan, but should not drive your program
- not useful after full bloom
Tissue testing:

Whole leaf sampling for total N, P and K:

✓ better measure of overall crop nutrient status
✓ changes more slowly than petioles, so projects farther into the future
✓ can provide useful information at any crop stage
## Tissue sufficiency standards:

<table>
<thead>
<tr>
<th>Sample type</th>
<th>Nutrient</th>
<th>Early flower</th>
<th>Full bloom</th>
<th>First red fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>whole leaf</td>
<td>% N</td>
<td>4.0</td>
<td>3.5</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>% P</td>
<td>0.32</td>
<td>0.25</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>% K</td>
<td>2.2</td>
<td>1.6</td>
<td>0.8</td>
</tr>
<tr>
<td>petiole</td>
<td>PPM NO$_3$-N</td>
<td>8,000</td>
<td>3,000</td>
<td>??</td>
</tr>
<tr>
<td></td>
<td>PPM PO$_4$-P</td>
<td>2,500</td>
<td>2,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% K</td>
<td>4.5</td>
<td>3.0</td>
<td></td>
</tr>
</tbody>
</table>