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 P₂O₅ equivalent
- 5 lb K₂O equivalent
How are drip-irrigated tomatoes different?

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

![Graph showing nutrient uptake over weeks](image)

- **N**: Nitrogen uptake
- **P2O5**: Phosphate uptake
- **K2O**: Potassium uptake

**Weekly N uptake (lb/acre)**

**Week after transplanting**
Nutrient uptake is predictable:

![Bar chart showing nutrient uptake over weeks after transplanting]

- **N (Nitrogen)**
- **P2O5 (Phosphate)**
- **K2O (Potassium)**

**Weekly N uptake (lb/acre)**

Week after transplanting:

- Week 5: 20 lb/acre
- Week 6: 30 lb/acre
- Week 7: 25 lb/acre
- Week 8: 35 lb/acre
- Week 9: 40 lb/acre
- Week 10: 35 lb/acre
- Week 11: 40 lb/acre
- Week 12: 35 lb/acre
- Week 13: 40 lb/acre
- Week 14: 35 lb/acre
- Week 15: 40 lb/acre

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*Note: The chart above is illustrative and does not represent actual data.*
Nutrient uptake is predictable:

![Bar graph showing weekly nutrient uptake (lb/acre) from week 5 to week 15 after transplanting. The graph compares nitrogen (N), phosphorus (P2O5), and potassium (K2O).]
Nutrient uptake by processing tomato:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>total</th>
<th>in fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>240 - 280</td>
<td>160 - 200</td>
</tr>
<tr>
<td>P$_2$O$_5$</td>
<td>80 - 100</td>
<td>50 - 70</td>
</tr>
<tr>
<td>K$_2$O</td>
<td>300 - 450</td>
<td>250 - 350</td>
</tr>
</tbody>
</table>
# Nutrient budget for processing tomato:

## Nutrient Budget

<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>$P_2O_5$</td>
<td>80 - 100</td>
<td>50 - 70</td>
</tr>
<tr>
<td>$K_2O$</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 levels in 0-12 and 12-24 inches depth for 10 tomato fields.]

✓ 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
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 K₂SO₄ 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.
Soil NO$_2$-N (PPM)

13  8  20

7  11  16
Tissue testing:

Petiole sampling for \( \text{NO}_3\)-N, \( \text{PO}_4\)-P and 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
- \textit{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 NO₃-N</td>
<td>8,000</td>
<td>3,000</td>
<td>??</td>
</tr>
<tr>
<td></td>
<td>PPM PO₄-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>