Soil fertility management for pepper production
Typical nutrient uptake by a bell pepper crop producing 50,000 lb of fruit/acre:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
</tr>
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<tbody>
<tr>
<td>total plant content</td>
<td>200 - 260</td>
<td>40 - 60</td>
<td>240 - 320</td>
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<tr>
<td>fruit content</td>
<td>80 - 110</td>
<td>20 - 30</td>
<td>120 - 180</td>
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additional fruit at ≈ 3 lb / ton
Phosphorus requirement for pepper:

Common soil tests for P availability:

Olsen (bicarbonate) test - extraction in sodium bicarbonate at pH 8.5
best method if soil pH > 6.5

Bray test - extraction in dilute acid
useful in acidic soil (pH < 6.5)

Bray values higher than Olsen in most cases
Is P application always necessary?
What application rate is reasonable?

Soil P availability requirement:

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60 PPM  | 20 PPM

Agronomic threshold (Olsen test)
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**Application rate?**
- limit application to crop removal rate in fields with high soil P
- rates > 120-150 lb P$_2$O$_5$/acre questionable, regardless of soil test level
Nitrogen management:

- Crop N uptake is predictable by growth stage

  lb N per acre per day:

  - < 1
  - 4 - 5
  - < 3
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- Not all N needs to come from fertilizer application:
  - residual soil NO₃-N can be substantial
  - soil N mineralization can be up to 1 lb / acre / day
Excessive N application generally not an agronomic problem, but can be an environmental problem:

- Environmental targets for N concentration in groundwater is 10 PPM NO₃-N; for surface water may be as low as 1 PPM
- Any water that escapes a pepper field is likely to greatly exceed environmental targets
Irrigation efficiency and N management:

- at common soil NO₃-N levels during the season, one inch of leaching may carry 20-30 lb NO₃-N/acre out of the root zone

- that water may be 10 times the Federal drinking water standard of 10 PPM NO₃-N
Potassium management:

- Crop K uptake is predictable by growth stage

  lb N per acre per day:

  < 1  4 - 7  < 4
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- Crop K uptake is predictable by growth stage

\[
\text{lb N per acre per day:}
\]

\[
\begin{align*}
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\end{align*}
\]

- pepper has a moderately high K requirement (240 - 320 lb K\textsubscript{2}O/acre)
- majority of K ends up in fruit
- leaf K declines to ‘feed’ the fruit; that’s why deficiency shows late
Evaluating soil K supply:

- ‘exchangeable’ K, usually expressed as PPM
- K as a % of base exchange

\[
\text{[milliequivalent of K / (meq Ca + Mg + Na + K)] \times 100}
\]
Soil test K interpretation:

- fields > 200 PPM exchangeable K, and > 3% of base exchange, do not require K fertilization
- soils < 150 PPM, or < 2% of base exchange, should be fertilized
- K fertilization is most effective during fruit set and early fruit development
Crop monitoring options

In-season soil nitrate testing:

✓ high root zone soil NO$_3$-N concentration (> 20 PPM) indicate that additional N application can be postponed

Soil nitrate testing most useful early in the season
Petiole testing as a management tool?

- high NO$_3$-N or PO$_4$-P concentration guarantees *current* sufficiency, but does not project far into the future.
Petiole testing as a management tool?

- high NO$_3$-N or PO$_4$-P concentration guarantees *current* sufficiency, but does not project far into the future
- lower NO$_3$-N or PO$_4$-P concentration *does not prove deficiency*
2004-05 survey of 75 coastal lettuce fields
at early heading stage:

Leaf total N of the 20 highest yielding fields ...
at early heading stage:

Midrib NO$_3$-N of the 20 *highest yielding fields* ...
Tissue sampling in processing tomato:
✓ 4 high yield commercial fields
✓ UCD fertilizer trial
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[Graph showing leaf N (g kg⁻¹) over growing degree days for different fields and UCD fertilizer levels]
Tissue sampling in processing tomato:

- 4 high yield commercial fields
- UCD fertilizer trial

![Graph showing Leaf N (g kg⁻¹) and Petiole NO₃-N (PPM) over Growing degree days for different fields and treatments.](image-url)
Calcium disorders:

- symptoms develop because insufficient Ca is moved into actively growing cells during fruit development
Calcium disorders:
- Symptoms develop because insufficient Ca is moved into actively growing cells during fruit development.
- Origin of the problem is the inefficient way plants move Ca into fruit; soil Ca limitation seldom the primary problem.
Calcium doesn’t move into fruit easily:

- Ca moves in transpirational flow in xylem, so leaf Ca is high
- Ca does not move in phloem, so fruit Ca is low; surface wax on fruit makes foliar application questionable
What can be done to minimize calcium disorders?

- prevent water stress
- choose adapted varieties
- avoid high ammonium levels during early fruit development