Phosphorus Management in Floriculture Production

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Topic Outline

Phosphorus Nutrition

- Maximum Growth
- Color Enhancement
- Reproductive Stage Deficiency
Phosphorus Nutrition: Maximum Growth

- N rate and type (NO$_3^-$ vs NH$_4^+$) affect plant growth
- P rate significantly impacts internode stretch

Phosphate vs. Compactness

P$_2$O$_5$ as a % of N in post-plant fertilizer

P$_2$O$_5$ = 50% of N
(e.g. 20-10-20)

15%
(13-2-13)

7.5%

0%
Phosphorus Nutrition: Maximum Growth

- Low P nutrition limits internode stretch, keeping plants compact
  - Easy to implement for short-term crops like plugs
  - Narrow margin for error
Phosphorus Nutrition: Maximum Growth

• The Challenge: Soilless substrates have a low P holding capacity, so it is easy to go too low
  – This poses some questions
What phosphorus rates maximize vs. control growth?
Experiment

• Grew several species with range of P rates holding other nutrients constant
  – 0 – 80 ppm P
  – 150 ppm N & K

• Measured growth response and recorded symptoms

\[ y = 7.69 + 1.817x - 0.0731x^2 \]
\[ X_0 = 12.42; r^2 = 0.98 \]
Part I – Growth Response to Phosphorus

Petunia ‘Potunia Neon’

Phosphorus Rate (ppm)
Foliar P Concentrations

Phosphorus Rate (ppm)

Tissue Phosphorus Concentration

Part I

Growth Response to Phosphorus

Foliar P Concentrations
Vinca ‘Cora Burgundy’

Phosphorus Rate (ppm)

0  2.5  5  10  20
New Guinea Impatiens
‘Pure Beauty Red on Pink’

Phosphorus Rate (ppm)
Angelonia ‘Sungelonia Blue’

Part I – Growth Response to Phosphorus
Iresine ‘Blazin’ Rose’

Phosphorus Rate (ppm)

0  2.5  5  10  20

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Part I – Growth Response to Phosphorus
Maximum Growth

Generally...

Maximum Growth:
5 – 15 ppm

Deficiency:
≤ 2.5 ppm

Growth Control:
3 – 5 ppm

<table>
<thead>
<tr>
<th>Species</th>
<th>Max P Rate (ppm)</th>
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</thead>
<tbody>
<tr>
<td>Alternanthera</td>
<td>5.5</td>
</tr>
<tr>
<td>Angelonia</td>
<td>8.0</td>
</tr>
<tr>
<td>New Guinea Impatiens</td>
<td>11.0</td>
</tr>
<tr>
<td>Ornamental Pepper</td>
<td>13.1</td>
</tr>
<tr>
<td>Petunia</td>
<td>8.9</td>
</tr>
<tr>
<td>Vinca</td>
<td>6.6</td>
</tr>
</tbody>
</table>
Phosphorus Supplied by Common Fertilizers

- 20-20-20
- 20-10-20
- 15-5-15
- 13-2-13

Nitrogen Rate (ppm) vs. Phosphorus Rate (ppm)

STOP
GO

NC STATE UNIVERSITY
College of Agriculture and Life Sciences
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Phosphorus Nutrition: Effects on Coloration

• Red leaf color is a desirable trait found in several ornamental species
  – Zonal geraniums
  – Alternanthera
  – Iresine
  – Coleus
Can low P fertilization enhance foliar coloration in red leafed species?
• Grew alternanthera with 0 – 20 ppm P
  – Some plants switched to 0 ppm P after 4 weeks
  – Some plants switched to 2.5 ppm P after 4 weeks

• Measured growth and documented color
**Final P Rate (ppm)**

Original

2.5

0

Starting P Rate (ppm)
Final P Rate (ppm)

Original

Starting P Rate (ppm)

0 2.5 5 10 20

0
Conclusions

• Low P fertilization resulted in redder plants
  – Increased red pigments

• Size up plants first with 10 ppm P, then lower P fertilization to enhance red coloration
  – Otherwise significant stunting, delayed flowering, or necrosis of lower leaves
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Phosphorus Nutrition: Deficiency

- P deficiency symptoms occur when plant tissue comprises less than 0.2% P
- Mobile within plants
  - Source-sink relationships among tissues
  - Deficiency symptoms typically occur on lower foliage
Phosphorus Movement Within the Plant
Phosphorus Nutrition: Deficiency

• Typical symptoms
  – Foliar reddening or purpling, darker green coloration, stunted growth, and delayed flowering
  – Also, chlorosis with olive green spotting

![No P](Image)
![Healthy](Image)
Reproductive Stage Deficiency

• P deficiency symptoms on the upper foliage?
  • Chlorosis, necrosis, olive green spotting
Reproductive Stage Deficiency

- Symptoms resulted in significant losses for growers
  ~$130,000

- Why have these symptoms not been reported before?
  1. Likely have occurred, but not been associated with P
  2. With increased popularity of low P fertilization strategies, some growers limited P too greatly
What causes these atypical symptoms on the upper foliage?
Two Competing Sinks
Experiments

• Grew ornamental peppers and chrysanthemums range of initial P rates
  – Half restricted to 0 ppm P after 4 weeks

• Plants divided into separate parts to analyze tissue P concentrations throughout the plant
  – Illustrate P movement
10 ppm P after 3 weeks without P
Initial Rate of 10 ppm

Restricted P
(5 weeks without P)

Continuous P
‘Crystal Misty Purple’ Chrysanthemum
Necrotic curling of the leaf margins

Overall purpling with green spots
Conclusions

• Restricting P upon floral initiation resulted in upper leaf symptomology
  – Requires conditions of sufficient P earlier, restricted later
  – Lower initial P rates led to typical lower leaf symptoms

• P preferentially translocates to developing flowers and fruit
Overall Conclusions

• From these experiments, growers can obtain numerous benefits from low P fertilization
  – Growth Control (3 – 5 ppm P)
  – Enhanced Coloration

• Due to poor nutrient holding capacity of soilless substrates, P must be supplied to avoid deficiency
  – Symptom development in 2 – 3 weeks
  – For most species, 5 – 10 ppm P will prevent symptom development
GrowerTalks Magazine

• Articles in June through September 2017 editions
Questions?

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