Organic High Tunnel Nutrient Management

Vern Grubinger
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nutrient management for quality and yield
often a diversity of crops and conditions
organics usually = amended soil culture
the soil may be in containers
amendments typically include compost
high rate of aged manure
perhaps some pre-mixed potting soil
synthetic fertilizers, wetting agents...?
‘reading the plants’ is not precise
plan ahead for heavy nutrient demand
hydroponics can be precisely monitored and controlled
organic growing medium is a ‘black box’
looks good, feels good…what’s in it?
‘field’ soil test not very helpful: nutrients usually ‘off the chart’ also does not include soluble salts, nitrate-N, ammonium-N
Saturated media extract (SME) is "the" method of testing soilless greenhouse media and it is almost universally done by commercial and university labs.

In this test a paste is made using soil and water and then the liquid portion (the extract) is separated from the solid portion for pH, soluble salt, and nutrient analysis.
Greenhouse ‘Soil’ Tests = SME
for samples less than ~20-50% mineral soil

UConn: saturated media extract $10

UMass: ‘soilless greenhouse media’ $12

UMaine: ‘greenhouse media analysis’ $15
(or high tunnel package for $22)

Cornell: ‘greenhouse root media analysis’ $15

A&L: ‘potting media test’ $27
General interpretation guidelines for greenhouse growth media analyzed by the Saturated Media Extract Method.

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Optimum</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble salts (dS/m)</td>
<td>0-.75</td>
<td>2.0-3.5</td>
<td>5.0+</td>
</tr>
<tr>
<td>Nitrate-N (ppm)</td>
<td>0-39</td>
<td>100-199</td>
<td>300+</td>
</tr>
<tr>
<td>Phosphorus (ppm)</td>
<td>0-2</td>
<td>6-10</td>
<td>19+</td>
</tr>
<tr>
<td>Potassium (ppm)</td>
<td>0-59</td>
<td>150-249</td>
<td>350+</td>
</tr>
<tr>
<td>Calcium (ppm)</td>
<td>0-79</td>
<td>200+</td>
<td></td>
</tr>
<tr>
<td>Magnesium (ppm)</td>
<td>0-29</td>
<td>70+</td>
<td></td>
</tr>
</tbody>
</table>

optimal soil nutrient levels
for greenhouse tomatoes or lettuce using the SME test

- pH: 5.8 – 6.8
- nitrate-N: 125 – 200 ppm
- P: 8 – 13 ppm
- K: 175 – 275 ppm
- Ca: > 250 ppm
- Mg: > 60 ppm
- soluble salts: 1.5 – 3.0 (mmhos)

Adapted from: Greenhouse Tomatoes, Lettuce and Cucumbers.
Get accurate results

• Sample prior to adding amendments

• Take a representative sample

• Keep warm and moist for ~2 weeks prior

• Send at least 1 pint to the lab
**pH:** 6.2  
**Soluble Salts (mS/cm):** 4.97

<table>
<thead>
<tr>
<th>Macronutrients</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate-N (NO₃-N)</td>
<td>520</td>
</tr>
<tr>
<td>Ammonium-N (NH₄-N)</td>
<td>1</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>66</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>539</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>376</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>280</td>
</tr>
</tbody>
</table>
pH: 7.4  
Soluble Salts (mS/cm): 1.25  

<table>
<thead>
<tr>
<th>Macronutrients</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate-N (NO₃-N):</td>
<td>72</td>
</tr>
<tr>
<td>Ammonium-N (NH₄-N):</td>
<td>0</td>
</tr>
<tr>
<td>Phosphorus (P):</td>
<td>3</td>
</tr>
<tr>
<td>Potassium (K):</td>
<td>23</td>
</tr>
<tr>
<td>Calcium (Ca):</td>
<td>139</td>
</tr>
<tr>
<td>Magnesium (Mg):</td>
<td>43</td>
</tr>
</tbody>
</table>
most growers need this test

- 2008 – 2009 study

- 75 ‘soil’ samples

- for greenhouse / tunnel tomatoes
pH of greenhouse ‘soil’
75 samples 2008-09
NO$_3$-N in greenhouse ‘soil’
75 samples  2008-09
NH$_4$-N in greenhouse ‘soil’
75 samples 2008-09
P in greenhouse ‘soil’
75 samples 2008-09
K in greenhouse ‘soil’
75 samples  2008-09
‘Salts’ in greenhouse ‘soil’
75 samples 2008-09
know your organic fertilizer options, beyond compost
organic fertilizers

- **Ca**: lime, gypsum (mined)
- **Mg**: dolomite, sul-po-mag, epsom salts
- **P**: rock phosphate, bone meal or char
- **K**: potassium sulfate, sul-po-mag
- **N**: dried blood, Chilean nitrate*
  seed meals (alfalfa, soy, peanut)
- **Blends**: pelletized poultry manure, etc.
- **Micros**: borax, chelates, sulfates
PRO-GRO 5-3-4
A NATURAL/ORGANIC FERTILIZER

This product is blended from the following list of natural ingredients:

- Bonemeal
- Rock phosphate
- Colloidal phosphate
- Oyster meal
- Kelp meal
- Greensand
- Langbeinite
- Vegetable protein meals
- Meat and bone meal
- Natural nitrate of soda
- Leather meal
- Fish meal
- Beneficial bacteria
- Humates
- Trace minerals
Dried Blood 12-0-0
NITRATE OF SODA
For Greener Growth
16-0-0
NET WT. 5 LBS.
Sulfate of Potash-Magnesia

0-0-22

11.0 Mg

GUARANTEED ANALYSIS

Soluble Potash (K₂O) ... 22.00%
Sulfur (S) ................. 22.00%
Water Soluble Magnesium (Mg) ... 11.00%
2-1-2

7-2-1

alfalfa meal

soy meal
peat moss
adds organic matter, not nutrients

gypsum
adds calcium, doesn’t change soil pH
0.5 - 2.5 compressed cubic yard peat moss per 1000 sq ft (+ lime as needed)
Estimated fertilizer rates to increase SME nutrient levels

<table>
<thead>
<tr>
<th></th>
<th>Pounds/1,000 sq. ft needed to raise N approximately 10 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilean nitrate 16-0-0</td>
<td>3.2</td>
</tr>
<tr>
<td>Blood meal 12-0-0</td>
<td>4.2</td>
</tr>
<tr>
<td>Alfalfa meal 2.5-2-2</td>
<td>20.1</td>
</tr>
<tr>
<td>Soy meal 7-2-1</td>
<td>7.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pounds/1,000 sq. ft needed to raise P approximately 2 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone meal 0-15-0</td>
<td>26.6</td>
</tr>
<tr>
<td>Rock phosphate 0-3-0</td>
<td>133</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pounds/1,000 sq. ft needed to raise K approximately 20 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sul-po-mag 0-0-22-11Mg</td>
<td>2.6</td>
</tr>
<tr>
<td>Potassium sulfate 0-0-52</td>
<td>1.1</td>
</tr>
</tbody>
</table>
Estimated fertilizer rates to alter greenhouse soils

Pounds/1,000 sq. ft needed to raise Ca approximately 25 ppm

- Calcium sulfate (gypsum) 7.5
- Calcitic lime 7.5
- Dolomite (high mag lime) 5.3

Pounds/1,000 sq. ft of lime to raise pH approximately 1 unit

- Sandy soil 40
- Clayey / High organic matter 120

Amount of lime needed to neutralize acidity of peat moss

8.5 lb/ loose cu. yd (=1/2 compressed)
ANALYSIS REPORT

GROWING MEDIUM

Type: Compost amended soil
Origin: VT Compost Fort V
Brand:
% Field Soil: 60-70%

FERTILIZATION

Fertilizers: North Country Pro-Gr
Slow Release?:
Rates:
Frequency:

GROWER CONCERNS:

ANALYSIS OF SATURATION EXTRACT

pH: 6.8
Soluble Salts (mS/cm): 1.27

<table>
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<tr>
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<th>mg/L</th>
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<tbody>
<tr>
<td>Nitrate-N (NO3-N):</td>
<td>35</td>
</tr>
<tr>
<td>Ammonium-N (NH4-N):</td>
<td>0</td>
</tr>
<tr>
<td>Phosphorus (P):</td>
<td>0</td>
</tr>
<tr>
<td>Potassium (K):</td>
<td>13</td>
</tr>
<tr>
<td>Calcium (Ca):</td>
<td>182</td>
</tr>
<tr>
<td>Magnesium (Mg):</td>
<td>40</td>
</tr>
<tr>
<td>Sulfur (S):</td>
<td>99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Micronutrients</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc (Zn):</td>
<td>0.01</td>
</tr>
<tr>
<td>Boron (B):</td>
<td>0.06</td>
</tr>
<tr>
<td>Manganese (Mn):</td>
<td>0.01</td>
</tr>
<tr>
<td>Copper (Cu):</td>
<td>0.06</td>
</tr>
<tr>
<td>Iron (Fe):</td>
<td>0.74</td>
</tr>
<tr>
<td>Sodium (Na):</td>
<td>24.09</td>
</tr>
</tbody>
</table>

RECOMMENDATIONS AND COMMENTS

25 # blood
100 # soy
20 # superfish
25 # gypsum
ANALYSIS REPORT

GROWING MEDIUM
Type:
Origin:
Brand:
% Field Soil: 15 %

FERTILIZATION
Fertilizers:
Slow Release?:
Rates:
Frequency:

GROWER CONCERNS:

ANALYSIS OF SATURATION EXTRACT

<table>
<thead>
<tr>
<th>pH: 7.2</th>
<th>Soluble Salts (mS/cm): 4.65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macronutrients</td>
<td>Micronutrients</td>
</tr>
<tr>
<td>Nitrate-N (NO₃-N): 456</td>
<td>Zinc (Zn): 0.05</td>
</tr>
<tr>
<td>Ammonium-N (NH₄-N): 1</td>
<td>Boron (B): 0.23</td>
</tr>
<tr>
<td>Phosphorus (P): 8</td>
<td>Manganese (Mn): 0.03</td>
</tr>
<tr>
<td>Potassium (K): 334</td>
<td>Copper (Cu): 0.41</td>
</tr>
<tr>
<td>Calcium (Ca): 200</td>
<td>Iron (Fe): 0.97</td>
</tr>
<tr>
<td>Magnesium (Mg): 143</td>
<td>Sodium (Na): 399.0</td>
</tr>
</tbody>
</table>

RECOMMENDATIONS AND COMMENTS

1 cu yd house peat + 4-16-16 line
25 16 gypsum
ANALYSIS REPORT

GROWING MEDIUM

Type: 
Origin: 
Brand: 
% Field Soil: 

GROWER CONCERNS:

FERTILIZATION

Fertilizers: 
Slow Release?: 
Rates: 
Frequency: 

ANALYSIS OF SATURATION EXTRACT

pH: 7.2
Soluble Salts (mS/cm): 1.40

Macronutrients mg/L
Nitrate-N (NO₃-N): 110
Ammonium-N (NH₄-N): 0
Phosphorus (P): 4
Potassium (K): 34
Calcium (Ca): 126
Magnesium (Mg): 65

Micronutrients mg/L
Zinc (Zn): 0.00
Boron (B): 0.11
Manganese (Mn): 0.00
Copper (Cu): 0.12
Iron (Fe): 0.34
Sodium (Na): 38.09

RECOMMENDATIONS AND COMMENTS

1/2 cu yd compost
50 15 sq yd or peat
8 1b potassium sulfate
10 1b gypsum
leaf analysis is the next step: what’s in the plant?
optimal leaf tissue nutrient levels
for greenhouse tomatoes in leaves by latest open flowers

- N: 2.5 – 3.5 %
- P: 0.5 – 1.0 %
- K: 6.0 – 10 %
- Ca: 1.3 – 3.0 %
- Mg: 0.3 – 1.0 %
- Mn: 20 -100 ppm
- B: 20 – 40 ppm
- Cu: 5 – 25 ppm