

# FERTILIZING GREENHOUSE CROPS



CLF 150 ppm      SRF 6m-5g      SRF 9m-5g

David Trinklein  
Division of Plant Sciences



---

---

---

---

---

---

---

---

## Fertilizing Greenhouse Crops



gallery.yopriceville.com

A Difficult Process??

---

---

---

---

---

---

---

---

## Fertilizing Greenhouse Crops

### Putting It All Together

- Strategies
- Equipment
- Precautions



---

---

---

---

---

---

---

---

## Plant Nutrition Vs Plant Fertilization

### Nutrition:

Availability & type of chemical elements in

plant tissue



### Fertilization:

Adding nutrients to growing medium in proper amounts



---

---

---

---

---

---

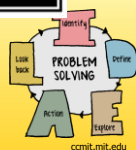
---

---

## Why do we still have problems?



- **“Need to focus on preventing problems”**



---

---

---

---

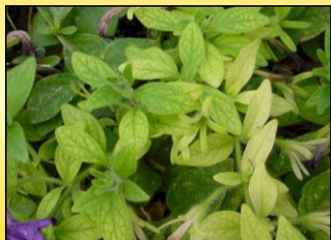
---

---

---

---

## Must understand factors that affect plant nutrition



---

---

---

---

---

---

---

---

# pH

- pH affects the solubility of fertilizers and the availability of nutrients
  - Some elements more available at low pH values others the opposite
- Also influences efficacy of pesticides and growth regulators
  - Materials less soluble at high water pH

---

---

---

---

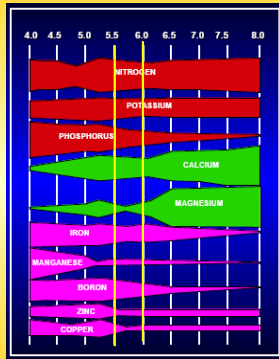
---

---

---

---

- Influence of pH on nutrient availability



---

---

---

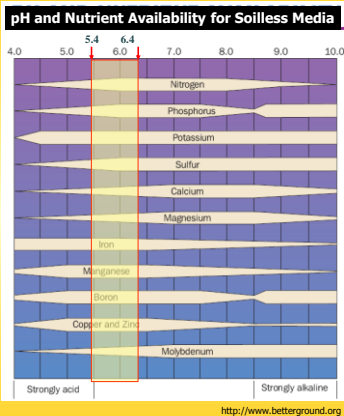
---

---

---

---

---



---

---

---

---

---

---

---

---

## Problems Associated With Improper pH

Low pH	High pH
<ul style="list-style-type: none"><li>• Toxic:<ul style="list-style-type: none"><li>– Iron</li><li>– Manganese</li><li>– Zinc</li><li>– Copper</li></ul></li><li>• Deficient<ul style="list-style-type: none"><li>– Calcium</li><li>– Magnesium</li></ul></li><li>• Sensitive<ul style="list-style-type: none"><li>– Ammonium-N</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Deficient:<ul style="list-style-type: none"><li>– Iron</li><li>– Manganese</li><li>– Zinc</li><li>– Copper</li><li>– Boron</li></ul></li></ul>

---

---

---

---

---

---

---

---

## Nutrition Affected By

- Chemical considerations
  - pH - water, fertilizer solution
  - alkalinity - water, fertilizer solution
  - EC - water, fertilizer solution
- Fertilizer analysis
  - macronutrients, micronutrients
- Non-nutritional elements – possible toxicities
  - Na, Cl, F, Al

---

---

---

---

---

---

---

---

## Another Problem

- Nutrient antagonism



---

---

---

---

---

---

---

---

## Common Antagonisms

Excess in Media	Def. in Plant
N	K
K	N, Ca, Mg
P	Cu, Fe, Zn
Ca	Mg, B
Mg	Ca, K
Fe	Mn
Mn	Fe, Mo
Zn	Mn, Fe
Cu	Mn, Fe, Mo
Mo	Cu

---

---

---

---

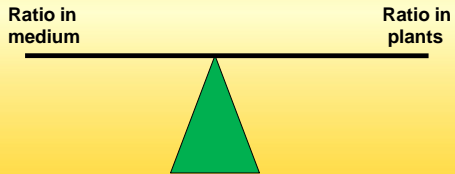
---

---

---

---

## It's All About Balance of Elements



---

---

---

---

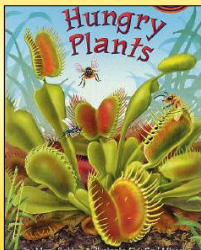
---

---

---

---

## How do we actually get the fertilizer to our plants?



---

---

---

---

---

---

---

---

## ***Application Options***

- Pre-plant
    - Substrate incorporation
  - Post-plant
    - Top dress/incorporate
    - Liquid feed
- (Might use all three on one crop)

---

---

---

---

---

---

---

---

## ***Substrate Incorporation***

- Separately
  - Ground limestone (Ca, for pH)
  - Superphosphate (P)
  - Trace elements
  - Slow release materials
- Package
  - “Starter charge” - liquid or granular

---

---

---

---

---

---

---

---

## ***Fertilizer Types***

- Granular
  - E.g. super phosphate, gypsum
- Slow (controlled) release
  - E. g. Osmocote, MagAmp
- Water soluble
  - E.g. Excel, Jack’s Classic

---

---

---

---

---

---

---

---

## Additional types

- Chelated
  - E.g. Sequestrene® 330 Fe
- Organic
  - E.g. fish emulsion



---

---

---

---

---

---

---

## Slow Release Fertilizers

- + Extended release period
- + Fewer nutrients leached
- + Use instead of or with liquid feed
- + Form of automation
- Release rate varies
- Affects salts measurement
- Hard to leach excess salts



---

---

---

---

---

---

---

## Slow Release--Types

- Plastic encapsulated
  - Osmocote (analysis varies)
  - 12 week to nine month release
- Slowly soluble fertilizers
  - Mag-Amp
- Sulfur-coated urea
  - Primarily for turf



---

---

---

---

---

---

---

## Post-plant (liquid)

- Most commonly used
- Constant feed (CLF)
  - dilute concentration
  - every watering
- Periodic feed
  - more concentrated
  - intervals (e.g. weekly)




---

---

---

---

---

---

---

---

GUARANTEED ANALYSIS	
NET WEIGHT 25 POUNDS (11.34 KG)	
<b>PETERS® PEAT-LITE® SPECIAL 15-16-17</b>	
GUARANTEED ANALYSIS	
TOTAL NITROGEN (N)	15%
8.00% NITRATE NITROGEN	
3.16% AMMONIACAL NITROGEN	
3.84% UREA NITROGEN	
AVAILABLE PHOSPHORIC ACID (P <sub>2</sub> O <sub>5</sub> )	16%
SOLUBLE POTASH (K <sub>2</sub> O)	17%
Primary Plant Nutrient Sources: Nitrate of Soda, Urea, Ammonium Phosphate, Potassium Nitrate	
Potential Acidity 215 lbs. Calcium Carbonate Equivalent Per Ton	
WARNING: Contains more than 100% microencapsulated and should not be used on foliage glass for livestock	
Manufactured by: Peters' Fertilizer Products, W. R. GRACE & CO., Fogelsville, Pa. 18051	

---

---

---

---

---

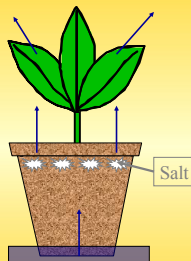
---

---

---

## Feeding Rates

- Constant liquid feed
  - 250 ppm N (top)
  - 150 ppm N (sub)
- Periodic feeding
  - 500 ppm N weekly
  - may top dress with Osmocote
- Bedding plants
  - 150 - 250 ppm N as needed




---

---

---

---

---

---

---

---



## Calculations

To determine amount of fertilizer to add to make stock solution:

$$\frac{\text{injector ratio (:1)}}{\% \text{ element}} \times \frac{\text{desired ppm}}{100} \times 1.35$$

= ounces fertilizer/gallon stock

---

---

---

---

---

---

---

---

## Calculations

How much fertilizer does one add to a 5 gallon bucket of stock to get 200 ppm N from a 20-10-20 fertilizer using a Hozon injector (1:16)?

$$\frac{16}{20} \times \frac{200}{100} \times 1.35 =$$

$$0.8 \times 2.0 \times 1.35 = 2.16 \text{ oz/gal}$$

$$2.16 \text{ oz/gal} \times 5 \text{ gal} = 10.8 \text{ oz in bucket}$$

---

---

---

---

---

---

---

---

## Calculations

How much fertilizer does one add to a 20 gallon tank of stock to get 250 ppm N from a 21-5-19 fertilizer using a Smith injector (1:100)?

$$\frac{100}{21} \times \frac{250}{100} \times 1.35 =$$

$$4.76 \times 2.5 \times 1.35 = 16.1 \text{ oz/gal}$$

$$16.1 \text{ oz/gal} \times 20 \text{ gal} = 322 \text{ oz}$$

$$322/16 = 20.1 \text{ lbs fert in tank}$$

---

---

---

---

---

---

---

---

## Checking injector/calculations

- Check accuracy with salts meter every time new batch of stock is mixed
- Fertilizer companies supply tables of EC values for each of their fertilizers at various concentrations

### 20-10-20 peat-lite special

- 200 ppm = EC of 1.30
- 250 ppm = EC of 1.63
- 300 ppm = EC of 1.95

---

---

---

---

---

---

---

---

## Fertilizers: Cautions

- N sources
  - $\text{NH}_4^+$ ,  $\text{NO}_3^-$ ; Urea
  - $\leq 40\%$   $\text{NH}_4^+$  best (20-10-20 Peatlite Special)
  - $\text{NH}_4^+$  toxicity under winter conditions (low temp/light)
- Micronutrients
  - Can be in mix, fe
  - Soluble Trace E



Ammonium toxicity in tomato

---

---

---

---

---

---

---

---

## Nutritional Monitoring

- Visual inspection
  - Too late
  - Symptoms = impaired growth
- Check “vital signs” of plant
  - pH and soluble salts
- Foliar (tissue) analysis
  - Once per crop (expensive)

---

---

---

---

---

---

---

---

## Fertilizing Equipment



---

---

---

---

---

---

---

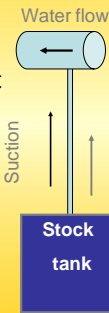
---

## Venturi Proportioners

- Use pressure differences to draw stock solution into water line
- Pressure changes cause different uptake rate
- Must calibrate for local conditions
  - Water pressure
  - Hose length



Hozon.com



---

---

---

---

---

---

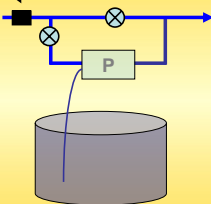
---

---

## Proportioner Installation

- By-pass line for clear water
- Dual lines preferable
- Anti-back flow valve
- Siphoning from stock tanks

Back Flow Valve



---

---

---

---

---

---

---

---

## Positive Displacement

- Flowing water drives piston that pumps stock solution
- Rated w/ min & max flow rates
- Not affected by pressure changes (within range)
- Smith (1:100, 1:200)
- Dosatron (variable)

---

---

---

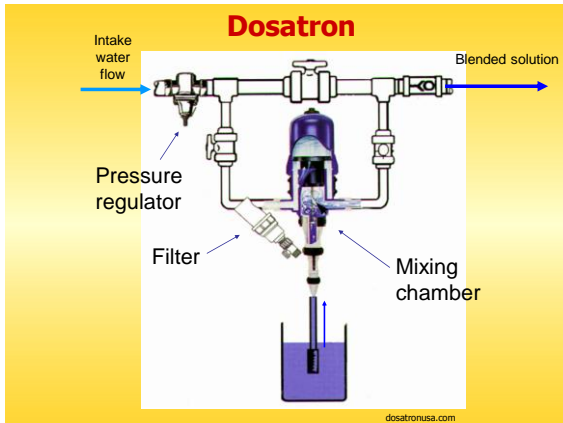
---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---




---

---

---

---

---

---

---

---

### Stock Mixing

High quality, water soluble materials  
Mix in separate tank - pump from another

Best to use hot water when mixing stock - increases solubility

Use separate tanks for different fertilizers

---

---

---

---

---

---

---

---

### Stock Mixing Cautions

++ Ca & Mg vs SO<sub>4</sub> & PO<sub>4</sub> --

- High concentrations (>100:1) can cause precipitates
- Precipitates form sludge in tank bottom
- Use two injectors
- Use dual head injector

---

---

---

---

---

---

---

---

## ***Conclusion***

- Taking a plant from “seed to sale” involves proper fertilization.
- There are many ways to get the job done.
- The best way is the one that works consistently for you.

---

---

---

---

---

---

---

---