

# Dealing with High Soluble Salts Levels in High Tunnels

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# Pennsylvania Vegetable Research and Marketing Board

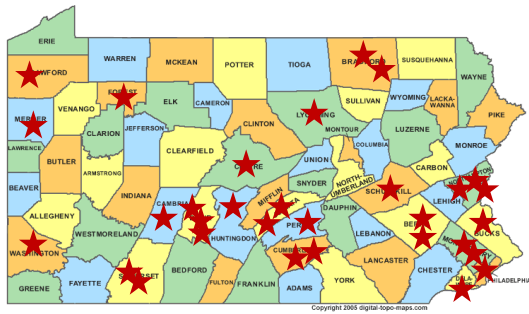
Issues with High Soluble Salt Levels in High Tunnels



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33 growers



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# Soil Test Report

SOIL NUTRIENT LEVELS	Deficient	Optimum	Excess Crop Needs
Soil pH	7.2		
Phosphorus (P <sub>2</sub> O <sub>5</sub> )	1209	80-160	
Potash (K <sub>2</sub> O)	218	80-160	
Magnesium (Mg)	1160	80-160	
Calcium (Ca)	8208	80-160	

**Recommendations for MIXED VEGETABLE CROP**

Limestone and Magnesium: NONE

Calcitic Limestone (to correct calcium depletion): NONE      Magnesium (Mg): NONE

**Plant Nutrient Needs:**

Nitrogen (N)	Phosphorus (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)
0	200	200

**MESSAGES:**

These recommendations are generalized and therefore cannot be considered deficient or specific to these genes by substrate type. All of the recommendations are given in lb/acre. Divide by 41.5 to convert to lb/1000 sq ft.

\*The nutrient needed for all different crops is as follows:

15 lb/A, Celery; 10 lb/A, Beet, Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Collard, Kohlrabi, Onion, Potato, Squash, Spinach, Sweet Corn and Tomatoes (Fresh Market); 10 lb/A, Asparagus, Carrot, Cauliflower, Eggplant, Radish, Rutabaga, Turnip, Watermelon, Zucchini, Leaf Lettuce, Mushroom (Commercial), Parsnips, Pepper, Processing Tomatoes, Pumpkin, Squash, Squash, Taro, Turnip Green and Winter Squash; 40 lb/A, Bean, Broad Leafed Herb, Mustard Green, Peas, Radicchio, Radish, Rutabaga, Sweet Potato, Tomato, Turnip Root, Turnip and Watermelon.

Apply all of the above fertilizers per year to planting and do it. See current PENNSYLVANIA COMMERCIAL VEGETABLE FERTILIZER GUIDELINES for soil-test interpretation.

For additional information, see back messages 1, 2, 3, 4, 5 and 12.

LABORATORY RESULTS							Optional Tests			
pH	P B/A	Acidity	K	Mg	Ca	CEC	% Saturation of the CEC	Organic Matter %	Nitrate-N ppm	Soluble salt concentration (1:2 Soil:Water)
6.6	1118	2.0	0.7	3.6	23.2	21.3	3.2	17.1	70.4	7.3

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Test Methods: 1-1 soil water pH; Mehlich 3 (Ca, P); Mehlich Buffer pH; Summation of Cations

The high calcium level in this sample indicates the probable presence of soluble calcium. Therefore the CEC and the percent saturations were calculated using a maximum exchangeable calcium level of 15 meq/100 g.

## Soluble Salts Level

- Interpretation is very important
- 0.14 – 9.27 mmhos/cm; 1.48 average
- Many cases of levels leading to plant growth problems

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## Plant Response to Salinity Levels

mmhos/cm	Effects
<0.40	Negligible salinity; beans, carrots
0.40-0.80	Very slightly saline; 25-50% decrease carrots, onions, peppers, lettuces
0.81-1.20	Moderately saline; seedling injury possible; 25-50% decrease broccoli, potatoes
1.21-1.60	Saline; tolerant beets
1.61-3.20	Strongly saline
>3.2	Very strongly saline

1:2 method

Adapted from Ag Analytical

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### High Soluble Salts Levels

Saline soils associated with drier areas



### Strategies

- Monitor soluble salt levels in soil
- Use irrigation water with low soluble salt levels (EC 0-0.6 mmhos/cm – PSU Ag Analytical)
- Avoid over application of nutrients



### Treatments

1. Compost applied at 1 inch depth, incorporated 12 inches
2. Compost applied at 2 inches depth, incorporated 12 inches
3. Inorganic fertilizer at rate of 75-150-75

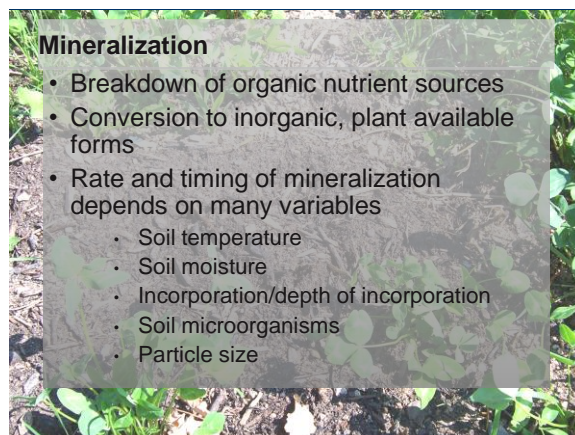
Compost – plant and dairy manure based



### N-P-K Added

Nutrient	Fertilizer	lb/acre	
		1 inch	2 inches
Nitrogen	75	441 *	883*
Phosphate	150	1345	2683
Potash	75	1559	3118

\*assuming 15% mineralization



### Marketable Pepper Yield

Treatment	2000	2001
	lb/ft <sup>2</sup>	
Fertilizer	2.1	3.3
1 inch compost	2.4	3.3
2 inches compost	1.4	2.9

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### Soil Properties After Harvest

Property	2000		
	Fertilizer	1 inch	2 inches
pH	6.4	7.3	7.4
Organic matter (%)	2.5	4.8	6.6
Salts (mmhos/cm)	0.14	0.45	0.81

Property	2001		
	Fertilizer	1 inch	2 inches
pH	6.8	7.3	7.3
Organic matter (%)	2.3	4.7	6.6
Salts (mmhos/cm)	0.30	0.95	1.9

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### Conclusions

- Possible salt injury led to lower yields
  - 0.40 mmhos/cm threshold for peppers (PSU Ag Analytical)
  - Above threshold 25-50% yield reduction
- Exclude precipitation and drip irrigation
- Leaching reduced; can lead to accumulation of salts

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### How to Avoid Over Application

- Use analysis
- Calculate how much to apply

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### Strategies

- Use sprinkler system (vs. drip) to establish seedlings
- Crop rotation

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Adapted from Ag Analytical

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## Strategies

- Limit use of organic nutrient sources with animal manures
- Select fertilizers with low salt indexes

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## Salt Index

Fertilizer	Salt Index
Ammonium nitrate (34-0-0)	102
Sodium nitrate (16-0-0)	100
Urea (45-0-0)	73
Ammonium sulfate (21-0-0)	69
Calcium nitrate (15-0-0-19)	65
Diammonium phosphate (18-46-0)	29
Monoammonium phosphate (11-55-0)	27
Superphosphate (0-45-0)	10
Superphosphate (0-20-0)	8
Potassium chloride (0-0-60)	116
Potassium nitrate (14-0-47)	74
Potassium sulfate (0-0-54)	46

Adapted from Foth & Ellis, 1996

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## Reclamation

- Leaching
  - Guideline for estimating soluble salts leaching from top 1 foot of soil (Ca Fertilizer Assoc., 1985)
    - 6 inches water, leach about 50% salts
    - 12 inches water, leach about 80% salts
    - 24 inches water, leach about 90% salts

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## Hours required to apply 1 inch of water

Drip tube flow rate gpm/100 ft	Mulched width/bed width (ft)				
	2.0	2.5	3.0	3.5	4.0
0.20	10.5	13.0	15.5	18.0	21.0
0.27	8.0	10.0	11.5	13.5	15.5
0.30	7.0	8.5	10.5	12.0	14.0
0.33	6.0	8.0	9.5	11.0	12.5
0.40	5.0	6.5	8.0	9.0	10.5
0.45	4.5	6.0	7.0	8.0	9.5
0.50	4.0	5.0	6.0	7.0	8.5
0.60	3.5	4.5	5.0	6.0	7.0
0.67	3.0	4.0	4.5	5.5	6.0

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## Remove Tops of High Tunnels

- Fall 2007 – Spring 2008 (Nov – March)
- Fall 2007 soluble salts level average  
0.40 mmhos/cm
- Precipitation 11.5 inches
- Spring 2008 soluble salts level  
0.09 mmhos/cm

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## Reclamation

- Run irrigation
  - Several growers in the Northeast
  - Strawberries 2005

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### Details

- 3.85 mmhos/cm
- Ran irrigation 10 days, 8 hours/day; 13 inches of water
- Plants recovered, but yields affected
  - 'Chandler' 0.8 lb/plant, 1.25 lbs/plant previously, 60%

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