

# Keeping greenhouse soils fertile: nutrients, compost and salt

Rupert Jannasch, Ironwood Farm

ACORN Greenhouse Workshop

Feb 28, 2012

# Greenhouse soils are unlike field soils!

- Higher nutrient levels
- Less crop diversity
- Higher production
- Greater water use
- Less rainfall and frost



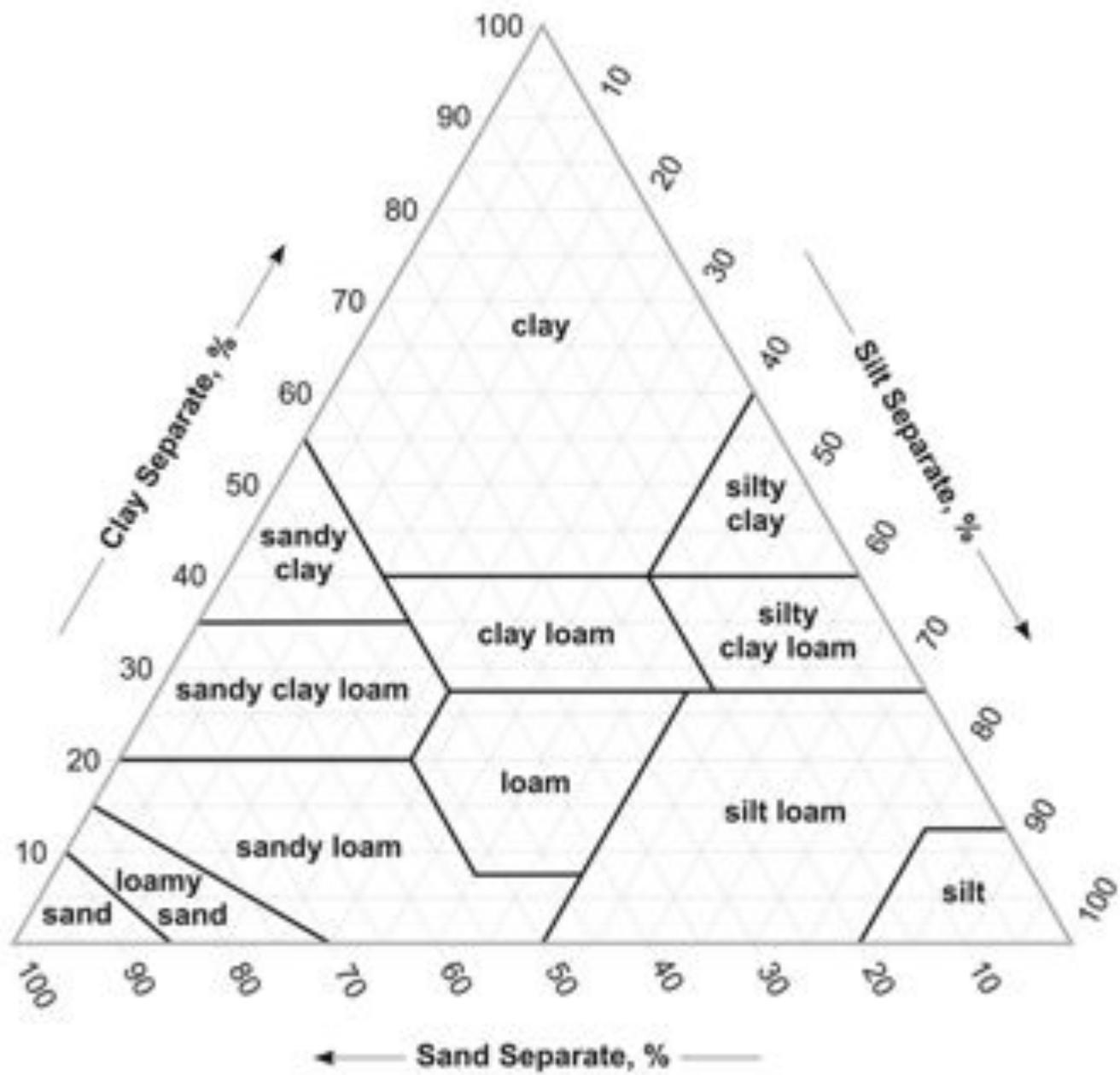
07/09/2008



# Soil Fertility = Drainage!!!!



- **Location, location and location**
- Choose a well drained site
- If you don't have one, build one!
- Pay attention to soil texture.







# What soil test to use?

- For field soils commonly use the Mehlich III test to report nutrients in lbs/acre
- Results “off the chart”<sup>↙</sup>
- Use saturated media extract (SME) test for greenhouse soils
- Reports nutrients in parts per million (ppm)<sup>↘</sup>
- Reports soluble salts (electrical conductivity)<sup>↘</sup>

# NOVA SCOTIA Soil Test Report

## Agriculture

PO Box 559  
 Truro, Nova Scotia  
 Canada  
 B2N 5G3

URL: <http://www.gov.ns.ca/soil/>  
 Tel: 902-850-6565  
 Fax: 902-850-4183



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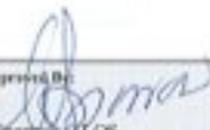
RUPERT JANNASCH  
 RUPERT NEWPORT  
 5184 HWY 215  
 SUMMERSVILLE FAX: 633-2338  
 BBN 2A0

Client Number: 45070  
 Accession: 61347  
 Samples Reported: 5/ 7/2007  
 Samples Received: 5/ 2/2007

Lab #	1		2		3							
Sample ID	GREEN WEST		GREEN EAST		PORTING SIDE							
Field Size (ha)												
Maturity Code												
Soil Code												
Crop to be Grown	TOMATOES		TOMATOES		TOMATOES							
	Analysis	Rating	Analysis	Rating	Analysis	Rating	Analysis	Rating				
pH	6.7		6.7		6.1							
Organic Matter (%)	5.8		4.1		21.2							
P2O5 (kg/ha)	2273	E	1466	E	2983	E						
K2O (kg/ha)	3887	E	3140	E	7077	E						
Ca (kg/ha)	14630	E	7755	E	3046	M						
Mg (kg/ha)	1511	E	1388	E	1708	E						
Na (kg/ha)	739		840		1428							
Sulfur (kg/ha)	7488		3490		357							
Fe (ppm)	178		132		246							
Mn (ppm)	72		71		69							
Cu (ppm)	1.42		1.20		0.31							
Zn (ppm)	15.9		9.7		13.9							
B (ppm)	1.67		1.28		1.60							
Nitrate - N (ppm)												
Salt (mlhos x 10 <sup>-3</sup> )												
CEC (meq/100g)	49.5		31.4		26.6							
Base Sat. K (%)	8.3		10.6		28.2							
Ca (%)	33.9		61.8		28.6							
Mg (%)	12.7		18.4		26.7							
Na (%)	3.2		5.8		11.7							
H (%)	1.8		3.3		4.8							
Lime Required (t/ha)	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5				
Required Nutrient	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
	60	0	0	60	0	0	60	0	0			

Comments: Result(s) relate only to sample(s) tested  
 Your sulfur result(s) are obtained using Mehlich 3 extractant.

(1) Sample sent to an accredited lab for analysis  
 1 kg/ha = 0.89 lb/ac 1 tonne/ha = 0.45 ton/ac  
 To convert kg/ha to ppm divide by 2  
 L - Low M - Medium H - High E - Excessive

Client Fax: \_\_\_\_\_ Analysis Approved By:   
 Michelle Sparrow, M.Sc.

# NOVA SCOTIA Greenhouse Soil Analysis Report

Agriculture

PO Box 550  
Truro, Nova Scotia  
Canada  
B2N 5E2

URL: <http://www.gov.ns.ca/matl/>  
Tel: 902-893-4345  
Fax: 902-893-4193



RUPERT JANNASCH  
BONWOOD FARM  
RR01, 5184 HWY 215  
NEWPORT, NS  
B0N 2A0

Client Number: 45070  
Accession: 90081  
Samples Reported: 24/06/2011  
Samples Received: 20/06/2011

*eat soil*  
*NPK values are lower than what growers recommend*

Lab #	1							
Crop	TOMATOES							
Sample ID	TOMATOES							
	Analysis	Normal Range	Analysis	Normal Range	Analysis	Normal Range	Analysis	Normal Range
Cond. (umhos)	4.83	+	0.75-3.50					
pH	7.30	+	5.2-6.5					
Nitro-N (ppm)	78.40		60-175					
Phosphorus (ppm)	5.02		5.00-15.00					
Potassium (ppm)	109.78		75.0-200.0					
Calcium (ppm)	234.41	+	75-250					
Magnesium (ppm)	144.67	+	40-75					
Sulfur (ppm)	1229.90							
Chloride (ppm)	572							
Sodium (ppm)	1.05.79							
Iron (ppm)	0.46	-	0.5-3.0					
Manganese (ppm)	< 0.00	-	0.50-1.00					
Copper (ppm)	< 0.05	-	0.100-0.500					
Zinc (ppm)	< 0.02	-	0.5-2.0					
Boron (ppm)	0.18		0.10-0.50					
Aluminum (ppm)	0.56							

Result(s) relate only to sample(s) tested

ppm = mg/l = g/l  
Kg/t = results given in % x 10  
umhos = mS/cm

Method of analysis for this report is Saturated Media Extraction (SME).

Comments:

Client To:	Analysis Approved: <i>[Signature]</i> Michelle Sparrow, TLCS
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# How many ppm does a plant need?

- Find optimal SME soil test ranges for different vegetables
- Invest \$\$\$ in soil tests
- Consider tissue testing
- Challenging to manage for a variety of crops in the same greenhouse space

# Optimal nutrient ranges for greenhouse tomatoes and lettuce using SME Test

pH:	5.8-6.8
Nitrogen (as N03)	125-200 ppm
Phosphorus	8-13 ppm
Potassium	175-275 ppm
Calcium	over 250 ppm
Magnesium	over 60 ppm
Soluble salts	1.50-3.00

(adapted from Grubinger, UVM)

# Estimated fertilizer rates to increase SME (ppm) nutrient levels

- Pounds/1000 sq. Ft to raise N approx. 10 ppm
    - Blood meal 12-0-0 4.2
    - Alfalfa meal 2.5-2-2 20.1
  - Pounds/1000 sq. Ft to raise P approx. 2 ppm
    - Bone meal 0-15-0 26.6
    - Rock phos. 0- 3- 0 133 ?????
  - Pounds/1000 sq. Ft to raise K approx. 20 ppm
    - Sul-po-mag 0-0-22-11 2.6
    - Potassium sulphate 0-0-52 1.1
- (adapted from Grubinger, UVM)

# Estimated fertilizer rates to increase SME (ppm) nutrient levels

- Pounds lime/1000 sq. Ft to raise pH 1 full unit

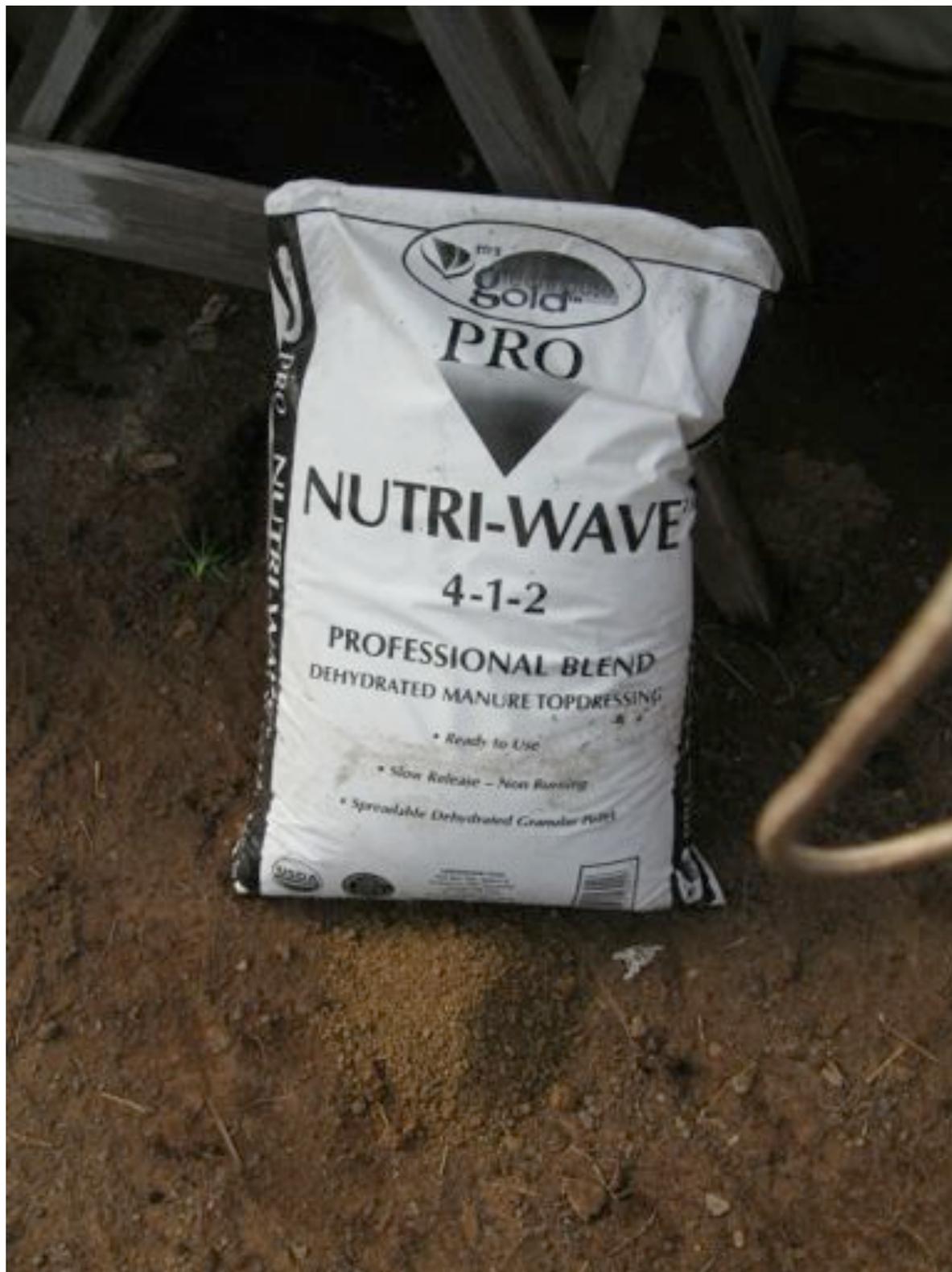
Sandy loam	40
Loam	80
Clay loam or peat	120
- Assuming calcitic lime, not dolomitic lime
- pH in greenhouse soils tends to be too high rather than too low



# What makes good compost?



- Biologically active
- Nutrient level
- Humus content
- Biodynamic
- Plant or animal



PRO

NUTRI-WAVE

4-1-2

PROFESSIONAL BLEND  
DEHYDRATED MANURE TOPDRESSING

- Ready to Use
- Slow Release - Non Burning
- Spreadable Dehydrated Granular Part



# Factors affecting compost quality

- Ingredients (manure, plant residues, leaves etc)
- Frequency of turning
- Heating
- Covering
- Exposure to wind and snow
- Aging

# Animal manures = salts?

- Repeated applications of compost made from animal manures can lead to high salt levels in greenhouse soils.



# What is a salt?

- Inorganic soil constituents (ions) dissolved in soil solution
- Acid + Base » Salt + Water
- Common salts include, NaCl, KCl, MgSO<sub>4</sub>, Ca(NO<sub>3</sub>)<sub>2</sub>, BaSO<sub>4</sub> and many others
- Measured by testing electrical conductivity of water
- mmhos/cm = decisiemens

# The effect of salt on plants

- Plants absorb nutrients in the form of soluble salts
- High salt levels restrict seed germination, seedling growth and root growth
- Burn foliage and inhibit flowering
- Reduce water intake
- Soil must be kept wetter to supply same amount of plant available water




 RUBERT JANNASCH  
 AVONMOUTH FARM  
 SUMMERSVILLE, HANTS CO.  
 B2N 2K0

 Client Number: 45070  
 Accession: 634  
 Samples Reported: 2/22/2006  
 Samples Received: 2/20/2006

Lab #	1		2		3			
Crop	UNKNOWN		UNKNOWN		UNKNOWN			
Sample ID	GREENHOUSE WEST		GREENHOUSE SOUTH		TRANSPLANT MIX			
	Analysis	Normal Range	Analysis	Normal Range	Analysis	Normal Range	Analysis	Normal Range
Cond. (mmhos)	2.15	0.75-3.50	4.05 +	0.75-3.50	1.65	0.75-3.50		
pH	7.30 +	5.2-6.5	7.30 +	5.2-6.5	5.20	5.2-6.5		
Nitrate-N (ppm)	141.00	60-175	151.00	60-175	103.00	60-175		
Phosphorus (ppm)	0.42 -	5.00-15.00	0.83 -	5.00-15.00	30.09 +	5.00-15.00		
Potassium (ppm)	269.00 +	75.0-200.0	485.76 +	75.0-200.0	219.86 +	75.0-200.0		
Calcium (ppm)	137.67	75-250	183.67	75-250	68.17 -	75-250		
Magnesium (ppm)	35.76 +	40-75	124.69 +	40-75	53.17	40-75		
Sulfate (ppm)	129.09		173.01		129.24			
Chloride (ppm)	290		463		124			
Sodium (ppm)	51.76		151.04		39.43			
Iron (ppm)	2.43	0.5-3.0	2.25	0.5-3.0	3.55 +	0.5-3.0		
Manganese (ppm)	0.06 -	0.50-3.00	0.08 -	0.50-3.00	0.59	0.50-3.00		
Copper (ppm)	0.05 -	0.100-0.500	0.03 -	0.100-0.500	0.04 -	0.100-0.500		
Zinc (ppm)	0.01 -	0.5-2.0	0.02 -	0.5-2.0	0.13 -	0.5-2.0		
Boron (ppm)	0.08 -	0.10-0.50	0.13	0.10-0.50	0.28	0.10-0.50		
Aluminum (ppm)	4.08		4.03		6.36			

**Comments:**

Method of analysis for this report is Saturated Media Extraction (SME).

 ppm = mg/l = g/t  
 Kg/t = results given in % x 10  
 mmhos = mS/cm/cm

Copies To:	Analysis Approved By:  Jason Barnham, M.Sc. P.Ag., Technical Supervisor
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# NOVA SCOTIA Soil Test Report

## Agriculture

PO Box 550  
 Trent, Nova Scotia  
 Canada  
 B2N 5E3

URL: <http://www.gov.ns.ca/aaaf>  
 Tel: 902-893-4565  
 Fax: 902-893-4193



*u*

RUPERT JANNASCH  
 R.R#1  
 5184 HWY 215  
 NEWPORT, NS BIN 2A8

Client Number: 45070  
 Accession: 62496  
 Samples Reported: 2/14/2008  
 Samples Received: 1/22/2008

Lab #	1		2									
Sample ID	EAST		WEST									
Field Size (ha)												
Manner Code												
Soil Code												
Crop to be Grown	SOYBEANS		TOMATOES									
	Analysis	Rating	Analysis	Rating	Analysis	Rating	Analysis	Rating				
pH	6.9		6.9									
Organic Matter (%)	5.0		5.4									
P2O5 (kg/ha)	2442	E	2622	E								
K2O (kg/ha)	3372	E	3078	E								
Ca (kg/ha)	12948	E	11836	E								
Mg (kg/ha)	2010	E	1909	E								
Na (kg/ha)	794		680									
Sulfur (kg/ha)	6028		4608									
Fe (ppm)	148		174									
Mn (ppm)	85		83									
Cu (ppm)	2.76		2.18									
Zn (ppm)	18.0		19.8									
B (ppm)	2.15		2.20									
Nitrate - N (ppm)												
% Nitrogen												
Sat. (cation x 10 <sup>-3</sup> )												
CEC (meq/100gm)	47.6		44.0									
Base Sat. K (%)	7.5		7.4									
Ca (%)	67.9		67.5									
Mg (%)	17.6		18.1									
Na (%)	3.6		3.2									
H (%)	3.4		3.8									
Lime Required (t/ha)	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5				
Required Nutrient (kg/ha)	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
	60	0	0	60	0	0						

Result(s) relate only to sample(s) tested

(1) Sample sent to an accredited lab for analysis  
 1 kg/ha = 0.89 lb/acre 1 tonne/ha = 0.45 ton/acre  
 To convert kg/ha to ppm divide by 2  
 L = Low M = Medium H = High E = Excessive

Copies To:

Analysis Approved By:

Michelle Spence, TLCS

# NOVA SCOTIA Greenhouse Soil Analysis Report

Agriculture



PO Box 550  
 Truro, Nova Scotia  
 Canada  
 B2N 5E3

URL: <http://www.gov.ns.ca/aeaff>  
 Tel: 902-893-6565  
 Fax: 902-893-4191

RUPERT JANNASCH  
 IRONWOOD FARM  
 RR#1, 5184 HWY 215  
 NEWPORT NS  
 B0N 2A0

Client Number: 65070  
 Accession: 90037  
 Samples Reported: 2/ 4/2010  
 Samples Received: 2/ 1/2010

Lab #	1							
Crop	TOMATOES							
Sample ID	TOMATOES/PEPPERS							
	Analysis	Normal Range	Analysis	Normal Range	Analysis	Normal Range	Analysis	Normal Range
Cond. (mmhos)	7.64	+ 0.75-3.50						
pH	7.10	+ 5.2-6.5						
Nitrate-N (ppm)	232.00	+ 60-175						
Phosphorus (ppm)	6.16	3.00-15.00						
Potassium (ppm)	429.57	+ 75.0-200.0						
Calcium (ppm)	725.33	+ 75-250						
Magnesium (ppm)	366.92	+ 40-75						
Sulfate (ppm)	220.06							
Chloride (ppm)	1343							
Sodium (ppm)	309.71							
Iron (ppm)	0.93	0.5-3.0						
Manganese (ppm)	≤ 0.10	- 0.50-3.00						
Copper (ppm)	≤ 0.05	- 0.100-0.500						
Zinc (ppm)	0.05	- 0.5-2.0						
Boron (ppm)	0.29	0.10-0.50						
Aluminum (ppm)	1.06							

Result(s) relate only to sample(s) tested

ppm = mg/l = g/t  
 Kg/t = results given in % x 10  
 mmhos = mS/cm/cm

Method of analysis for this report is Saturated Media Extraction (SME).

Comments:

Copies To:	Analysis Approved By:  Michelle Spangher, B.Sc.
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# Tolerance of vegetable crops to salt

- Non-tolerant      carrots, beans, onion, radish
- Slightly tolerant      cucumber, lettuce, pepper
- Medium tolerant      beet, spinach, tomato
- High tolerance      swiss chard

# General fertility guidelines for greenhouse soils using Saturated Media Extract Method

	<u>Low</u>	<u>Optimal</u>	<u>V. High</u>
Soluble salts (ds/m)	0.75	2.0-3.5	5.0
Nitrate-N (ppm)	0-3.9	100-199	300+
Phosphorus	0-2	6-10	19+
Potassium (ppm)	0.59	150-249	350+
Calcium	0.79	200+	
Magnesium	0.29	70+	

(adapted from Warnke, 2009, Michigan State Extension)

# Leaching out Salts

- 6 inches water leaches 50% salts in foot of soil
- 12 inches leaches about 80%
- 24 inches leaches about 90%  
(CFA, Western Fertilizer Handbook, 8<sup>th</sup> Ed.)  
(results will vary depending on soil type)

# The Value of Peat

- Few nutrients, weed seeds, diseases
- Useful when soil nutrients are high and need organic matter
- 1 cubic yard loose peat (0.5 cubic yard compressed peat) per 1000 square feet
- Peat is acidic (pH =4), neutralize with lime (17 lbs per compressed yard) (Grubinger, UVM)
- Lime not recommended if soil pH is high

# Risks of not using compost

- A primary reason for using compost in a greenhouse is to promote biological activity
- Materials like peat, nutrients in liquid form, alfalfa meal and composted chicken manure are less likely to stimulate biological activity.
- Does this matter?
- By substituting fertilizers for compost, we risk losing the biological advantage an active soil provides and therefore encountering more diseases and pests.

