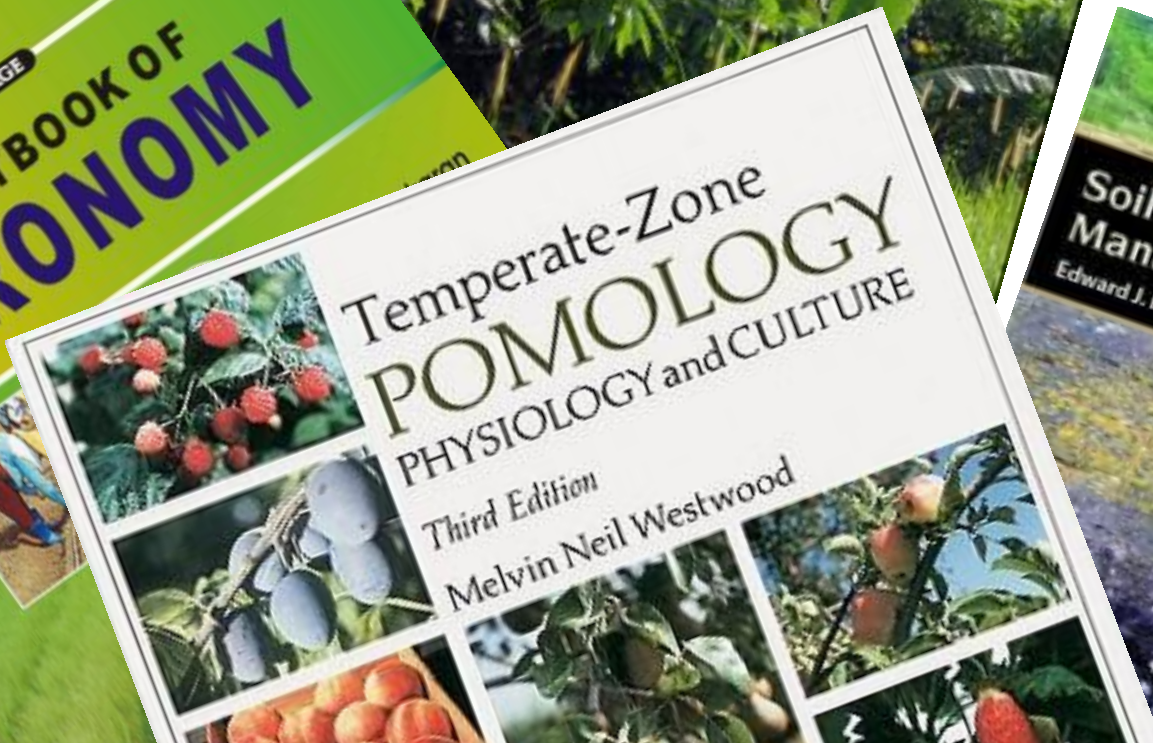
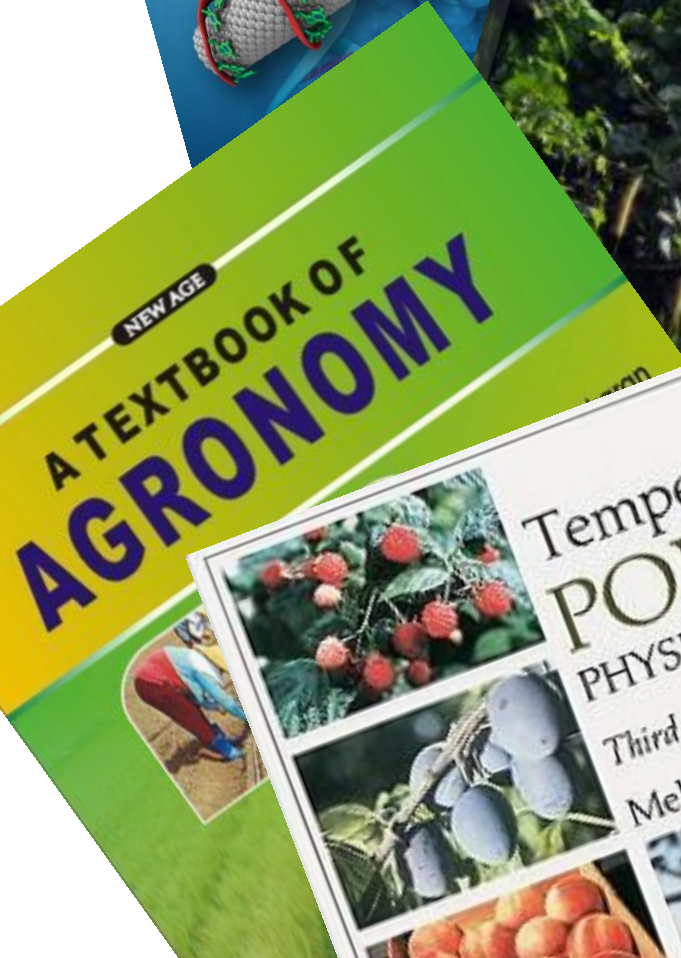
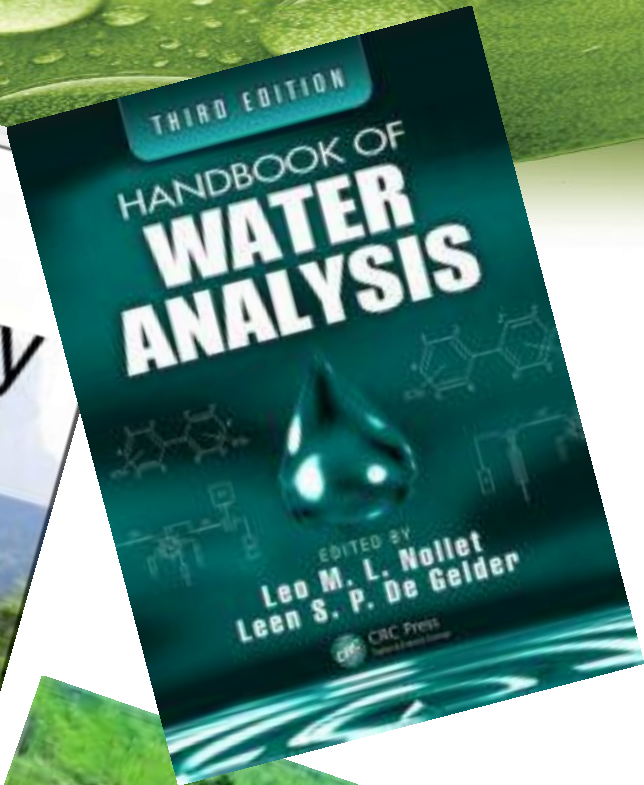
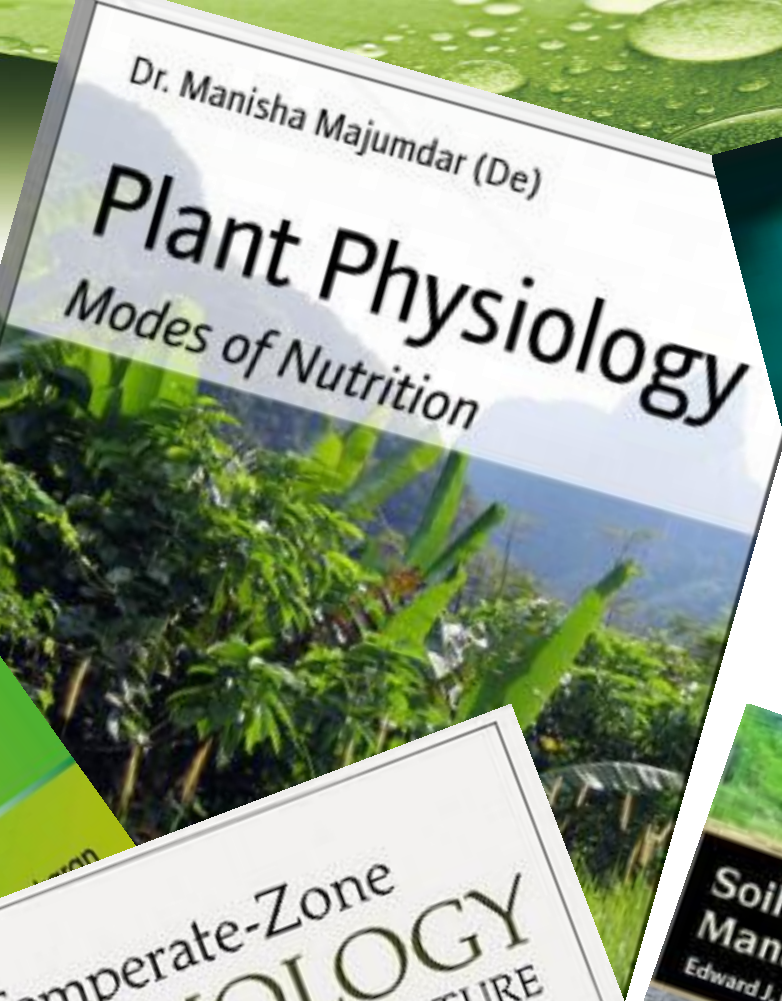
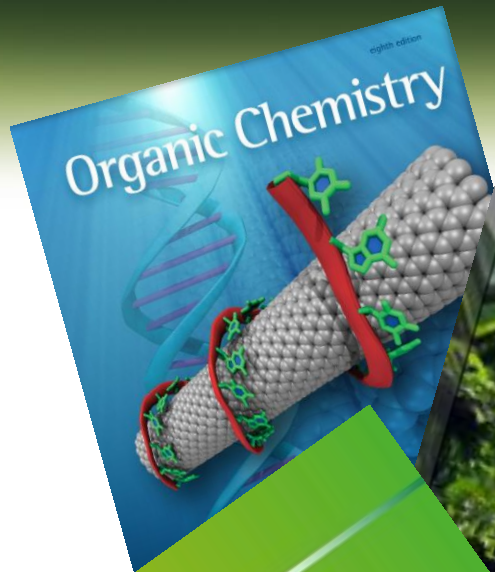
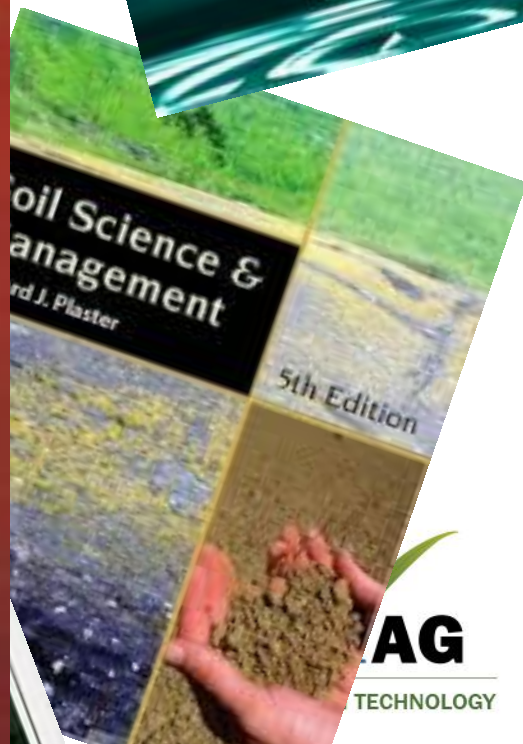
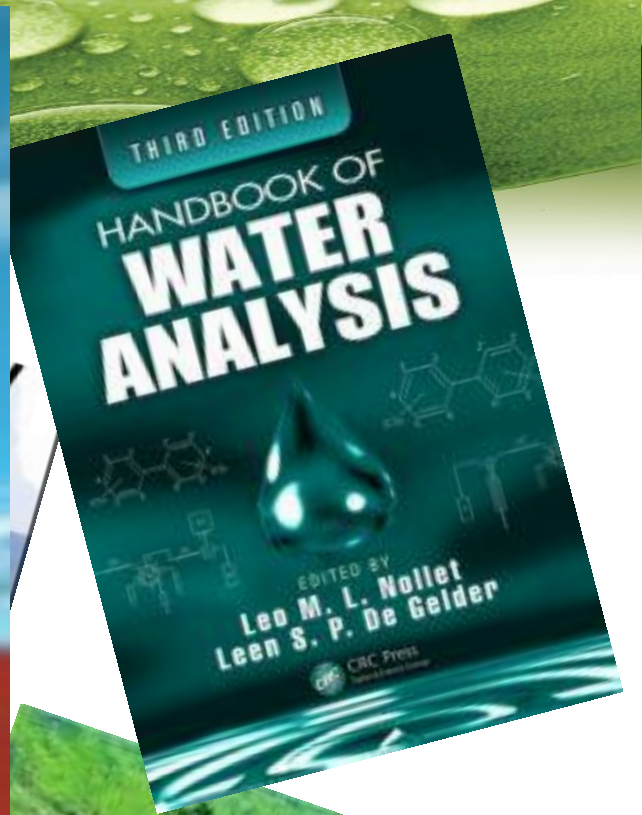
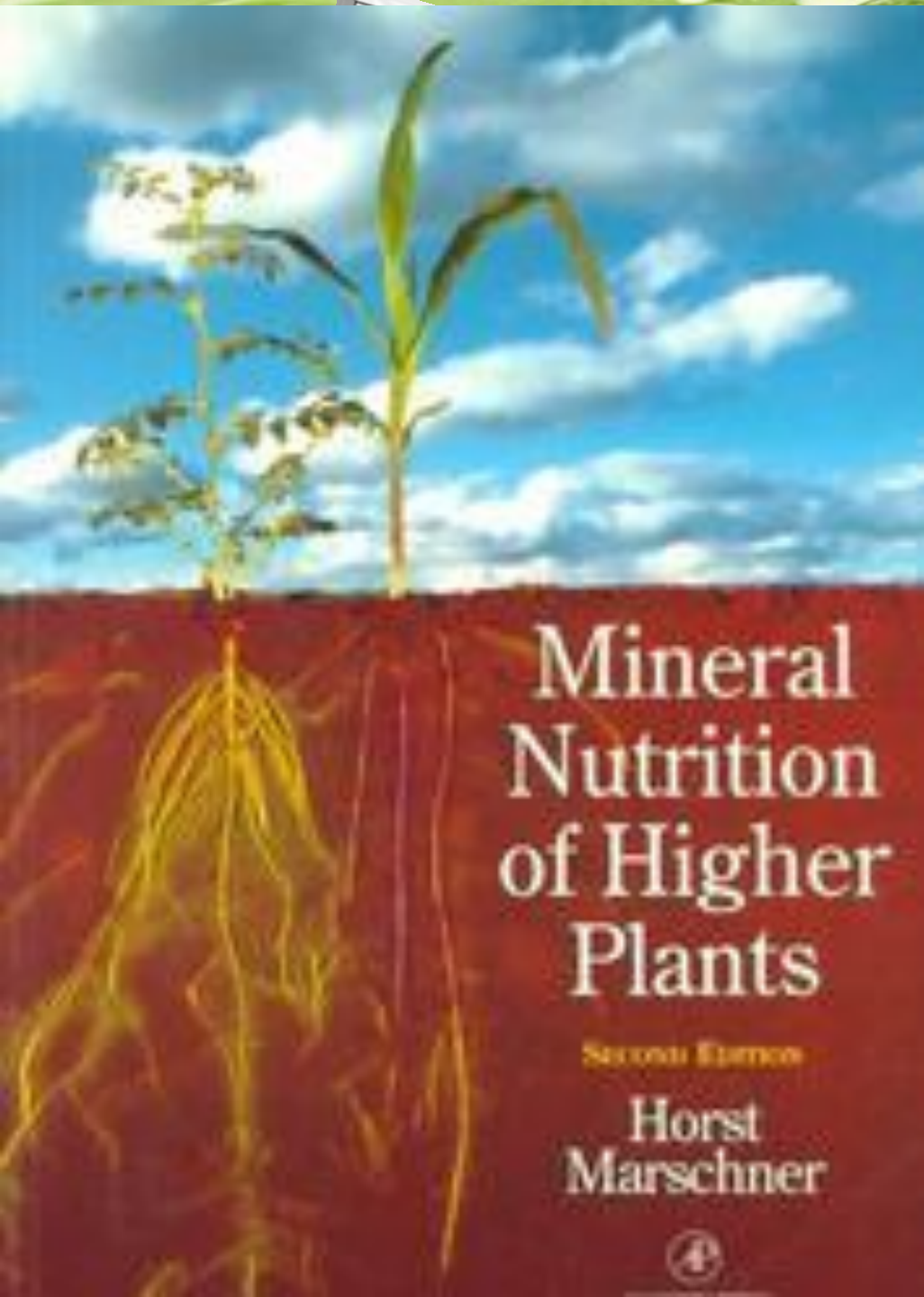




**To get the most out of the tree...  
You need to get the most out of the  
Farmer**

**A Tribute to Jerry Haak; December 31, 2013**





**AG**  
TECHNOLOGY

# Soil Analysis



FOR  
DUMMIES

# Primarily Two Types of Soil Samples

## Acid Extraction

### A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

NUMBER: 00-336-047

CLIENT NO: 9999-D

SEND TO: A & L WESTERN AGRICULTURAL LABS  
1311 WOODLAND AVE.  
MODESTO, CA 95351-

SUBMITTED BY:

GROWER: EXAMPLE REPORT

REPORT: 04/30/04

### SOIL ANALYSIS REPORT

LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	CATION SA	
	% Rating	ENR lbs/A	(Weak Bray) ppm	(OlsenMethod) ppm	K ppm	Mg ppm	Ca ppm	Na ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %
55931	4.0H	110	23M	14**	110L	460M	992VL	104L	4.7	6.2	9.7	19.1	1.5	19.8
55932	1.5L	60	27H	6**	41VL	569M	1154VL	185M	4.6	5.9	13.3	24.7	0.4	19.0
55933	3.5M	100	12L	11**	64L	471VH	841VL	87L	5.2	6.5	4.5	13.1	1.2	29.5
55934	2.8M	86	8VL	9**	29L	553VH	665VL	89M	5.3	6.6	3.7	12.1	0.6	37.7

\*\* NaHCO3-P unreliable at this soil pH

Nitrogen	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Excess Lime	Soluble Salts	Chloride	PARTICLE SIZE AN			
										NO <sub>3</sub> -N ppm	SO <sub>4</sub> -S ppm	Zn ppm	Mn ppm
5L	5L	0.3VL	3M	53VH	0.2VL	0.1VL	L	0.3L		44	25	31	CLAY
3VL	41VH	0.1VL	1VL	14M	0.2VL	0.1VL	L	0.6L		60	16	25	SAND
2VL	5L	0.1VL	2L	50VH	0.1VL	0.3VL	L	0.2VL		42	36	23	LOAM
2VL	4L	0.1VL	1VL	53VH	0.1VL	0.2VL	L	0.1VL		40	35	25	LOAM

TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).  
ESTIMATED NITROGEN RELEASE:  
PLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM  
PLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P<sub>2</sub>O<sub>5</sub>  
PLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE P<sub>2</sub>O  
5 WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. 5  
of thirty days after testing.

Mike But  
A & L WESTERN

## Soluble Paste Extraction

Sample Location	Ideal					
Sample ID	1	2	3	4	5	
Lab Number						
Water Used	DI	DI	DI	DI	Irrigation	
pH	6.3	6.5	6.5	7.1	7.1	
Soluble Salts ppm	<960	134	150	121	114	
Chloride (Cl) ppm	<50	8	4	8	10	
Bicarbonate (HCO <sub>3</sub> ) ppm	<50	40	176	73	366	
ANIONS	SULFUR ppm	5-10	10.72	36.67	11.71	9.59
	PHOSPHORUS ppm	1-3	0.61	< 0.1	0.38	0.46
SOLUBLE CATIONS	CALCIUM ppm	40-60	42.59	25.54	14.34	13.32
	meq/l	0	2.13	1.28	0.72	0.67
MAGNESIUM	ppm	8-12	2.06	5.74	2.11	1.95
	meq/l	0	0.17	0.48	0.18	0.16
POTASSIUM:	ppm	15-20	25.52	10.86	24.51	13.06
	meq/l	0	0.66	0.28	0.64	0.34
SODIUM	ppm	<20	4.56	17.39	5.17	24.82
	meq/l	0	0.20	0.76	0.22	1.08
PERCENT	Calcium	55-60	67.34	45.71	40.87	29.64
	Magnesium	18-20	5.43	17.12	10.02	7.23
	Potassium	9-12	20.96	10.10	36.29	15.10
TRACE ELEMENTS	Sodium	2-8	6.27	27.07	12.81	48.03
	Boron (p.p.m.)	0.1	0.02	0.03	< 0.02	< 0.02
	Iron (p.p.m.)	0.3	1.35	3.12	1.25	2.55
	Manganese (p.p.m.)	0.1	0.03	0.15	0.03	< 0.02
	Copper (p.p.m.)	0.08	0.07	< 0.02	0.08	< 0.02
	Zinc (p.p.m.)	0.08	0.08	< 0.02	0.11	0.06
HER	Aluminum (p.p.m.)		1.86	7.27	1.47	2.94

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INNOVATIVE PLANT GROWTH TECHNOLOGY

# Which Method is Best?





Neither!!!



# Neither!!!

Each Give you Half of the Picture!  
Both should be used to understand your soil



# Neither!!!

Each Give you Half of the Picture!

Both should be used to understand your soil

(Both a Bat and a Ball are needed to play Baseball)



OCTOBER 17, 2012

AG NUTRIENTS LLC  
52979

CLM  
(20-Z)

CEC: 10.9  
% Organic Matter: 3.7  
pH: 7.7

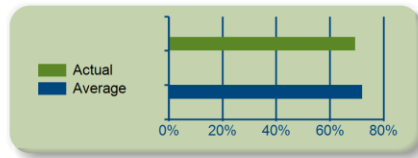
Soil Solution Weight: 112477  
Soluble Salts - EC: 0.14

CHEMICAL EXTRACTION

PASTE EXTRACTION

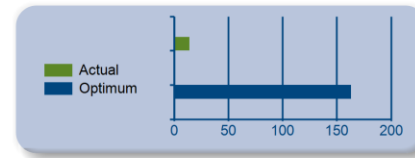
**CALCIUM**

Soil ppm: 1509.0 (ok)  
% Soil Cations (CEC): 69.5% (ok)



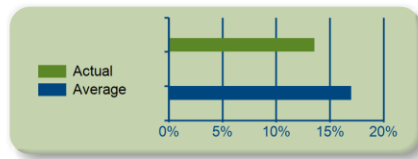
**CALCIUM**

Solution ppm: 14.22 (very low)  
% Solution Cations: 51.2% (ok)



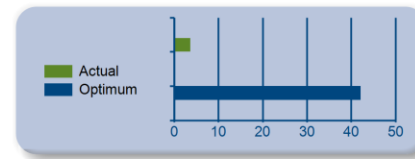
**MAGNESIUM**

Soil ppm: 176.8 (ok)  
% Soil Cations (CEC): 13.6% (ok)



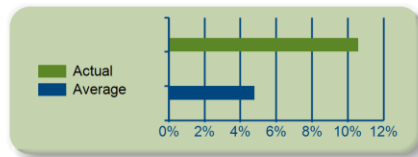
**MAGNESIUM**

Solution ppm: 3.67 (very low)  
% Solution Cations: 22.0% (ok)



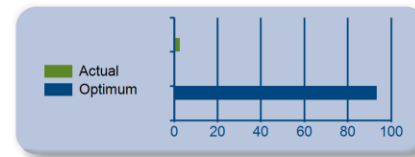
**POTASSIUM**

Soil ppm: 448.4 (ok)  
% Soil Cations (CEC): 10.6% (ok)



**POTASSIUM**

Solution ppm: 2.63 (very low)  
% Solution Cations: 4.9% (very low)





# What Acid Extraction Reveals



# What Acid Extraction Reveals

- % Organic Matter

# What Acid Extraction Reveals

- % Organic Matter
- pH



# What Acid Extraction Reveals

- % Organic Matter
- pH
- CEC



# What Acid Extraction Reveals

- % Organic Matter
- pH
- CEC
- Soluble Salts (EC)



# What Acid Extraction Reveals

- % Organic Matter
- pH
- CEC
- Soluble Salts (EC)
- “Total” Mineral Content of Soil





# What Acid Extraction Reveals

- % Organic Matter 1-2%
- pH
- CEC
- Soluble Salts (EC)
- “Total” Mineral Content of Soil

# What Acid Extraction Reveals

- % Organic Matter 1-2%
- pH 6.5-7.5
- CEC
- Soluble Salts (EC)
- “Total” Mineral Content of Soil

# What Acid Extraction Reveals

- % Organic Matter 1-2%
- pH 6.5-7.5
- CEC 3-5=Sand 20=Clay
- Soluble Salts (EC)
- “Total” Mineral Content of Soil

# What Acid Extraction Reveals

- % Organic Matter 1-2%
- pH 6.5-7.5
- CEC 3-5=Sand 20=Clay
- Soluble Salts (EC) <1.0
- “Total” Mineral Content of Soil

OCTOBER 17, 2012

---

AG NUTRIENTS LLC  
52979

---

CLM  
(20-Z)

---

CEC: 10.9

% Organic Matter: 3.7

pH: 7.7

Soil Solution Weight: 112477

Soluble Salts - EC: 0.14

Redox**AG**

INNOVATIVE PLANT GROWTH TECHNOLOGY




# What Soluble Paste Extraction Reveals



# What Soluble Paste Extraction Reveals

## What the Roots See!



# What Soluble Paste Extraction Reveals

- Combined with Deionized Water
  - (irrigation water; weak acid)





# What Soluble Paste Extraction Reveals

- Combined with Deionized Water
  - (irrigation water; weak acid)
- Provides a picture of what nutrients are available in solution as it moves through the soil profile.



# What Soluble Paste Extraction Reveals

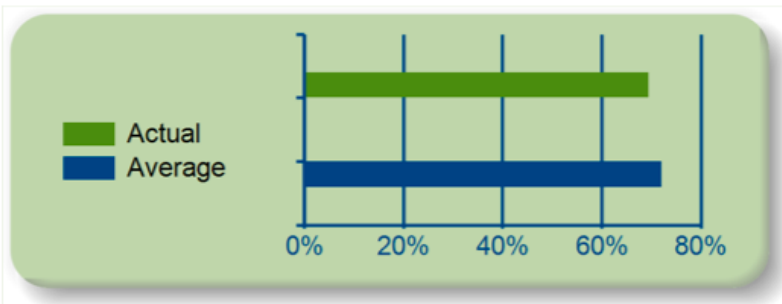
- Combined with Deionized Water
  - (irrigation water; weak acid)
- Provides a picture of what nutrients are available in solution as it moves through the soil profile.
- Paste extraction shows only the nutrients available to the plant (majority of ions are tied to soil)

## CHEMICAL EXTRACTION

## PASTE EXTRACTION

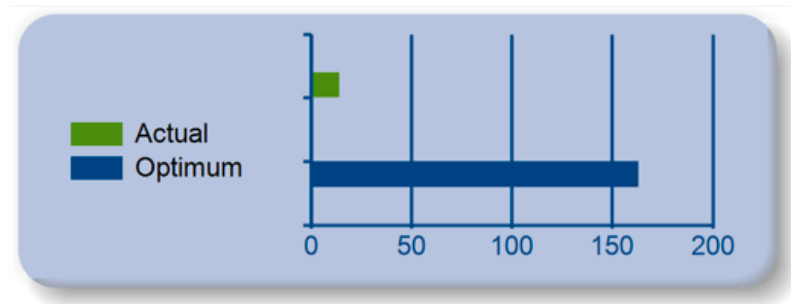
### CALCIUM

Soil ppm: 1509.0 (ok)  
% Soil Cations (CEC): 69.5% (ok)



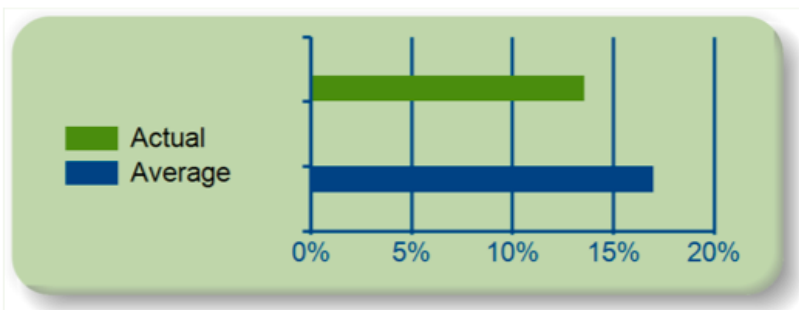
### CALCIUM

Solution ppm: 14.22 (very low)  
% Solution Cations: 51.2% (ok)



## MAGNESIUM

Soil ppm: 176.8 (ok)  
% Soil Cations (CEC): 13.6% (ok)



## MAGNESIUM

Solution ppm: 3.67 (very low)  
% Solution Cations: 22.0% (ok)





# Base Saturation

Ca

Mg

K

Na

Al

H



# Base Saturation

$$\begin{array}{l} \text{Cations} \\ \text{Positive Charge} \end{array} = \left( \begin{array}{l} \text{Ca} \\ \text{Mg} \\ \text{K} \\ \text{Na} \\ \text{Al} \\ \text{H} \end{array} \right)$$



# Base Saturation

Ca

Mg

K

Na

Al

H

---

100%

**Redox**AG

INNOVATIVE PLANT GROWTH TECHNOLOGY

# Base Saturation

Ca 65-80%

Mg 10-20%

K 4-7%

Na < 1%

Al

H

---

100%





IDEAL

Cation:Anion Ratio

>2:1

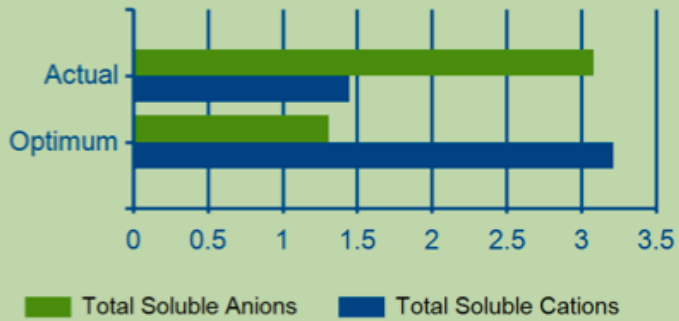
But the base saturation is Primary

# SOLUBLE CATION / ANION BALANCE

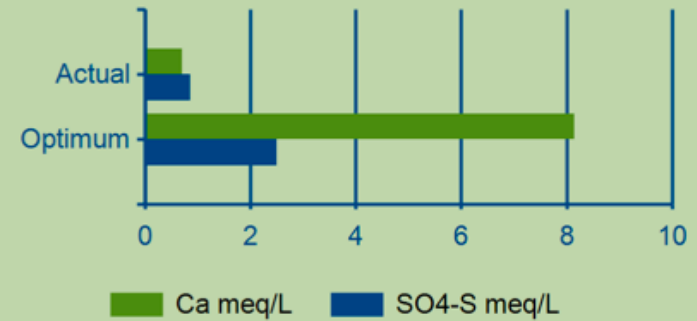
Cation:Anion ratio: 0.5 1

Calcium:Sulfate Sulfur ratio: 0.8 1

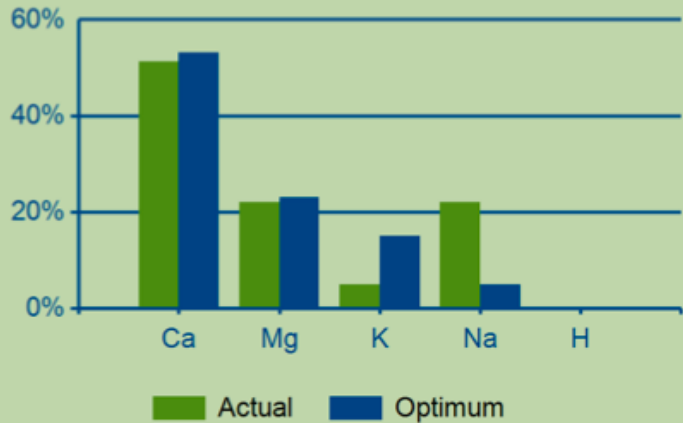
Cation:Anion Ratio



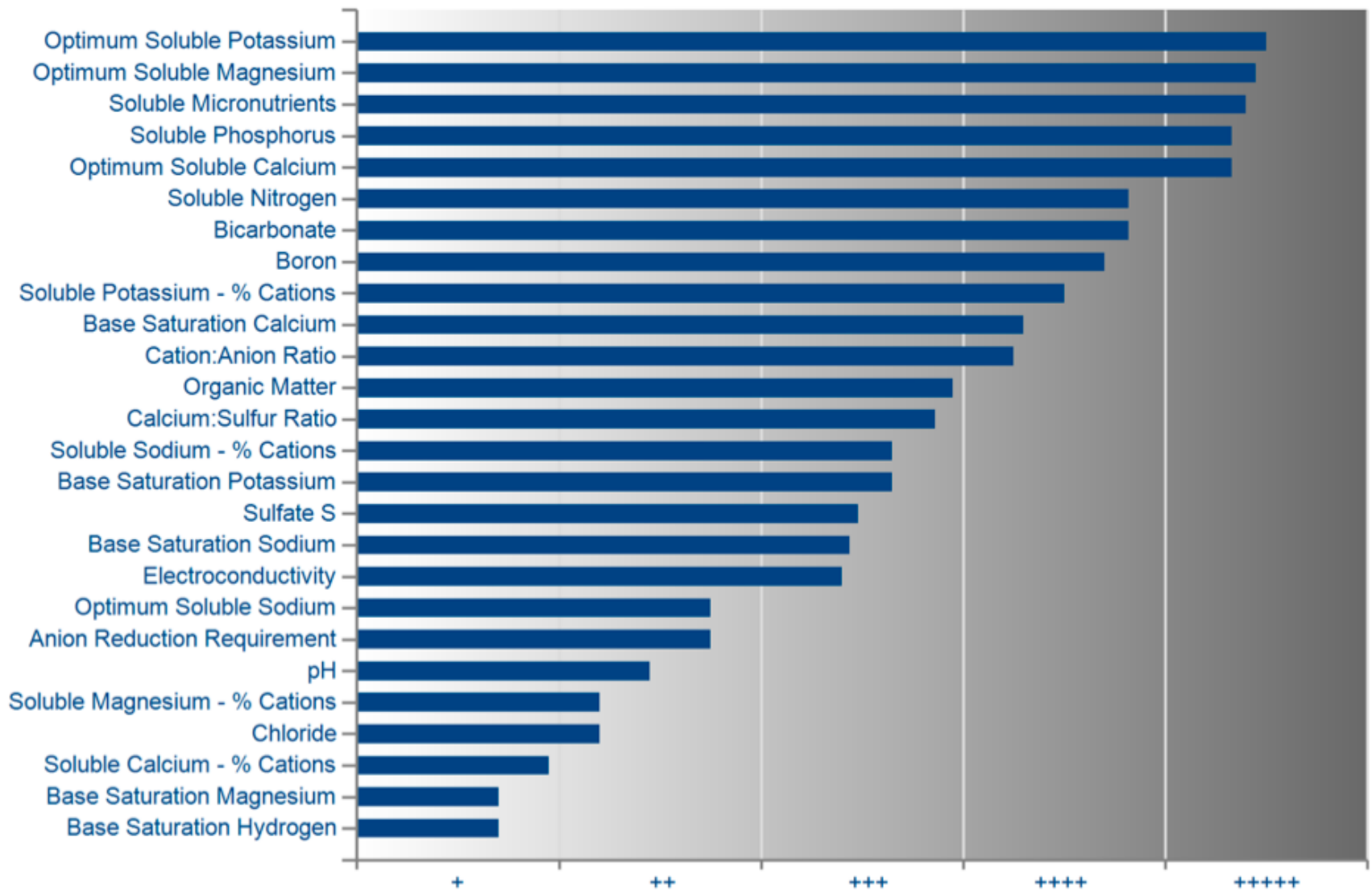
Calcium:Sulfur Ratio



Soluble Cation Ratio



## SOIL FACTORS - PRIORITIZED



LOW PRIORITY (+) HIGH PRIORITY (+++++)



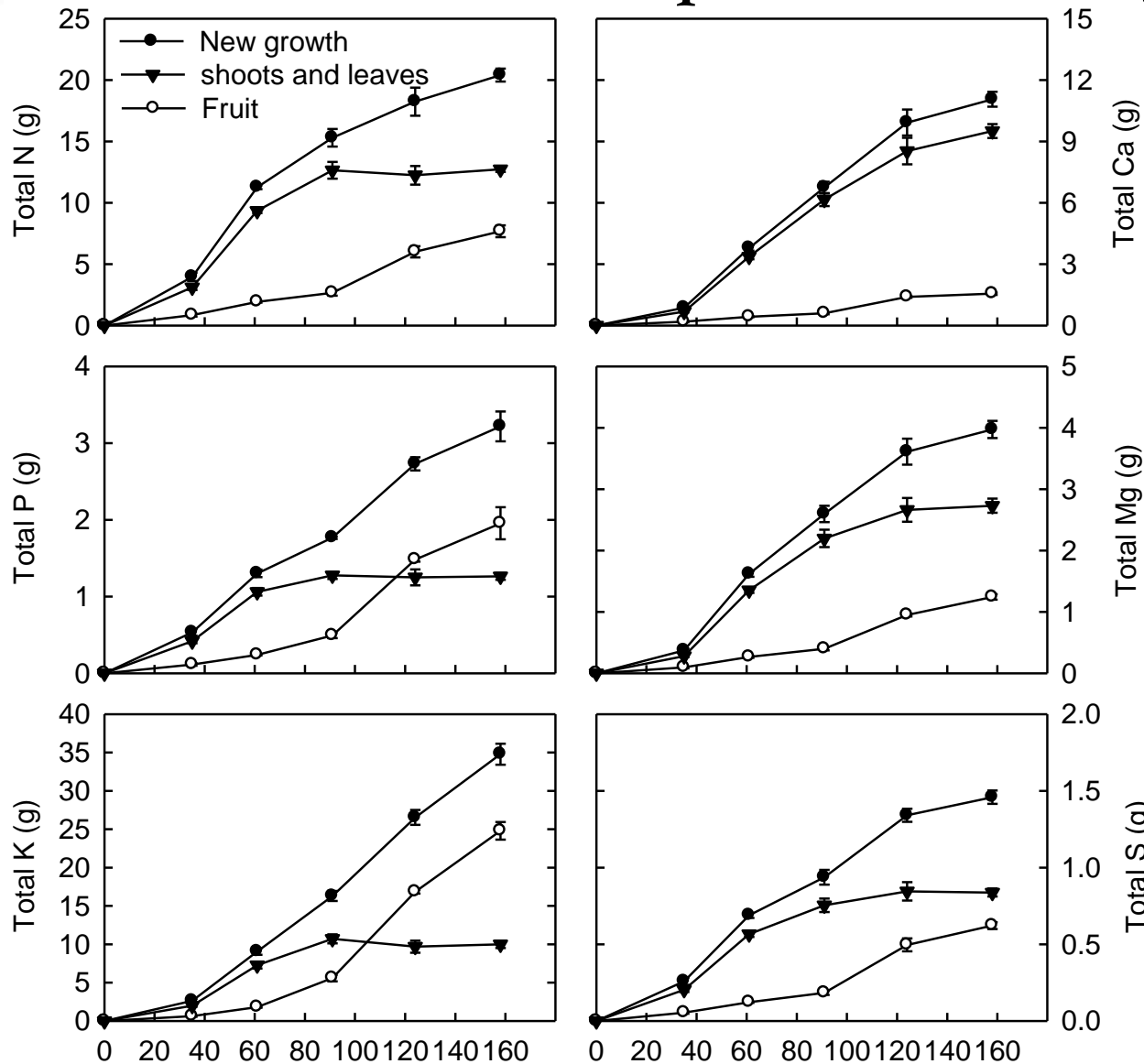
# What are the Seasonal Needs of Nutrients?



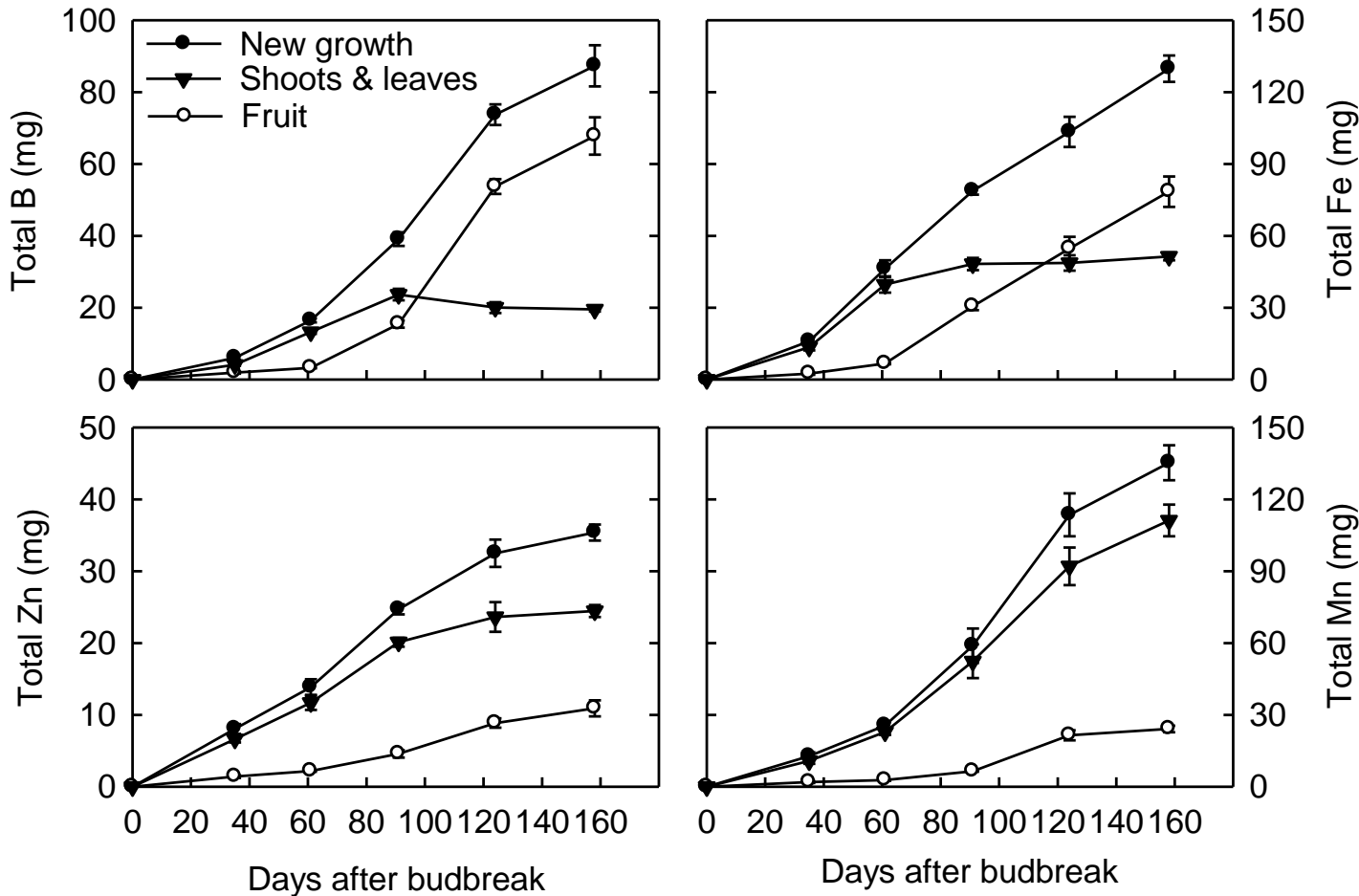
# What are the Seasonal Needs of Nutrients?

Dr. Lailiang Cheng, Cornell; 2012:  
Showed nutrients allocation and timing  
of major nutrients under High Density  
Canopy.

# Macronutrient accumulation patterns in new growth



# Micronutrient accumulation patterns in new growth



# Tree nutrient requirements in relation to yield

## Macronutrients (lbs/acre)

<i>Fruit yield (b/a)</i>	<i>N</i>	<i>P</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>	<i>S</i>
<b>500</b>	<b>22.1</b>	<b>3.7</b>	<b>40.2</b>	<b>15.9</b>	<b>4.9</b>	<b>1.8</b>
<b>750</b>	<b>33.2</b>	<b>5.5</b>	<b>60.2</b>	<b>23.9</b>	<b>7.3</b>	<b>2.7</b>
<b>1000</b>	<b>44.3</b>	<b>7.4</b>	<b>80.3</b>	<b>31.8</b>	<b>9.8</b>	<b>3.6</b>
<b>1250</b>	<b>55.4</b>	<b>9.2</b>	<b>100.4</b>	<b>39.8</b>	<b>12.2</b>	<b>4.5</b>
<b>1500</b>	<b>66.4</b>	<b>11.1</b>	<b>120.5</b>	<b>47.7</b>	<b>14.7</b>	<b>5.4</b>
<b>1750</b>	<b>77.5</b>	<b>12.9</b>	<b>140.6</b>	<b>55.7</b>	<b>17.1</b>	<b>6.3</b>
<b>2000</b>	<b>88.6</b>	<b>14.8</b>	<b>160.6</b>	<b>63.6</b>	<b>19.6</b>	<b>7.2</b>





## 'Gala' nutrient removal by fruit harvest in relation to yield

### Macronutrients (lbs/acre)

<i>Yield (b/a)</i>	<i>N</i>	<i>P</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>
<b>500</b>	8.6	2.2	27.7	1.8	1.4
<b>1000</b>	17.2	4.4	55.3	3.5	2.8
<b>1500</b>	25.7	6.6	83.0	5.3	4.2
<b>2000</b>	34.3	8.8	110.7	7.0	5.6



Things that make you go....

Hmmmmmmmmmm??

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Things that make you go....

Hmmmmmmmmmm??

(Other things to factor when maximizing mineral uptake)

Things that make you go....

Hmmmmmmmmmm??



Soil Moisture Content

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INNOVATIVE PLANT GROWTH TECHNOLOGY

Things that make you go....

Hmmmmmmmmmm??



Root Mass







Things that make you go....

Hmmmmmmmmmm??

Other Nutrient Availability





Things that make you go....

Hmmmmmmmmmm??

## Other Nutrient Availability

- ◆ K Regulates Water and Nutrient Flow

Careful with Rates and Timings, K can Displace Ca



Things that make you go....

Hmmmmmmmmmm??

(Other things to factor when maximizing mineral uptake)

## Other Nutrient Availability

- ◆ K Regulates Water and Nutrient Flow
- ◆ B & Zn aids in Ca Uptake



Things that make you go....

Hmmmmmmmmmm??

Insure Nutrients end up where you want them



Things that make you go....

Hmmmmmmmmmm??

Insure Nutrients end up where you want them

- **Employ horticultural techniques to maximize nutrition**
  - **Still filling space, or producing quality fruit?**



Things that make you go....

Hmmmmmmmmmm??

Insure Nutrients end up where you want them

- **Employ horticultural techniques to maximize use**
  - **Still filling space, or producing quality fruit?**
- **Only \$ paid for fruit? Maximize Fruit Quality**
  - **Ca uptake is driven by Transpiration, therefore end up in shoots and leaves**
  - **Hydrocooling, Apogee, Summer Pruning help direct Ca to fruit**

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INNOVATIVE PLANT GROWTH TECHNOLOGY



*Thank You!*

**Rob Lynch**  
*Horticulturist*

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Cell: 509-952-5252

Office: 208-678-2610

Fax: 208-677-3609

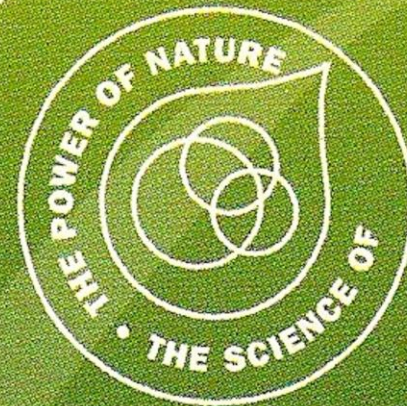
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130 South 100 West

Burley, Idaho 83318

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