

Tools for Nutrient Management



Bryant Mason

Certified Crop Advisor

Organic Nutrient Management

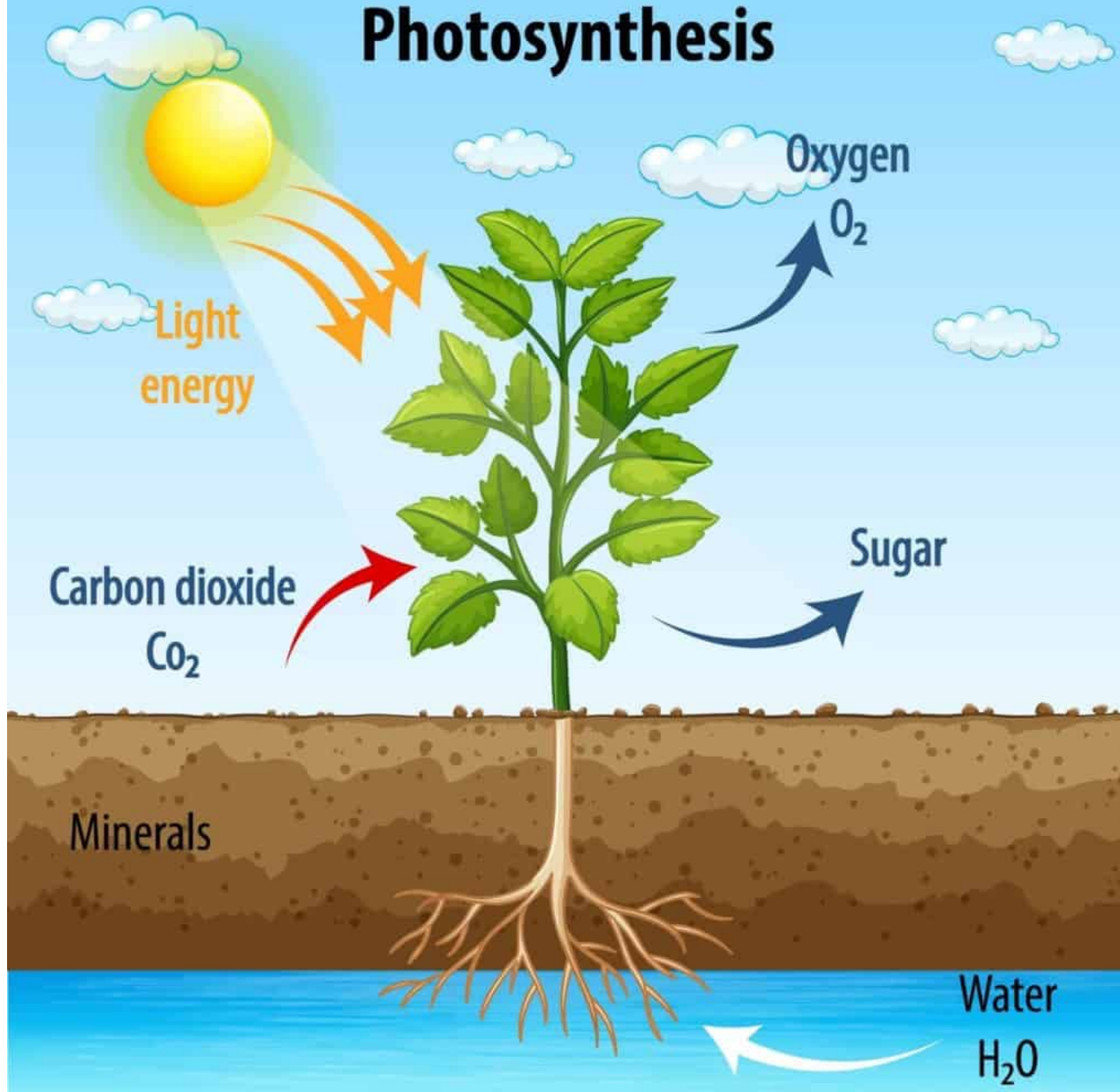
Bryant@soildoctorconsulting.com

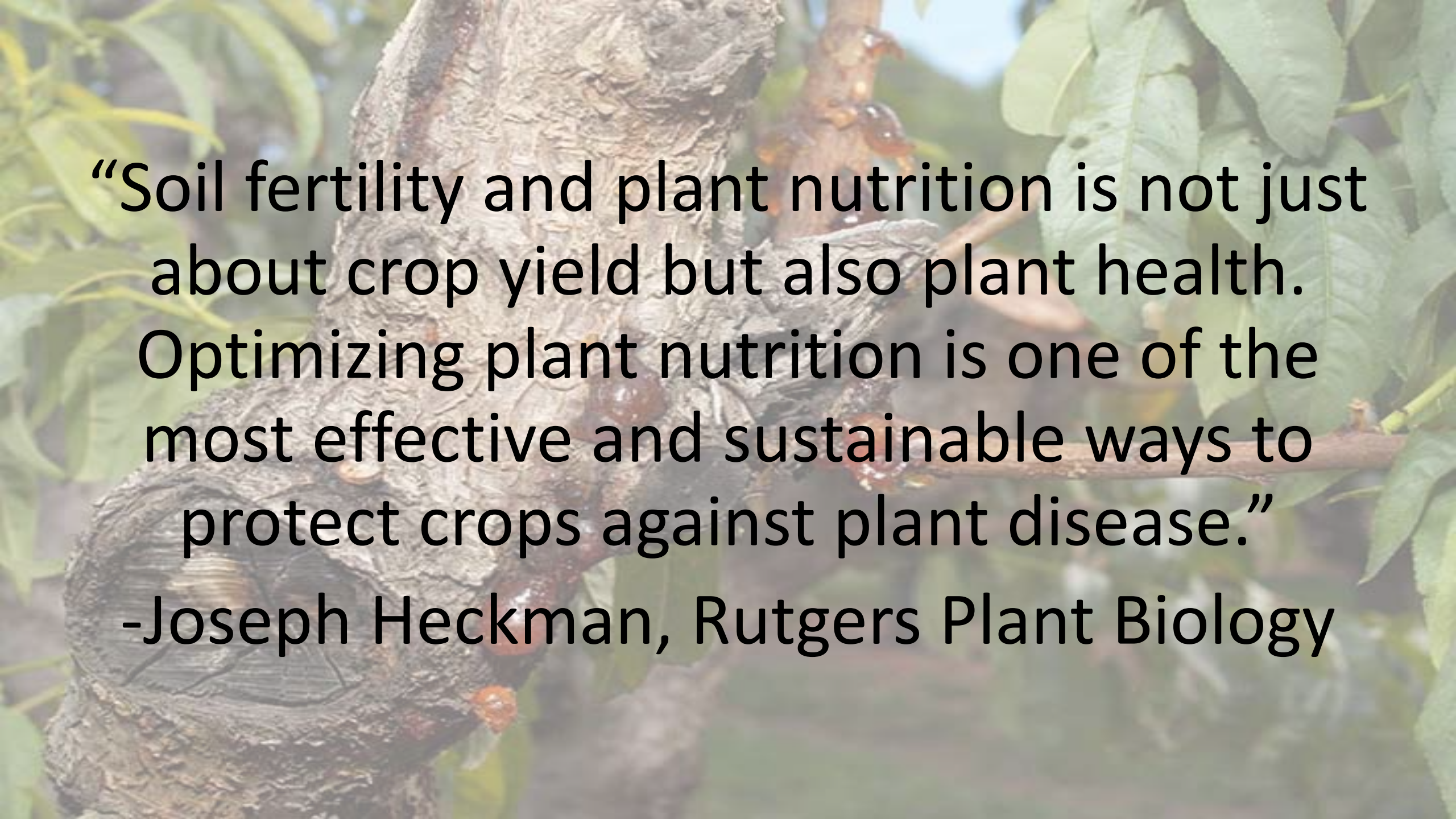
“Success lies in the
ruthless execution of the
basics.”

-Eric Bach

“Success lies in the
ruthless execution of
the fundamentals.”

Photosynthesis





“Soil fertility and plant nutrition is not just about crop yield but also plant health. Optimizing plant nutrition is one of the most effective and sustainable ways to protect crops against plant disease.”

-Joseph Heckman, Rutgers Plant Biology

Soil



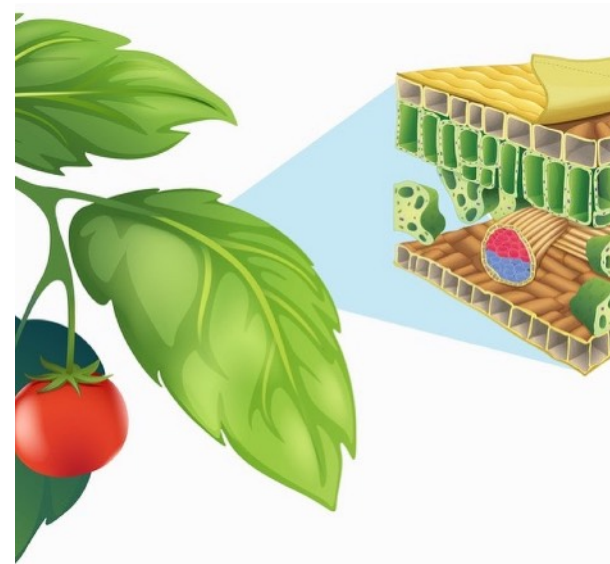
Water



Tissue

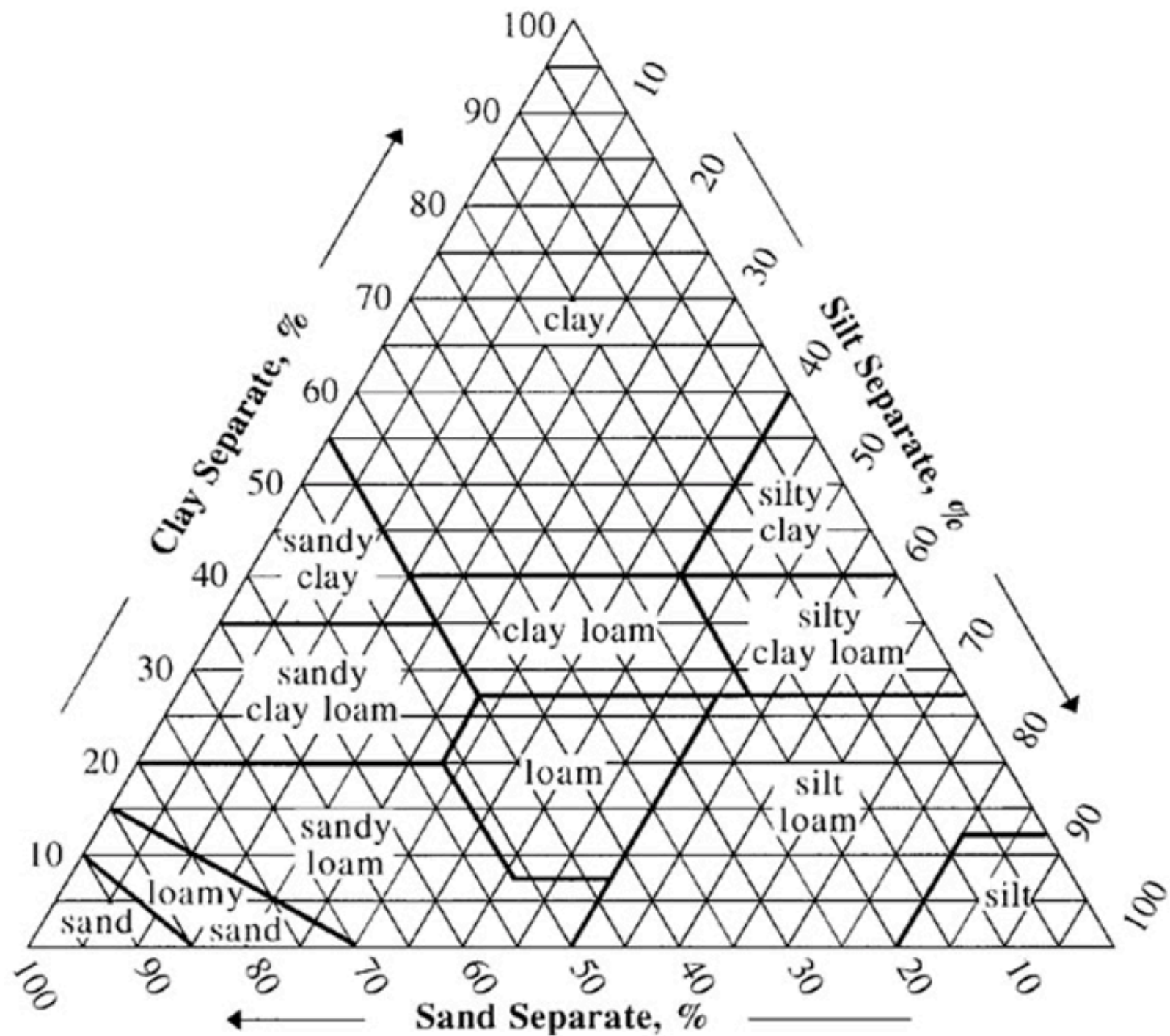


Sap



Suggested Soil Tests

1. Standard Soil Test
2. Saturated Paste Test
3. Texture Analysis (once)



Cations in soil solution

H⁺

Ca⁺⁺

Ca⁺⁺

Ca⁺⁺

Mg⁺⁺

Ca⁺⁺

H⁺

Mg⁺⁺

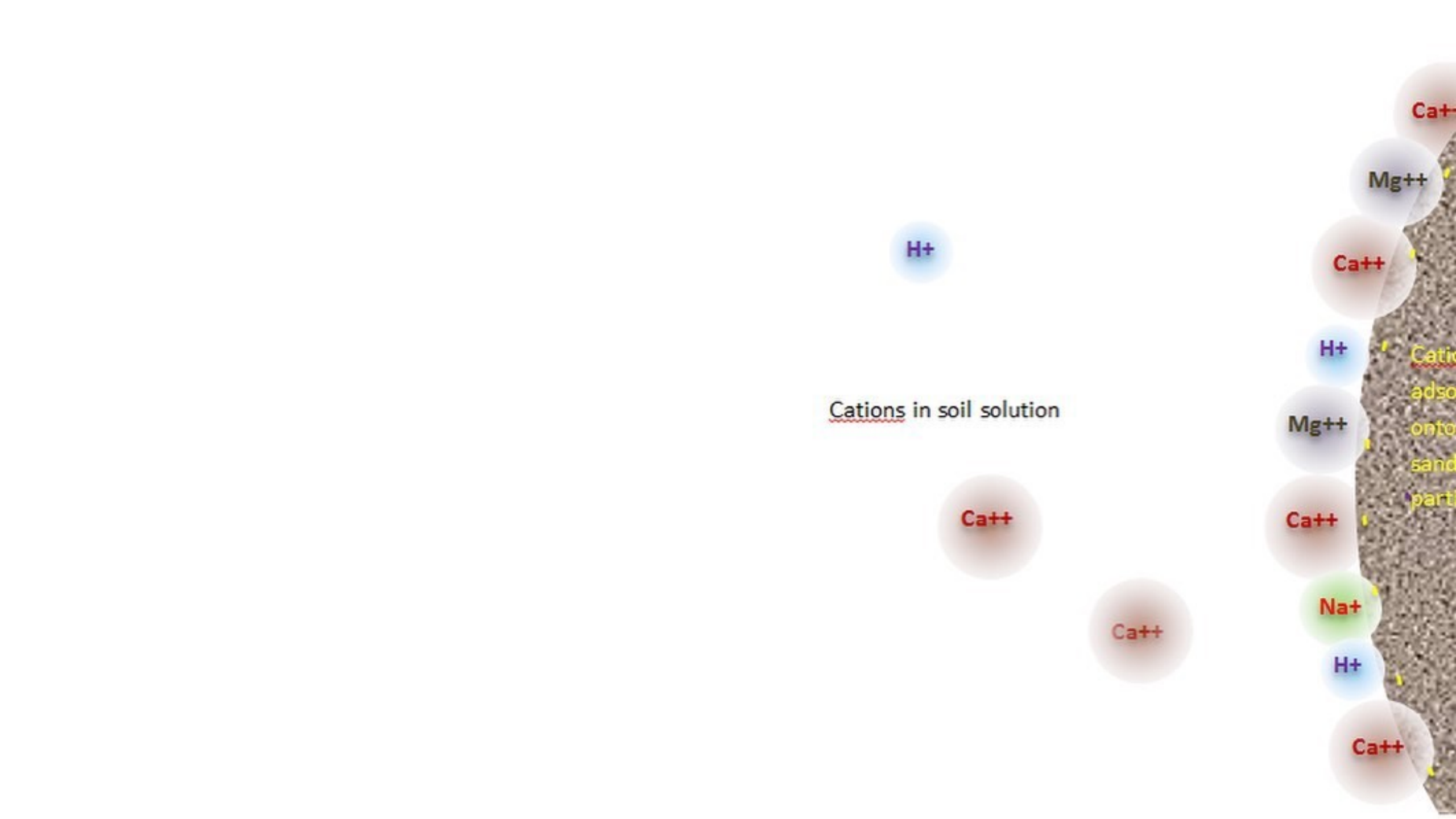
Ca⁺⁺

Na⁺

H⁺

Ca⁺⁺

Cation
adsor
onto
sand
part



Soil Testing Pitfalls

1. Home Testing
2. Only doing a standard test
3. Over-testing
4. Self-Interpretation
5. Redox State





Irrigation Water Testing

- Issues: Salinity, Sodium, Bicarbonates/Alkalinity
- Test Once or Twice
- Solutions: adjust nutritional program or acidify water



Tissue Testing

- When to Use
- How to Take Sample
- Interpretation
- Pitfalls



Plant Analysis Handbook IV

A Guide to Sampling, Preparation, Analysis and
Interpretation for Agronomic and Horticultural Crops



Edited by
Gretchen M. Bryson
Harry A. Mills

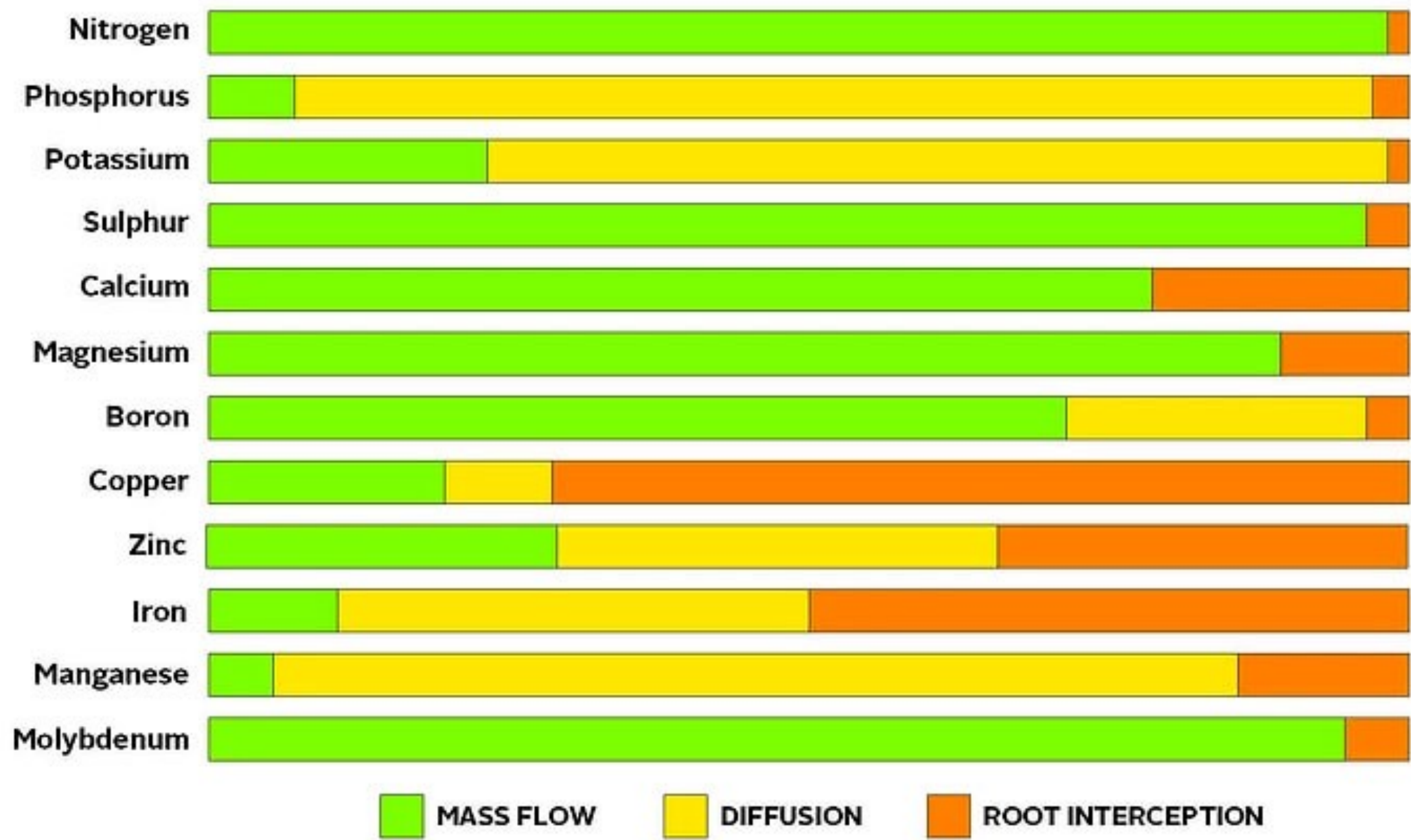
SCIENTIFIC NAME		<i>Prunus persica</i>	
COMMON NAME		Peach or Nectarine	
COLLECTED FROM		Production orchards	
PLANT PART		25 midshoot leaves	
SEASON		Spring, at fruit set	
DATA TYPE		Sufficiency Range	
CULTIVARS USED		Species only	
Macronutrients		Micronutrients	
	%		ppm
N	1.80 - 3.50	Fe	50 - 800
P	0.13 - 0.25	Mn	40 - 230
K	1.75 - 3.00	B	20 - 60
Ca	1.50 - 2.70	Cu	5 - 20
Mg	0.30 - 0.80	Zn	15 - 125
S	0.20 - 0.45	Mo	1.60 - 2.80

SCIENTIFIC NAME		<i>Malus domestica</i>	
COMMON NAME		Apple	
COLLECTED FROM		Experimental test plots	
PLANT PART		50 mature leaves from new growth	
SEASON		Summer	
DATA TYPE		Sufficiency Range	
CULTIVARS USED		Species only	
Macronutrients		Micronutrients	
	%		ppm
N	1.90 - 2.60	Fe	50 - 300
P	0.09 - 0.40	Mn	25 - 200
K	1.20 - 2.00	B	25 - 50
Ca	0.80 - 1.60	Cu	6 - 25
Mg	0.25 - 0.45	Zn	20 - 100
S	0.20 - 0.40	Mo	0.10 - 2.00

SCIENTIFIC NAME		<i>Prunus avium</i>		SCIENTIFIC NAME		<i>Prunus cerasus</i>	
COMMON NAME		Sweet Cherry		COMMON NAME		Sour Cherry	
COLLECTED FROM		Production orchards		COLLECTED FROM		Production orchards	
PLANT PART		50 mature leaves from new growth		PLANT PART		50 mature leaves from new growth	
SEASON		Summer		SEASON		Summer	
DATA TYPE		Sufficiency Range		DATA TYPE		Sufficiency Range	
CULTIVARS USED		Species only		CULTIVARS USED		Species only	
Macronutrients		Micronutrients		Macronutrients		Micronutrients	
	%		ppm		%		ppm
N	2.10 - 3.00	Fe	100 - 250	N	2.60 - 3.00	Fe	100 - 200
P	0.16 - 0.50	Mn	40 - 200	P	0.16 - 0.22	Mn	40 - 60
K	2.50 - 3.00	B	20 - 100	K	1.60 - 2.10	B	20 - 55
Ca	2.00 - 3.00	Cu	5 - 30	Ca	1.50 - 2.60	Cu	8 - 30
Mg	0.30 - 0.80	Zn	20 - 60	Mg	0.30 - 0.75	Zn	20 - 50
S	0.19 - 0.34	Mo	0.09 - 0.24	S	0.16 - 0.30	Mo	0.06 - 0.08

My Favorite Test

- The plant doesn't lie
- *Great for nitrogen management (DIY)
- Hidden Hunger
- Interpretation is Technical
 1. **Low soil paste levels
 2. Nutrient excesses that create antagonisms
 3. Nutrient uptake mechanisms
 4. Root issues
 5. Transpiration



Low Soil Levels

Lab Number		22			
Sample Depth in inches		6			
Total Exchange Capacity (M. E.)		29.08			
pH of Soil Sample		7.8			
Organic Matter, Percent		4.00			
ANIONS	SULFUR: p.p.m.	18			
	Mehlich III Phosphorous: as (P ₂ O ₅) lbs / acre	302			
EXCHANGEABLE CATIONS	CALCIUM: lbs / acre Desired Value Value Found Deficit	7910 8619			
	MAGNESIUM: lbs / acre Desired Value Value Found Deficit	837 1246			
	POTASSIUM: lbs / acre Desired Value Value Found Deficit	907 897 -10			
	SODIUM: lbs / acre	66			
BASE SATURATION %	Calcium (60 to 70%)	74.09			
	Magnesium (10 to 20%)	17.85			
	Potassium (2 to 5%)	3.95			
	Sodium (.5 to 3%)	0.50			
	Other Bases (Variable)	3.60			
	Exchangeable Hydrogen (10 to 15%)	0.00			
TRACE ELEMENTS	Boron (p.p.m.)	0.81			
	Iron (p.p.m.)	64			
	Manganese (p.p.m.)	83			
	Copper (p.p.m.)	4.67			
	Zinc (p.p.m.)	6.41			
	Aluminum (p.p.m.)	474			
OTHER	Ammonium (p.p.m.)	1.4			
	Nitrate (p.p.m.)	13.1			

Water Used		DI			
pH		7.8			
Soluble Salts ppm		124			
Chloride (Cl) ppm		19			
Bicarbonate (HCO ₃) ppm		71			
ANIONS	SULFUR ppm	2.02			
	PHOSPHORUS ppm	0.12			
SOLUBLE CATIONS	CALCIUM	ppm	20.02		
		meq/l	1.00		
	MAGNESIUM	ppm	6.97		
		meq/l	0.58		
	POTASSIUM:	ppm	4.09		
		meq/l	0.11		
	SODIUM	ppm	5.67		
		meq/l	0.25		
PERCENT	Calcium	51.74			
	Magnesium	30.04			
	Potassium	5.50			
	Sodium	12.73			
TRACE ELEMENTS	Boron (p.p.m.)	0.07			
	Iron (p.p.m.)	0.73			
	Manganese (p.p.m.)	0.06			
	Copper (p.p.m.)	0.03			
	Zinc (p.p.m.)	< 0.02			
	Aluminum (p.p.m.)	0.53			
OTHER					

Low Tissue Levels

Submitted By Bryant Mason

Sample Location Peach

Sample Name Yellow

		%
Calcium	Ca	1.37
Magnesium	Mg	0.57
Phosphorus	P	0.36
Potassium	K	2.98
Nitrogen	N	3.27
Sulfur	S	0.12
Sodium	Na	0.004
		ppm
Boron	B	53.91
Copper	Cu	2.7
Iron	Fe	135.4
Manganese	Mn	20.48
Zinc	Zn	21.8

Sample Yellow

Crop	N%	P%	K%	Ca%	Mg%	S%	Fe (ppm)	Mn (ppm)	B (ppm)	Cu (ppm)	Zn (ppm)	Ca:K
Peach	3.274	0.359	2.977	1.368	0.567	0.1197	135.4	20.48	53.91	2.7	21.8	0.46
Severity %	0%	84%	0%	-9%	0%	-40%	0%	-49%	0%	-46%	0%	-72%

Positive numbers indicate the nutrient concentration is high, while negative numbers indicate the concentration is low. Green indicates the levels are in-range, yellow is slightly out-of-range, and red indicates the concentration is significantly out-of-range. If concentrations are significantly high and out-of-range, it is often a result of foliar residual on the leaves.

Sample Yellow

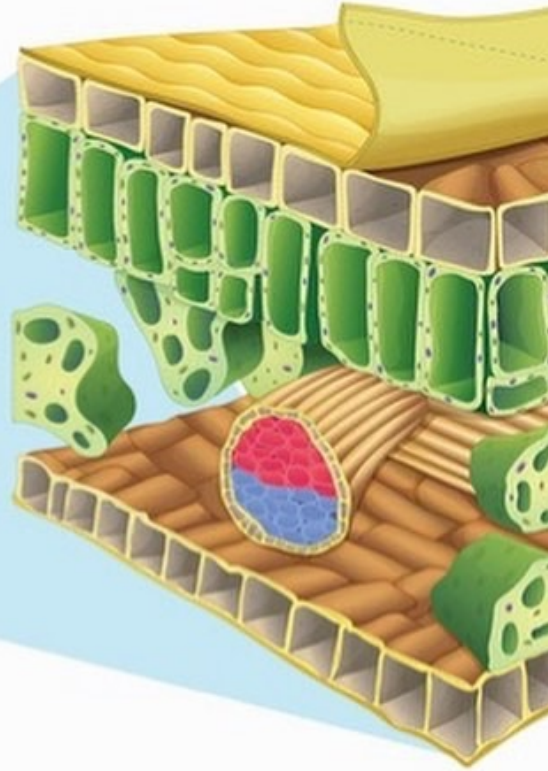
Crop	N%	P%	K%	Ca%	Mg%	S%	Fe (ppm)	Mn (ppm)	B (ppm)	Cu (ppm)	Zn (ppm)	Ca:K
Peach	3.274	0.359	2.977	1.368	0.567	0.1197	135.4	20.48	53.91	2.7	21.8	0.46
Severity %	0%	84%	0%	-9%	0%	-40%	0%	-49%	0%	-46%	0%	-72%

Positive numbers indicate the nutrient concentration is high, while negative numbers indicate the concentration is low. Green indicates the levels are in-range, yellow is slightly out-of-range, and red indicates the concentration is significantly out-of-range. If concentrations are significantly high and out-of-range, it is often a result of foliar residual on the leaves.

Tissue Testing Pitfalls

1. Not enough testing
2. Pulling leaves that are too young
3. Foliar residual
4. Wrong timing
5. Wide Target Ranges
6. Sometimes tough to understand WHY things are low



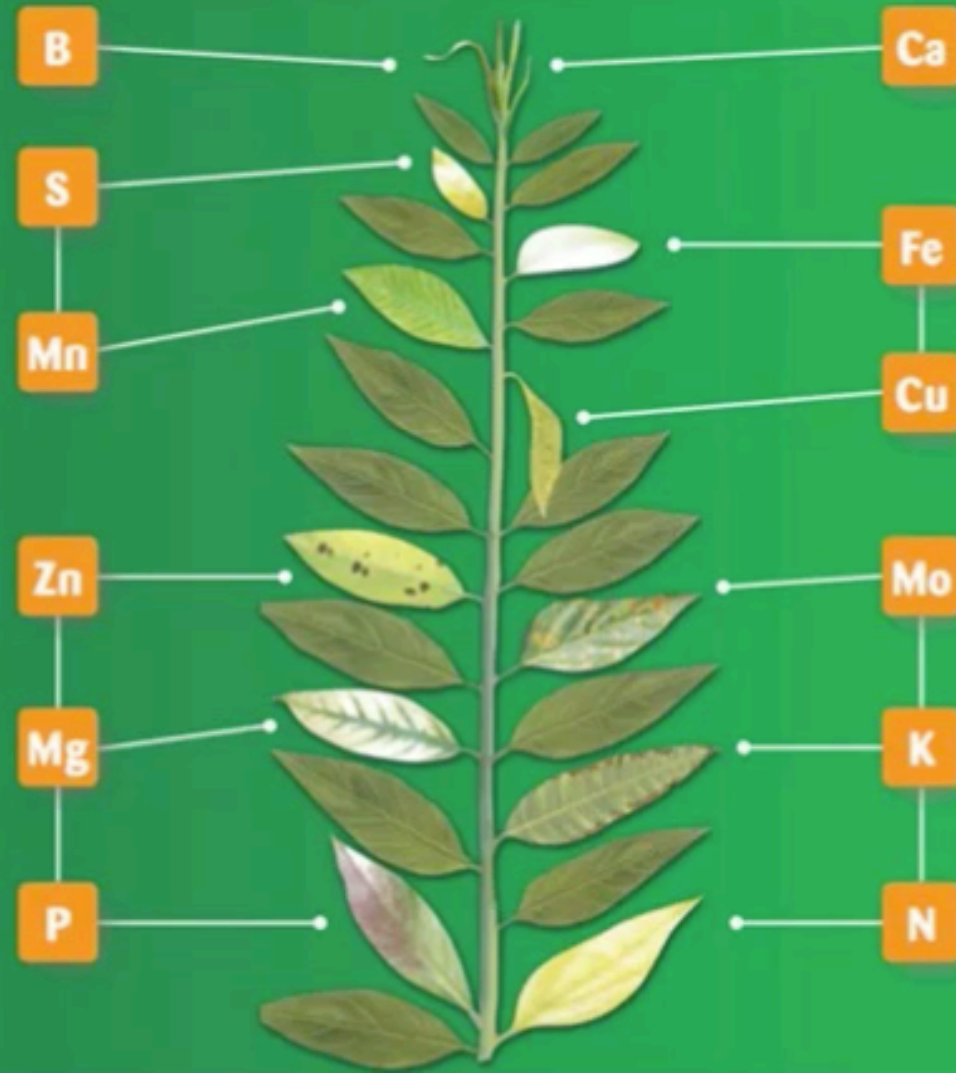


Sap Analysis

- What is sap?
- How it works
- Testing protocols
- Pitfalls

Nutrient deficiency based on the position in the plant

Nutrient Mobility



How to Use Sap Testing

- Bitter Pit in apples
- Sap is more responsive to management decisions
- Critical points of influence (ex: early in the season)

Pitfalls

- Double the price
- Very few labs
- Not enough frequency
- No targets so bad recommendations and product sales. Extremely sophisticated analysis.
- Two-day shipping on ice



Example

1. Texture

Particle Size Analysis		%
Clay		24.00
Silt		47.90
Sand		28.10
Organic Matter		5.61
Fine Gravel	mm	%
	2.00	0.00
Sand Fractions	mm	%
	1.00	2.90
	.25	11.60
	.15	6.10
	.05	7.50
Texture Classification		
clay loam		

2. Water

Sample Location	Fire			Notes
Sample Name	Mtn			
pH			7.7	
Hardness	ppm		81.9	
Hardness Grains	/gal		4.79	
Conductivity	mmhos/cm		0.11	
Sodium Adsorption Ratio			0.36	
		ppm	meq/L	lbs/A in
Calcium	Ca	26.6	1.33	6.04
Magnesium	Mg	3.8	0.31	0.86
Potassium	K	1.9	0.05	0.42
Sodium	Na	7.6	0.33	1.72
Iron	Fe	2.2		0.49
			meq/L	lbs/A in
Total Alkalinity		57.5		13.07
Carbonate		0.0	0.00	0.00
Bicarbonate		70.0	1.15	15.91
Chloride		27.0	0.77	6.14
Sulfate		5.4	0.11	1.23
Salt Concentration		69.1		15.71
Boron		< 0.02		
Cation/Anion Ratio			1.00	

Example

3. Standard Soil Test

Lab Number			216			
Sample Depth in inches			6			
Total Exchange Capacity (M. E.)			19.52			
pH of Soil Sample			7.6			
Organic Matter, Percent			5.61			
ANIONS	SULFUR:	p.p.m.	19			
	Mehlich III Phosphorous:	as (P ₂ O ₅) lbs / acre	2144			
EXCHANGEABLE CATIONS	CALCIUM:	Desired Value lbs / acre Value Found Deficit	5310 5834			
	MAGNESIUM:	Desired Value lbs / acre Value Found Deficit	562 655			
	POTASSIUM:	Desired Value lbs / acre Value Found Deficit	609 1081			
	SODIUM:	lbs / acre	39			
BASE SATURATION %	Calcium (60 to 70%)		74.70			
	Magnesium (10 to 20%)		13.98			
	Potassium (2 to 5%)		7.10			
	Sodium (.5 to 3%)		0.43			
	Other Bases (Variable)		3.80			
	Exchangeable Hydrogen (10 to 15%)		0.00			
TRACE ELEMENTS	Boron (p.p.m.)		0.83			
	Iron (p.p.m.)		122			
	Manganese (p.p.m.)		50			
	Copper (p.p.m.)		11.66			
	Zinc (p.p.m.)		21.08			
	Aluminum (p.p.m.)		314			
OTHER	Ammonium (p.p.m.)		0.4			
	Nitrate (p.p.m.)		10			

4. Saturated Paste Test

Lab Number			169196				
Water Used			Fire Mtn				
pH			7.3				
Soluble Salts		ppm	81				
Chloride (Cl)		ppm	13				
Bicarbonate (HCO ₃)		ppm	65				
ANIONS	SULFUR	ppm	1.65				
	PHOSPHORUS	ppm	0.59				
SOLUBLE CATIONS	CALCIUM	ppm	10.63				
		meq/l	0.53				
	MAGNESIUM	ppm	4.28				
		meq/l	0.36				
	POTASSIUM:	ppm	8.03				
		meq/l	0.21				
	SODIUM	ppm	3.99				
		meq/l	0.17				
	PERCENT	Calcium		41.85			
		Magnesium		28.06			
Potassium			16.41				
Sodium			13.67				
TRACE ELEMENTS	Boron (p.p.m.)		0.09				
	Iron (p.p.m.)		2.59				
	Manganese (p.p.m.)		0.04				
	Copper (p.p.m.)		< 0.02				
	Zinc (p.p.m.)		< 0.02				
	Aluminum (p.p.m.)		2.04				

Example

5. Tissue Test

<i>Sample Location</i>	Honey	
<i>Sample Name</i>	Crisp	
		<i>%</i>
<i>Calcium</i>	<i>Ca</i>	1.34
<i>Magnesium</i>	<i>Mg</i>	0.23
<i>Phosphorus</i>	<i>P</i>	0.46
<i>Potassium</i>	<i>K</i>	1.73
<i>Nitrogen</i>	<i>N</i>	1.58
<i>Sulfur</i>	<i>S</i>	0.12
<i>Sodium</i>	<i>Na</i>	0.004
		<i>ppm</i>
<i>Boron</i>	<i>B</i>	57.04
<i>Copper</i>	<i>Cu</i>	4.2
<i>Iron</i>	<i>Fe</i>	406.3
<i>Manganese</i>	<i>Mn</i>	13.60
<i>Zinc</i>	<i>Zn</i>	22.92

Crop	N%	P%	K%	Ca%	Mg%	S%	Fe (ppm)	Mn (ppm)	B (ppm)	Cu (ppm)	Zn (ppm)
Apple	1.575	0.464	1.733	1.337	0.2293	0.1179	406.3	13.6	57.04	4.2	22.92
Severity %	-17%	71%	0%	0%	-8%	-41%	213%	-46%	28%	-30%	0%

Customized Recommendations for Bitter Pit

1. Apply Manganese
2. Focus on summer pruning
3. Stop potassium applications
4. Calcium/cytokinin foliars at cell division
5. Start sap testing
6. Soil moisture management changes
7. Gypsum or Elemental Sulfur

Additional Applications & Thoughts

- **Do Foliars Work?**



Tissue Values

Analyte ◆ Nitrogen %



Soil High Target

87.78

Soil Low Target

30.00

Soil Analyte
Average

66.64

Tissue Analyte
Average

3.72

Tissue High Target

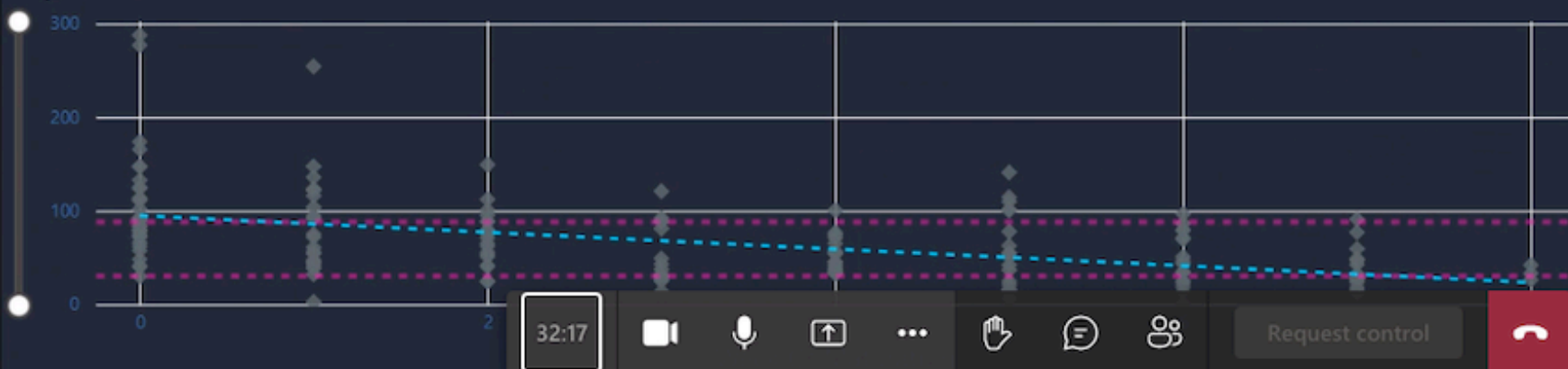
4.67

Tissue Low Target

2.88

Soil Values

Analyte ◆ Nitrate



32:17



Request control



Week Of Maturation

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

Bloom Room

- B1
- B2
- B3
- B4
- B5
- B6
- B7
- B8

Tissue Crop ID's

Crop ID

All

Soil Crop IDs

Crop ID

All

Soil Analytes

Analyte

- Aluminum
- Bicarbonate
- Boron
- Calcium
- Calcium %
- Chloride
- Copper
- Iron
- Magnesium
- Magnesium %
- Manganese
- Nitrate
- pH
- Phosphorus
- Potassium
- Potassium %
- Sodium
- Sodium %
- Soluble Salts
- Sulfur
- Zinc

Tissue Analytes

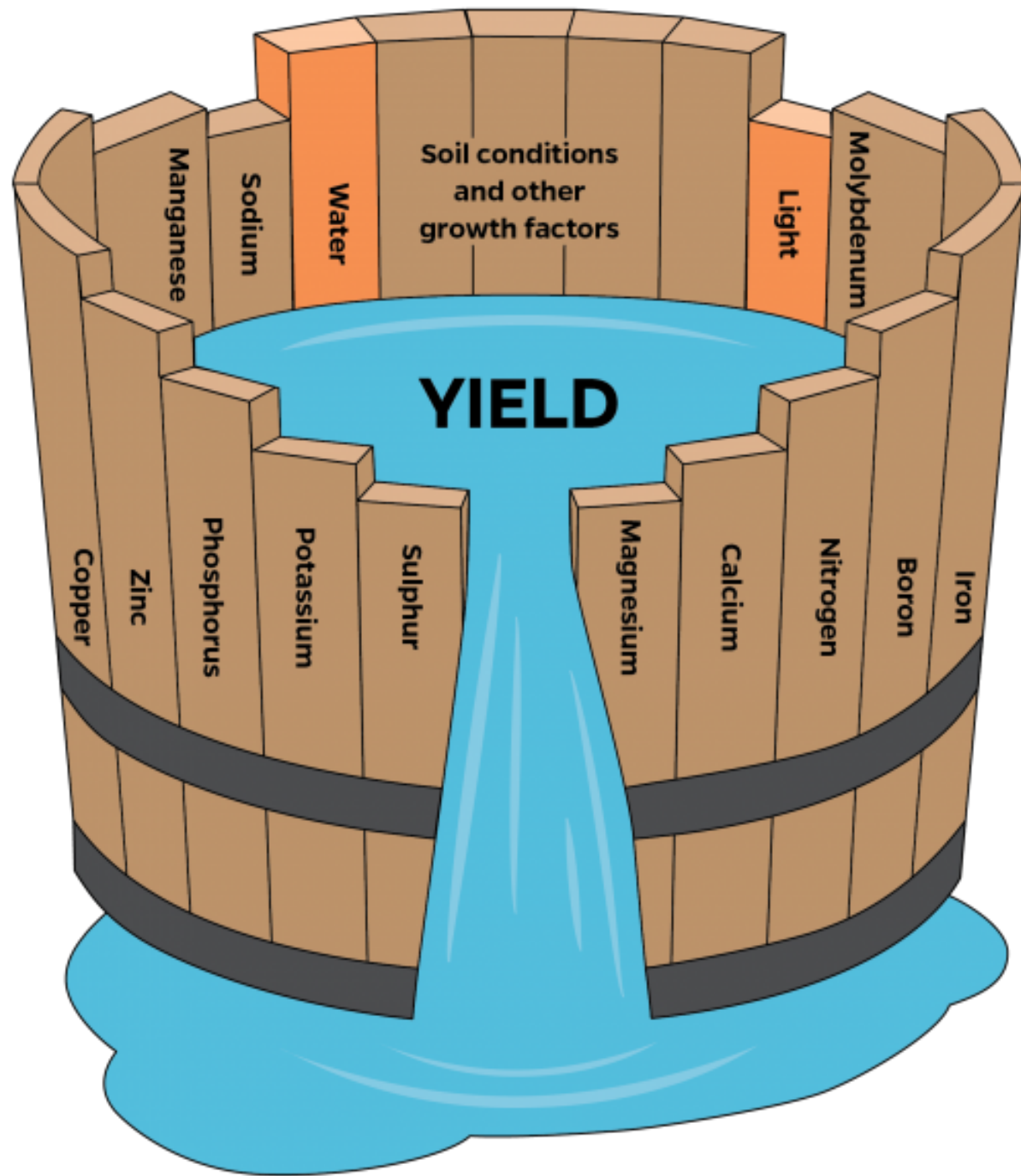
Analyte

- Boron
- Calcium %
- Copper
- Iron
- Magnesium %
- Manganese
- Nitrogen %
- Phosphorus %
- Potassium %
- Sodium %
- Sulfur %
- Zinc

Additional Applications & Thoughts

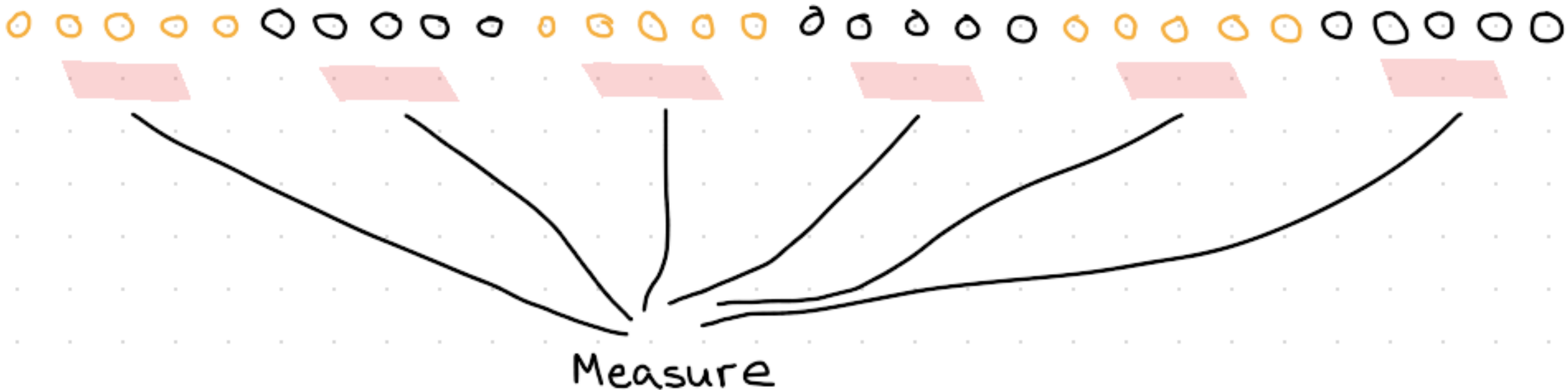
Fertigation





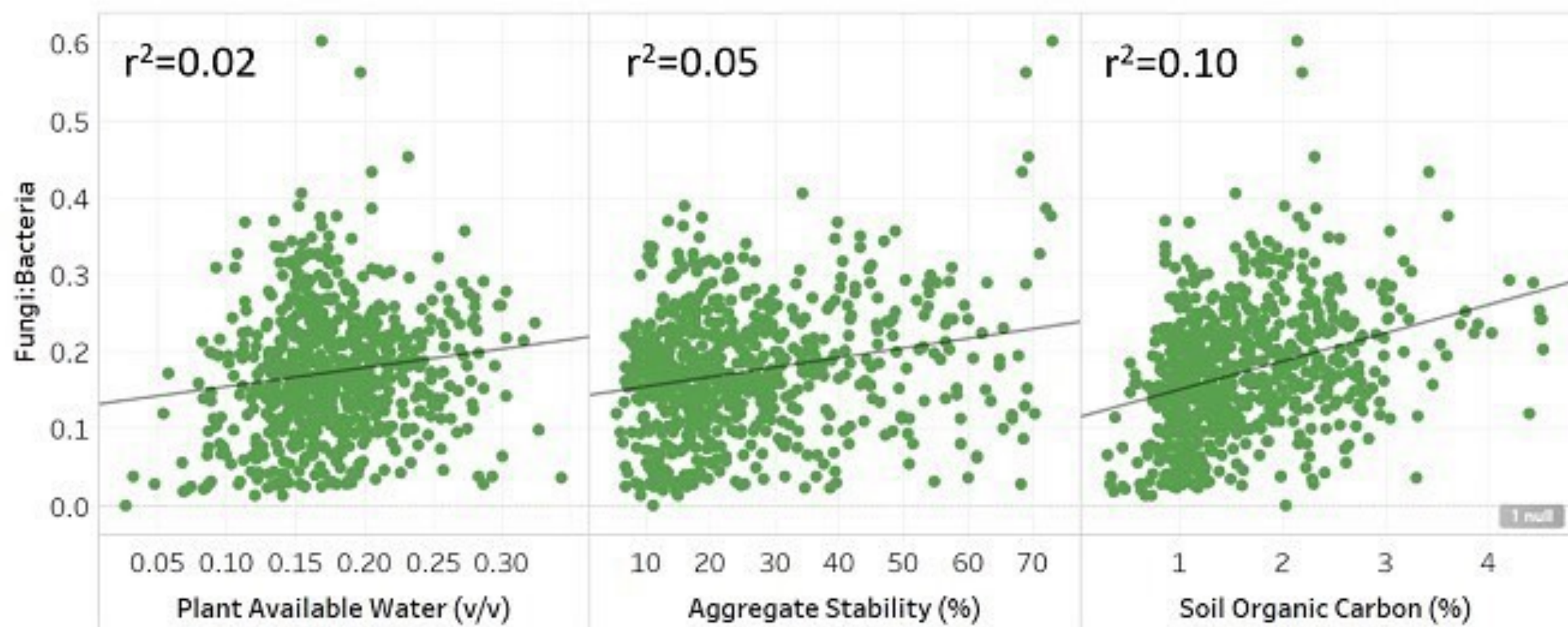
Additional Applications & Thoughts

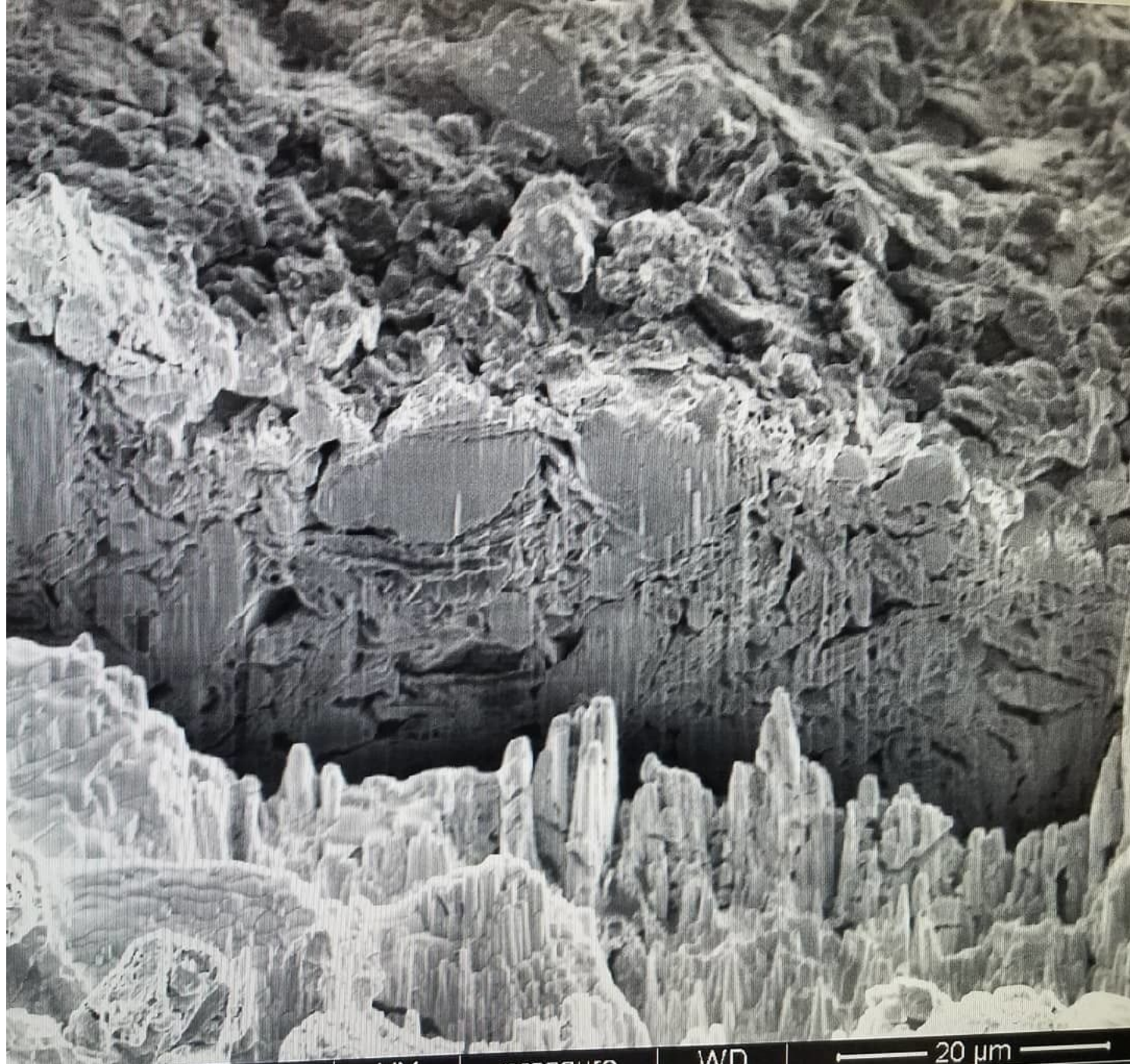
- Split test everything



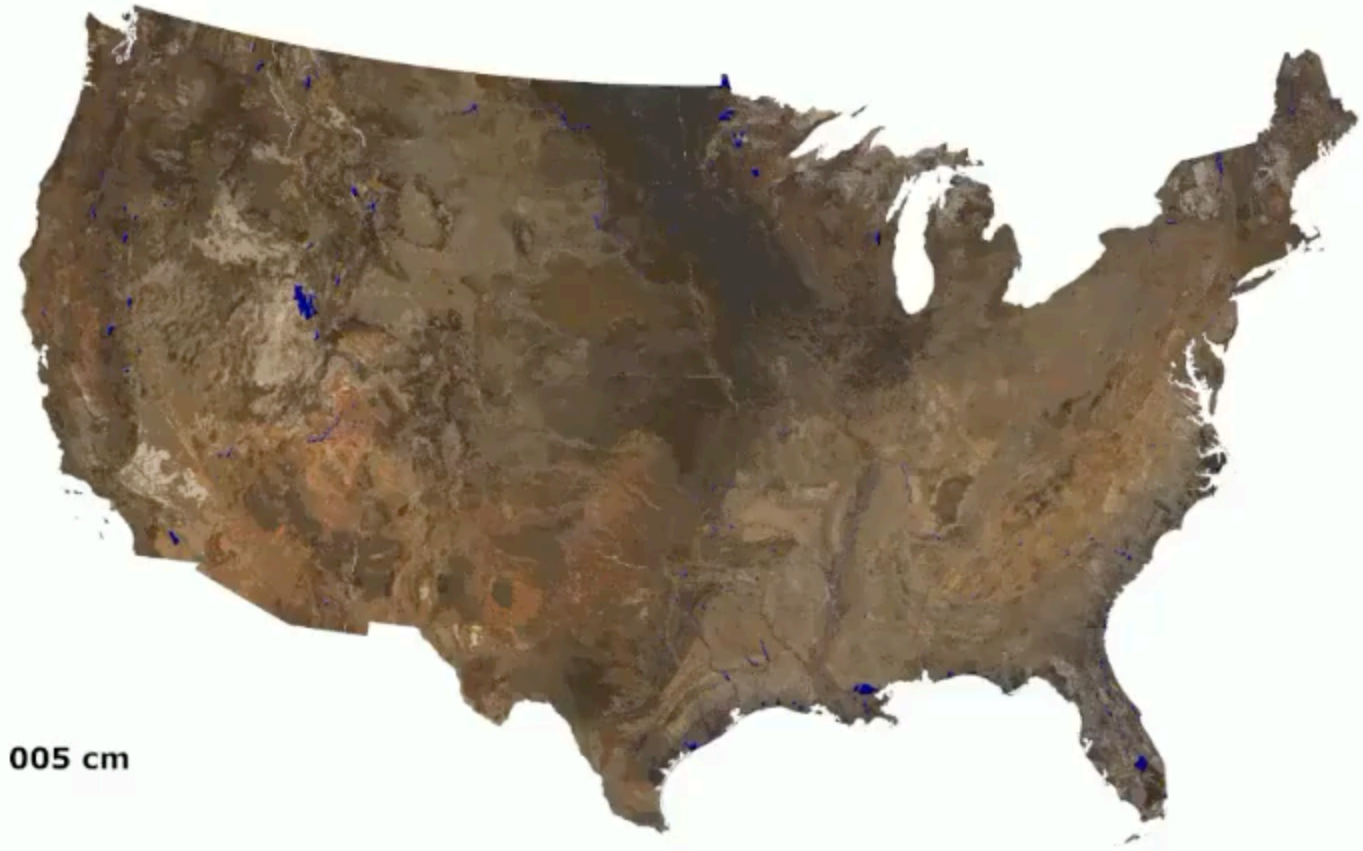
PLFA – Fungal to Bacterial Ratio

- Claim: More fungi the healthier the soil
- Bacteria and fungi work together





11/14/2018	mag 田	HV	pressure	WD	20 μm
5:08:15 PM	1 800 x	3.00 kV	7.87e-6 mbar	10.3 mm	Tool2_CON_28-38



005 cm



GENIUSES ONLY
Look Closely at the details

Which Tank will Fill up First?

