

Soil and Plant Nutrient Management

Fall Gardening Workshop
October 31, 2018



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Soils and Nutrient Management Specialist

Outline

- Environment and pH
- Soil Testing
- Fertilizer

C

H

O

17

Essential
Elements

Ca

Mg

S

N

P

K

B

Cl

Cu

Mn

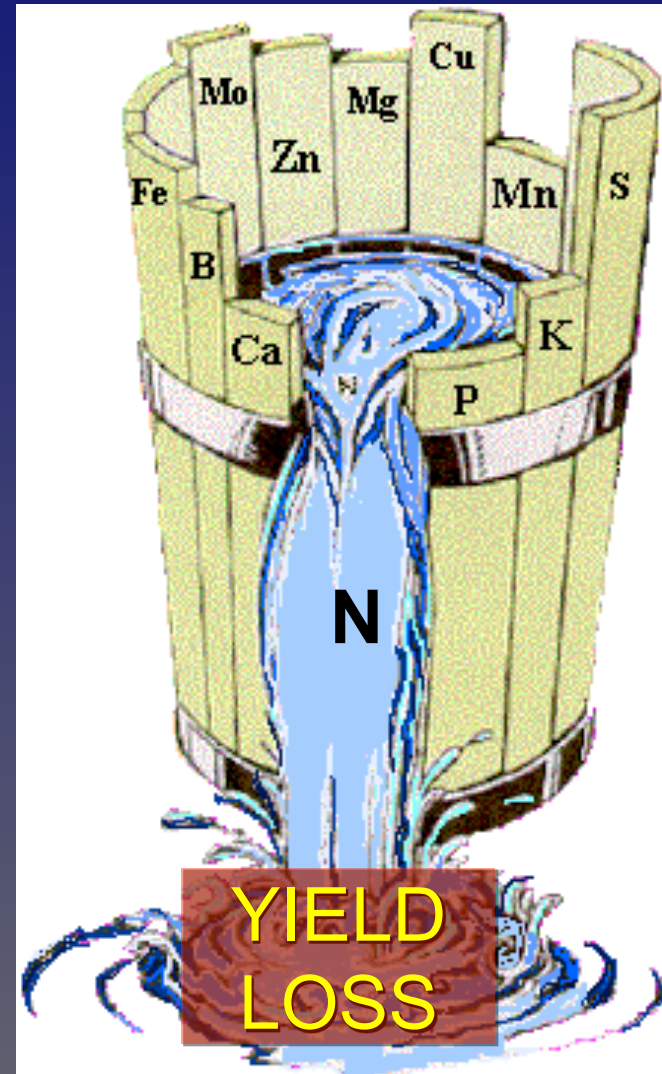
Fe

Ni

Zn

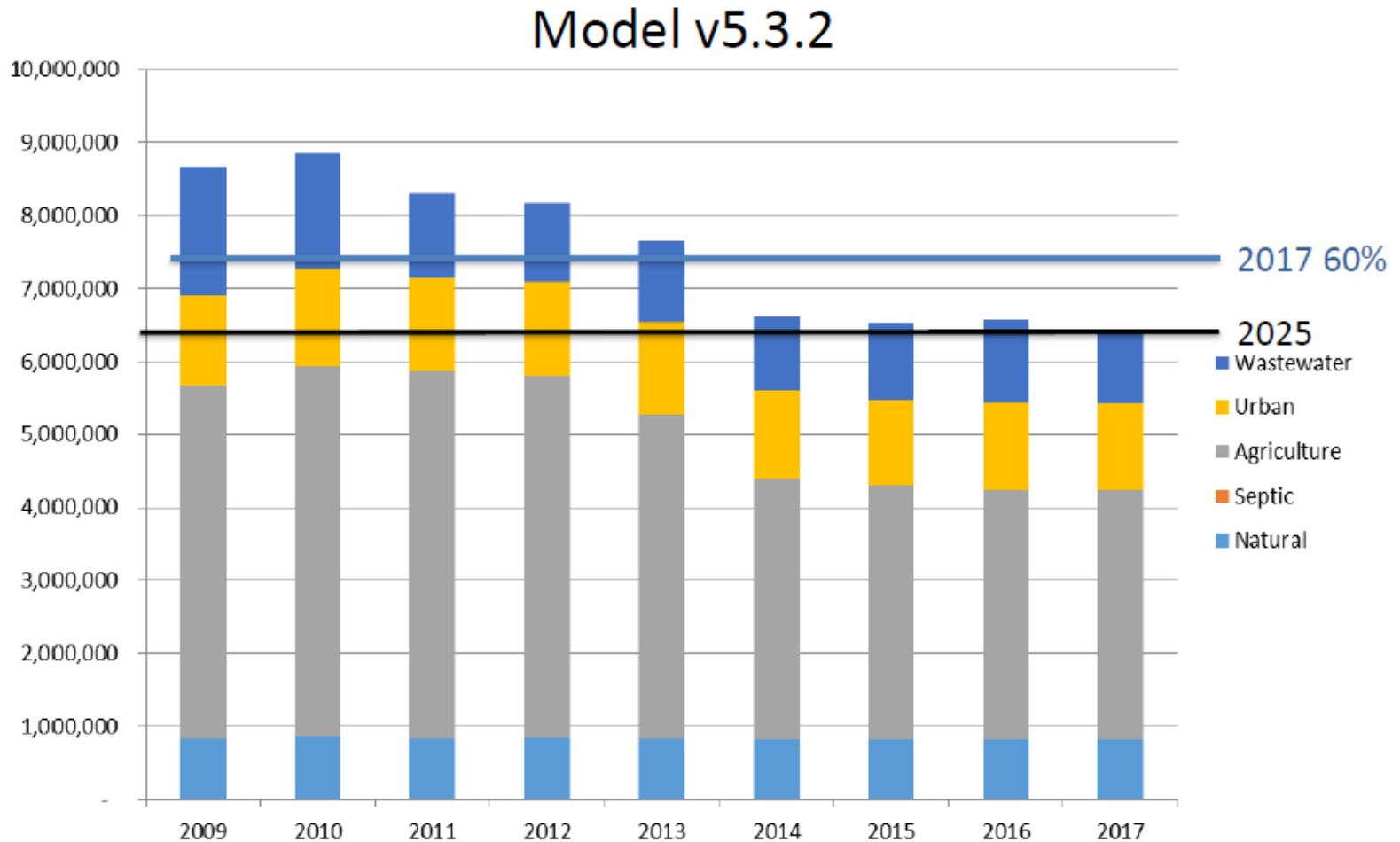
Increase Fertilizer Efficiency

- The best way to get “more bang for your buck”
- You have to use fertilizer
- Focus on proper nutrient



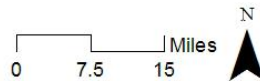
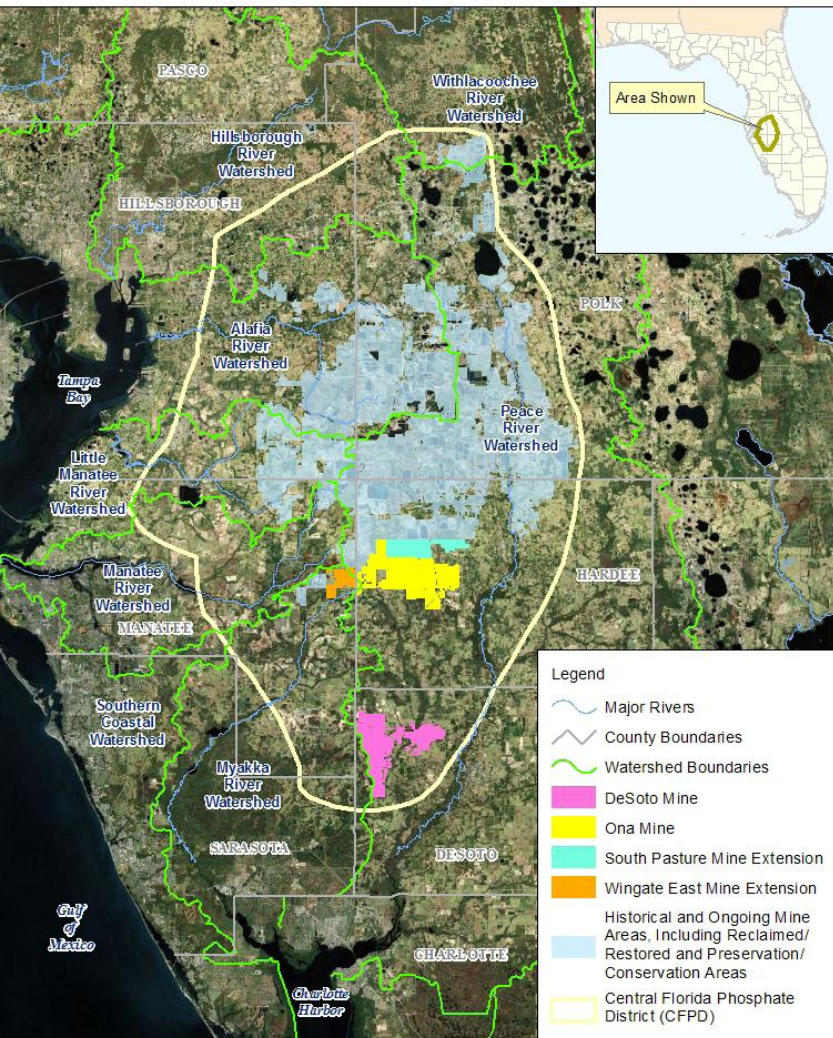
WATERSHED IMPLEMENTATION PLAN

VIRGINIA PHOSPHORUS LOADS



Phosphorus Mining

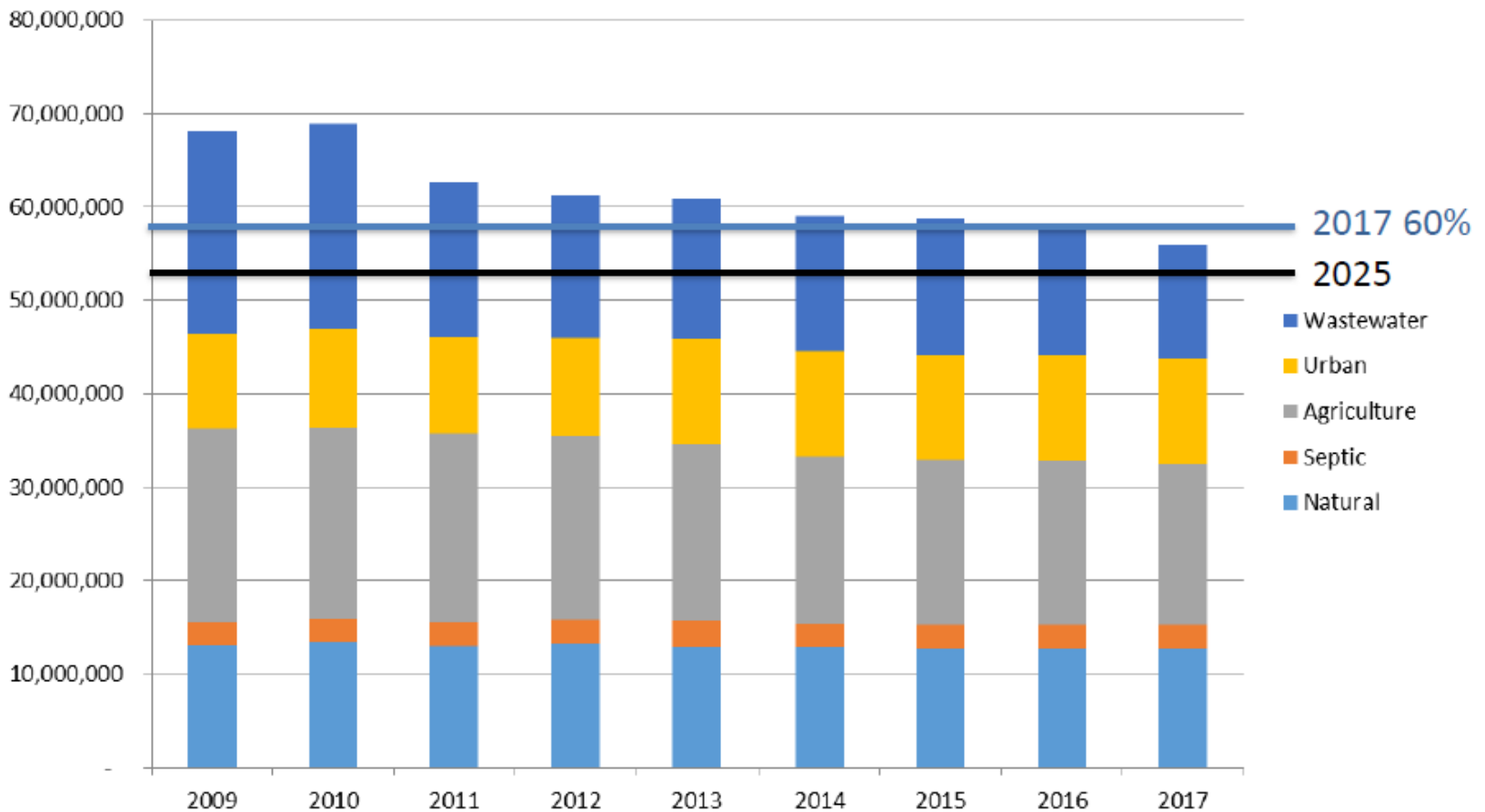
- 30 to 50 year supply left in Florida.
- The “good stuff” is gone.
- 300 years worldwide?



WATERSHED IMPLEMENTATION PLAN

VIRGINIA NITROGEN LOADS

Model v5.3.2



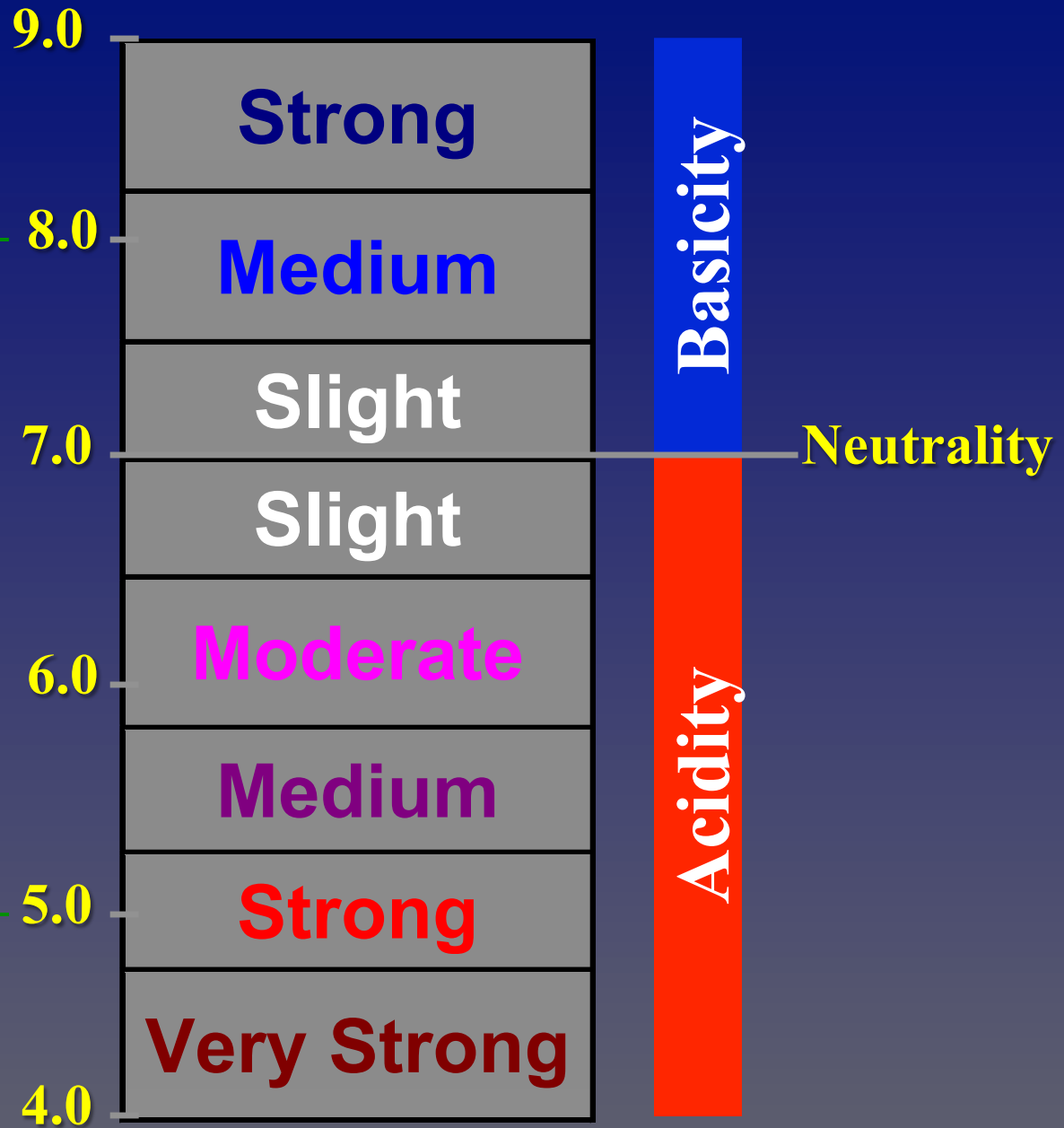
Crop Uptake and Removal

Crop	Yield	P_2O_5		K_2O	
		Uptake	Removal	Uptake	Removal
-----Pounds per acre-----					
Wheat	80 bu	54	40	184	28
Corn	180 bu	102	79	240	52
Soybeans	40 bu	38	32	144	56
Sweet Potatoes	400 bu	68	52	295	224
Tomatoes	40 tons	87	68	463	288

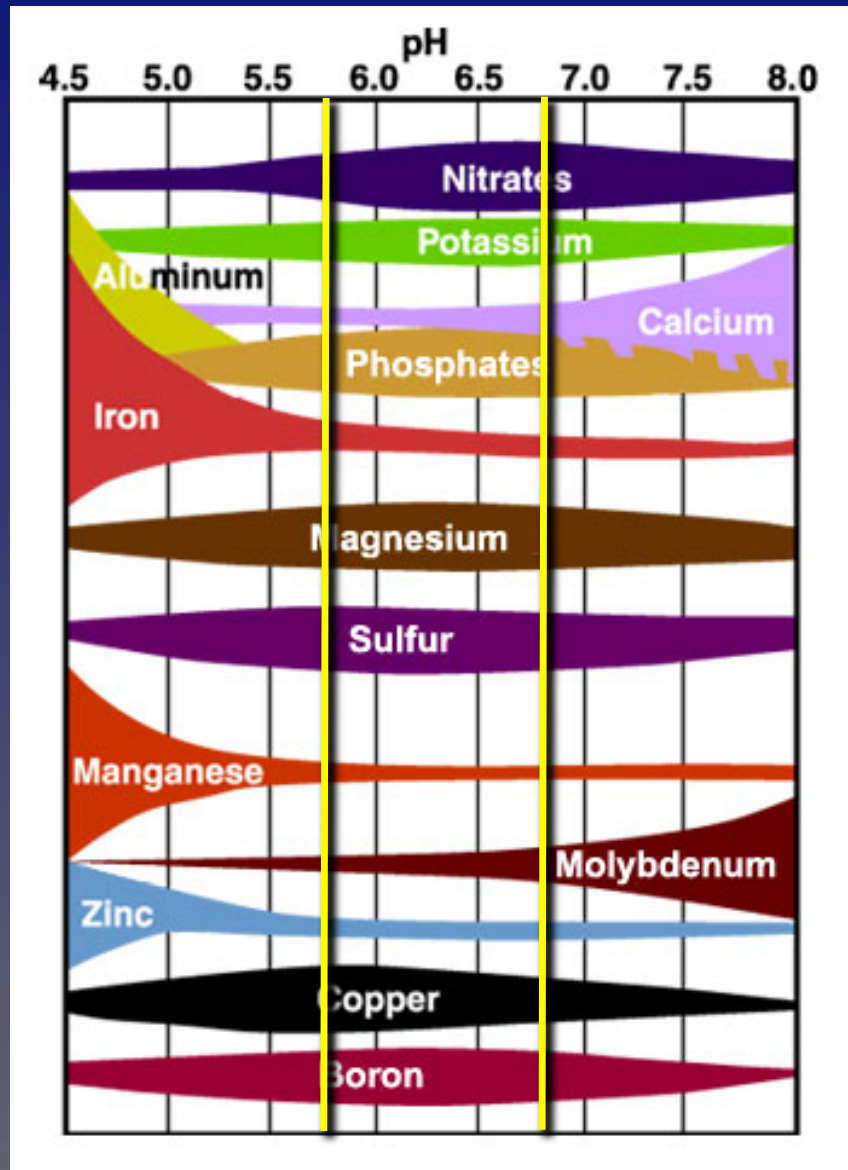
pH value
defines
relative
acidity or
basicity

$$\text{pH} = -\log[\text{H}^+]$$

Most Productive Soils



Efficient Fertilizer Use



How does a soil become acidic?

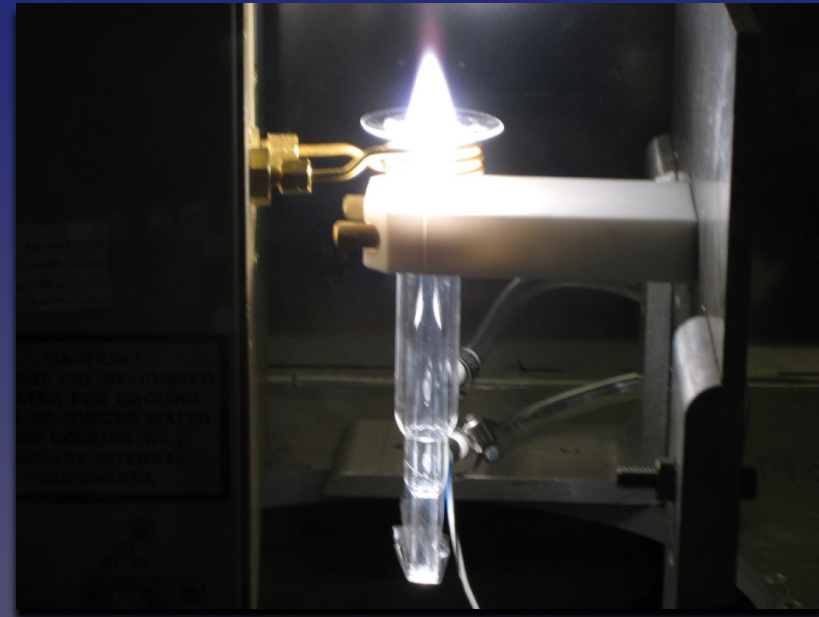
- Will happen in Virginia naturally.
- Rain = pH of 5.6
- Natural breakdown of minerals releases aluminum
 - ✓ Acidic in the soil system
- Soil microbe activity
- Many fertilizers (depending on type)
 - ✓ Nitrogen
 - ✓ Sulfur

Outline

- Environment and pH
- **Soil Testing**
- Fertilizer

Soil Test

- Determine soil pH
- Determine nutrient levels
- Soil test every 3 years
- Soil test consistently (spring or fall)
 - ✓ Watch values over time
- Wide range of soils

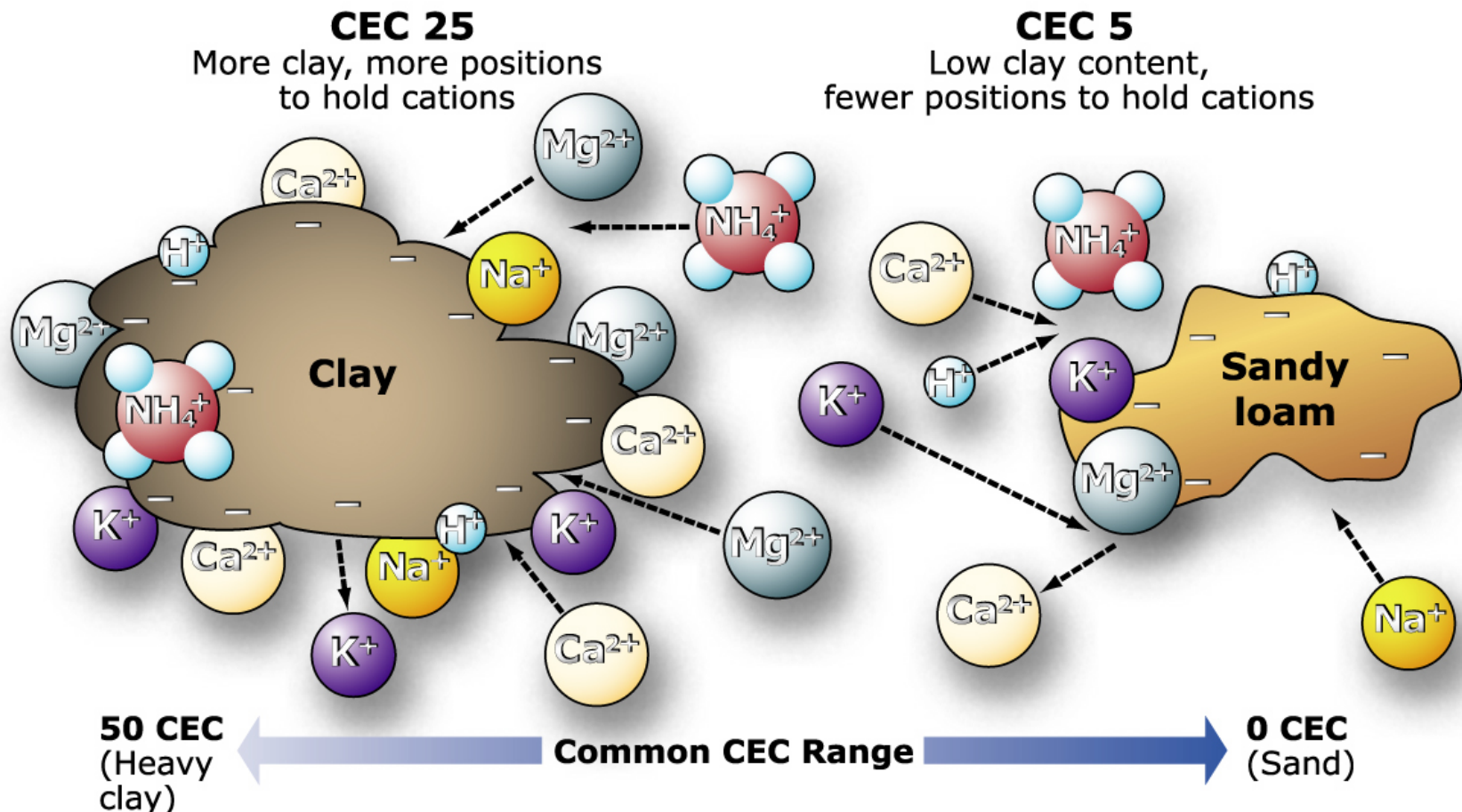


Varying Soils and Systems

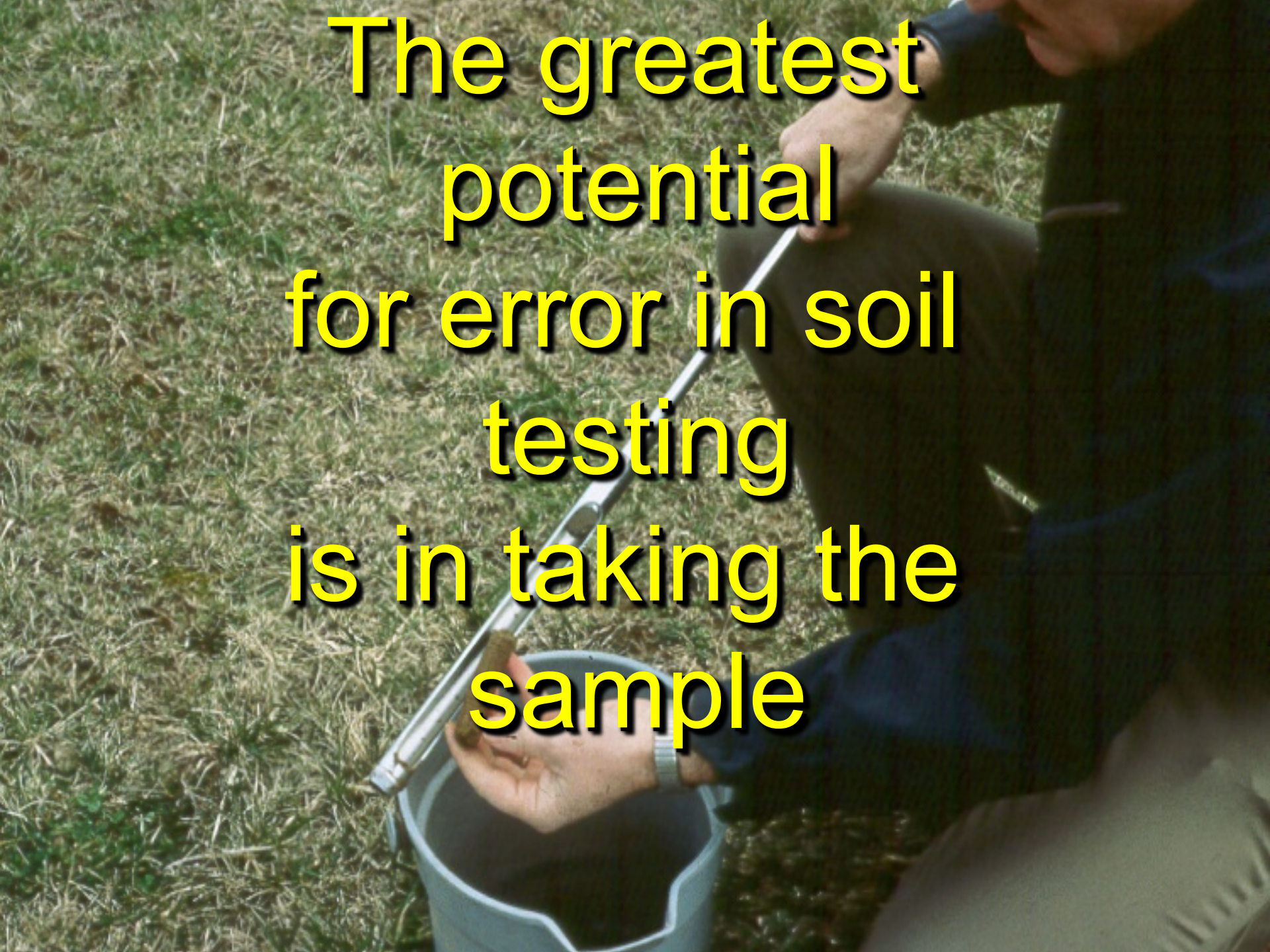


Cation Exchange Capacity

A schematic look at cation exchange

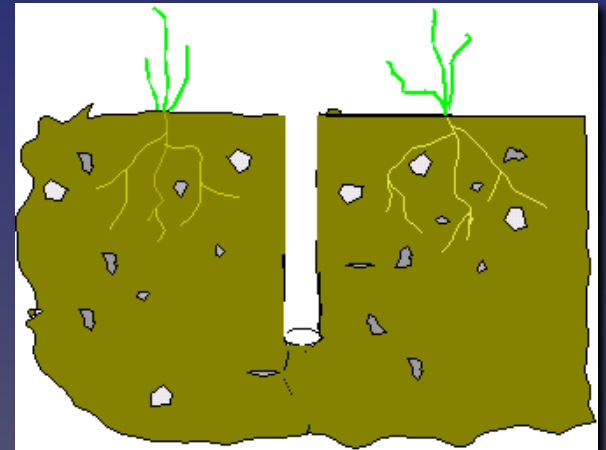


The greatest
potential
for error in soil
testing
is in taking the
sample



Accuracy is Key!

- Test is only as good as your sample.
 - ✓ Only about 3 oz. (10 g) of soil represents 20 acres or more
- Depth
 - ✓ 6 inches (or plow depth)
 - ✓ 4 inches in no-till/yards/pasture
- 20 cores from field or area
 - ✓ Each core represents 2,000,000 pounds of soil
- Mix well





Halifax Rd

State Route 604
7838

792A

20 acres

A

Halifax Rd

State Route 604
7838

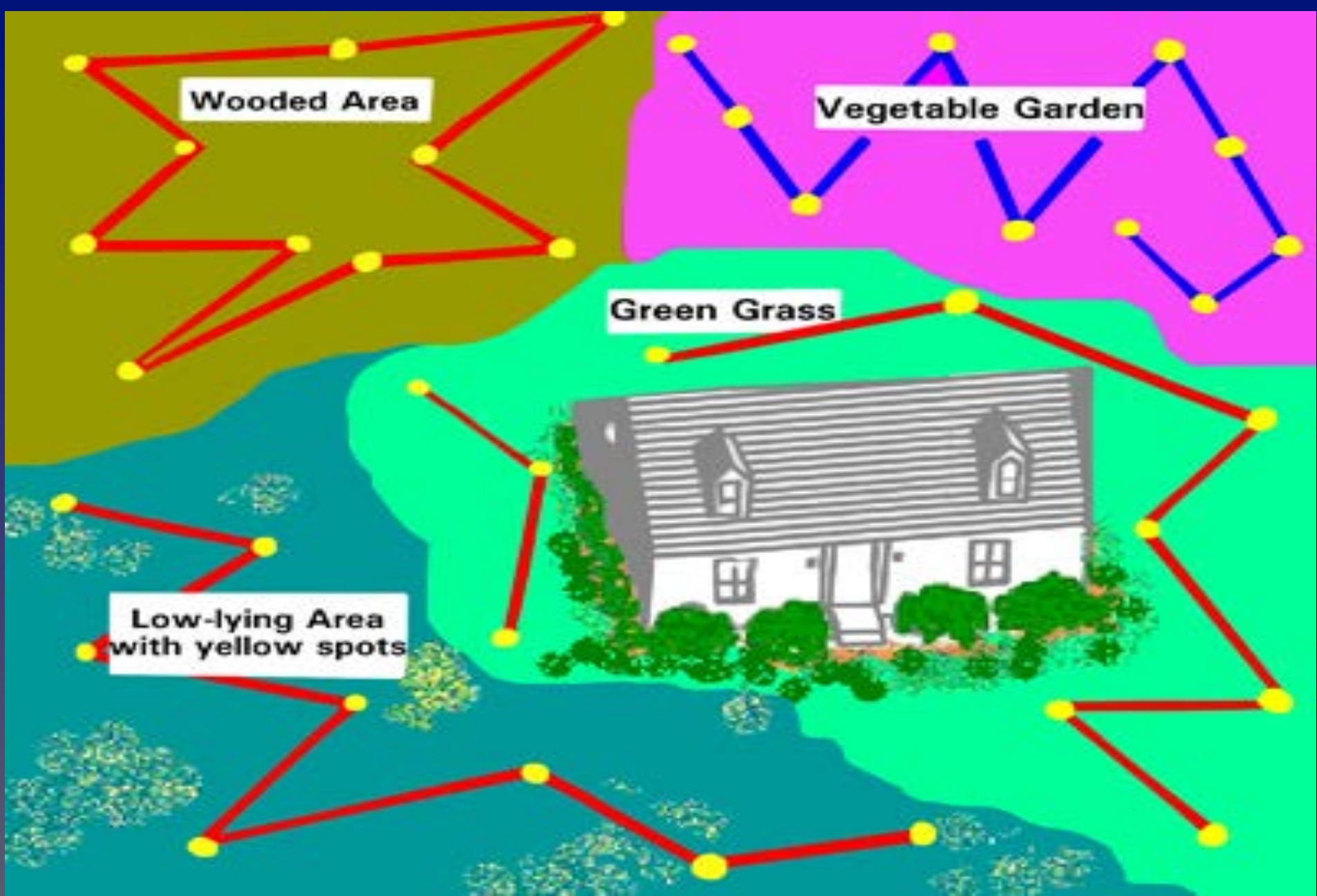
792A

5 acres

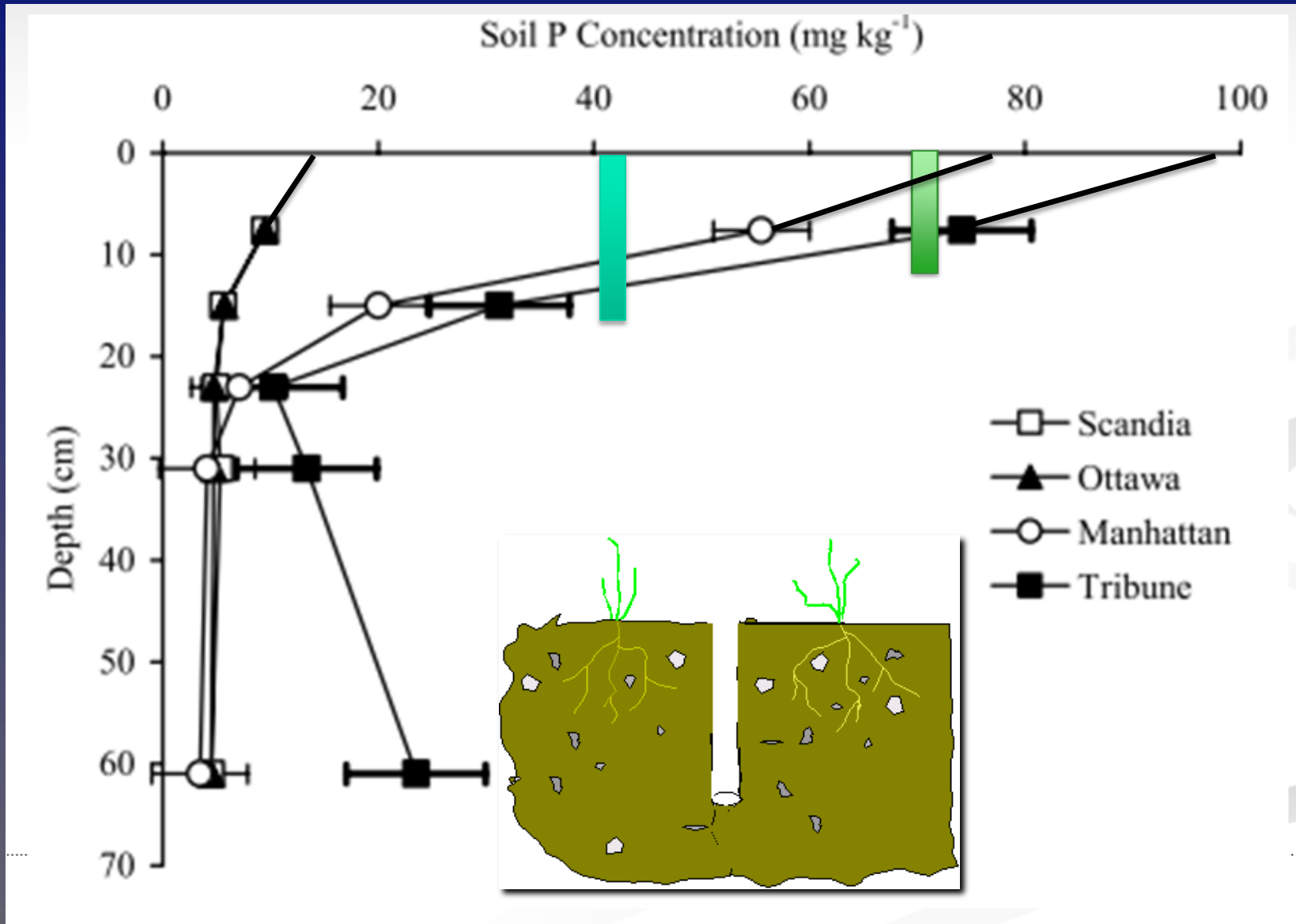
15 acres

A





Nutrient Stratification – grass or no-till





RESPIRATION

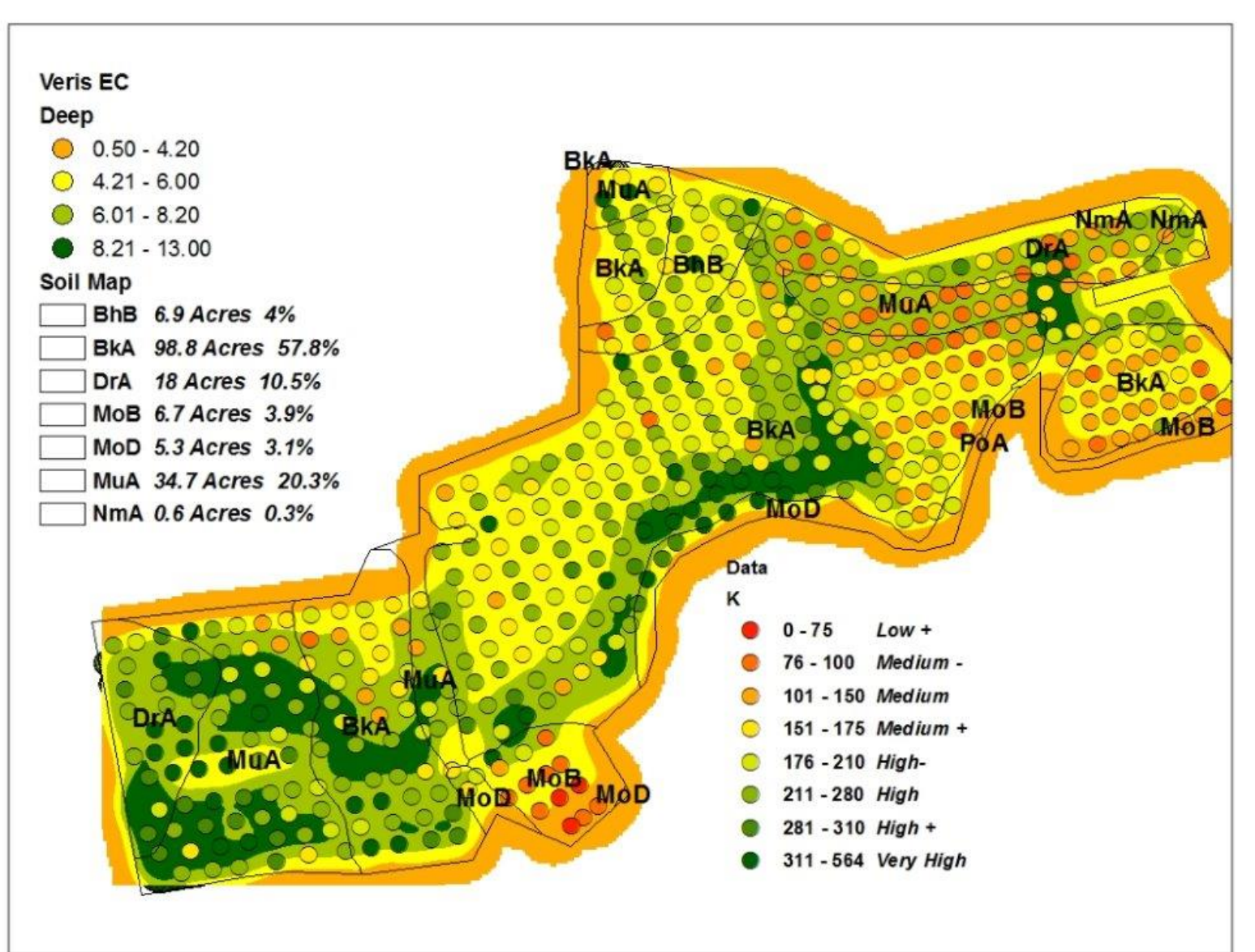
Sample No.	
Date	
Time	
Location	





Garbage In ► Garbage Out

Painter, VA: Potassium Levels



Soil Sample Information Sheet for Commercial Crop Production

Please Print (Form expires July 2013)

INSTRUCTIONS: Follow sampling instructions on box. For a recommendation, be sure to fill in the crop code number. Place check marks (✓) where appropriate. Use another form for home lawns, gardens, etc. Send samples, forms, and any payment to Virginia Tech Soil Testing Lab, 145 Smyth Hall (0465), Blacksburg, VA 24061, in a sturdy shipping carton. Processing will be delayed if soil is not received in an official sample box. See www.soiltest.vt.edu for more information.

Your Name:			Date sampled:
E-mail:		Phone:	
Mailing Address:			MM/DD/YY
City:		ZIP Code (required):	
County Where Soil is Located (required):			Office Use only Extension Unit Code:
Copy Report To (Consultant, etc.):			
Their E-mail:			

Your Sample Box ID		Sample Track & Field ID	
--------------------	--	-------------------------	--

Crop to be Grown		Last Crop (if a legume)		
Crop Code # (from list on back)	Name	Crop Code # (from list on back)	Name	Yield Bu/A, etc.

Last Lime Application		Check <input type="checkbox"/> if	Prominent Soils in Field (see back)		Your Yield Estimate
Months Previous	Rate Ton/Acre	<input type="checkbox"/> Field has artificial drainage	Soil Map Unit Symbol for:*	Percent (%) of Field	(For crop to be grown) Select Units
<input type="radio"/> -	<input type="radio"/> 0	<input type="checkbox"/> Soil is a Histosol	Largest area		<input type="checkbox"/> Tons/Acre
<input type="radio"/> 0-6	<input type="radio"/> 0.1-1.0	<input type="checkbox"/> Manure will be applied	2 nd Largest Area		<input type="checkbox"/> Bushels/Acre
<input type="radio"/> 7-12	<input type="radio"/> 1.1-2.0		3 rd Largest Area		<input type="checkbox"/> Acres/AU*
<input type="radio"/> 13-18	<input type="radio"/> 2.1-3.0				
<input type="radio"/> 19+	<input type="radio"/> 3.1+				

SOIL TEST DESIRED AND FEES	COST PER SAMPLE	
	IN-STATE	OUT-OF-STATE
<input type="checkbox"/> Routine (soil pH, P, K, Ca, Mg, Zn, Mn, Cu, Fe, B, and estimated CEC)	No-Charge	\$16.00
<input type="checkbox"/> Organic Matter	\$4.00	\$6.00
<input type="checkbox"/> Soluble Salts	\$2.00	\$3.00
<input type="checkbox"/> Fax Results: FAX # (w/area code)	\$1.00	\$2.00

Method of Payment: Check Enclosed or Bill my Business Tax ID # required for billing

Send in payment along with soil sample and form; make check or money order payable to "Treasurer, Virginia Tech."

www.ext.vt.edu

➤ http://pubs.ext.vt.edu/452/452-124/452-124_pdf.pdf

➤ Contact information

➤ Crop to be grown

➤ Last crop

✓ Residual nitrogen

➤ Lime history

✓ Residual

➤ Soil series

✓ Productivity

➤ Test desired

Virginia Tech Soil Testing Laboratory

Soil Sample Information Sheet for Home Lawns, Gardens, Fruits, and Ornamentals

Please Print

INSTRUCTIONS: See other side for sampling instructions. For a recommendation, be sure to fill in the plant code number. Place check marks (✓) where appropriate. Use another form for commercial crop production. Send samples, forms, and payment to Virginia Tech Soil Testing Lab, 145 Smyth Hall (0465), Blacksburg, VA 24061, in a sturdy shipping carton. Processing will be delayed if soil is not received in an official sample box. See www.soiltest.vt.edu for more information.

Your Name _____		Date sampled: _____
Street, Route _____		
City _____	ZIP (required) _____	Office Use only Extension Unit Code: _____
Telephone No. _____	County _____	
Extra Copy For (Dealer, etc.): _____		
Street, Route _____		
City _____	ZIP (required) _____	

SAMPLE IDENTIFICATION	PLANT TO BE GROWN
Your Sample Box Number or Name (Up to 5 digits) _____	Insert Plant Code # from list at right _____

PLANT CODE LIST	
Lawn: Kentucky Bluegrass, Fescue, or Ryegrass	Non-Acid-Loving Shrubs and Trees
201 Establishing New Lawn	245 Shrubs - Lilac, Forsythia, Boxwood, etc.
202 Maintaining Lawn, Repair of Bare Spots	246 Trees - Pine, Maple, Oak, etc.
Lawn: Bermudagrass, Zoysiagrass, or St. Augustine	Fruits
203 Establishing New Lawn	220 Apples
204 Maintaining Lawn, Repair of Bare Spots	221 Blackberries
	222 Blueberries
	223 Currants
	224 Gooseberries
	225 Grapes
	226 Nectarines
	227 Peaches
	228 Pears
	229 Plums
	230 Quince
	231 Raspberries
	232 Sour Cherry
	233 Strawberries
	234 Sweet Cherries
Garden	House Plants
210 Vegetable Garden	250 Potted House Plants
211 Flower Garden	
212 Roses	
Acid-Loving Shrubs	
240 Azaleas	
241 Andromedas	
242 Camellias	
243 Laurel	
244 Rhododendron	

SOIL INFORMATION	
Last Lime Application	
Months Previous	Pounds per 1,000 sq ft.
<input type="checkbox"/> -	<input type="checkbox"/> 0
<input type="checkbox"/> 0-6	<input type="checkbox"/> 10-50
<input type="checkbox"/> 7-12	<input type="checkbox"/> 51-100
<input type="checkbox"/> 13-18	<input type="checkbox"/> 101-150
<input type="checkbox"/> 19+	<input type="checkbox"/> 151+

SOIL TESTS DESIRED AND FEES	COST PER SAMPLE	
	IN-STATE	OUT-OF-STATE
<input type="checkbox"/> Routine (soil pH, P, K, Ca, Mg, Zn, Mn, Cu, Fe, B, and estimated CEC)	\$ 10.00	\$16.00
<input type="checkbox"/> Organic Matter - Determines percentage in soil - no recommendation given	\$ 4.00	\$ 6.00
<input type="checkbox"/> Soluble Salts - Determines if fertilizer salts are too high	\$ 2.00	\$ 3.00
<input type="checkbox"/> Fax Results: FAX # ()	\$ 1.00	\$ 2.00

Send in payment along with soil sample and form; make check or money order payable to "Treasurer, Virginia Tech."

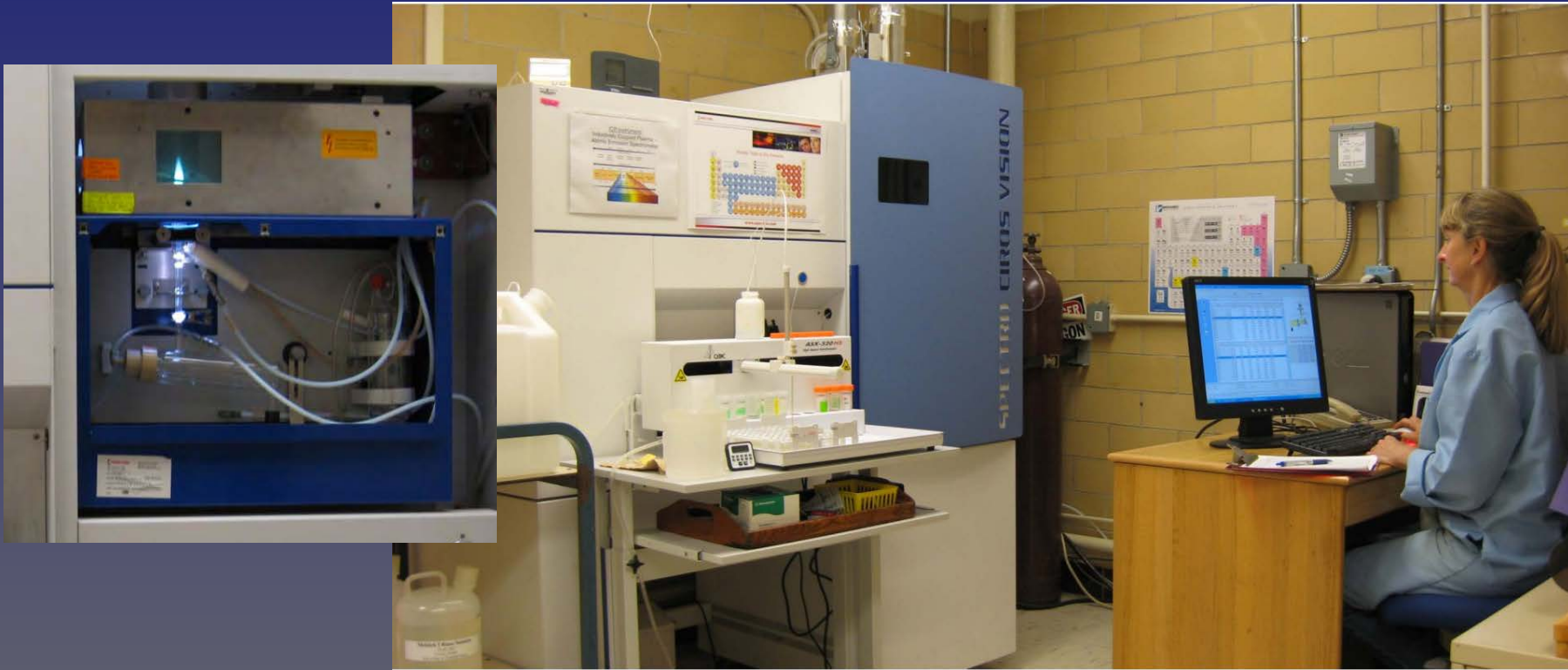
- http://pubs.ext.vt.edu/452/452-125/452-125_pdf.pdf
- Contact information
- Plant to be grown
- Lime history
 - ✓ Residual
- Test desired

Soil Testing – Nutrient Extraction



Sample Analysis

- Inductively Coupled Plasma Atomic Emission Spectrometer (ICP)



Soil Testing Lab, Virginia Tech

Soil Test Report

SAMPLE HISTORY

Sample ID	Field ID	LAST CROP		LAST LIME APPLICATION		SOIL INFORMATION				
		Name	Yield	Months Prev.	Tons/Acre	SMU-1 %	SMU-2 %	SMU-3 %	Yield Estimate	Productivity Group
TMN03	TARECMN3			---	0	BKA 100				II

LAB TEST RESULTS (see Note 1)

Analysis	P (lb/A)	K (lb/A)	Ca (lb/A)	Mg (lb/A)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	B (ppm)	S.Salts (ppm)
Result	136	134	1084	197	1.3	3.6	0.2	43.2	0.3	
Rating	VH	M	M	H+	SUFF	SUFF	SUFF	SUFF	SUFF	

Analysis	Soil pH	Buffer Index	Est.-CEC (meq/100g)	Acidity (%)	Base Sat. (%)	Ca Sat. (%)	Mg Sat. (%)	K Sat. (%)	Organic Matter (%)
Result	5.3	6.23	4.7	21.5	78.5	57.6	17.3	3.7	

FERTILIZER AND LIMESTONE RECOMMENDATIONS

Crop: Soybeans (10)

Lime, Tons/Acre	
Amount	Type
1.25	AG

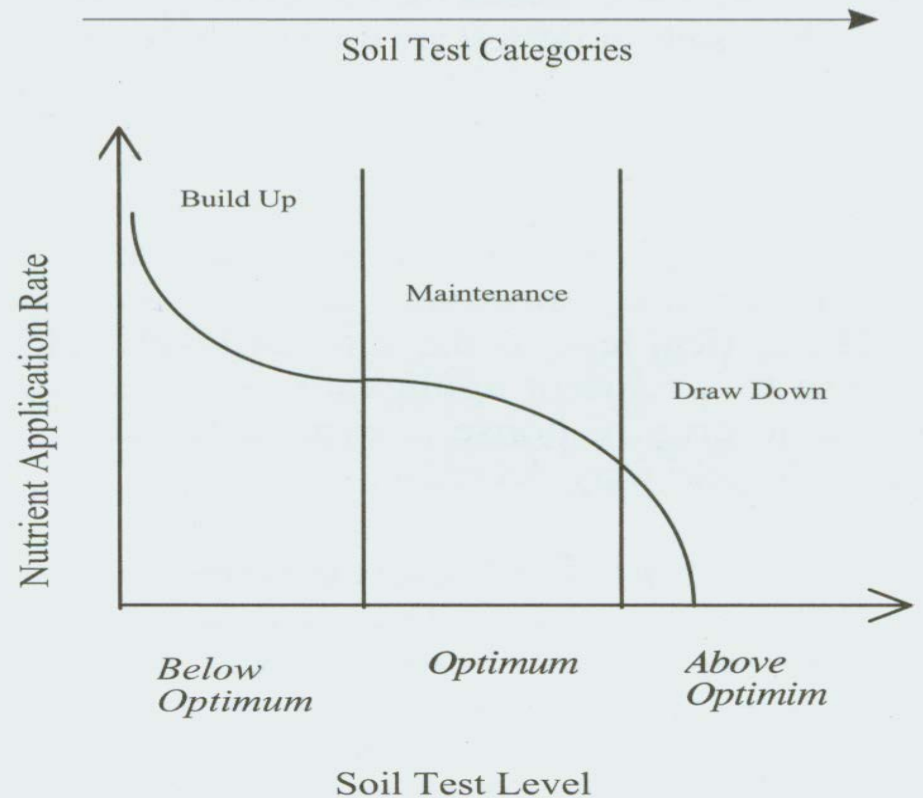
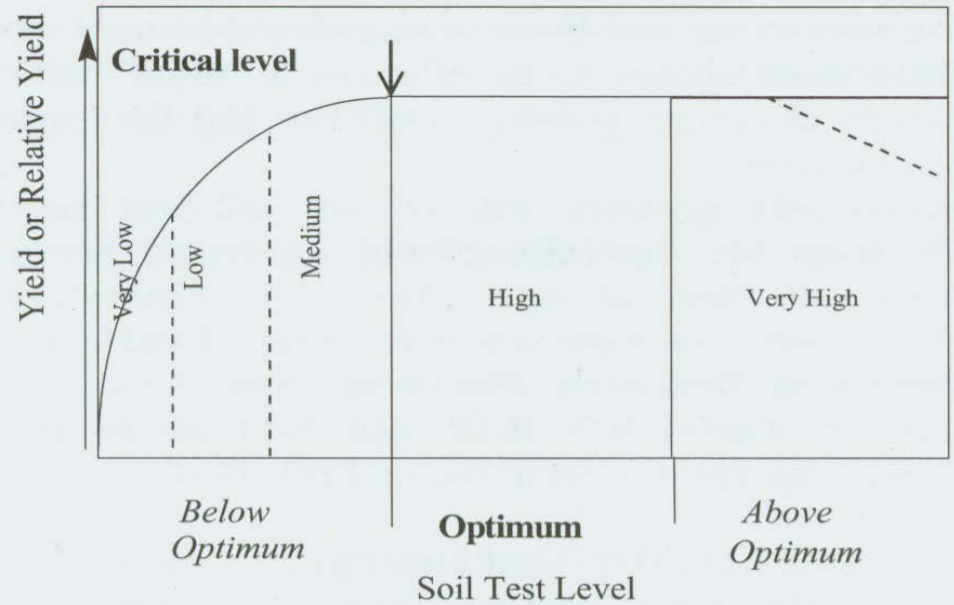
Fertilizer, lb/A		
N	P205	K20
0	0	60

Crop response to fertilizer

Phosphorus (P) and Potassium (K) Tests, Virginia Tech Soil Testing

Soil Test P	lb/A	P-ppm
L-	0-3	0-2
L	4-8	2-4
L+	9-11	5-6
M-	12-20	6-10
M	21-30	11-15
M+	31-35	16-18
H-	36-55	18-28
H	56-85	28-43
H+	86-110	43-55
VH	110+	55+

Soil Test K	lb/A	K-ppm
-	0-15	0-8
L	16-55	8-28
+	56-75	28-38
M-	76-100	38-50
M	101-150	51-75
M+	151-175	76-88
H-	176-210	88-105
H	211-280	106-140
H+	281-310	141-155
VH	310+	155+



Nutrient Recommendation

Crop: Tomatoes - Fresh Market

Crop Code: 71, 471

Target pH = 6.5

See Notes: 1, 4

Possible Trace Element Need: B

Soil Test Level	Fertilizer Recommendations (lb/A)		
	N	P ₂ O ₅	K ₂ O
L	80	200	300
M		150	200
H		100	100
VH		50	50

For more information see VCE Pub. #456-420, *Commercial Vegetable Production Recommendations*.

Nutrient Recommendation

Crop: Vegetable Garden, Flower Garden, Roses

Crop Code: 210 – 212

Target pH = 6.5

See Notes: 1, 19

Soil Test Level		Comment No.	Fertilizer Recommendations
P ₂ O ₅	K ₂ O		
L-M	L-M	*221	FERTILIZER RECOMMENDATIONS: Apply 4 lbs (10 cups) of 5-10-10 or 2 lbs of 10-20-20 per 100 sq. ft. For additional information on fertilization, see Note 19 (enclosed).
L-M	H-VH	*222†	FERTILIZER RECOMMENDATIONS: Apply 4 lbs (9 cups) of 5-10-5 per 100 sq. ft. For additional information on fertilization, see Note 19 (enclosed).
H	L-VH	*223	FERTILIZER RECOMMENDATIONS: Apply 2 lbs (4 1/2 cups) of 10-10-10 per 100 sq. ft. For additional information on fertilization, see Note 19 (enclosed).
VH	L	*224	FERTILIZER RECOMMENDATIONS: Apply 1.5 lbs (3 cups) of potassium nitrate (13-0-44) per 100 sq. ft. If you are unable to find this fertilizer, apply 2 lbs (4 1/2 cups) of 10-10-10 per 100 sq.ft. For additional information on fertilization, see Note 19 (enclosed).
VH	M-VH	*225‡	FERTILIZER RECOMMENDATIONS: Apply a nitrogen-only fertilizer, such as one of the following amounts per 100 sq. ft. --- 1.25 lbs (2 cups) of nitrate of soda (16-0-0) or 0.5 lbs (1 cup) of ammonium nitrate (33-0-0) or 0.4 lbs (1 cup) of urea (46-0-0). Do not over fertilize! These products will burn plants at high rates! If you are unable to find either of these fertilizers, apply 2 lbs. (4 1/2 cups) of 10-10-10 per 100 sq. ft. For additional information on fertilization, see Note 19 (enclosed).

Nutrient Record

Crop: Vegetable Garden, Flower Garden, Roses

Target pH = 6.5

SAMPLE HISTORY		LAST CROP		LAST LIME APPLICATION		SOIL INFORMATION				
Sample ID	Field ID	Name	Yield	Months Prev.	Tons/Acre	SMU-1 %	SMU-2 %	SMU-3 %	Yield Estimate	Productivity Group
TMN03	TARECMN3			---	0	BKA 1.00				II

LAB TEST RESULTS (see Note 1)

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Result	136	134	1084	197	1.3	3.6	0.2	43.2	0.3	
Rating	VH	M	M	H+	SUFF	SUFF	SUFF	SUFF	SUFF	

Analysis	Soil pH	Buffer Index	Est. CEC (meq/100g)	Acidity (%)	Base Sat. (%)	Ca Sat. (%)	Mg Sat. (%)	K Sat. (%)	Organic Matter (%)
Result	5.3	6.23	4.7	21.5	78.5	57.6	17.3	3.7	

FERTILIZER AND LIMESTONE RECOMMENDATIONS

Crop: Soybeans (10)

Lime, Tons/Acre		Fertilizer, lb/A		
Amount	Type	N	P2O5	K2O
1.25	AG	0	0	60

Soil Test Level		Comment No.	Fertilizer Recommendations
P ₂ O ₅	K ₂ O		
L-M	L-M	*221	FERTILIZER RECOMMENDATIONS: Apply 4 lbs (10 cups) of 5-10-10 or 2 lbs of 10-20-20 per 100 sq. ft. For additional information on fertilization, see Note 19 (enclosed).
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Southern Coastal Plain: Soil Test Summary

Crop Name	Crop Code	No of Samples	pH Range (min on top, max below)					P Rating				K Rating				Ca Rating				Mg Rating				
			0.0-4.9	5.0-5.4	5.5-5.9	6.0-6.4	6.5-6.9	7.0+	L	M	H	VH	L	M	H	VH	L	M	H	VH	L	M	H	VH
			%					%				%				%								
SUMMARY																								
GREENHOUSE	301-399	45	2	7	24	47	13	7	2	9	62	27	2	7	51	40	0	29	58	13	0	2	7	91
COMMERCIAL	1-199	38238	1	6	27	45	18	3	2	28	59	11	18	67	13	2	61	33	4	1	23	52	17	9
HOMEOWNER	201-299	3312	7	13	18	20	20	22	5	18	33	43	23	50	20	7	10	22	20	48	4	15	20	61
RESEARCH	599	36	8	25	14	33	17	3	0	6	58	36	25	47	11	17	61	39	0	0	36	36	11	17
TOTALS		41631																						

➤ No soil test calibrations for sulfur or nitrogen.

Past Lime Credit

Last Lime Application, Months	Allowance For Previous Amount Applied, %
1. None applied	0
2. 1 - 6	75
3. 7 - 12	50
4. 13 - 18	25
5. > 18	0

Lime Materials:

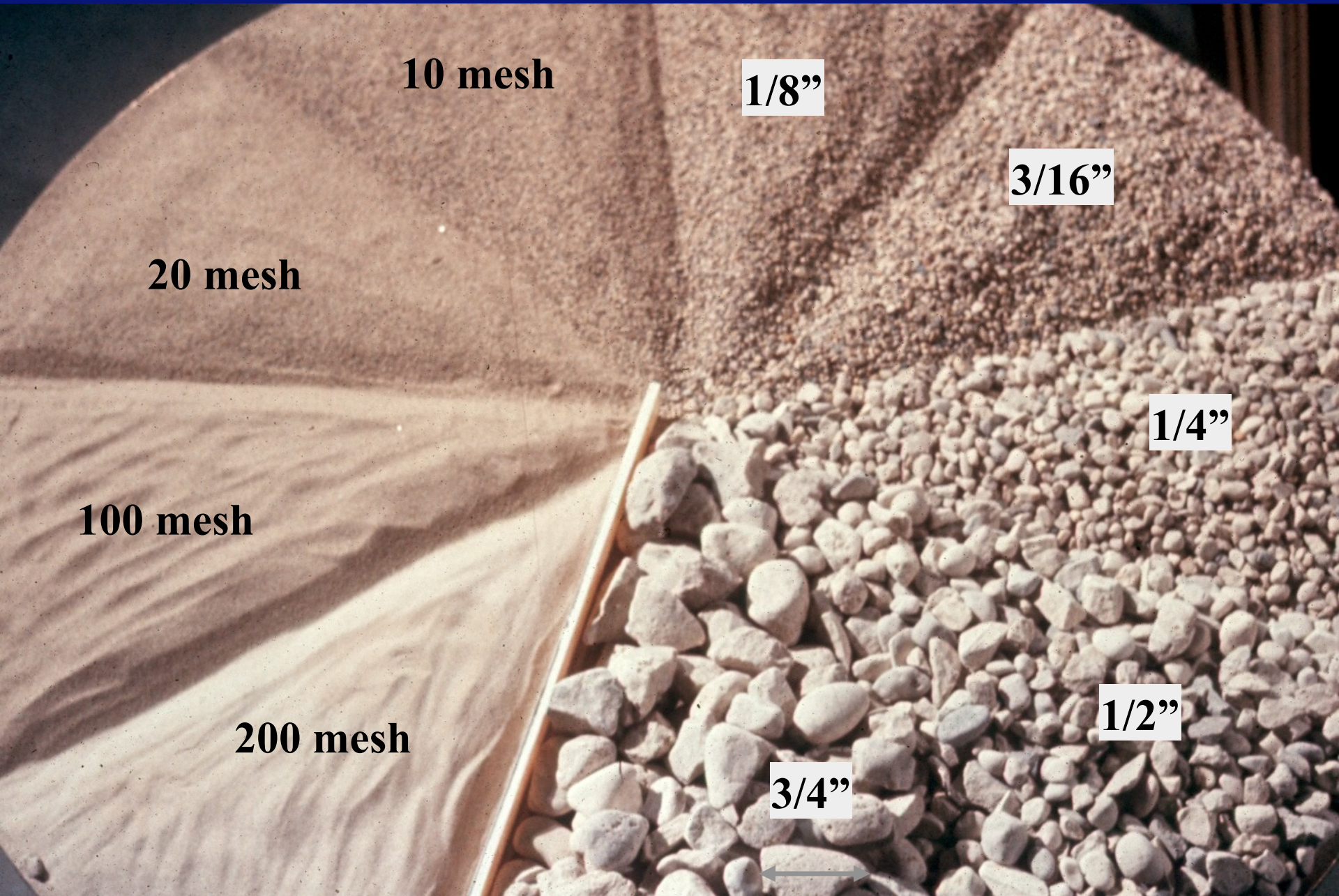
- Effectiveness is Determined:
 - ✓ Particle Size
 - ✓ Neutralizing Power

Neutralizing Power or Calcium Carbonate Equivalency (CCE)

- CaCO_3 set to 100.
- All other materials compared to it.

Properties of various lime materials

Material	Chemical Formula	CCE	Comments
Calcitic	CaCO₃	100	Supplies Ca
Dolomitic	CaCO₃ + Ca·MgCO₃	109	Supplies Ca & Mg
Burned	CaO	150-175	Absorbes H₂O
Hydrated	Ca(OH)₂	120-135	quickly, caustic
Marl	CaCO₃	70-90	Unconsolidated



10 mesh

1/8"

3/16"

20 mesh

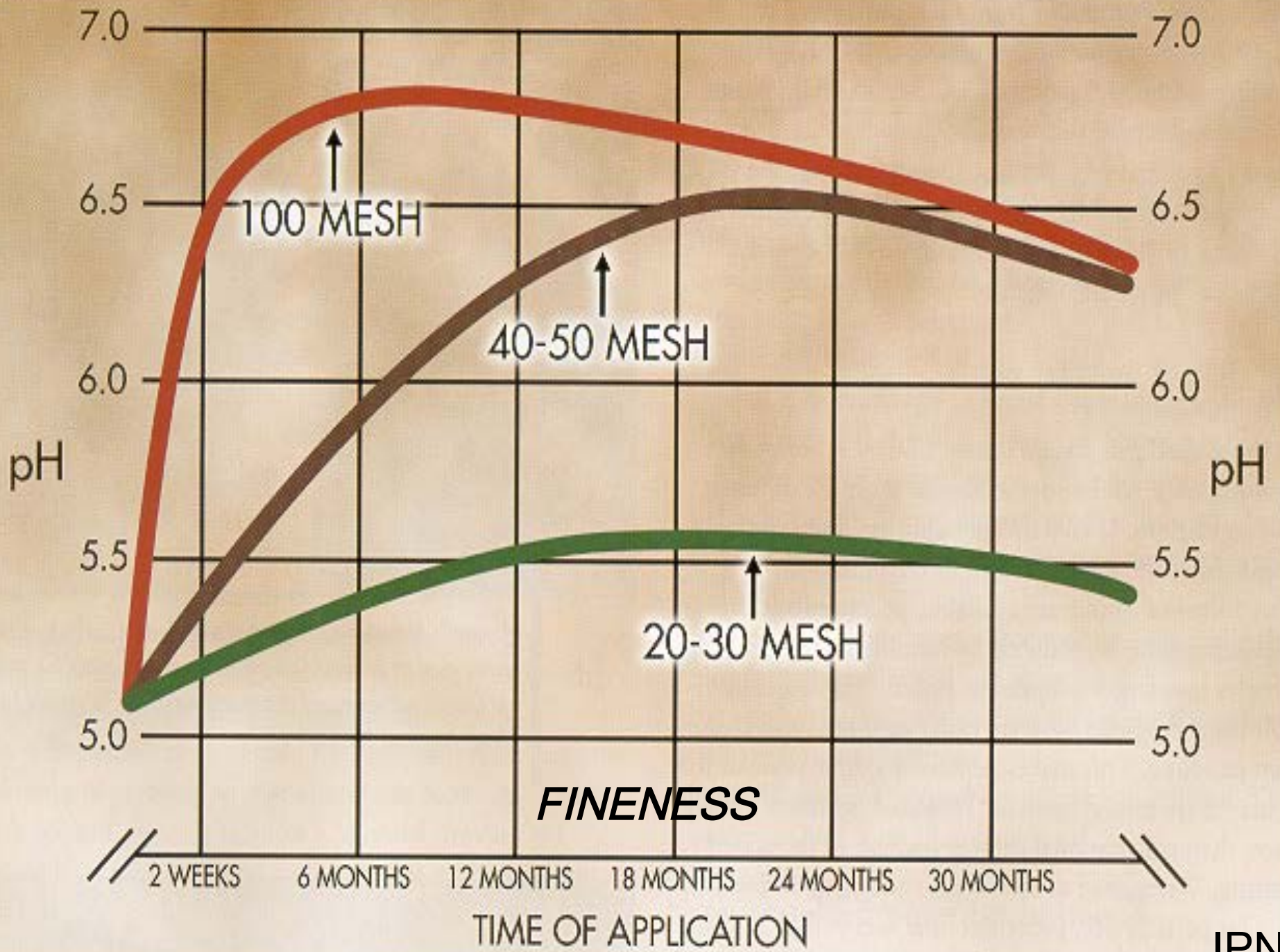
1/4"

100 mesh

1/2"

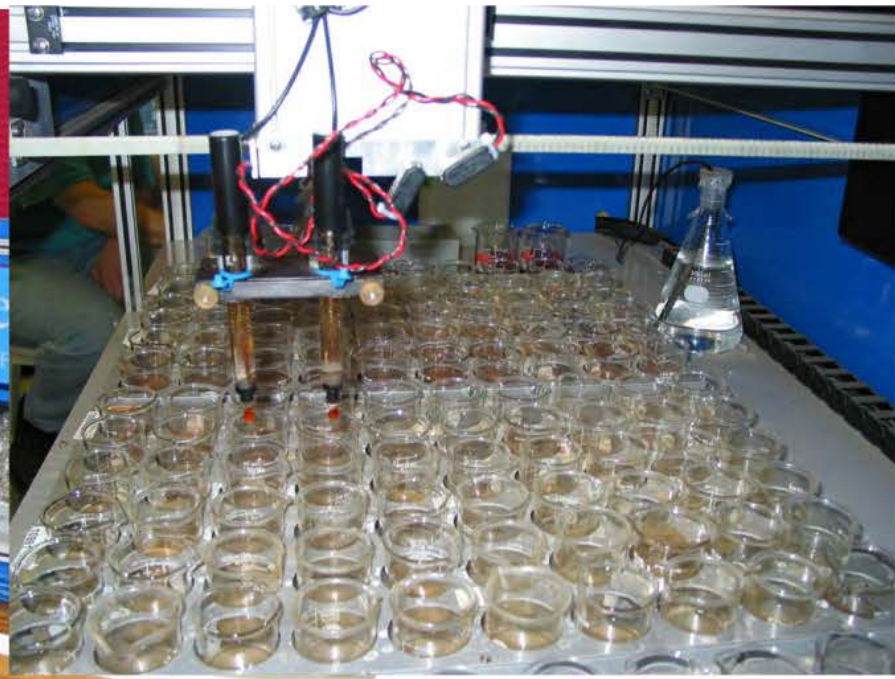
200 mesh

3/4"





Soil Testing – pH Measurement



Soil Test Report

SAMPLE HISTORY

Sample ID	Field ID	LAST CROP		LAST LIME APPLICATION		SOIL INFORMATION				
		Name	Yield	Months Prev.	Tons/Acre	SMU-1 %	SMU-2 %	SMU-3 %	Yield Estimate	Productivity Group
TMN03	TARECMN3			---	0	BKA 100				II

LAB TEST RESULTS (see Note 1)

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Rating	VH	M	M	H+	SUFF	SUFF	SUFF	SUFF	SUFF	

Analysis	Soil pH	Buffer Index	Est.-CEC (meq/100g)	Acidity (%)	Base Sat. (%)	Ca Sat. (%)	Mg Sat. (%)	K Sat. (%)	Organic Matter (%)
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FERTILIZER AND LIMESTONE RECOMMENDATIONS

Crop: Soybeans (10)

Lime, Tons/Acre	
Amount	Type
1.25	AG

Fertilizer, lb/A		
N	P205	K20
0	0	60

Lime recommendations

➤ Water pH = pH “now”

✓ What the plant currently “sees”

✓ Not used unless target pH is more than 0.2 points higher

SAMPLE HISTORY

Sample ID	Field ID	LAST CROP		LAST LIME APPLICATION		SOIL INFORMATION				
		Name	Yield	Months Prev.	Tons/Acre	SMU-1 %	SMU-2 %	SMU-3 %	Yield Estimate	Productivity Group
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Rating	VH	M	M	H+	SUFF	SUFF	SUFF	SUFF	SUFF	

Analysis	Soil pH	Buffer Index	Est.-CEC (meq/100g)	Acidity (%)	Base Sat. (%)	Ca Sat. (%)	Mg Sat. (%)	K Sat. (%)	Organic Matter (%)
Result	5.3	6.23	4.7	21.5	78.5	57.6	17.3	3.7	

FERTILIZER AND LIMESTONE RECOMMENDATIONS

Crop: Soybeans (10)

Lime, Tons/Acre	
Amount	Type
1.25	AG

Fertilizer, lb/A		
N	P205	K20
0	0	60

Lime recommendations

- Buffer pH = Used for lime recommendations
 - ✓ Active and reserve acidity
 - ❖ What the plant “sees” now and what the plant will see in the future.
 - ✓ Takes out “salt” effects
 - ❖ Can cause a water pH change of 1 unit or more

SAMPLE HISTORY										
Sample ID	Field ID	LAST CROP		LAST LIME APPLICATION		SOIL INFORMATION				
		Name	Yield	Months Prev.	Tons/Acre	SMU-1 %	SMU-2 %	SMU-3 %	Yield Estimate	Productivity Group
TMN03	TARECMN3			---	0	BKA 100				II

LAB TEST RESULTS (see Note 1)										
Analysis	P (lb/A)	K (lb/A)	Ca (lb/A)	Mg (lb/A)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	B (ppm)	S.Salts (ppm)
Result	136	134	1084	197	1.3	3.6	0.2	43.2	0.3	
Rating	VH		M	H+	SUFF	SUFF	SUFF	SUFF	SUFF	

Analysis	Soil pH	Buffer Index	Est.-CEC (meq/100g)	Acidity (%)	Base Sat. (%)	Ca Sat. (%)	Mg Sat. (%)	K Sat. (%)	Organic Matter (%)
Result	5.3	6.23	4.7	21.5	78.5	57.6	17.3	3.7	

FERTILIZER AND LIMESTONE RECOMMENDATIONS

Lime, Tons/Acre		Fertilizer, lb/A		
Amount	Type	N	P205	K20
1.25	AG	0	0	60

Crop: Soybeans (10)

<http://www.soiltest.vt.edu/PDF/recommendation-guidebook.pdf>

March 2011 Updated.

➤ Soil test report
buffer index = 6.23

➤ How much lime?

Lime Recommendations for Virginia Plants in Pounds per 1,000 sq. ft.

Lime Rates in lbs/1,000 sq. ft. of Ag Lime
(rounded to the nearest 10 pounds)

Buffer Index	Target pH					Acidity meq/100g
	5.2	5.8	6.2	6.5	6.8	
6.60	0	0	0	0	0	0.00
6.50	0	0	0	0	0	0.03
6.40	0	0	0	0	20	0.06
6.38	0	0	0	20	30	0.12
6.36	0	0	20	20	40	0.24
6.34	0	0	20	20	40	0.36
6.32	0	0	30	30	50	0.48
6.30	0	0	30	40	60	0.59
6.28	0	0	40	40	60	0.71
6.26	0	20	40	50	70	0.83
6.24	0	20	50	60	80	0.95
6.22	0	30	60	60	80	1.07
6.20	0	30	60	70	90	1.19
6.18	0	40	70	80	100	1.30
6.16	0	40	70	80	100	1.42
6.14	20	50	80	90	110	1.54
6.12	20	60	90	100	120	1.66
6.10	20	60	90	100	120	1.78
6.08	30	70	100	110	130	1.90
6.06	30	70	100	110	140	2.02
6.04	40	80	110	120	140	2.13
6.02	50	80	110	130	150	2.25
6.00	50	90	120	130	160	2.37
5.95	60	100	140	150	170	2.67
5.90	80	120	150	170	190	2.96
5.85	90	130	160	180	210	3.26

<http://www.soiltest.vt.edu/PDF/recommendation-guidebook.pdf>

March 2011 Updated.

➤ Soil test report
buffer index = 6.23

➤ What if I put out
100 lbs./1000 sq.
ft.?

Lime Recommendations for Virginia Plants in Pounds per 1,000 sq. ft.

**Lime Rates in lbs/1,000 sq. ft. of Ag Lime
(rounded to the nearest 10 pounds)**

Buffer Index	Target pH					Acidity
	5.2	5.8	6.2	6.5	6.8	meq/100g
6.60	0	0	0	0	0	0.00
6.50	0	0	0	0	0	0.03
6.40	0	0	0	0	20	0.06
6.38	0	0	0	20	30	0.12
6.36	0	0	20	20	40	0.24
6.34	0	0	20	20	40	0.36
6.32	0	0	30	30	50	0.48
6.30	0	0	30	40	60	0.59
6.28	0	0	40	40	60	0.71
6.26	0	20	40	50	70	0.83
6.24	0	20	50	60	80	0.95
6.22	0	30	60	60	80	1.07
6.20	0	30	60	70	90	1.19
6.18	0	40	70	80	100	1.30
6.16	0	40	70	80	100	1.42
6.14	20	50	80	90	110	1.54
6.12	20	60	90	100	120	1.66
6.10	20	60	90	100	120	1.78
6.08	30	70	100	110	130	1.90
6.06	30	70	100	110	140	2.02
6.04	40	80	110	120	140	2.13
6.02	50	80	110	130	150	2.25
6.00	50	90	120	130	160	2.37
5.95	60	100	140	150	170	2.67
5.90	80	120	150	170	190	2.96
5.85	90	130	160	180	210	3.26

<http://www.soiltest.vt.edu/PDF/recommendation-guidebook.pdf>

March 2011 Updated.

- Soil test report
buffer index = 6.40
- Water soil pH = 5.8
- How much lime?

Lime Recommendations for Virginia Plants in Pounds per 1,000 sq. ft.

**Lime Rates in lbs/1,000 sq. ft. of Ag Lime
(rounded to the nearest 10 pounds)**

Buffer Index	Target pH					Acidity meq/100g
	5.2	5.8	6.2	6.5	6.8	
6.60	0	0	0	0	0	0.00
6.50	0	0	0	0	0	0.03
6.40	0	0	0	0	20	0.06
6.38	0	0	0	20	30	0.12
6.36	0	0	20	20	40	0.24
6.34	0	0	20	20	40	0.36
6.32	0	0	30	30	50	0.48
6.30	0	0	30	40	60	0.59
6.28	0	0	40	40	60	0.71
6.26	0	20	40	50	70	0.83
6.24	0	20	50	60	80	0.95
6.22	0	30	60	60	80	1.07
6.20	0	30	60	70	90	1.19
6.18	0	40	70	80	100	1.30
6.16	0	40	70	80	100	1.42
6.14	20	50	80	90	110	1.54
6.12	20	60	90	100	120	1.66
6.10	20	60	90	100	120	1.78
6.08	30	70	100	110	130	1.90
6.06	30	70	100	110	140	2.02
6.04	40	80	110	120	140	2.13
6.02	50	80	110	130	150	2.25
6.00	50	90	120	130	160	2.37
5.95	60	100	140	150	170	2.67
5.90	80	120	150	170	190	2.96
5.85	90	130	160	180	210	3.26

<http://www.soiltest.vt.edu/PDF/recommendation-guidebook.pdf>

March 2011 Updated.

- Soil test report
buffer index = 6.40
- Water soil pH = 5.8
- How much lime?
- 20 lbs./1,000 sq. ft.
 - ✓ Based on 0.2 points below desirable pH of 6.5

Lime Recommendations for Virginia Plants in Pounds per 1,000 sq. ft.

Lime Rates in lbs/1,000 sq. ft. of Ag Lime
(rounded to the nearest 10 pounds)

Buffer Index	Target pH					Acidity meq/100g
	5.2	5.8	6.2	6.5	6.8	
6.60	0	0	0	0	0	0.00
6.50	0	0	0	0	0	0.03
6.40	0	0	0	0	20	0.06
6.38	0	0	0	20	30	0.12
6.36	0	0	20	20	40	0.24
6.34	0	0	20	20	40	0.36
6.32	0	0	30	30	50	0.48
6.30	0	0	30	40	60	0.59
6.28	0	0	40	40	60	0.71
6.26	0	20	40	50	70	0.83
6.24	0	20	50	60	80	0.95
6.22	0	30	60	60	80	1.07
6.20	0	30	60	70	90	1.19
6.18	0	40	70	80	100	1.30
6.16	0	40	70	80	100	1.42
6.14	20	50	80	90	110	1.54
6.12	20	60	90	100	120	1.66
6.10	20	60	90	100	120	1.78
6.08	30	70	100	110	130	1.90
6.06	30	70	100	110	140	2.02
6.04	40	80	110	120	140	2.13
6.02	50	80	110	130	150	2.25
6.00	50	90	120	130	160	2.37
5.95	60	100	140	150	170	2.67
5.90	80	120	150	170	190	2.96
5.85	90	130	160	180	210	3.26

pH Importance



Low pH = Mo Def.

High pH = Mn Def.

Outline

- Environment and pH
- Soil Testing
- **Fertilizer**

Soil Test Report

SAMPLE HISTORY

Sample ID	Field ID	LAST CROP		LAST LIME APPLICATION		SOIL INFORMATION				
		Name	Yield	Months Prev.	Tons/Acre	SMU-1 %	SMU-2 %	SMU-3 %	Yield Estimate	Productivity Group
TMN03	TARECMN3			---	0	BKA 100				II

LAB TEST RESULTS (see Note 1)

Analysis	P (lb/A)	K (lb/A)	Ca (lb/A)	Mg (lb/A)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	B (ppm)	S.Salts (ppm)
Result	136	134	1084	197	1.3	3.6	0.2	43.2	0.3	
Rating	VH	M	M	H+	SUFF	SUFF	SUFF	SUFF	SUFF	

Analysis	Soil pH	Buffer Index	Est.-CEC (meq/100g)	Acidity (%)	Base Sat. (%)	Ca Sat. (%)	Mg Sat. (%)	K Sat. (%)	Organic Matter (%)
Result	5.3	6.23	4.7	21.5	78.5	57.6	17.3	3.7	

FERTILIZER AND LIMESTONE RECOMMENDATIONS

Crop: Soybeans (10)

Lime, Tons/Acre	
Amount	Type
1.25	AG


Fertilizer, lb/A		
N	P205	K20
0	0	60

Reading a Fertilizer Label

- What does this mean?
- 14-0-26-19S

Reading a Fertilizer Label

➤ 14-0-26-19S



FERTILIZER
14-0-26

Nitrogen N
Phosphate P_2O_5
Potash K_2O

GUARANTEED ANALYSIS

TOTAL NITROGEN (N).....	14.00 %
14.45% Urea Nitrogen (N)*	
SOLUBLE POTASH (K_2O).....	26.00 %
SULFUR (S) Total.....	19.70 %
10.50% Free sulfur (S)	
9.20% Combined sulfur (S)	
IRON (Fe) Total.....	0.96 %
0.19% Water Soluble Iron (Fe)	
MANGANESE (Mn) Total.....	0.48 %
0.1% Water Soluble Manganese (Mn)	
DERIVED FROM: Polymer Coated Sulfur Coated Urea, Sulfate of Potash, Iron Oxide, Manganese Oxide.	
CHLORINE (Cl) Max.....	2.00%
*7.00% Slowly Available Urea Nitrogen from Polymer Coated Sulfur Coated Urea.	

Reading a Fertilizer Label

➤ 4-3-3



AGGRAND®
Natural Fertilizer enhances plant productivity by providing the important nutrients: Nitrogen, Phosphorus and Potassium.

USDA ORGANIC

AGGRAND®
Natural
Fertilizer
4 - 3 - 3

RECycled MATERIAL
For Use In Organic Agriculture
American State Dept. of Agriculture

Fish/Kelp Formulation

GUARANTEED ANALYSIS

Total Nitrogen (N)	4.0%
2.5% Water Soluble Nitrogen	
1.5% Water Insoluble Nitrogen	
Available Phosphate (P ₂ O ₅)	3.0%
Soluble Potash (K ₂ O)	3.0%

Derived from:
Fish, Kelp, Bloodmeal, and Sulfate of Potash.

F1136


7 97012 05301 7

PRODUCT CODE NOF-QT

AMSOIL INC.
925 Tower Ave. • Superior, WI 54880 U.S.A.
Visit us on the web at www.altrunonline.com

An effective supplement to a well-balanced nutrition program
Ideal for foliar applications
Filtered through #100 mesh

NET WT. 2.25 lbs (1.02 kg) 32 fl oz (946 ml)

Take Home Message

- Only put out the nutrients you need!
- Monitor soil nutritional “health” via soil samples
- Plant tissue samples are useful for finding deficiency problems
- Tissue and soil test if unsure of problem:
 - ✓ Good area
 - ✓ Bad area
- Tissue = short term fix; Soil = Long term

QUESTIONS?



- Follow us on Facebook:
- Virginia Tech Eastern Shore AREC Crop & Soil Environmental Sciences
- <http://www.facebook.com/EasternShore.Soils>
- Mark Reiter
- 757-414-0724 ext. 16
- mreiter@vt.edu

Outline

- Environment and pH
- Soil Testing
- **Plant Tissue Testing**
- Troubleshooting

Taking Plant Tissue Samples

- Avoid samples contaminated with dust or soil.
 - ✓ Shake, brush off, wash if needed
- Do not sample plants with other problems.
 - ✓ Diseased
 - ✓ Insect injury
 - ✓ Mechanically damaged

Taking Plant Tissue Samples

- Mail the sample in a paper bag
 - ✓ Do not mail in a plastic bag
 - ✓ Let the sample air dry if wet to prevent mold
- Sample at the correct growth stage
- Sample the correct plant part
- Make sure everything is labeled

Growth Stage

http://pubs.ext.vt.edu/424/424-100/PDF_part7.pdf

Crop	Time	Plant Part to Sample	No. of Plants to Sample
Alfalfa	Early bloom	Top 4-6" of plant	30
Bermudagrass	Optimum time for maximum quality hay	Upper half of plant	50
Corn	Prior to 4th leaf stage	Whole plant, cutting at ground level	30
	Prior to tasseling	Entire leaf immediately below whorl, removing at stalk	20
	At silk when silks are still green	Entire ear leaf, removing at stalk	20
Cotton	At full bloom	Youngest recently mature leaves on main stem, collecting 2 leaves per plant	25
Peanut	At bloom stage	Last fully mature leaves at top of the plant, collecting 3 leaves per plant	25
Small Grains	Prior to jointing	Whole plant above ground, remove dead leaves	50
	Jointing to heading	Uppermost fully developed leaf	50
Soybeans	Prior to or at initial bloom	Uppermost fully developed trifoliolate leaf set (composed of 3 leaflets) per plant. Remove leaf stem (petiole)	25
Tobacco	Prior to or at bloom	Entire 4th leaf from the top of the plant	15

Growth Stage

http://pubs.ext.vt.edu/424/424-100/PDF_part7.pdf

Vegetable			
Asparagus	Midgrowth	Mature fern from 18-36" up	10
Beet	Midgrowth	Young mature leaf, 3 leaves/plant	25
Broccoli	Heading	Young mature leaf, 2 leaves/plant	
Brussels sprout	Midgrowth	Young mature leaf, 3 leaves/plant	25
Cabbage	Head half grown	Young wrapper leaf, 2 leaves/plant	30
Cantaloupe	Prior to or at initial fruit set	Mature leaf near growing tip, 3 leaves/plant	25
Cauliflower	Buttoning	Mature leaf with stem removed	30
Collards	Midgrowth	Young mature leaf, 3 leaves/plant	25
Cucumber	Prior to or at initial fruit set	Mature leaf near growing tip, 3 leaves/plant	25
Green beans	Prior to or at early bloom	Uppermost mature leaves, 3 leaves/plant	20
Kale	Midgrowth	Young mature leaf, 3 leaves/plant	30
Onion	Midgrowth	Young mature leaf, 2 leaves/plant	30
Peas	Bud to full bloom	Entire top growth	15
Peppers, bell	Midgrowth	Young mature leaf, 3 leaves/plant	30
Potatoes, Irish	Tubers half grown	Young mature leaf, 3 leaves/plant	25
Spinach	Midgrowth	Young mature leaf, 2 leaves/plant	25
Sweet corn	At silking when silks are green	Entire ear leaf, removing at stalk	20
Sweet potato	Midgrowth	4 th leaf from a primary vine, counting down from growing tip	30
Tomato,	Early fruiting	3 rd and 4 th leaf from growing tip mech. harvest	50
Turnip greens	Midseason	Young mature leaf, 3 leaves/plant	25
Watermelon	Prior to or at initial fruit set	Mature leaf near growing tip, 3	25

Sufficiency Ranges

Table 3. Plant Nutrient Sufficiency Ranges for Field, Forage, Fruit, and Nut Crops*

Crop**	N	P	K	Ca	Mg	Mn	Fe	B	Cu	Zn	Mo
	%					ppm					
Field, Forage											
Alfalfa	4.50-5.00	0.35	2.20	0.80	0.40	25	30	15	7	15	0.5
Bermudagrass	2.00-3.00	0.20-0.50	1.50-2.50	0.25-0.75	0.15-0.50	50-250	50-300	5-20	6-20	20-50	-
Corn-up to 12" tall	3.50-5.00	0.30-0.50	3.00-4.00	0.30-0.70	0.20-0.60	30-300	50-250	4-25	3-20	20-60	0.2
Corn-ear leaf at silk or leaf below whorl	3.00-3.50	0.25-0.45	2.00-2.75	0.25-0.80	0.20-0.50	30-200	50-300	3-20	3-20	20-60	0.2
Cotton	3.50-4.50	0.30-0.50	2.00-3.00	2.25-3.00	0.50-0.90	50-350	50-250	20-60	8-20	20-60	—
Peanut	3.50-4.50	0.25-0.50	2.00-3.00	1.25-2.00	0.30-0.80	50-350	50-300	25-60	-	20-50	0.5
Small grains	4.00-5.00	0.20-0.40	1.50-3.00	0.20-0.50	0.15-0.50	25-100	25-100	3-20	5-25	20-70	—
Soybeans	4.25-5.00	0.30-0.50	1.75-2.50	0.50-1.50	0.25-0.80	20-200	50-300	25-60	6-30	20-50	0.5
Tobacco	3.50-4.25	0.25-0.50	2.50-3.20	1.50-3.50	0.20-0.65	30-250	50-200	20-50	15-60	20-80	—
Fruit, Nut											
Apple	2.00-3.00	0.15-0.50	1.25-3.00	1.00-2.00	0.20-0.50	20-200	50-400	20-60	5-20	15-50	—
Blueberry	1.80-2.00	0.10-0.20	0.40-0.60	0.30-0.75	0.20-0.30	20-200	60-150	10-50	10-20	10-50	—
Cherry	2.00-3.00	0.15-0.50	1.25-2.50	1.50-2.50	0.20-0.50	20-200	50-400	20-60	5-20	15-50	—
Grape	0.80-1.00	0.20-0.50	1.50-2.50	1.75	0.40-0.80	30-200	30	40-60	5-20	20-50	—
Peach	2.75-3.50	0.25-0.50	1.20-2.50	1.50-2.50	0.20-0.50	20-200	60-400	20-100	5-20	15-50	—
Pear	2.20-3.00	0.15-0.50	1.00-3.00	1.00-2.00	0.20-0.50	20-200	50-400	20-60	5-20	15-50	—
Pecan	2.50-3.90	0.12-0.30	1.00-1.50	0.70-1.50	0.30-0.60	100-800	50-300	20-45	10-30	50-100	—

Outline

- Environment and pH
- Soil Testing
- Plant Tissue Testing
- **Troubleshooting**

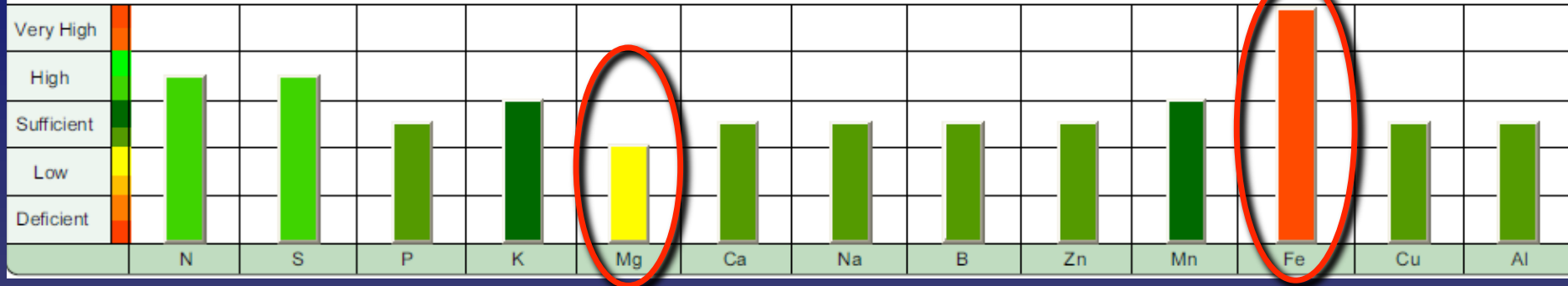
Troubleshooting

- Take at least four representative samples
- Soil
 - ✓ Good area
 - ✓ Bad area
- Plant Tissue
 - ✓ Good area
 - ✓ Bad area



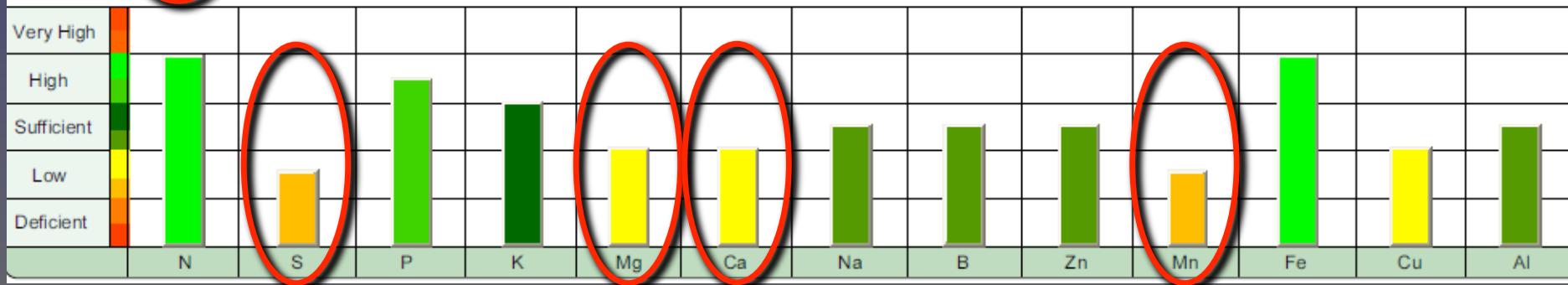
	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	3.81	0.32	0.28	2.77	0.13	0.35	0.01	7	25	48	112	7	33
Normal Range	2.00	0.20	0.20	1.50	0.15	0.30	0.00	5	21	32	36	6	0
	3.51	0.31	0.37	3.01	0.46	0.71	0.11	11	35	49	55	11	251

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	11.9	1.4	0.9	112.0	21.3	577.1	500.0	2.3					
Expected Ratio	10.8	1.2	1.1	101.8	7.4	556.8	631.3	1.1					

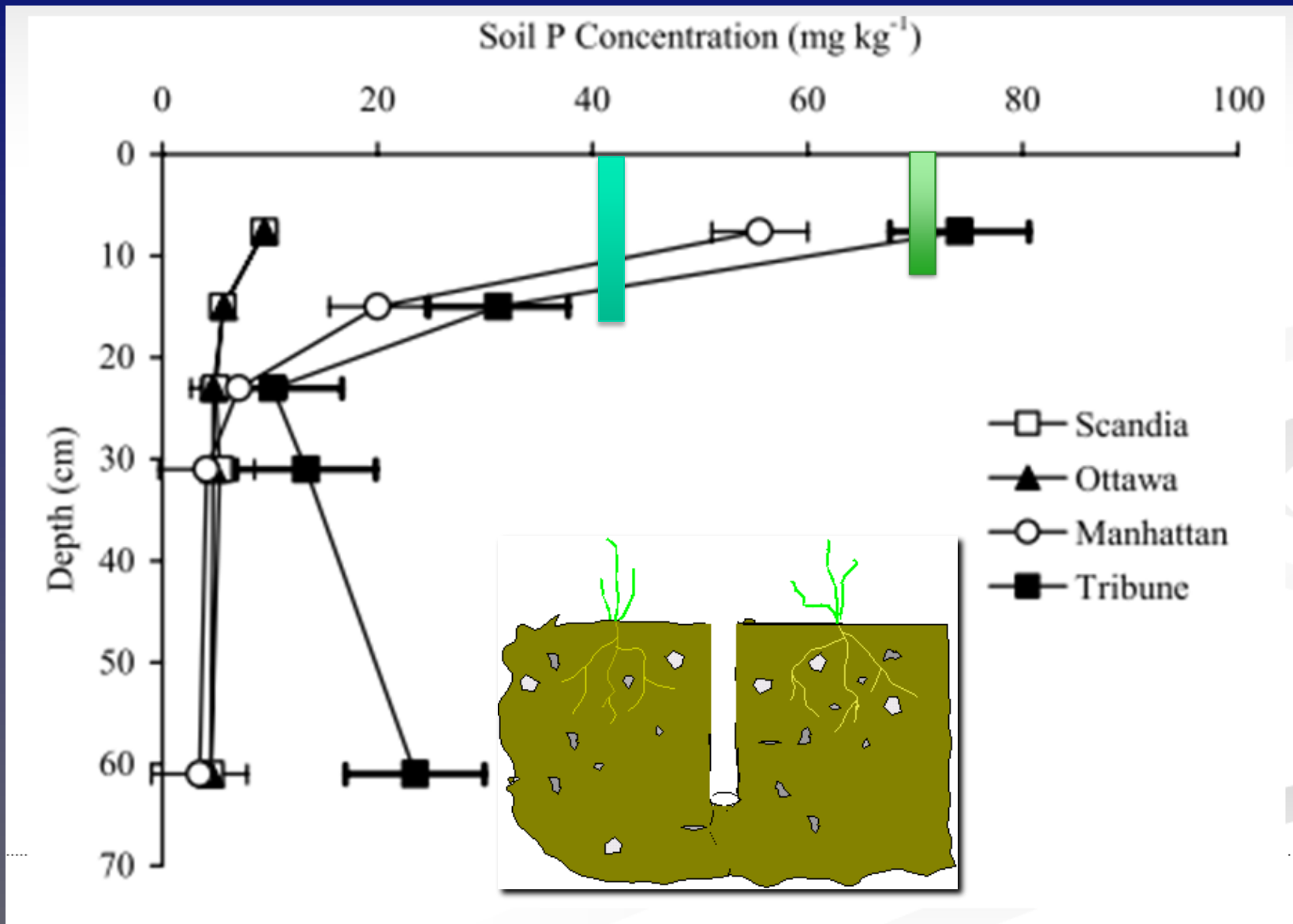


	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	4.08	0.18	0.40	2.76	0.13	0.28	0.01	7	28	29	81	6	19
Normal Range	2.00	0.20	0.20	1.50	0.15	0.30	0.00	5	21	32	36	6	0
	3.51	0.31	0.37	3.01	0.46	0.71	0.11	11	35	49	55	11	251

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	22.7	1.5	2.2	142.9	21.2	951.7	400.0	2.8					
Expected Ratio	10.8	1.2	1.1	101.8	7.4	556.8	631.3	1.1					



Nutrient Stratification – grass or no-till



How Lime Works



Al^{+++}



H_2O



Ca^{2+}



(Water)

(Carbon
Dioxide)



How Lime Reduces Soil Acidity

- A Ca^{2+} ion from the lime replaces two H^{+} ions on the cation exchange complex.
 - ✓ But realize, Ca is not actually reducing the number of H^{+} ions.
- The H^{+} ions combine with OH^{-} to form water.
- Soil pH increases because the acidity source (H^{+}) has been reduced.

Neutralizing Acidity with Lime



Displaces
Al & H from
Clay

Breaks down to
carbon dioxide
+ water

Combines with H^+
released from the clay
or from Al-OH
to form water

How Lime Works

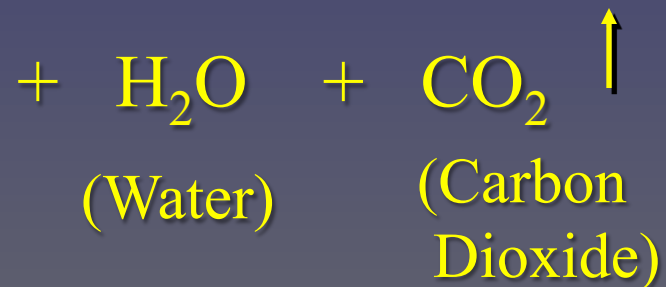


H⁺

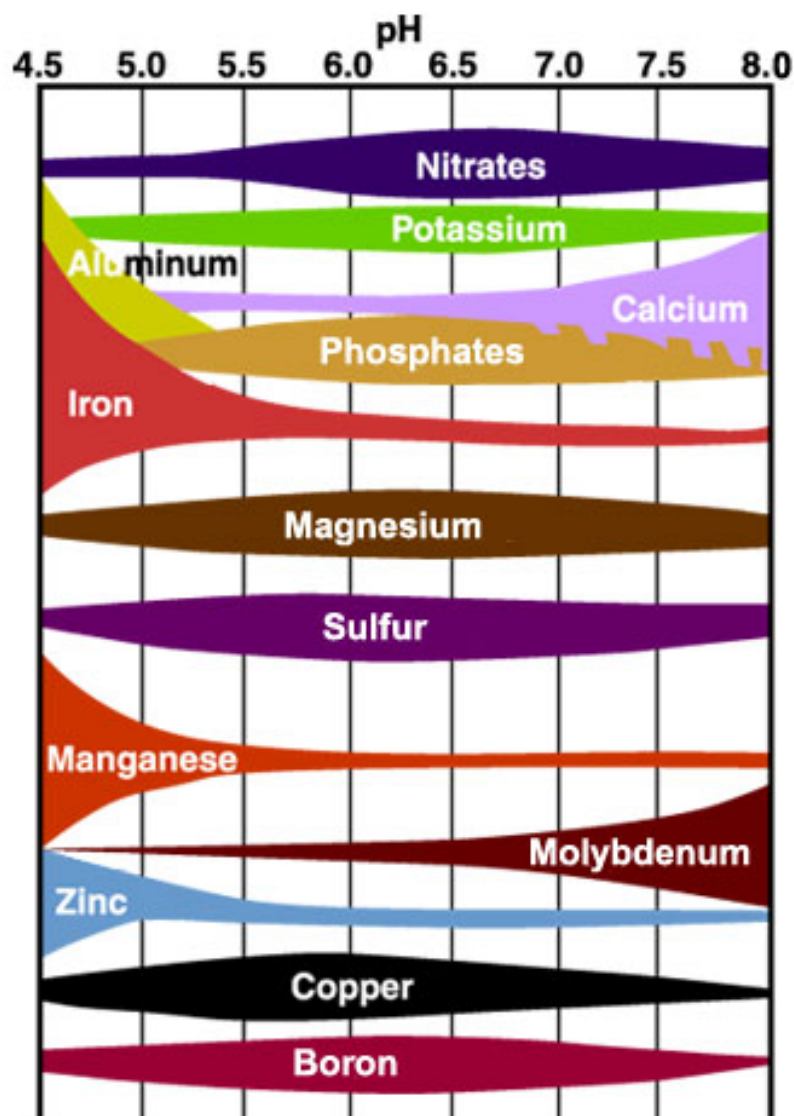
H⁺



Ca²⁺



Manganese (Mn) Soil Test Calibration



Manganese Calibration – Soybeans

Soil Test Manganese ppm	Recommend Manganese If The Soil pH Is Equal To Or Greater Than The Following (0.22733 x Mn ppm) + 5.1
0.0 - 0.4	5.1
0.5 - 0.9	5.2
1.0 - 1.4	5.3
1.5 - 1.6	5.4
1.7 - 1.9	5.5
2.0 - 2.4	5.6
2.5 - 2.9	5.7
3.0 - 3.4	5.8
3.5 - 3.9	5.9
4.0 - 4.4	6.0
4.5 - 4.9	6.1
5.0 - 5.1	6.2
5.2 - 5.4	6.3
5.5 - 5.9	6.4
6.0 - 6.4	6.5
6.5 - 6.9	6.6
7.0 - 7.4	6.7
7.5 - 7.9	6.8
8.0 - 8.4	6.9
8.5 -	7.0

Lab's web site www.soiltest.vt.edu

Virginia Tech - Calendar x Department of Crop and S... x

www.soiltest.vt.edu

phosphorus concentration in milk

Most Visited Getting Started VT Google Apps Portal JEQ

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Department of Crop and Soil Environmental Sciences - Virginia Tech Soil Testing Lab

Lab facts

- » Started operations in 1938.
- » Over 50,000 samples are tested each year.
- » More than a third of garden samples tested have too much lime, creating an alkaline soil that can cause micro-nutrient deficiencies in plants.
- » Lab uses over 1,000 gallons of liquid argon a year.
- » 1 in 7 existing lawn samples test low in phosphorus.
- » Lab uses automated pH analyzers designed and manufactured in Australia.
- » In a typical March, one person with half-time help types in client information for around 10,000 samples.
- » Data from soil test instrumentation is captured electronically, and never has to be entered by hand.

QUICKLINKS

- Department of Crop and Soil Environmental Sciences - Virginia Tech Soil Testing Lab
- Fees and Forms
- Sampling Instructions
- Report Notes
- About Our Laboratory
- Have Questions?
- Virginia Cooperative Extension
- College of Agriculture and Life Sciences
- Department of Crop & Soil Environmental Sciences
- Virginia Agricultural Experiment Station
- Agricultural Research and Extension Centers
- Extension Local Offices

Mission

The Virginia Tech Soil Testing Laboratory is affiliated with both Virginia Cooperative Extension and the department of Crop and Soil Environmental Sciences, and analyzes soil samples submitted by the public and university researchers. Tests are performed to evaluate the soil's nutrient potential and to determine the most beneficial application rates of fertilizer and lime for optimum plant growth. Accurate soil analysis with subsequent recommendations provide a tool for making economical and ecological land use decisions. Maximum economic yields are realized through careful management of nutrient availability. Over-fertilization is costly and may be damaging to the environment.

Operation

A routine soil test package includes analysis for soil pH, P, K, Ca, Mg, Zn, Mn, Cu, Fe, and B, along with fertilizer and lime recommendations for the specified crop. Soluble salts and organic matter tests are also available. Local Cooperative Extension offices in counties and cities throughout the state can provide soil sample boxes and information sheets.

Soil samples are analyzed and computer recommendations generated usually within three working days of receipt. The completed soil test reports, along with one or more soil test notes containing additional information on fertilization and liming, are either mailed or emailed directly to the client. A copy of the report is also made available to the local Cooperative Extension office.

Virginia Tech

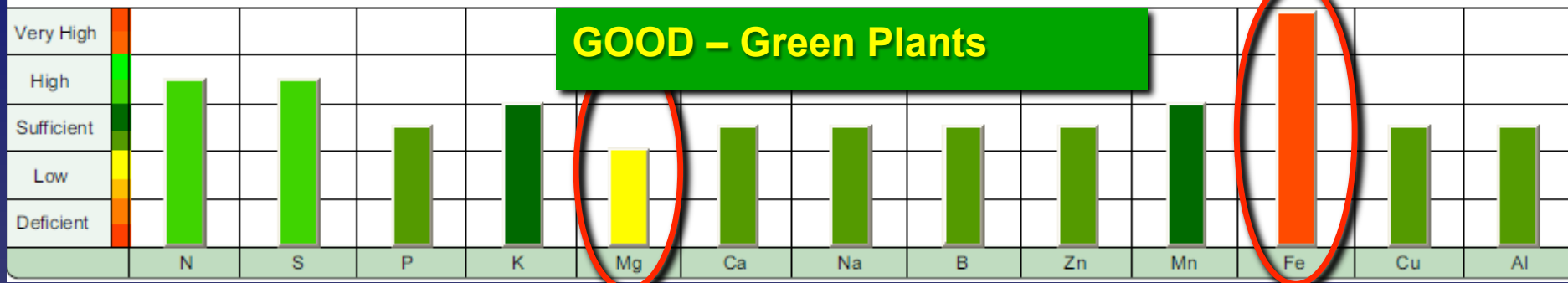
Sampling instructions

Report Notes

	Nitrogen (N)	Phosphate (P ₂ O ₅)	Potash (K ₂ O)	Physical State
Material Supplying	%	%	%	
Phosphorus				
Ammonium polyphosphate (APP)	10	34-37	0	liquid
Diammonium phosphate (DAP)	18-21	46-53	0	solid
Ground bone (raw)	2.5 to 4	20-25	0	solid
Ground rock phosphate	0	25-40 (14-65% avail.)	0	solid
Monammonium phosphate (MAP)	11-13	48-62	0	solid
Steamed bone meal	1 to 2.5	22-30	0	solid
Superphosphate, normal	0	16-22	0	solid
Superphosphate, triple	0	44-53	0	solid
Potassium				
Muriate of potash (potassium chloride)	0	0	60-62	solid
Potassium nitrate	13	0	44	solid
Potassium sulfate	0	0	50-53	solid
Potassium thiosulfate	-	0	25	liquid
Potassium orthophosphate	-	30-50		
Potassium magnesium sulfate	0	0	22	solid

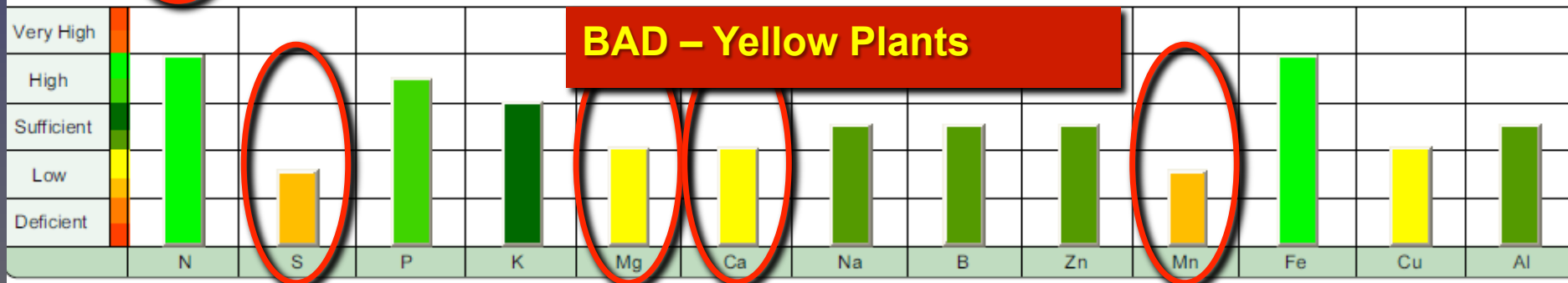
	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	3.81	0.32	0.28	2.77	0.13	0.35	0.01	7	25	48	112	7	33
Normal Range	2.00	0.20	0.20	1.50	0.15	0.30	0.00	5	21	32	36	6	0
	3.51	0.31	0.37	3.01	0.46	0.71	0.11	11	35	49	55	11	251

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	11.9	1.4	0.9	112.0	21.3	577.1	500.0	2.3					
Expected Ratio	10.8	1.2	1.1	101.8	7.4	556.8	631.3	1.1					



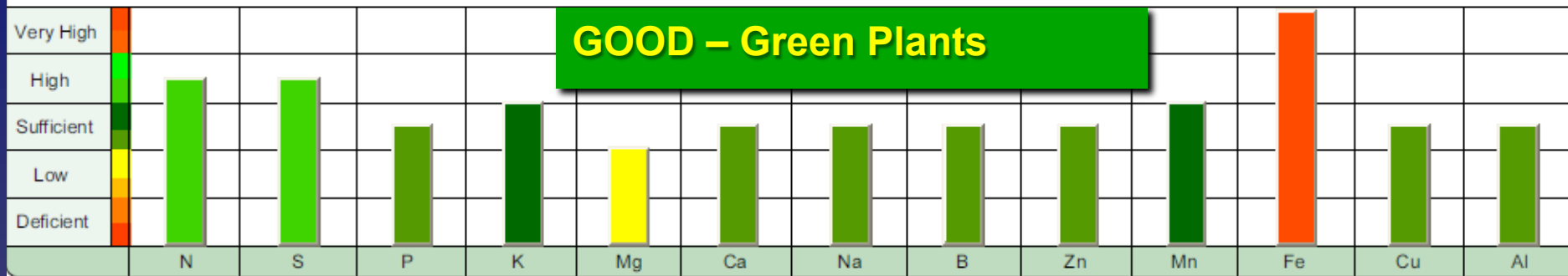
	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	4.08	0.18	0.40	2.76	0.13	0.28	0.01	7	28	29	81	6	19
Normal Range	2.00	0.20	0.20	1.50	0.15	0.30	0.00	5	21	32	36	6	0
	3.51	0.31	0.37	3.01	0.46	0.71	0.11	11	35	49	55	11	251

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	22.7	1.5	2.2	142.9	21.2	951.7	400.0	2.8					
Expected Ratio	10.8	1.2	1.1	101.8	7.4	556.8	631.3	1.1					



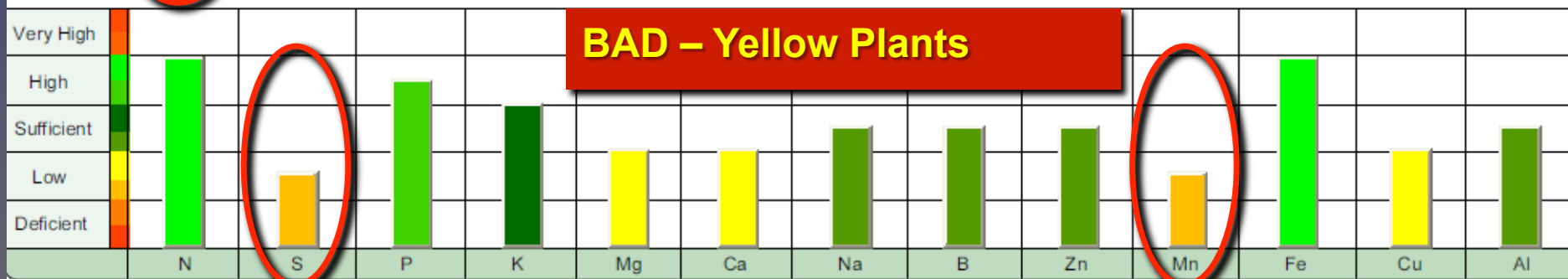
	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	3.81	0.32	0.28	2.77	0.13	0.35	0.01	7	25	48	112	7	33
Normal Range	2.00	0.20	0.20	1.50	0.15	0.30	0.00	5	21	32	36	6	0
	3.51	0.31	0.37	3.01	0.46	0.71	0.11	11	35	49	55	11	251

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	11.9	1.4	0.9	112.0	21.3	577.1	500.0	2.3					
Expected Ratio	10.8	1.2	1.1	101.8	7.4	556.8	631.3	1.1					



	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	4.08	0.18	0.40	2.76	0.13	0.28	0.01	7	28	29	81	6	19
Normal Range	2.00	0.20	0.20	1.50	0.15	0.30	0.00	5	21	32	36	6	0
	3.51	0.31	0.37	3.01	0.46	0.71	0.11	11	35	49	55	11	251

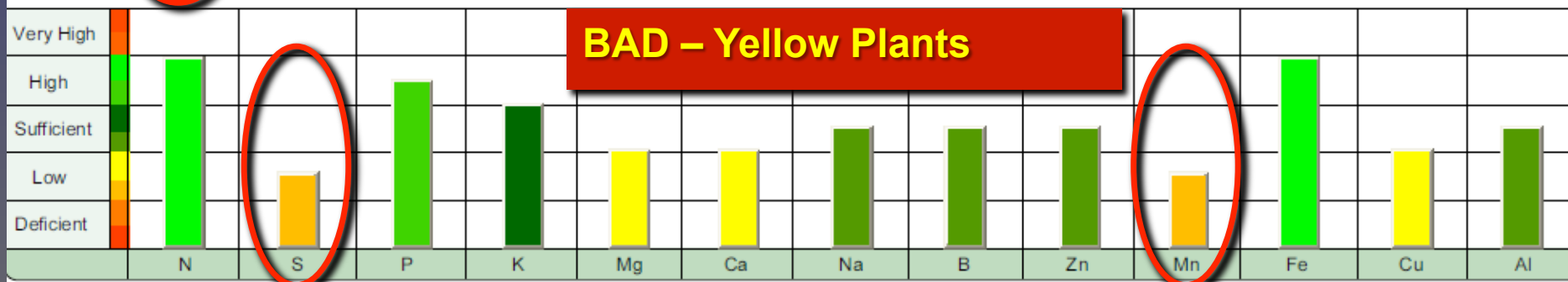
	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	22.7	1.5	2.2	142.9	21.2	951.7	400.0	2.8					
Expected Ratio	10.8	1.2	1.1	101.8	7.4	556.8	631.3	1.1					



- Sulfur greened up the wheat
- Higher soil pH would probably aggregate low Mn concentrations
 - ✓ Mg and Ca borderline low = low pH
- Drought? Sandy?

	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	4.08	0.18	0.40	2.76	0.13	0.28	0.01	7	28	29	81	6	19
Normal Range	2.00	0.20	0.20	1.50	0.15	0.30	0.00	5	21	32	36	6	0
	3.51	0.31	0.37	3.01	0.46	0.71	0.11	11	35	49	55	11	251

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	22.7	1.5	2.2	142.9	21.2	951.7	400.0	2.8					
Expected Ratio	10.8	1.2	1.1	101.8	7.4	556.8	631.3	1.1					

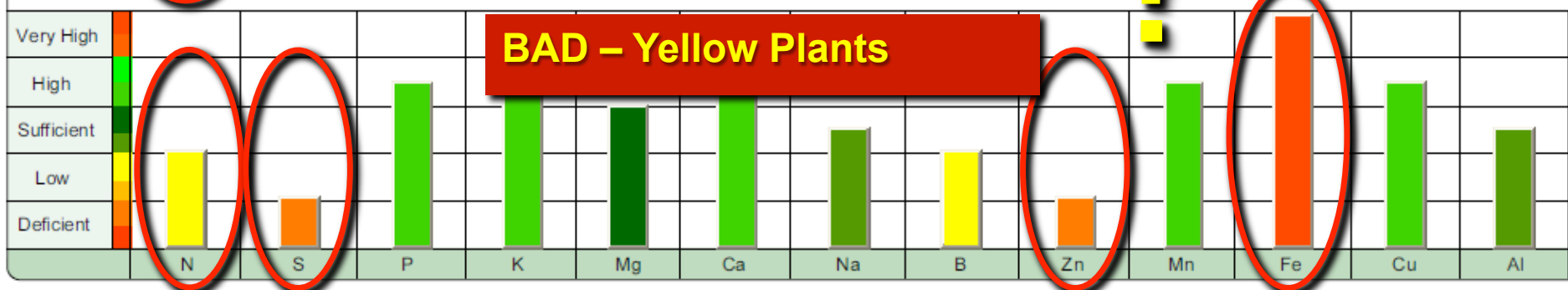


Soil Test Needed

	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	3.72	0.14	0.50	3.11	0.23	0.26	0.02	4	21	83	74	9	20
Normal Range	4.20	0.20	0.24	1.50	0.15	0.28	0.00	5	21	32	36	6	0
	5.01	0.31	0.46	3.01	0.31	0.43	0.11	11	35	49	55	11	251

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	26.6	1.2	3.6	312.5	13.5	536.2	880.0	2.2					
Expected Ratio	18.1	2.0	1.4	125.0	9.8	556.8	443.8	1.1					

BAD – Yellow Plants



	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	3.11	0.13	0.44	3.01	0.11	0.26	0.01	4	21	83	74	9	20
Normal Range	4.20	0.20	0.24	1.50	0.15	0.28	0.00	5	21	32	36	6	0
	5.01	0.31	0.46	3.01	0.31	0.43	0.11	11	35	49	55	11	251

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn					
Actual Ratio	23.9	1.0	3.4	209.5	27.4	362.7	650.0	0.9					
Expected Ratio	18.1	2.0	1.4	125.0	9.8	556.8	443.8	1.1					

GOOD – Green Plants

