How to Read a Soil Test Report

Beth Guertal
Auburn University

Survey

- How often do you soil test?
  - A Every year
  - B Every other year
  - C Twice or more a year
  - D Never

Another Quick Survey

- Who does your soil testing?
- A - I (or a member of my staff) do it
- B – turfgrass consultant
- C – fertilizer sales rep
- D - other

Why do we soil test?

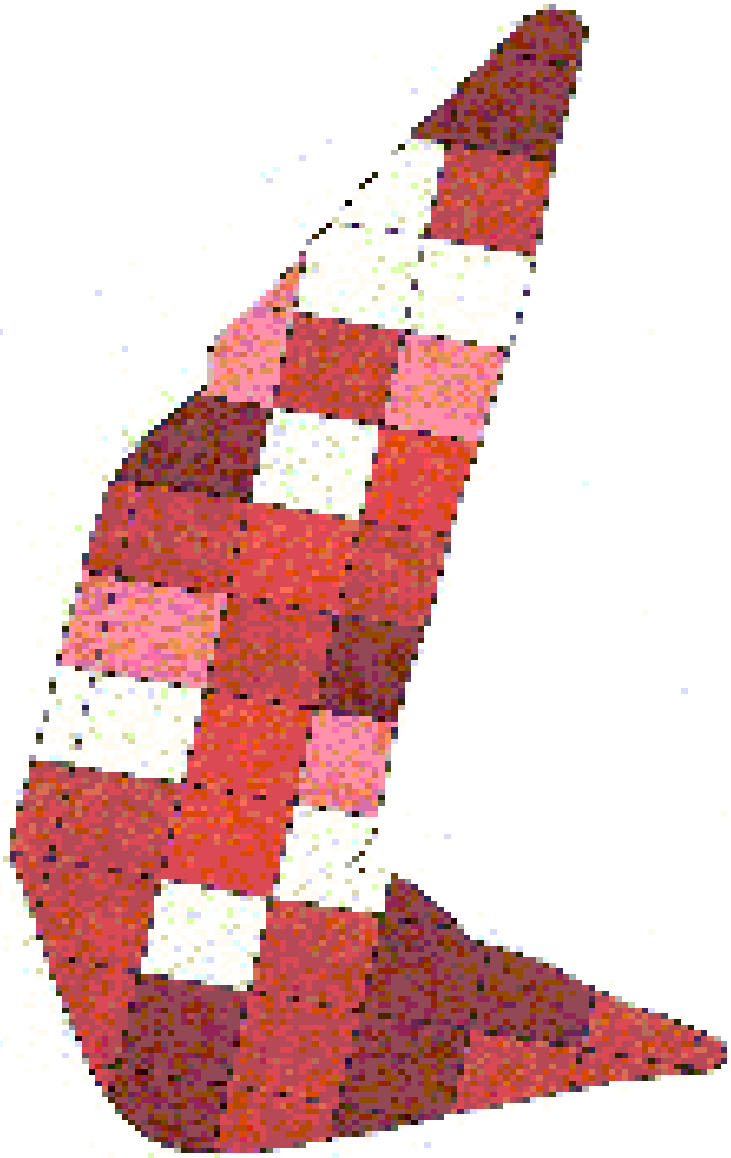
- Want to see how much of a given nutrient is in the soil.
- Use the soil level to help determine fertilizer needs.
- Also may be used to determine if detrimental levels of a nutrient exist.

The Steps in Soil Testing:

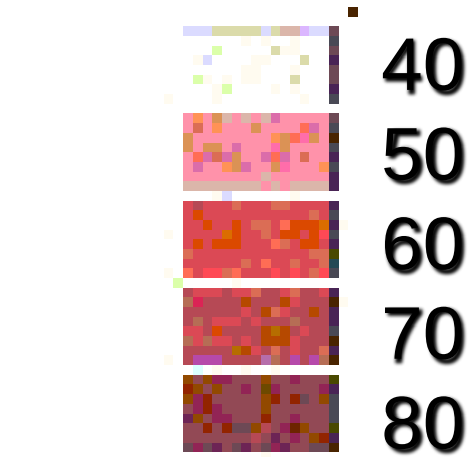
1. Sampling
2. Lab Analysis
3. Interpretation/Calibration
4. Recommendations

Grid Sampling

- newer method for developing site-specific links with GIS/GPS fertilizer application
- common in field crop production
- initial costs high - savings on fertilizer costs?
- trick is to figure out number of samples/area



Example: a 14 A sod field with soils sampled in 1/2 acre grids.



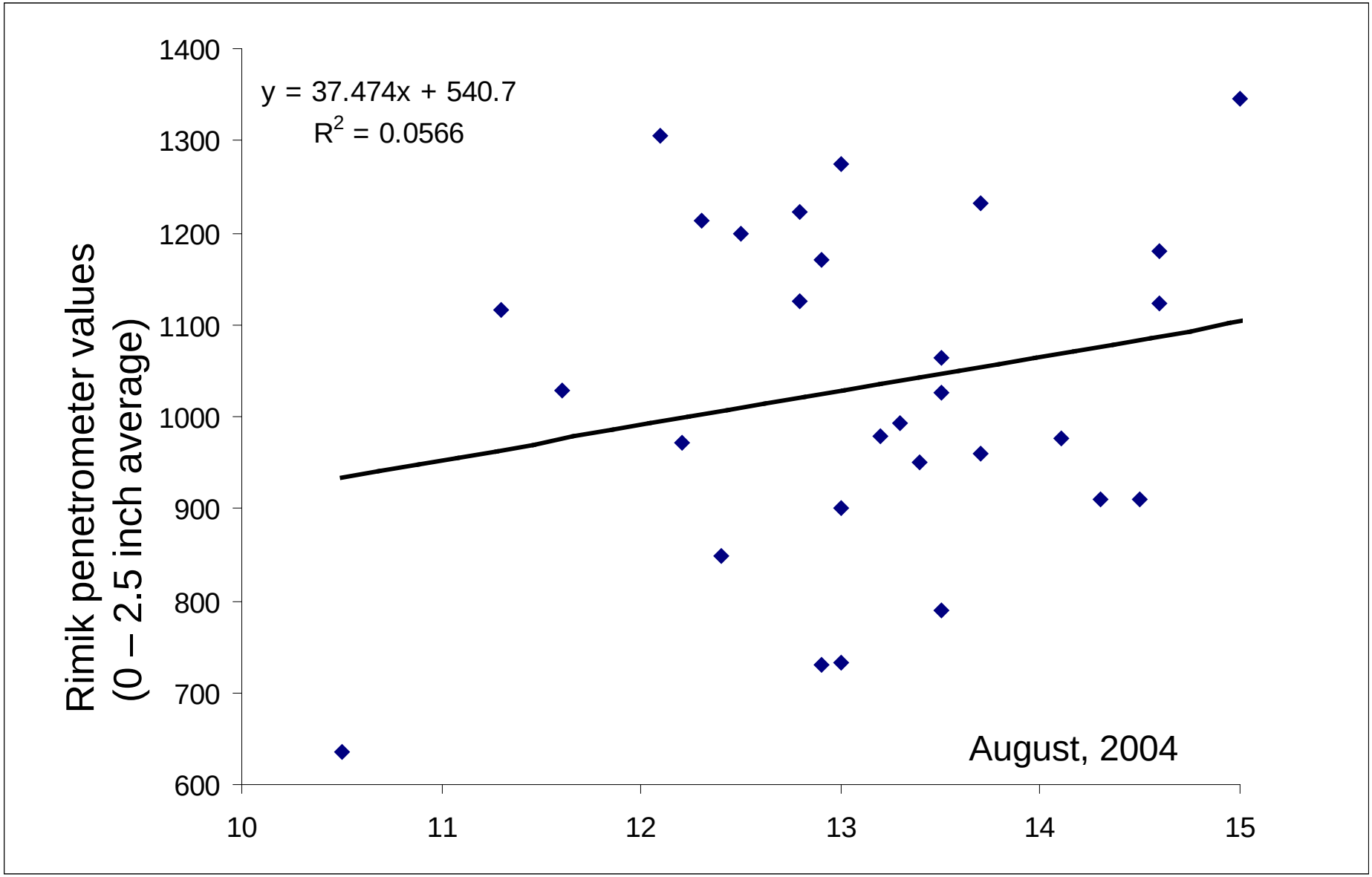
Lab Analysis

- sample dried/ground/sieved
- sample extracted - varies with region
- sample analyzed
- *make sure the extractant is correct for your region*

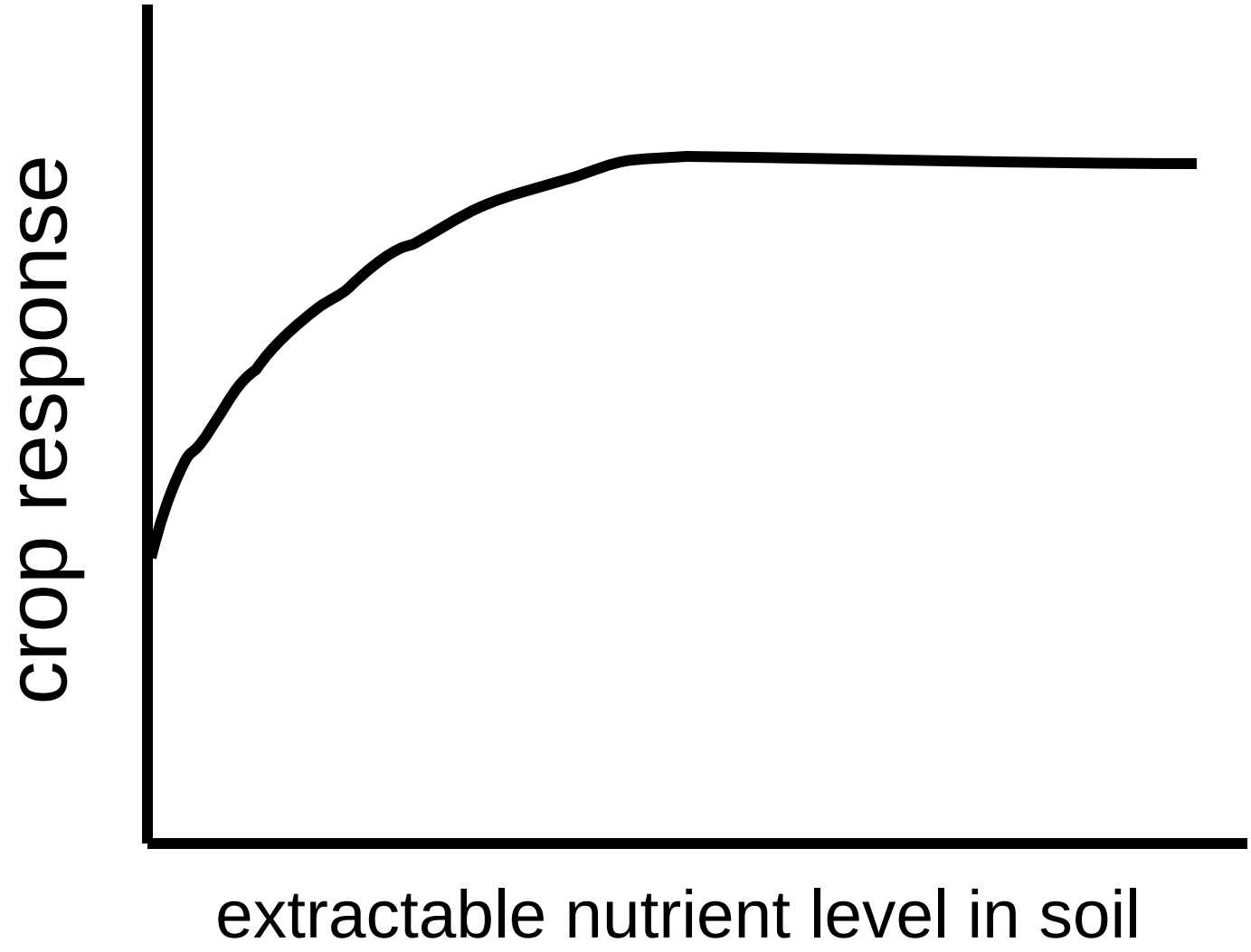
Calibration

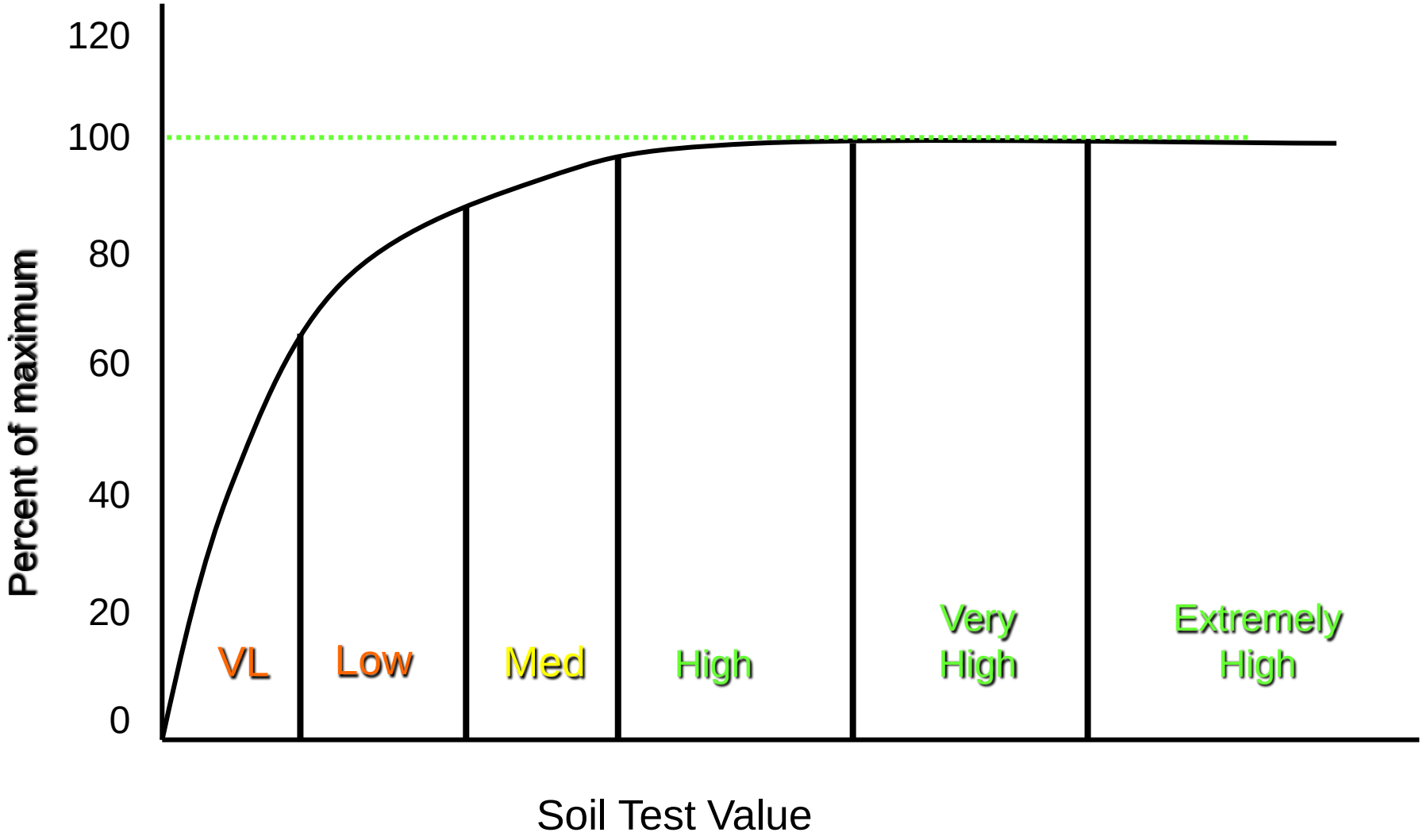
- what does the number mean?
- can a response be expected?
- the test result must be calibrated
- done on a wide range of soils, crops, locations
- lots of this research is missing in turf

We use calibration every day of our lives, we probably just don't realize it……


y = 37.474x + 540.7
R2 = 0.0566
Rimik penetrometer values
(0 – 2.5 inch average)
1400
1300
1200
1100
1000
900
800
700
600
10
11
12
13
14
15
August, 2004
Lang penetrometer values

Calibration




120
100
80
60
40
20
0
Percent of maximum
VL
Low
Med
High
Very
High
Extremely
High
Soil Test Value


Field Portable pH NPK Soil Test Kit


rapitest
Soil Test Kit
Juego de pruebas para el suelo
...Products for Successful Gardening From luster leaf
Easy to Use...
Fácil de usar...
Flowers • Vegetables • Shrubs • Lawns
Accurate Results in Minutes!
Flores • Vegetales • Arbustos • Césped
¡Resultado precisos en minutos!
pH TEST
N TEST
Nitrogen
P TEST
Phosphorus
K TEST
Potash


N TEST
Nitrogen
P TEST
Phosphorus
pH TEST
FILL WITH WATER
FILL WITH SOIL
K TEST
Potash

The standard information that is on almost every regions' soil-test report:

- phosphorus
- potassium
- calcium
- magnesium
- pH

The information that is on many regions' soil-test reports (but not all):

- Nitrate-N (SW and W)
- Sodium (SW and W)
- Sulfur (varies with region)
- Iron (varies with region)
- Manganese
- Zinc
- Salt
- Organic matter content

A Short Survey:

- I’m in a state or region that provides some measure of soil test nitrogen (nitrate or ammonium or total N) on the soil test.

- A. Yes
- B. No
- C. Not Sure

Other items that may be on the soil test report:

- Cation exchange capacity
- Base saturation
- Basic ion saturation
- Sodium absorption ratio (SAR)
- Buffer pH

A Brief Review of Cation Exchange Capacity (CEC)

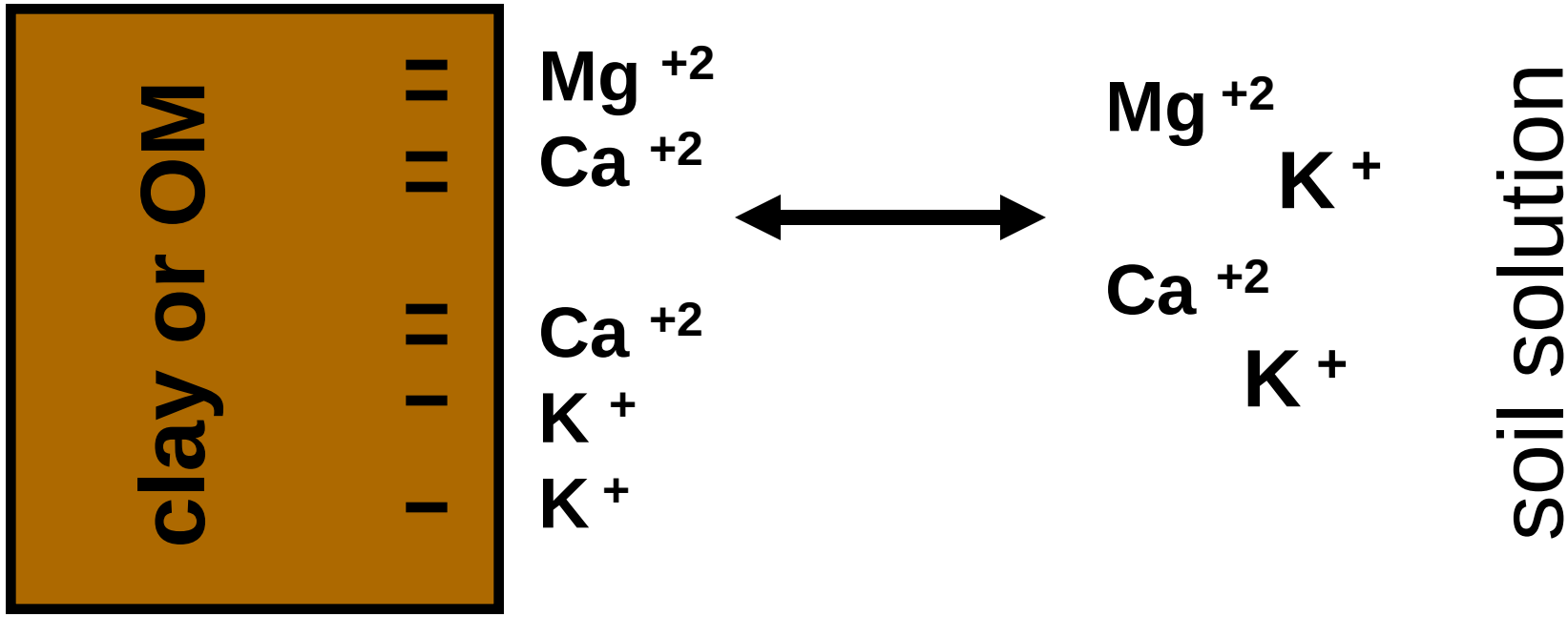
Cations (have a positive charge) in the soil:

- Calcium (Ca^{+2})
- Magnesium (Mg^{+2})
- Potassium (K^{+})
- Sodium (Na^{+})
- Ammonium (NH_4^{+})

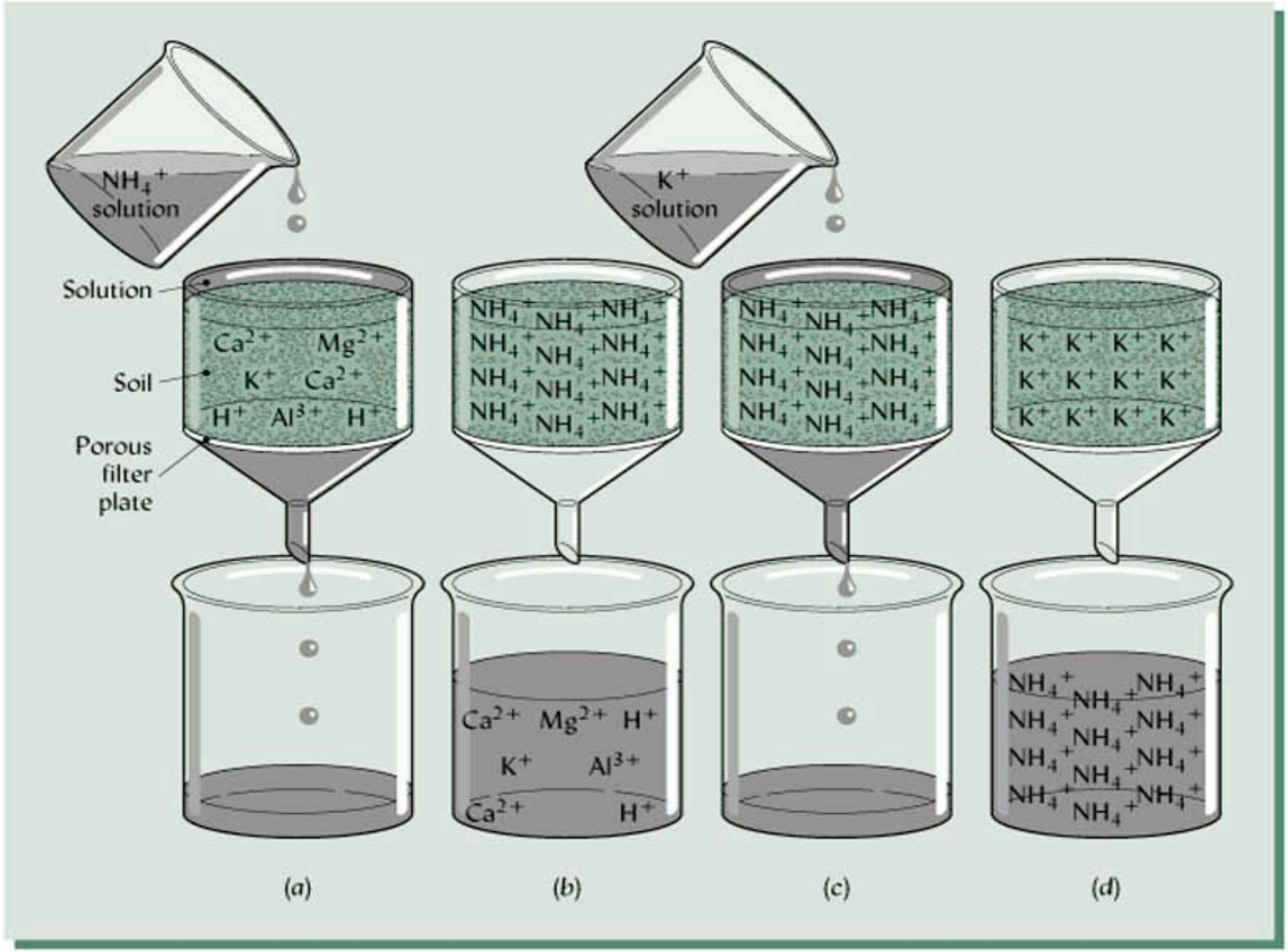
Their total is the Cation Exchange Capacity (CEC) of the soil.

Cation Exchange Capacity

Sum total of exchangeable cations that a soil can absorb



How we measure cation exchange capacity (CEC)



The Difference Between CEC and Effective CEC (called ECEC)

- This is important in acid humid soils.
- When we have pH dependent charge.

  $-Al\text{-}OH + OH^- \leftarrow\text{---}\rightarrow Al\text{-}O^- + H_2O$

  Increasing pH ----------→

- The reaction shown above can happen when we add NH_4-acetate at a pH of 7. It creates more negative sites, so more NH_4 gets adsorbed on those negative sites.
- So, in acid soils we may overestimate the CEC of the soil.

So how do we fix that problem?

- We calculate the Effective CEC (ECEC)
- Do the CEC determination as shown before, but don't measure the NH_4 collected.
- Instead, determine the individual amounts of Ca, Mg, K, Na collected from the first filtering.
- Then, extracted with an unbuffered salt solution (KCl), and then analyze for the Al and H content.

CEC versus ECEC

- ECEC = Ca + Mg + Al + H + Na + K

- In acid weathered soils will always be less than the CEC.
- Really – in most of our soils it's not an issue. Just be aware of it as some soil tests note the difference.

Typical CECs in Soils

material	Total CEC cmol/kg
organic matter	200
high clay soil	30-100
loam soil	10-20
greens amendments	40-100
USGA greens mix	2

Base Saturation

nonacid cations: Ca^{+2}, Mg^{+2}, K^{+}, Na^{+}

acid cations: H^{+}, Al^{+3}

$$\text{base saturation} = \frac{\text{nonacid cations}}{\text{CEC}\ (\text{acid + nonacid cations})} \times 100$$

Soil-test Reporting

- units of results can vary with test - lb/A, parts per million (ppm)
- recommendations will be in lbs/A or lbs/1,000 ft^2
- lime may be in tons/A
- ppm x 2 = lb/A (for field crops)
- Turfgrass: ppm = lb/A (3 inch sampling depth)
- A meq is the same as $cmol_c\ kg^{-1}$

Soil Acidity

- measured via soil pH
- pH = -log [H^+]
- active acidity : H^+ in soil solution
- potential acidity : H^+ on CEC, plus nonexchangeable H

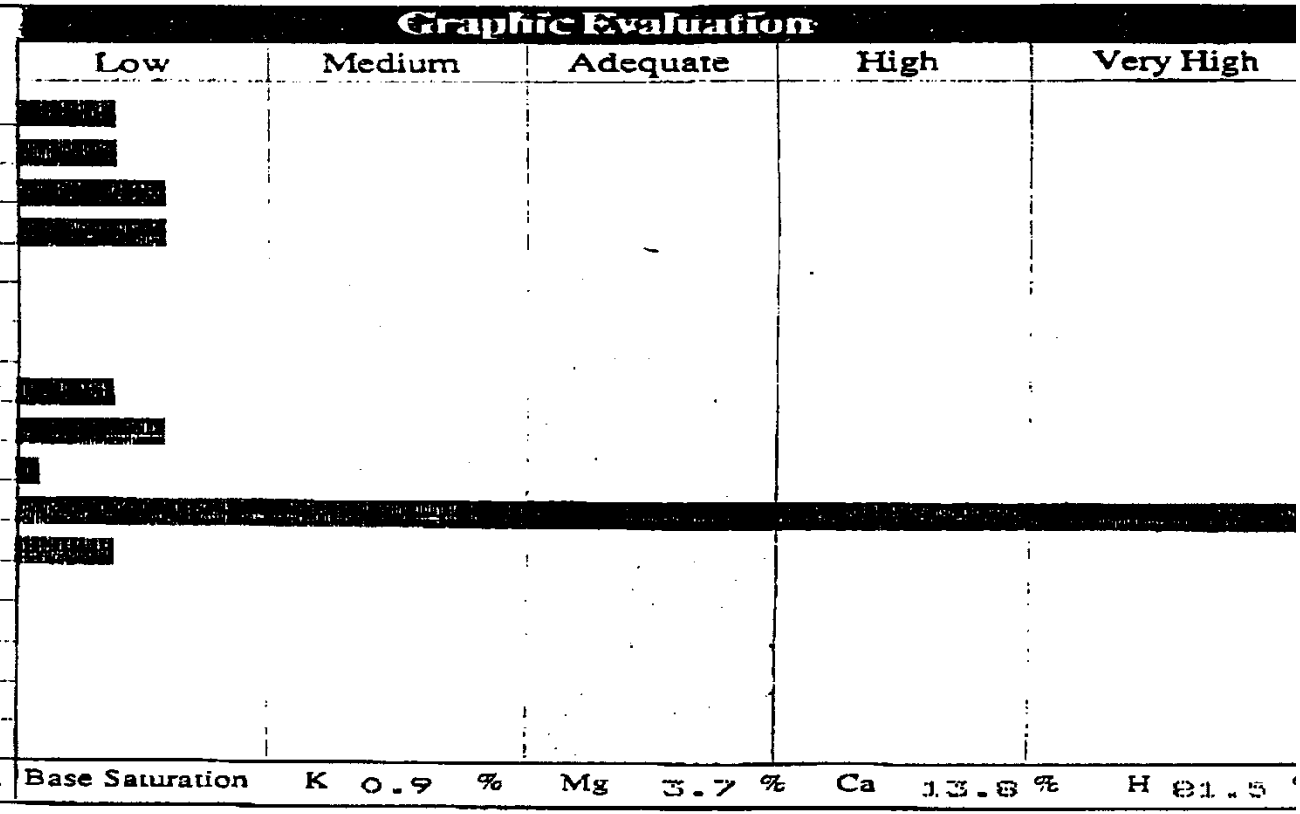
Another Survey

- A basic soil test in my state costs:

- A – free!
- B – less than $5.00
- C - $5.00 to 10.00
- D – more than $10.00

Lab Number : 3118930C Sample ID : 7 FWY Test Method : DOUBLE ACID

Element	Lab Results
Phosphorus	10 lbs./A
Potassium	28 lbs./A
Magnesium	35 lbs./A
Calcium	217 lbs./A
Soil pH	4.8
Buffer pH	7.60
Sulfur	
Boron	0.2 lbs./A
Zinc	1.3 lbs./A
Manganese	1 lbs./A
Iron	114 lbs./A
Copper	0.2 lbs./A
Aluminum	
Sodium	
Soluble Salts	
Organic Matter	
Nitrate Nitrogen	
Cation Exchange Capacity	3.9 meq/100g



Base Saturation K 0.9 % Mg 3.7 % Ca 13.8 % H 81.5

Soil Fertility Recommendations

Crop : GOLF-FAIRWAYS lbs. per 1000 Sq. Ft. Yield : MAX

Lime Tons/Acre	Gypsum Tons/Acre	N Nitrogen	P_2O_5 Phosphate	K_2O Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
69.0		4.0	2.1	5.1	1.03		0.018	0.046	0.32		0.018

M=Maintenance Recommendation Crossing Back

Comments :

NITROGEN AND POTASSIUM SHOULD BE APPLIED IN SPLIT APPLICATIONS - PREFERABLY 3 TO 5 TIMES - PREDICATED ON THE TYPE OF NITROGEN USED. PLANT SAMPLES (GRASS CLIPPINGS) SHOULD BE TAKEN DURING THE GROWING SEASON TO MONITOR ALL NUTRIENTS. ADDITIONAL NUTRIENTS MAY BE NEEDED ESPECIALLY NITROGEN AND POTASSIUM.

IF DOLOMITE LIME HAS BEEN APPLIED RECENTLY, MAGNESIUM RECOMMENDATION CAN BE CUT IN HALF.

CITY CAMPUS, AL .

LAB No.	SENDER'S SAMPLE DESIGNATION	CROP TO BE GROWN	SOIL* GROUP	SOIL TEST RESULTS					RECOMMENDATIONS			
				pH**	Phosphorus P***	Potassium K***	Magnesium Mg***	Calcium Ca***	LIME-STONE	N	P_2O_5	K_2O
					Pounds per acre				Tons/acre	Pounds per acre		
14208	NEW S 201 SEE COMMENT 59	GOLF GREEN	1	7.0	H 100	M 62	H 61	1010	0.0	400	0	130
14209	NEW S 202 SEE COMMENT 55	GOLF GREEN	1	6.9	VH 141	M 94	H 84	440	0.0	400	0	80
14210	NEW S 203 SEE COMMENT 62	GOLF GREEN	1	6.1	M 27	M 70	H 59	580	0.0	400	130	110
14211	NEW S 301 SEE COMMENT 62	GOLF GREEN	1	6.2	M 32	M 97	H 56	620	0.0	400	120	80
14212	NEW S 302 SEE COMMENT 55	GOLF GREEN	1	6.7	VH 157	M 116	H 123	480	0.0	400	0	50
14213	NEW S 303 SEE COMMENT 55	GOLF GREEN	1	6.7	VH 115	M 81	H 83	640	0.0	400	0	100
14214	NEW S 401 SEE COMMENT 56	GOLF GREEN	1	6.9	VH 105	L 57	H 87	740	0.0	400	0	130
14215	NEW S 402	GOLF GREEN	1	6.4	L 19	M 71	H 57	560	0.0	400	150	110

1. Sandy soils (CEC < 4.6 $cmol_c kg^{-1}$)
2. Loams & Light clays (CEC = 4.6-9.0 $cmol_c kg^{-1}$)
3. Clays and soils high in organic matter(CEC > 9.0 $cmol_c kg^{-1}$)
4. Clays of the Blackbelt(CEC > 9.0 $cmol_c kg^{-1}$)

* 7.4 or higher - Alkaline 6.6-7.3 - Neutral 6.5 or lower - Acid 5.5 or lower - Strongly Acid

** Extractable nutrients in pounds per acre

Report Number: F98001-001
Account Number: 00001

A & L GREAT LAKES LABORATORIES, INC.

3505 Conestoga Drive • Fort Wayne, Indiana 46808-4413 • Phone 260-483-4759 • Fax 260-483-5274

To: ACME AGRICULTURAL SERVICE
1001 EAST MAIN STREET
ADDRESS 2
ANYTOWN, US 98765

For: PROGRESSIVE FARMS
RR #1
ANYTOWN USA 98765
Farm: FARM NAME
Field: FIELD NAME

Date Received: 11/22/2001 Date Reported: 11/24/2001

SOIL TEST REPORT

Sample Number	Lab Number	Organic Matter %	Phosphorus Bray P1 ppm-P	Phosphorus Bray P2 ppm-P	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	pH Soil pH	pH Buffer pH	Cation Exchange Capacity meq/100g	Percent Base Saturation % K	% Mg	% Ca	% H	% Na
1	1026	3.9	24 *M*	36 *M*	136 *M*	370 *H*	2550 *H*		6.8		16.7	2.1	18.5	76.4	3.0	
2	1027	4.4	53 *VH*	89 *VH*	188 *H*	210 *H*	1000 *M*		7.2		7.2	6.7	24.2	69.1		
3	1028	2.7	9 *VL*	16 *L*	94 *M*	335 *H*	1400 *M*		6.0	6.8	11.8	2.0	23.7	59.3	15.0	
4	1029	2.1	102 *VH*	104 *VH*	136 *H*	25 *L*	250 *VL*		4.9	6.8	3.2	10.8	6.5	38.7	44.0	

VL = VERY LOW *L* = LOW *M* = MEDIUM *H* = HIGH *VH* = VERY HIGH

Sample Number	Sulfur S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Nitrate NO3-N ppm	Ammonium NH4-N ppm	Bicarb-P P ppm	Comments
1	13 *H*	4.0 *M*	18 *M*	78 *VH*	2.8 *H*	1.1 *M*		19 *M*			
2	18 *VH*	2.8 *L*	6 *L*	24 *H*	0.9 *M*	1.5 *H*		35 *H*			
3	9 *M*	4.6 *M*	33 *H*	48 *H*	1.2 *H*	0.8 *M*		15 *M*			
4	15 *H*	5.3 *H*	215 *VH*	75 *VH*	1.4 *H*	0.9 *M*		9 *L*			

Report Number: F00001-001
Account Number: 00001

A & L GREAT LAKES LABORATORIES, INC.

3505 Conestoga Drive • Fort Wayne, Indiana 46808-4413 • Phone 260-483-4759 • Fax 260-483-5274

!4 6 8 0 8 4!

To: ACME AGRICULTURAL SVC
1001 EAST MAIN STREET
ANYTOWN USA, . 98765

For: PROGRESSIVE FARMS
RR #1
ANYTOWN USA 98765

Date Received: 10/22/2001
Date Reported: 10/24/2001

SOIL FERTILITY RECOMMENDATIONS (lbs./A)

Sample ID	Intended Crop	Previous Crop	Yield Goal	Lime Tons/A	Nitrogen N	Phosphate P2O5	Potash K2O	Magnesium Mg	Sulfur S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
1	Corn	Soybeans	150 bu	0.0	145	70	90	0	4	2.0	0	0	0	0.0
2	Corn	Soybeans	180 bu	0.0	180	35	45	0	0	3.5	3	0	0	0.0
3	Corn	Alfalfa	175 bu	1.0	140	110	185	0	17	1.5	0	0	0	0.5
4	Corn	Corn	175 bu	3.0	225	0	50	45	5	0.0	0	0	0	0.0

Soil Test Report

and

Fertilizer Recommendations

USU Analytical Labs
Utah State University
Logan, Utah 84322-4830
(435) 797-2217
(435) 797-2117 (FAX)

Date Received: 5/12/98
Date Completed: 5/12/98

Name: Homeowner
Address:

County:

Lab Number: 98011000 Grower's Comments: Acres in Field:

Identification:

Crop to be Grown: Garden

Soil Test Results			Interpretations	Recommendations
Texture		Sandy Loam		
Lime		++	Normal	
pH		7.7	Normal	
Salinity - ECe	mmhos/cm	0.4	Normal	
Phosphorus - P	ppm	11	Low	1-2 lbs P2O5/1000 sq ft
Potassium - K	ppm	82	Low	2 lbs K2O/1000 sq ft
Nitrate-Nitrogen - N	ppm	1.5		2-4 lbs N/1000 sq ft
Zinc - Zn	ppm	1.2	Adequate	0 oz Zinc/1000 sq ft
Iron - Fe	ppm	7.9	Adequate	
Copper - Cu	ppm	0.4	Adequate	
Manganese - Mn	ppm	1.8	Adequate	
Sulfate-Sulfur - S	ppm	13.0	Adequate	0 lbs Sulfur/1000 sq ft
SAR				
Organic Matter	%	3.2		

Notes

Report Number: F07270-0115
Account Number: 71087

A & L GREAT LAKES LABORATORIES, INC.

3505 Conestoga Drive • Fort Wayne, Indiana 46808-4413 • Phone 260-483-4759 • Fax 260-483-5274
www.algreatlakes.com • lab@algreatlakes.com

[redacted]

Grower Name: [redacted]

P.O. Number: F73115

Date Received: 09/27/2007 Date Reported: 10/01/2007

SOIL TEST REPORT

Sample Number	Lab Number	Organic Matter %	Phosphorus Bray P1 ppm-P	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	pH		CATION EXCHANGE CAPACITY meq/100g	Base Saturation				Sulfur S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm
							Soil pH	Buffer pH		% K	% Mg	% Ca	% H						
9-G	75842	1.1	16	26	130	7350	7.7		37.9	0.2	2.9	97.0							
9-FT	75843	2.6	27	90	190	1950	7.9		11.6	2.0	13.7	84.3							
9-MT	75846	1.3	28	82	135	2450	7.9		13.6	1.5	8.3	90.2							
9-BT	75847	1.8	40	127	195	2150	7.9		12.7	2.6	12.8	84.6							
9-F	75848	2.9	31	117	350	1950	7.8		13.0	2.3	22.5	75.2							
10-G	75849	1.2	24	24	120	6450	7.7		33.3	0.2	3.0	96.8							
10-FT	75850	3.1	141	149	235	1950	7.6		12.1	3.2	16.2	80.6							
10-MT	75851	3.3	71	106	195	2300	7.9		13.4	2.0	12.1	85.8							
10-BT	75852	3.7	70	132	275	1950	7.7		12.4	2.7	18.5	78.8							
10-F	75853	3.5	34	111	325	1800	7.9		12.0	2.4	22.6	75.0							
11-G	75854	1.0	19	25	135	7650	7.8		39.4	0.2	2.9	97.0							
11-FT	75855	3.1	52	102	205	2050	7.7		12.2	2.1	14.0	83.9							
11-MT	75856	1.9	42	71	155	2950	7.9		16.2	1.1	8.0	90.9							
11-BT	75857	2.5	49	125	170	2050	7.9		12.0	2.7	11.8	85.5							
11-F	75858	3.3	28	126	340	2600	7.9		16.2	2.0	17.5	80.5							
12-G	75859	1.3	19	25	130	7500	7.9		38.6	0.2	2.8	97.0							
12-FT	75860	1.6	23	81	190	1800	8.0		10.8	1.9	14.7	83.4							
12-MT	75861	1.8	18	91	180	1850	8.1		11.0	2.1	13.7	84.2							
12-BT	75862	1.3	20	79	140	1850	8.0		10.6	1.9	11.0	87.1							
12-F	75863	2.6	37	136	325	1500	7.7		10.6	3.3	25.7	71.0							
13-G	75864	1.0	21	29	145	7750	8.0		40.0	0.2	3.0	96.8							
13-FT	75865	2.6	47	141	240	2100	7.9		12.9	2.8	15.6	81.6							
13-MT	75866	2.0	46	97	175	2200	8.0		12.7	2.0	11.5	86.6							
13-BT	75867	1.9	65	103	195	2150	7.9		12.6	2.1	12.9	85.1							

Virginia Cooperative Extension

Soil Test Report

Augusta County Office
County Government Center
POB 590
Verona, VA 24482-0590
540-245-5750

Virginia Tech Soil Testing Laboratory
145 Smyth Hall (0465)
Blacksburg, VA 24061
www.soiltest.vt.edu

SEE ENCLOSED NOTES:
1 3

OWNER
PHARMER JOE
123 RURAL RD

PENDROSS, VA 23648

COPY FOR
MY FERTILIZER DEALER
P O BOX 111
ROCKFORD, VA 23648

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
OCF11	4463	Orchardgrass/Fescue-Clover Pasture (40)		18+		40B2 100				III

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	9	95	1408	209	1.2	10.3	0.3	4.4	0.5	
Rating	L+	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	5.7	6.21	5.6	20.1	79.9	62.5	15.3	2.2	3.6

FERTILIZER AND LIMESTONE RECOMMENDATIONS

Crop: Orchardgrass/Fescue-Clover Pasture (40)

Lime, TONS/AC		Fertilizer, lb/A		
Amount	Type	N	P2O5	K2O
1	AG	50	40	50

825. If stand contains less than 25 per cent clover, apply 40-60 lbs N/A.

131. If additional production is needed later on, apply 40 to 60 lbs/A of N during the grazing season. If you are planning to overseed a legume into the stand, omit the N recommendation.

122. P2O5 and K2O recommendations are for annual application. However, rates can be doubled and applied every other year if desired.

The analytical methods used are from VCE Publication 452-881, *Laboratory Procedures - Virginia Tech Soil Testing Laboratory, revised 2006.* pH determinations by BR on 09-18-06. Elemental analysis by BR on 09-18-06.

03/08/07	2007	BACK 40	CUMBERLAND	6 Acres
PRINT DATE	LAB NO.	SAMPLE IDENTIFICATION	COUNTY	ACRES OR SQ. FT.

· SOIL TEST REPORT FOR:

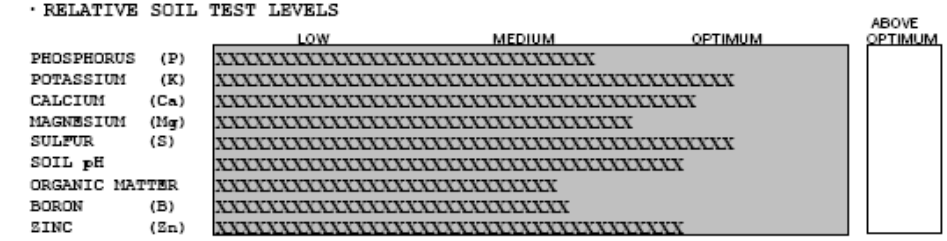
EXAMPLE COMMERCIAL CROP

100 BACK RD

ANYWHERE ME 04000

MAINE SOIL TESTING SERVICE
UNIVERSITY OF MAINE
5722 DEERING HALL
ORONO,MAINE 04469-5722

· RELATIVE SOIL TEST LEVELS



· RECOMMENDATIONS FOR CORN - Crop Code # 164

To raise soil pH to 6.0, apply 0 pounds of lime per acre.
To raise soil pH to 6.5, apply 2000 pounds of lime per acre.
Lime recommendation assumes a calcium carbonate equivalence (neutralizing value) of 100 %.
To meet crop magnesium requirement, use a magnesium lime.
Recommended major nutrient application rates as follows:
Nitrogen: See management statements below.
100 pounds phosphate per acre
150 pounds potash per acre

Apply up to 40 lb/A each of nitrogen, phosphate, and potash through the planter.
Remaining P & K should be broadcast preplant.

*******Nitrogen Management*******

*Best mgt: Sample soil for nitrate analysis when corn 8-12 inches tall.
Exact recommendations for N sidedress will be made at that time.
*Next best option: With no nitrate soiltest,
sidedress 80 lb N/acre when corn is 8-12 inches tall.
Note: for organic sources of nitrogen, calculate application rate to
supply 150 pounds of available N for a 20 ton/acre yield goal.

Soil zinc level is adequate. No extra yield expected from additional zinc.

·LABORATORY RESULTS (Test methodology: pH in water and Mehlich buffer, available nutrients by modified Morgan extract/ICP)

CEC and nutrient balance calculations assume the pH will be raised to 6.5

	Soil pH	Lime Index	P (lb/A)	K (lb/A)	Mg (lb/A)	Ca (lb/A)	CEC (me/100gm)	K (% Saturation)	Mg (% Saturation)	Ca (% Saturation)	Acidity (% Saturation)
Level Found	6.2	6.05	8.2	253	229	2555	9.7	3.3	9.7	65.6	21.4
Optimum Range	6.0-7.0	N/A	10-40	see % Saturation levels			> 5	2.8-4.0	10-25	60-80	< 10

	Organic Matter(%)	Sulfur (ppm)	Boron (ppm)	Zinc (ppm)	Sodium (ppm)	Sol.Salts (mmhos/cm)	Nitrate-N (ppm)
Level Found	4.3	20	0.4	1.1	N/A	N/A	N/A
Optimum Range	5 - 8	> 15	0.5-1.2	1.0-2.0			

Additional Results

Full payment received for the analysis of this sample. Thank you.

TURF AND ORNAMENTAL
SOIL TEST AND RECOMMENDATION REPORT

SUBMITTED BY/FOR:

CLC LABS
325 VENTURE DRIVE
WESTERVILLE, OHIO 43081
614 888-1663

REPORT REF. NUMBER	RESULTS OF ANALYSIS						CALCULATED VALUES						RESULTS OF ANALYSIS									
		Soil	Buffer	Pounds per Acre Available Nutrient				Cation Exchange	% Base Saturation					Pounds per Acre Available Nutrient								
	LAB NO.	pH	pH	P	K	Ca	Mg	Capacity	K	Ca	Mg	H	Na	Fe	Mn	Zn	Cu					
1	239673	7.8		31	218	6879	605	20.0	1.4	86	13	0.0		78	17	1.4	3.5					
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11	AVERAGE RESULTS →			31	218	6879	605	20.0	1.4	86	13	0.0		78	17	1.4	3.5					

DISPLAY OF AVERAGE RESULTS

SURPLUS							*												
HIGH							*												
			*	*			*												
MEDIUM			*	*			*					*			*				
	*	*	*	*	*		*	*				*	*		*				
LOW	*	*	*	*	*		*	*				*	*		*				
	*	*	*	*	*	*	*	*				*	*	*	*				
	*	*	*	*	*	*	*	*				*	*	*	*				

REPORT REF. NUMBER	SAMPLE INFORMATION				FERTILIZER RECOMMENDATIONS IN LBS. PER 1,000 SQ. FT.										
	SAMPLE IDENTIFICATION	PLANT TYPE	AREA TYPE	FERT/ MAINT. LEVEL	LIME LBS/M	LIME TYPE	NITROGEN	APP. FREQ	P_2O_5	K_2O	Mg	Fe	Mn	Zn	COMMENTS
1		BENTGRASS	FAIRWAY	HIGH			2.5 -3.5	S	2.0	2.0				0.02	See All
2															
3															
4															
5															
6															
7															
8															
9															
10															
11	RECOMMENDATIONS FOR AVERAGE RESULTS →						2.5 -3.5	S	2.0	2.0				0.02	See All

SEE COMMENTS ON REVERSE SIDE

THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSION
College of Agricultural and Environmental Sciences & Family and Consumer Sciences

Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9150
Web site: http://aesl.ces.uga.edu

Soil Test Report

(CEC/CEA Signature)

Sample ID: [redacted]

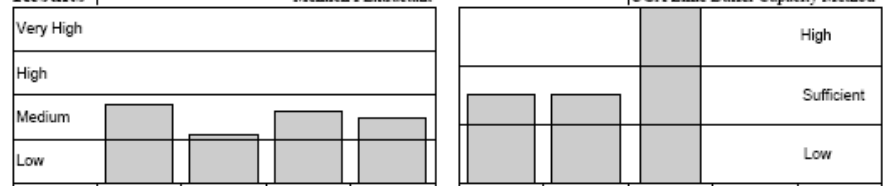
Sample: 3
Crop: Hybrid Bermuda Lawn

Lab Information
Lab #63874
Completed: 06/06/2007
Printed: 06/06/2007

Contact
Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, GA 30602
ph: 706-542-5350
e-mail: soiltest@uga.edu

Results

Mehlich I Extractant — UGA Lime Buffer Capacity Method*



	Phosphorus (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)	Zinc (Zn)	Manganese (Mn)	pH *	Lime Buffer Capacity (LBC)	
Soil Test Index	36 lbs/Acre	112 lbs/Acre	936 lbs/Acre	90 lbs/Acre	6 lbs/Acre	8 lbs/Acre	7.2	107	Soil Test Index

Recommendations

No Limestone recommended.

Recommended pH: 5.5 to 6.0

*For information on how the Soil, Plant, and Water Laboratory measures and reports pH and makes lime recommendations, see http://aesl.ces.uga.edu/publications/soilcirc.

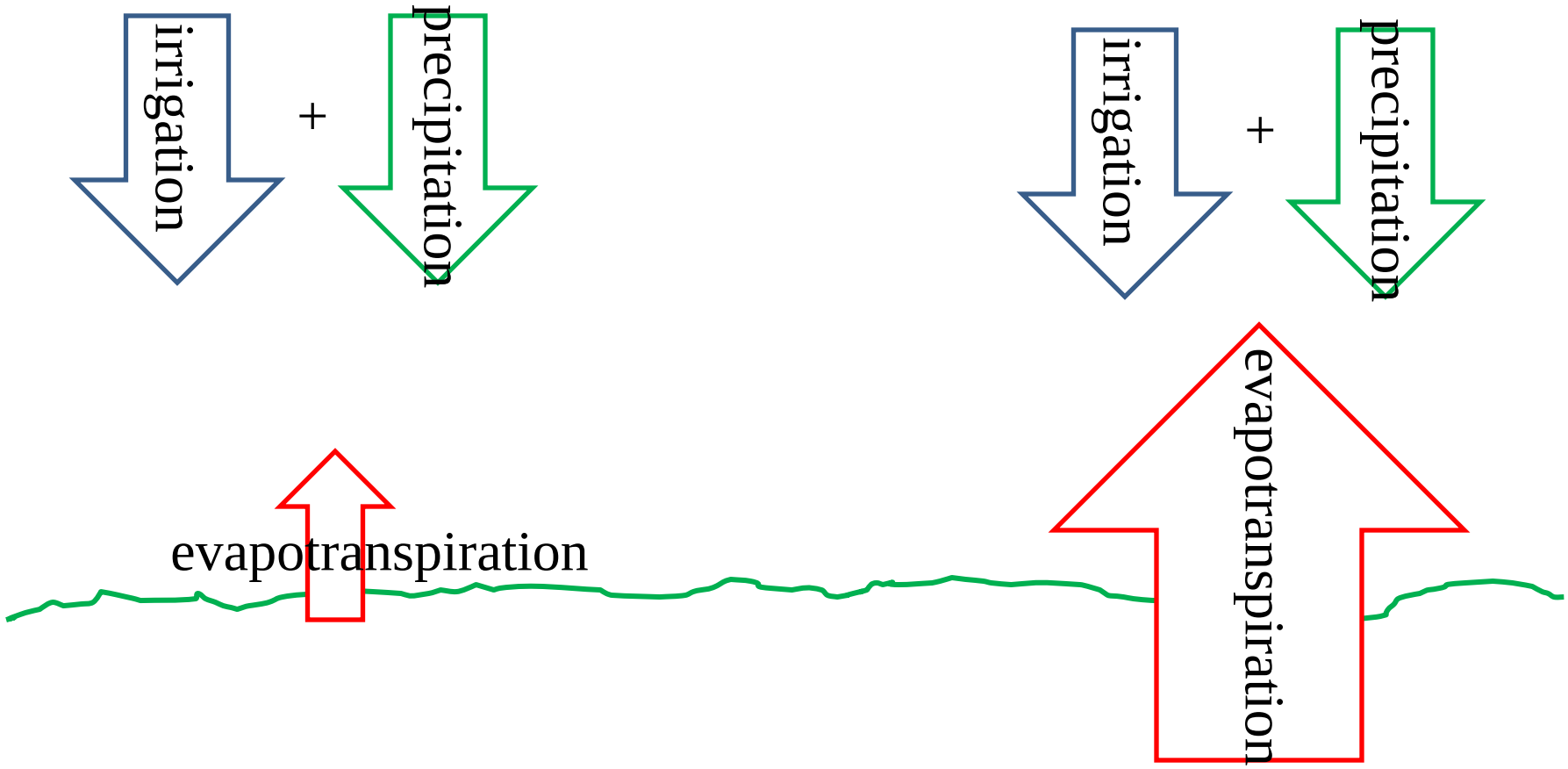
For establishment, incorporate 25 pounds of 5-10-15 per 1000 square feet into the top 4 to 6 inches of soil prior to seeding, sprigging, or sodding. Then apply 3 pounds of 34-0-0 or 2 pounds of 46-0-0 per 1000 square feet monthly during the growing season through August. To improve winter hardiness, apply 6 pounds of 16-4-8 or 8 pounds of 12-4-8 per 1000 square feet in September. Follow this fertilizer program for the first year only, then use the maintenance fertilizer program for the next 2 to 3 years. Retest 2 to 3 years after establishment.

For maintenance, apply 6 pounds of 16-4-8 per 1000 square feet when spring growth begins and again each month through September.

Clippings do not contribute to thatch under proper management and thus, do not need to be removed. If they are removed, increase the fertilizer application rate by 30%.

CAUTION: Water lawn thoroughly immediately after applying fertilizer. Do not apply fertilizer when grass is wet.

Salinity Tests



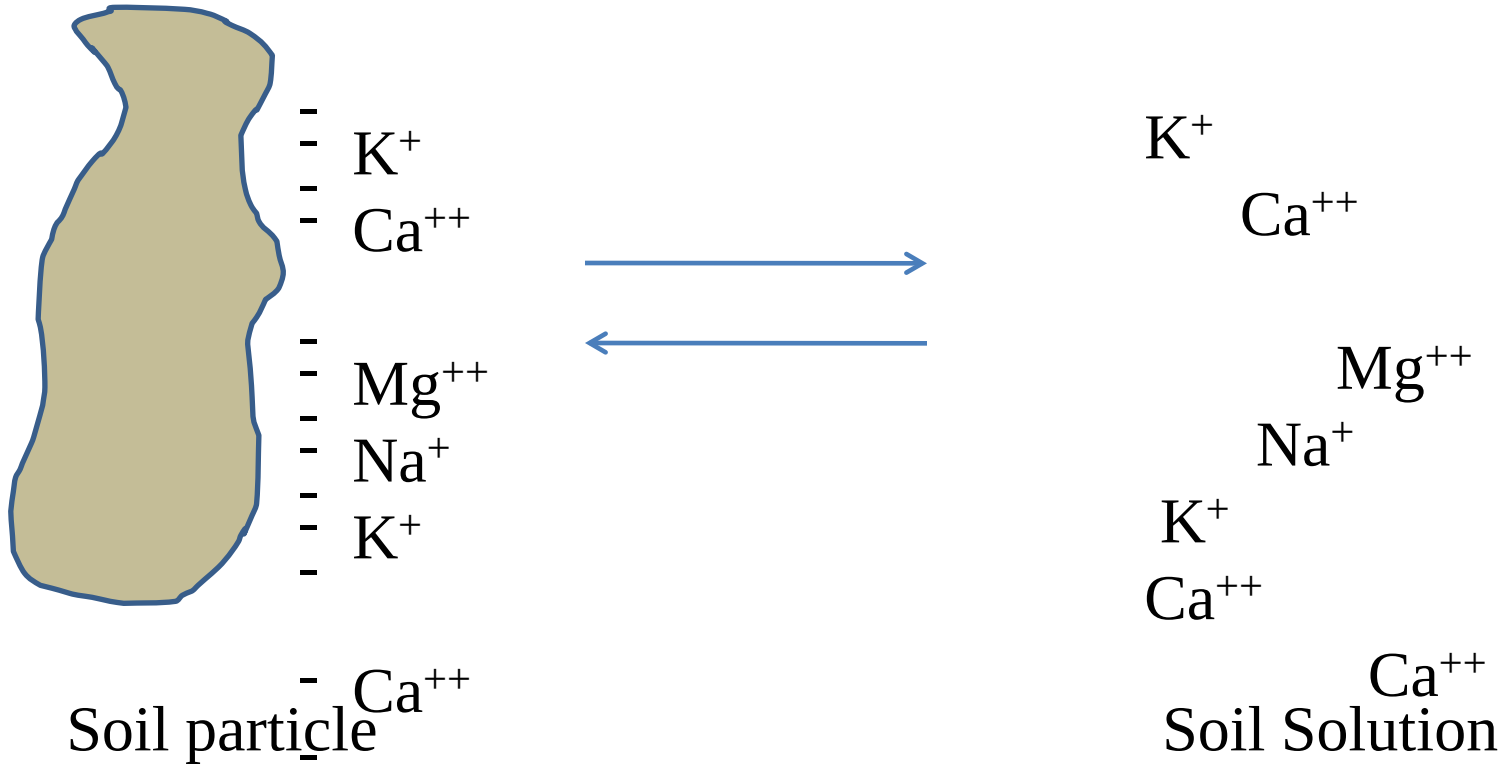
If I + P > ET
salts move down

If I + P < ET
salts accumulate

Soil Tests for Measuring Salinity

- Electrical conductivity (EC)
- Sodium adsorption ratio (SAR)
- Exchangeable sodium percentage (ESP)

Cation Exchange Capacity



Exchangeable Sodium Percentage

The degree to which the exchange complex is saturated with sodium (Na).

$$ESP = \frac{\text{exchangeable Na}}{\text{cation exchange capacity (CEC)}} \times 100$$

Numbers for Measuring Salt Content

- Total salinity – expressed as either electrical conductivity (EC) in dS m^{-1} or total dissolved salts (TDS) in parts per million (ppm) or mg L^{-1}.

- The relationship between the units is:

1 dS m^{-1} = 1 mmhos cm^{-1} ~ = 640 ppm (mg L^{-1}).

Electrical Conductivity

- Used to measure soil salinity in both water and soil.
- In soil – typically ECe (from a saturated paste extract)
- Soil ECe > 4 dS m^{-1} considered saline

Sodium Adsorption Ratio (SAR)

- Sodium Adsorption Ratio (SAR):
  - Relative proportion of sodium (Na) to calcium (Ca) + magnesium (Mg)

Classes of Salt-Affected Soils

- Saline – ECe > 4 dS m^{-1} ; ESP < 15 %; SAR < 13
  (high in all salts, especially Ca and Mg)

- Saline-Sodic - ECe > 4 dS m^{-1} ; ESP > 15 %; SAR > 13
  (high in all salts, but especially Na)

- Sodic - ECe < 4 dS m^{-1} ; ESP > 15 %; SAR > 13
  (high in Na)

Water Tests for Salinity

- Electrical conductivity (EC)
- Total dissolved salts (TDS)
- Sodium adsorption ratio (SAR)
- Exchangeable sodium percentage (ESP)

Electrical Conductivity

- In water – may be reported as ECw or just EC
- Units are dS m^{-1} or mmhos cm^{-1} (they are equal)
- EC < 0.7 – no restriction on use

  EC = 0.7 - 3.0 – slight to moderate restrictions

  EC > 3.0 – severe restrictions on use

Total Dissolved Solids (TDS)

- Reported as parts per million (ppm) or mg L^{-1}
- TDS < 450 ppm – no restriction on use

  TDS = 450 – 2,000 ppm – slight to moderate restriction on use

  TDS > 2,000 ppm – severe restrictions on use

$$1\ EC_w \sim= 640\ TDS$$

Sodium Adsorption Ratio (SAR)

- Same calculation method as for soil
- SAR < 3 – safe for turf
- SAR > 9 – can cause problems with permeability and infiltration
- High SAR is more of a problem on fine textured soil (high in clay), less of a problem in sandy soils.

Bicarbonate/Carbonate

- HCO_3^- (Bicarbonate)/CO_3^{2-} (Carbonate)
- Make the effect of excess Na worse, they take Ca and Mg out of solution:

  CO_3^{2-} + Ca^{2+} (or Mg^{2+}) ~~$CaCO_3$~~ (or $MgCO_3$)

- The $CaCO_3$ (or $MgCO_3$) is insoluble.
- Water with HCO_3^{-2} levels < 90 mg L^{-1} has no negative effect, > 500 mg L^{-1} severe effects

How to Fix Bicarbonate Issues

- Add sulfuric acid (Low Rate) to neutralize bicarbonates.
- Inject through irrigation system.
- Low rates of powdered sulfur (< 220 kg ha^{-1}) – watch for burn.

How to Manage Saline Waters and Soils

- For soils or waters that are high in Sodium (Na):

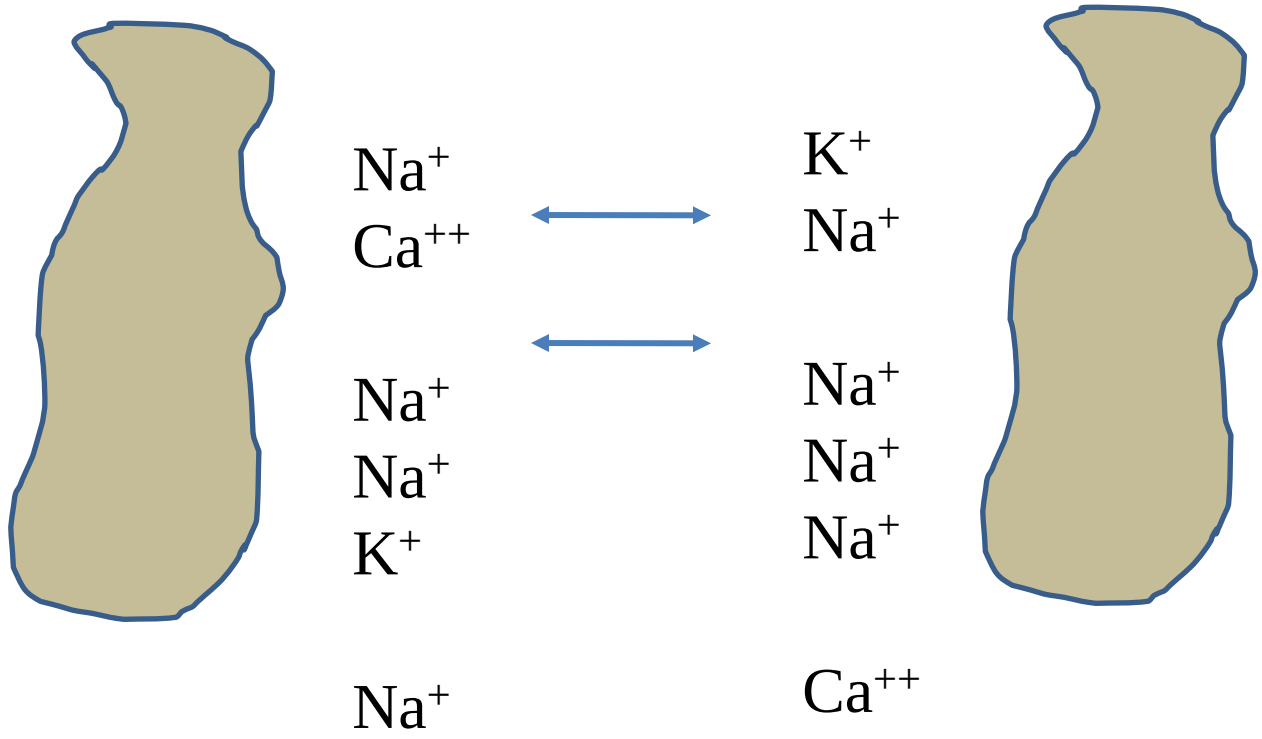
Use gypsum ($CaSO_4$) as an amendment

$2Na^{+}X + CaSO_4 \longrightarrow CaX_2 + Na_2SO_4$

The Calcium (Ca) displaces Sodium (Na) off soil exchange sites, lowering the exchangeable sodium %.

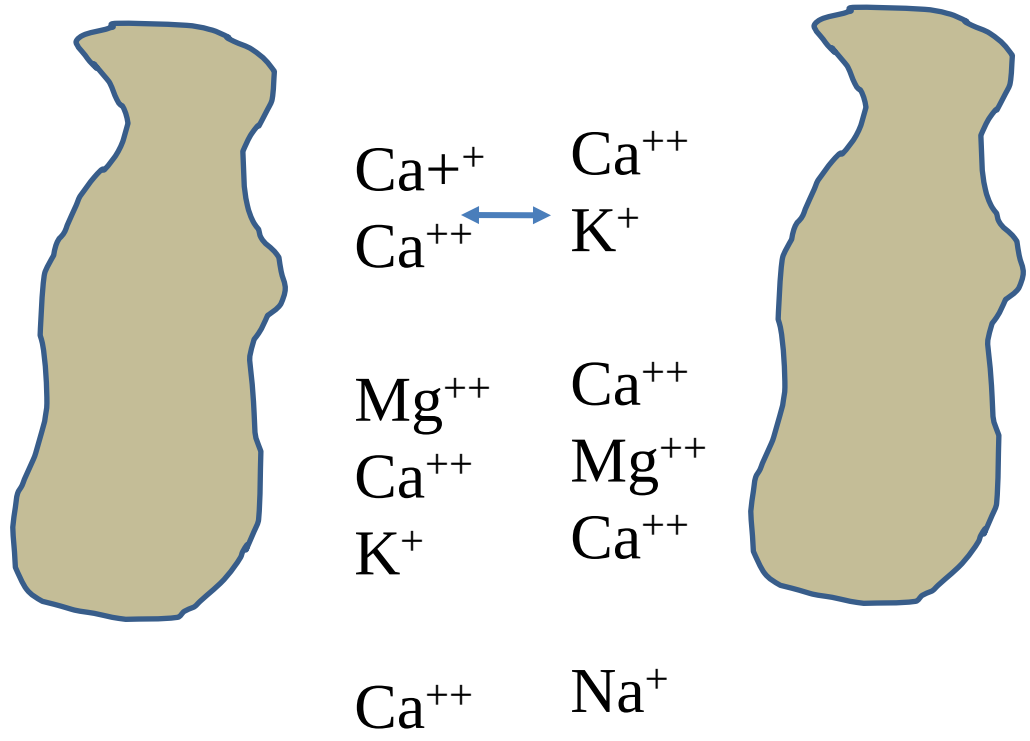
Soils High in Na:

(Saline-sodic and sodic)



Dispersion of soil colloids – poor soil structure

Adding Calcium to Flocculate



Calcium flocculates soil particles, improving soil structure.

Gypsum Rates?

- Light, frequent rates
- 0.11 to 0.22 kg m^{-2} $CaSO_4$ per month

Leaching for Salinity Management

- When irrigation water has a high salt content salts must be kept moving downward.
- Must use leaching to do this – either via irrigation or rainfall.

Take Home Message

- Soil test at least yearly
- 0-3 inch depth – don’t go too deep
- Nitrogen – no calibrated soil tests for fertilizer recommendations
- P, K – extractants will vary with region
- Tissues tests? Entertainment value….