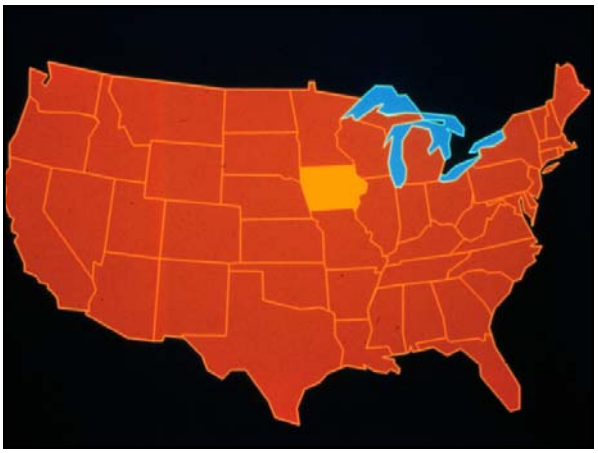
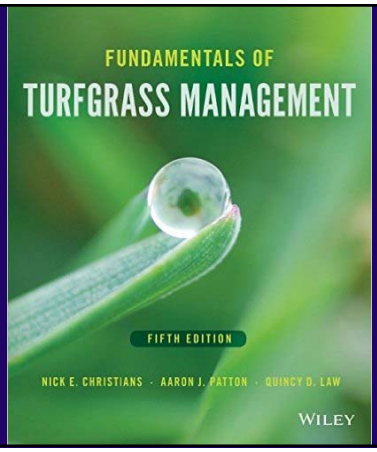
THE UPS AND DOWNS OF pH MODIFICATION

NICK CHRISTIANS
IOWA STATE UNIVERSITY



BACKGROUND

- COLORADO STATE
- ASSISTANT SUPERINTENDENT, FLAT IRONS COUNTRY CLUB
- SUPERINTENDENT, PUEBLO, COLO.
- GRAD SCHOOL, OHIO STATE UNIV.
- IOWA STATE, 1979



SOIL TESTING

FIRST THREE LINES OF SOIL TEST FILLED WITH INFORMATION

CEC

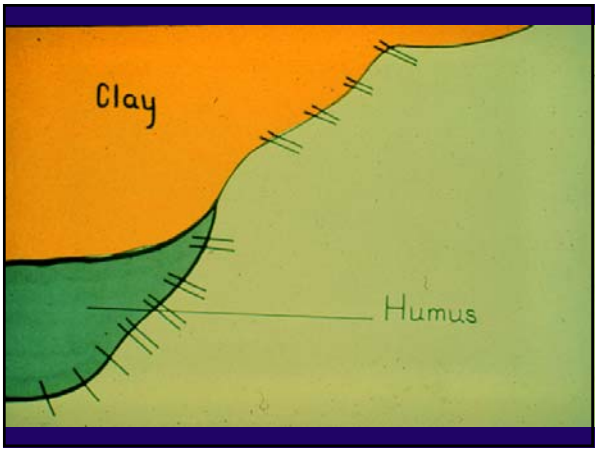
pH

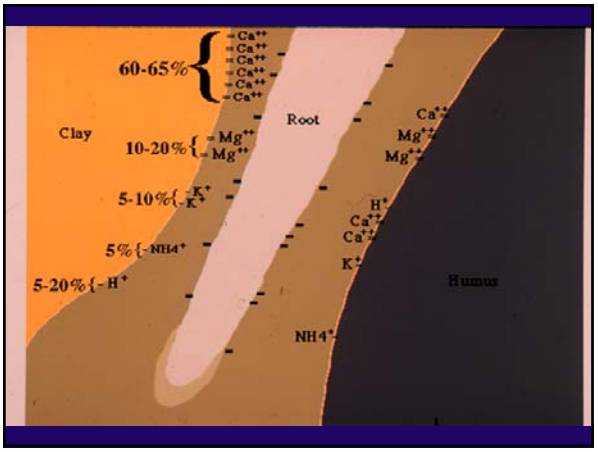
BUFFER pH

CATION EXCHANGE CAPACITY (CEC)

THE ABILITY TO EXCHANGE CATIONS

ELEMENT	SYMBOL	CATION
Hydrogen	H	H^+
Calcium	Ca	Ca^{++}
Magnesium	Mg	Mg^{++}
Potassium	K	K^+
Sodium	Na	Na^+





CATION EXCHANGE CAPACITY

SOIL TYPE	meq/100g
• SAND	• <1 - 8
• CLAY	• 80 - 120
• ORGANIC MATTER	• 150 – 500
• CLAY LOAM SOIL	• 25 – 30
• SAND GREEN	• <1 - 14

CATION EXCHANGE CAPACITY

1 milliequivalent (meq)

6.02×10^{20}

602,000,000,000,000,000,000

CATION EXCHANGE CAPACITY

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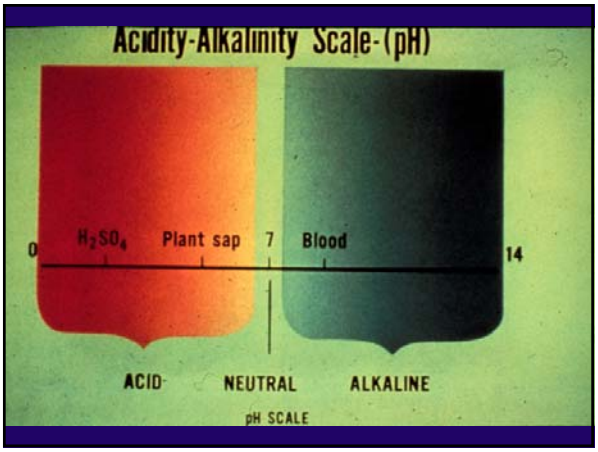
pH



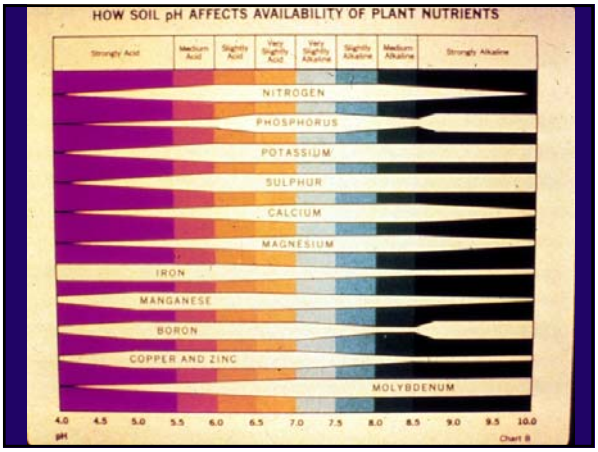
pH

Ca^{++}, Mg^{++},

(Al) H^+ K^+ Na^+

8.2

ACIDIC 7 ALKALINE



LIMING

LIME

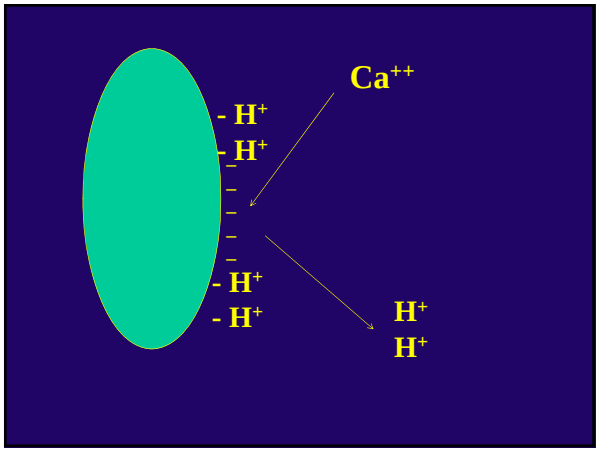
CALCIUM CARBONATE

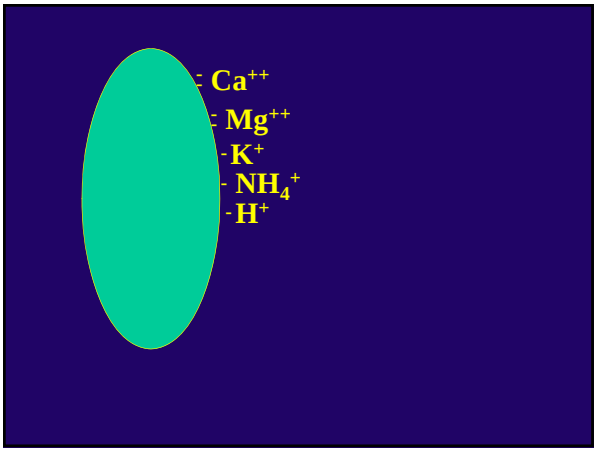
$CaCO_3$

LIME

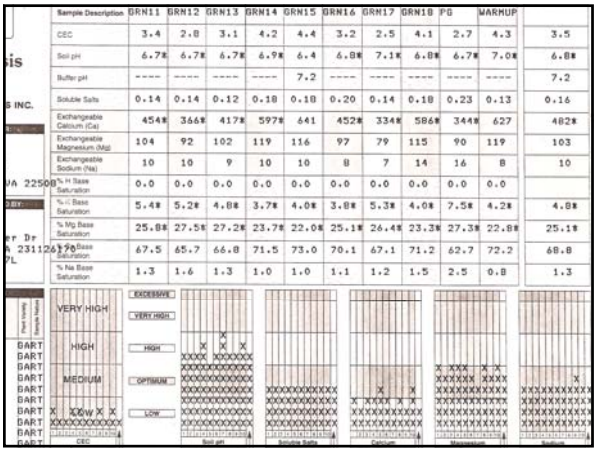
RAISES

pH





BUFFER pH



Sample Description	GRN11	GRN12	GRN13	GRN14	GRN15	GRN16	GRN17	GRN18	PG	MARMUP	
CEC	3.4	2.8	3.1	4.2	4.4	3.2	2.5	4.1	2.7	4.3	3.5
Soil pH	6.7*	6.7*	6.7*	6.9*	6.4	6.8*	7.1*	6.8*	6.7*	7.0*	6.8*
Buffer pH	----	----	----	----	7.2	----	----	----	----	----	7.2
Soluble Salts	0.14	0.14	0.12	0.18	0.18	0.20	0.14	0.18	0.23	0.13	0.16
Exchangeable Calcium (Ca)	454*	366*	417*	597*	641	452*	334*	586*	344*	627	482*
Exchangeable Magnesium (Mg)	104	92	102	119	116	97	79	115	90	119	103
Exchangeable Sodium (Na)	10	10	9	10	10	8	7	14	16	8	10
% H Base Saturation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
% K Base Saturation	5.4*	5.2*	4.8*	3.7*	4.0*	3.8*	5.3*	4.0*	7.5*	4.2*	4.8*
% Mg Base Saturation	25.8*	27.5*	27.2*	23.7*	22.0*	25.1*	26.4*	23.3*	27.3*	22.8*	25.1*
% Ca Base Saturation	67.5	65.7	66.8	71.5	73.0	70.1	67.1	71.2	62.7	72.2	68.8
% Na Base Saturation	1.3	1.6	1.3	1.0	1.0	1.1	1.2	1.5	2.5	0.8	1.3

BUFFERING

RESISTANCE TO CHANGE

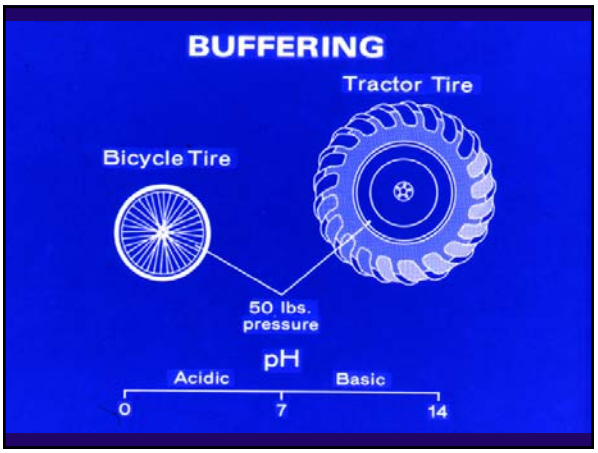
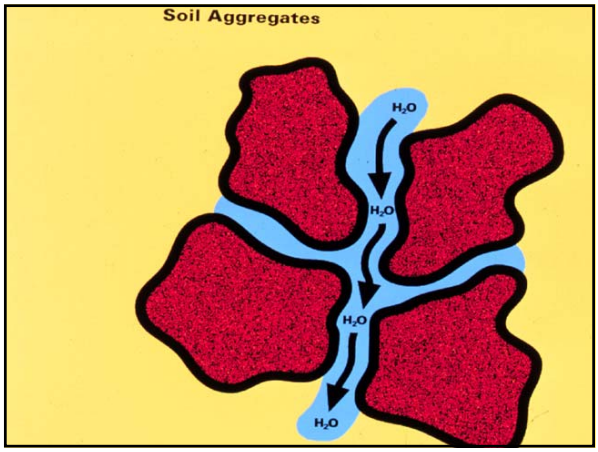


Table 7.3. Amount of $CaCO_3$, or its equivalent, in pounds per acre required to raise the pH to 6.5, based on the buffer pH.

	lb $CaCO_3$/acre required for			
Buffer pH	2-in. Depth	3-in. Depth	6-in. Depth	8-in. Depth
7.0	0	0	0	0
6.9	0	0	0	0
6.8	200	300	600	800
6.7	400	700	1300	1700
6.6	700	1100	2100	2800
6.5	900	1400	2800	3700
6.4	1200	1800	3500	4700
6.3	1400	2100	4200	5600
6.2	1700	2500	5000	6700
6.1	1900	2900	5700	7600
6.0	2200	3200	6400	8600
5.9	2400	3600	7100	9500
5.8	2600	4000	7900	10600
5.7	2900	4300	8600	11500

GYPSUM

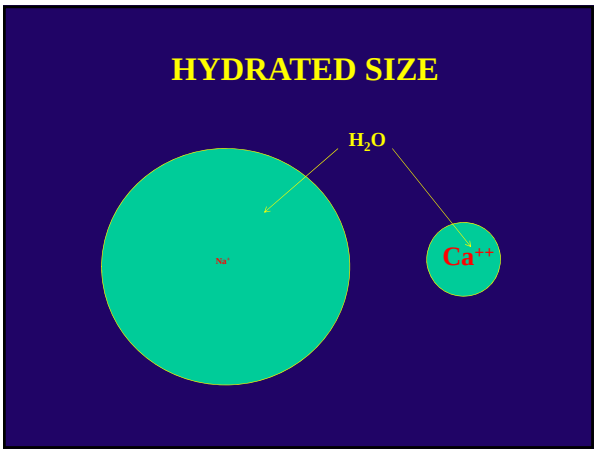
$CaSO_4$

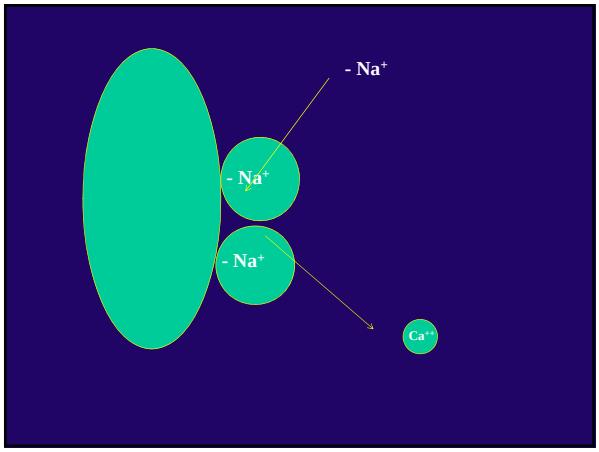


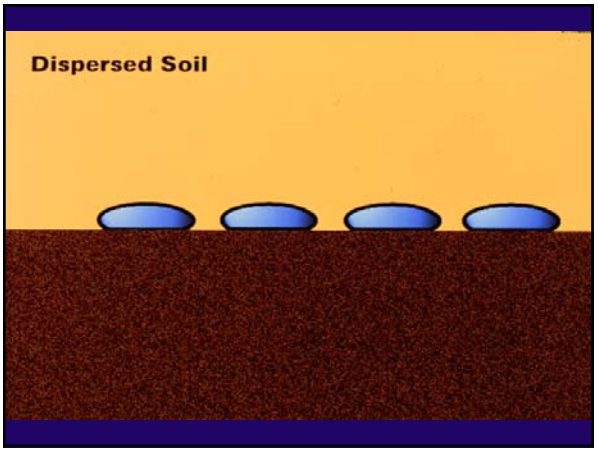
SODIUM Na^+

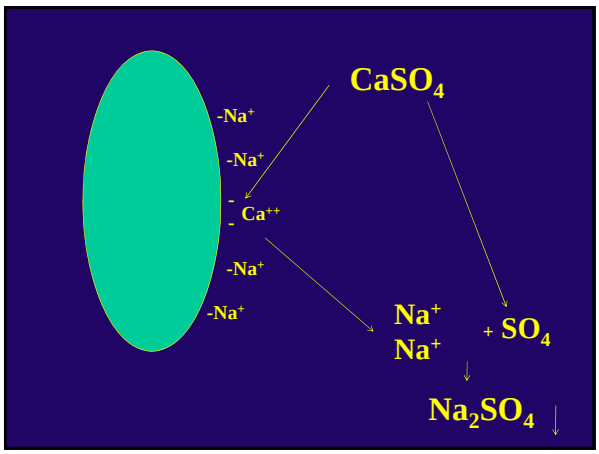
SODIUM

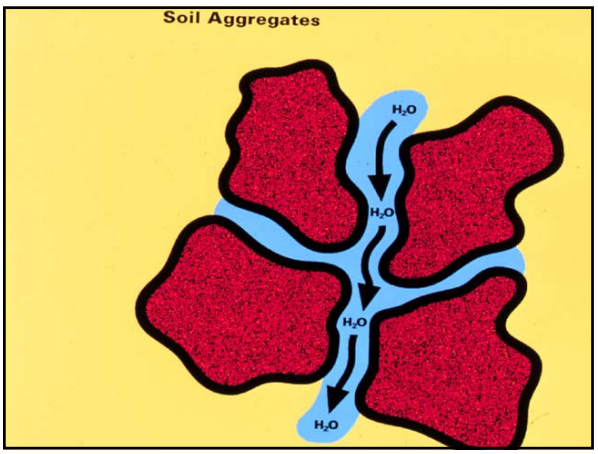
- NOT AN ESSENTIAL ELEMENT
- NATURALLY OCCURING
- SEWAGE EFFLUENT
- CAN DAMAGE PLANTS
- MONOVALENT (1+)
- LARGE HYDRATED SIZE
- CAN DAMAGE SOIL STRUCTURE







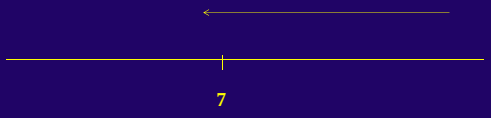




GYPSUM

- CALCIUM SULFATE $CaSO_4$
- Calcium replaces Na^+ on cation ex. Sites
- Sodium sulfate leaches from soil
- Soil structure is Slowly restored

ACIDIFICATION



SULFUR

SULFUR

- FERTILIZER
  - ESSENTIAL NUTRIENT ELEMENT
- ACIDIFYING AGENT
  - LOWERS pH

SULFUR DEFICIENCY

- Light green to yellow leaves
- Yellow veins
- Slow growth
- Appears on younger leaves first
- N may intensify yellowing

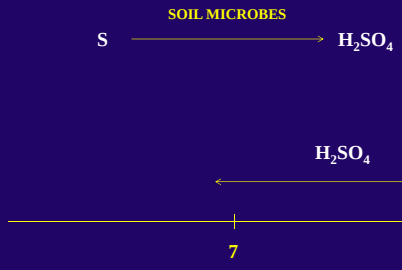
Sulfur From Precipitation in Midwest

12 - 15 lbs / Acre / Year

SULFUR

- FERTILIZER
  - –ESSENTIAL NUTRIENT ELEMENT
- ACIDIFYING AGENT
  - –LOWERS pH

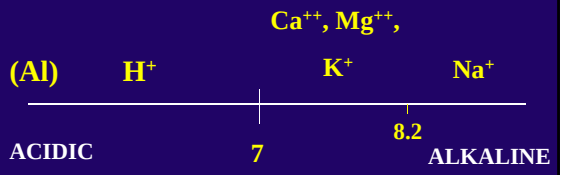
ACIDIFICATION

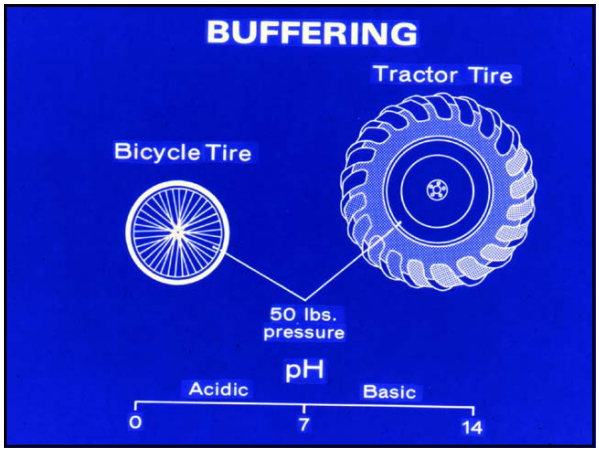


CALCAREOUS SOILS

- SOILS CONTAINING SOLID CALCIUM CARBONATE ($CaCO_3$)
  ALL CALCIUM CARBONATE HAS TO BE DESTROYED BEFORE pH CAN BE REDUCED

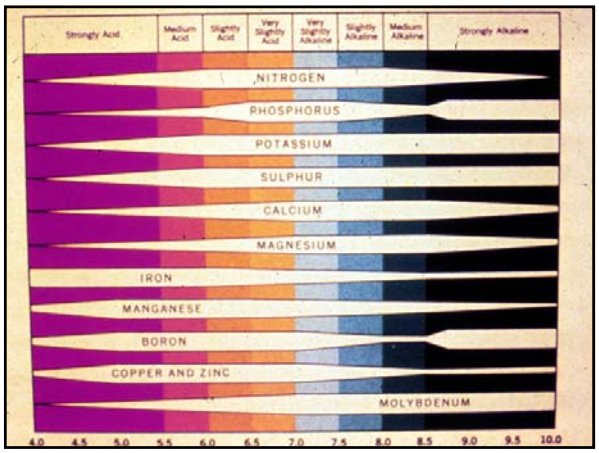
pH





AGRONOMIC IMPLICATIONS

- –MICRONUTRIENT DEFICIENCIES
  - IRON (Fe)



SULFUR

- IF YOU NEED IT, USE IT
- IF YOU DON'T NEED, DON'T USE IT