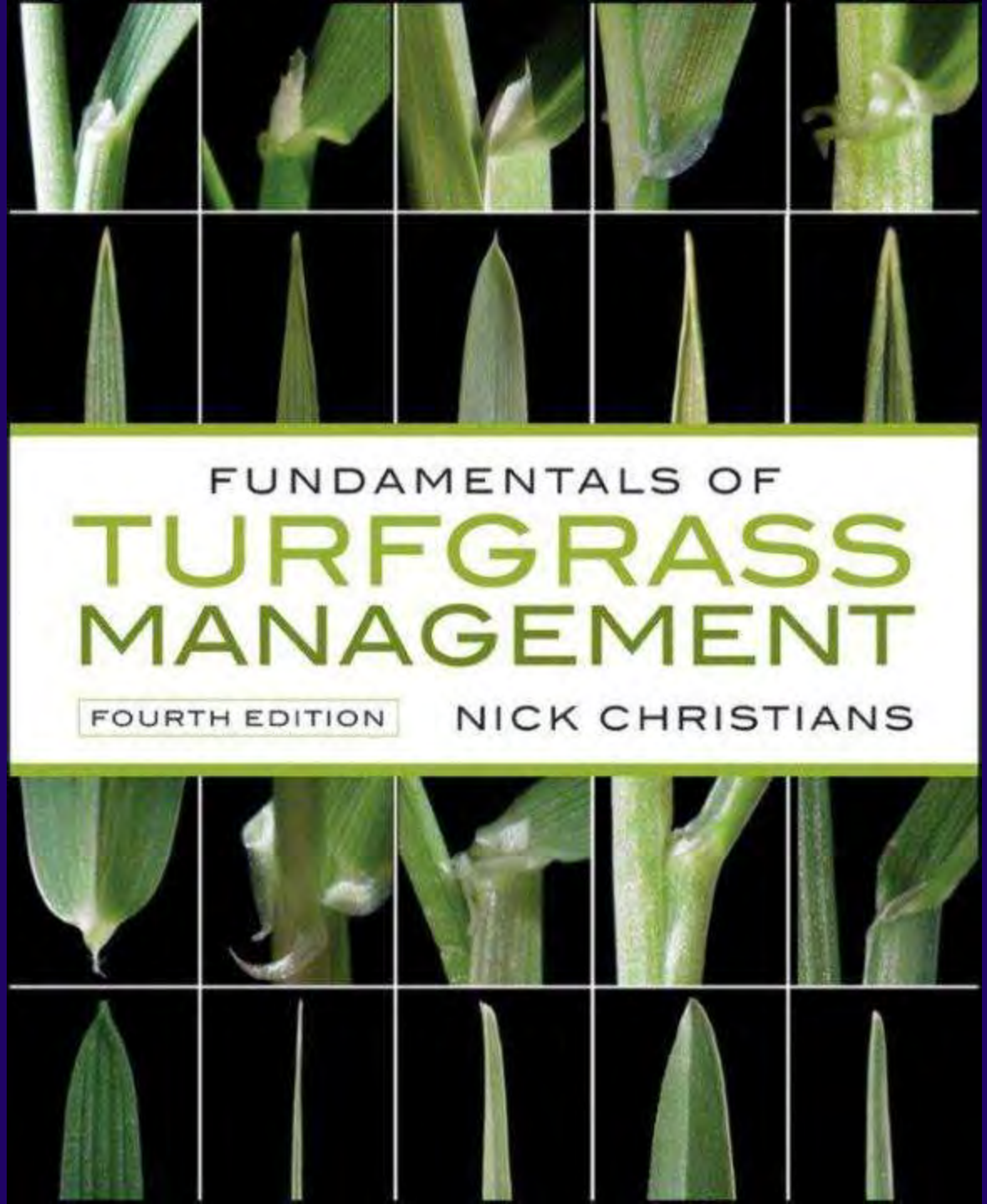
WATER QUALITY AND SOIL CONDITIONS

NICK CHRISTIANS
IOWA STATE UNIVERSITY

BACKGROUND

- BORN IN IOWA
- DORDT COLLEGE, SIOUX CENTER
- COLORADO STATE
- ASSISTANT SUPERINTENDENT, FLAT IRONS COUNTRY CLUB
- SUPERINTENDENT, PUEBLO, COLO.
- GRAD SCHOOL, OHIO STATE UNIV.
- IOWA STATE, 1979


FUNDAMENTALS OF
TURFGRASS
MANAGEMENT
FOURTH EDITION
NICK CHRISTIANS

IOWA TURFGRASS BLOG

iaturf.blogspot.com

BASIC PRINCIPLES AND TERMINOLOGY

REPORT NO.	809629	LD NO.	95635	DATE REC'D.	07-Dec-93	DATE REPORTED	08-Dec-93	SAMPLE WILL BE KEPT UNTIL	07-Jan-94	LABORATORY NUMBER	

Scotts ProTurf

Soil Analysis

Conducted by

HARRIS LABORATORIES INC.

THIS ANALYSIS RUN FOR:

RANDY CARPENTAR
MEADOWS FARMS GC
4300 FLAT RUN RD
LOCUST GROVE VA 22508

THIS ANALYSIS REQUESTED BY:

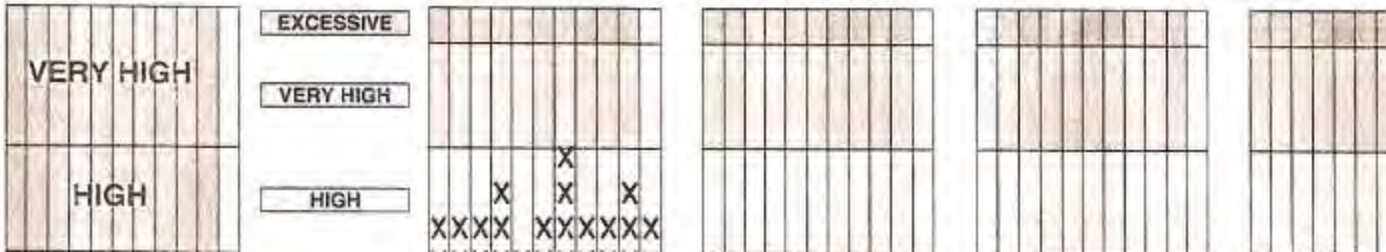
Robert Herring
7303 Native Dancer Dr
Midlothian VA 231126170
PH804-739-1050 77L

ALL NUTRIENT RESULTS EXPRESSED IN PPM

CODE →	1	2	3	4	5	6	7	8	9
Sample Description	GRN11	GRN12	GRN13	GRN14	GRN15	GRN16	GRN17	GRN18	PG
CEC	3.4	2.8	3.1	4.2	4.4	3.2	2.5	4.1	2.7
Soil pH	6.7*	6.7*	6.7*	6.9*	6.4	6.8*	7.1*	6.8*	6.7*
Buffer pH	----	----	----	----	7.2	----	----	----	----
Soluble Salts	0.14	0.14	0.12	0.18	0.18	0.20	0.14	0.18	0.23
Exchangeable Calcium (Ca)	454*	366*	417*	597*	641	452*	334*	586*	344*
Exchangeable Magnesium (Mg)	104	92	102	119	116	97	79	115	90
Exchangeable Sodium (Na)	10	10	9	10	10	8	7	14	16
% H Base Saturation	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*
% Mg Base Saturation	25.8*	27.5*	27.2*	23.7*	22.0*	25.1*	26.4*	23.3*	27.3*
% Ca Base Saturation	67.5	65.7	66.8	71.5	73.0	70.1	67.1	71.2	62.7
% Na Base Saturation	1.3	1.6	1.3	1.0	1.0	1.1	1.2	1.5	2.5

CODING INFORMATION

	Sample Description	Composite Information	Plant Variety	Sample Nature
1	GRN11		GART	
2	GRN12		GART	



FIRST THREE LINES FILLED WITH INFORMATION

CEC

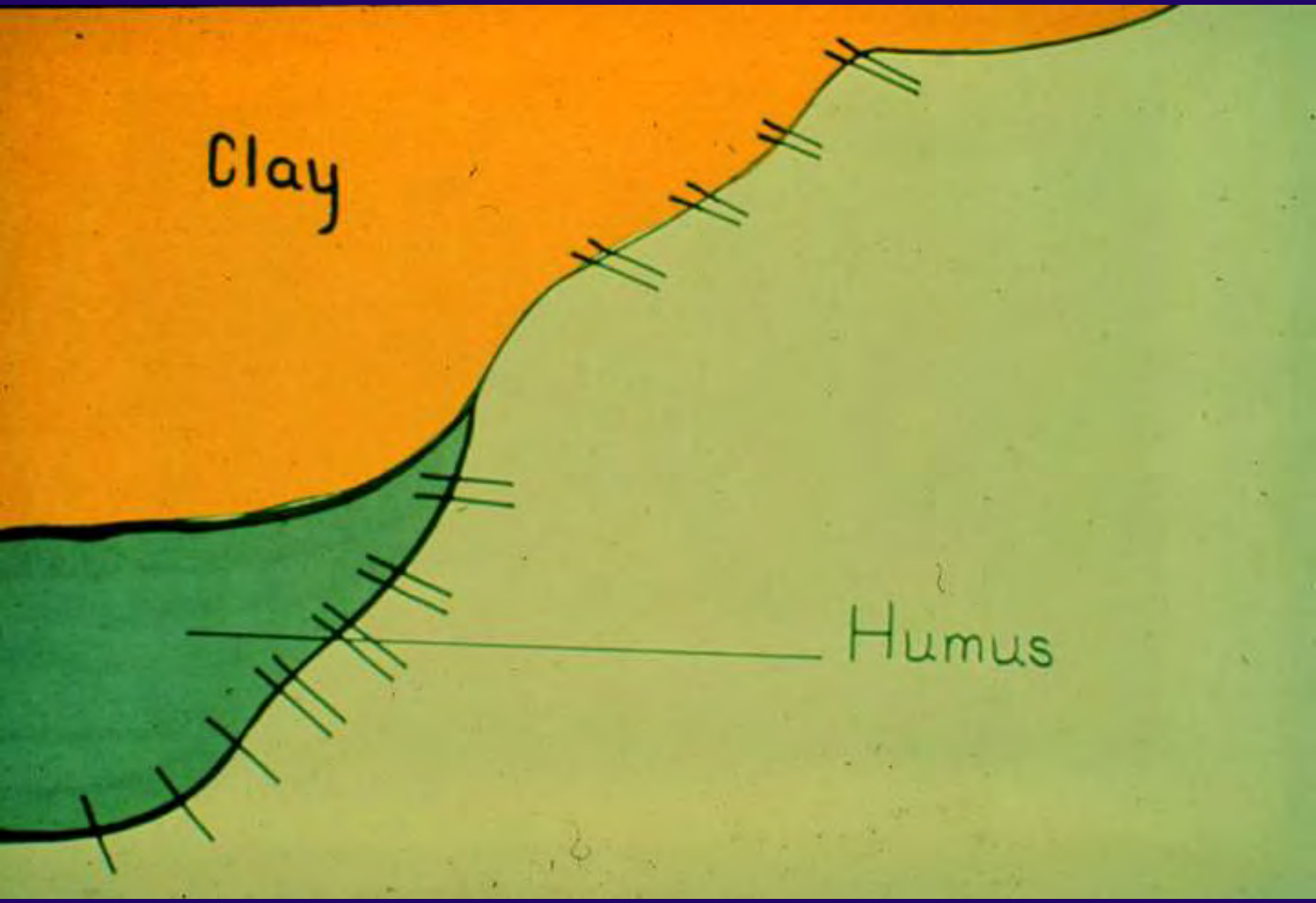
pH

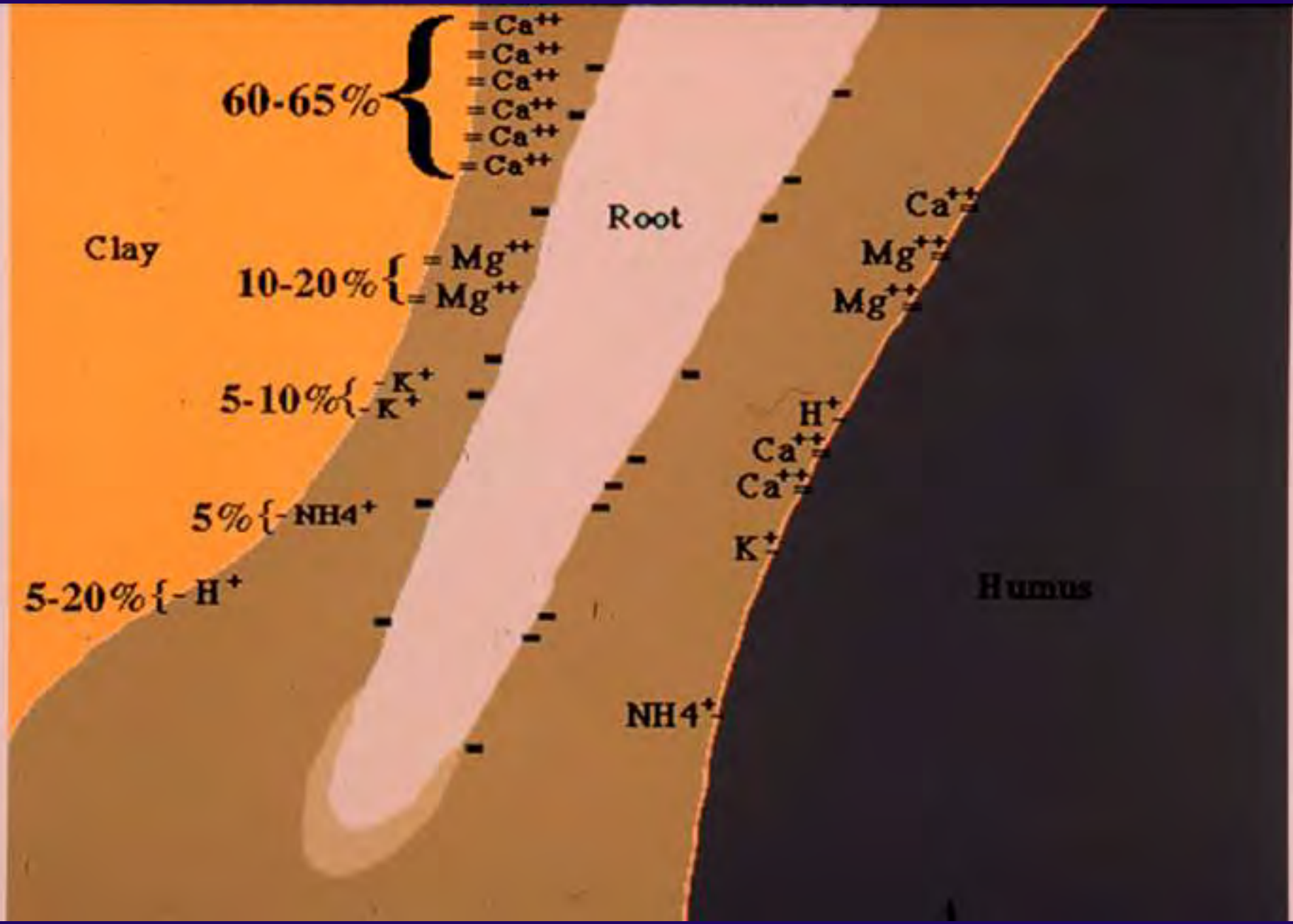
BUFFER pH

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^{+}


Clay
Humus


60-65%
= Ca++
= Ca++
= Ca++
= Ca++
= Ca++
= Ca++
Clay
10-20%
= Mg++
= Mg++
5-10%
- K+
- K+
5%
- NH4+
5-20%
- H+
Root
Ca++ =
Mg++ =
Mg++ =
H+ -
Ca++ =
Ca++ =
K+ -
NH4+ -
Humus

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)

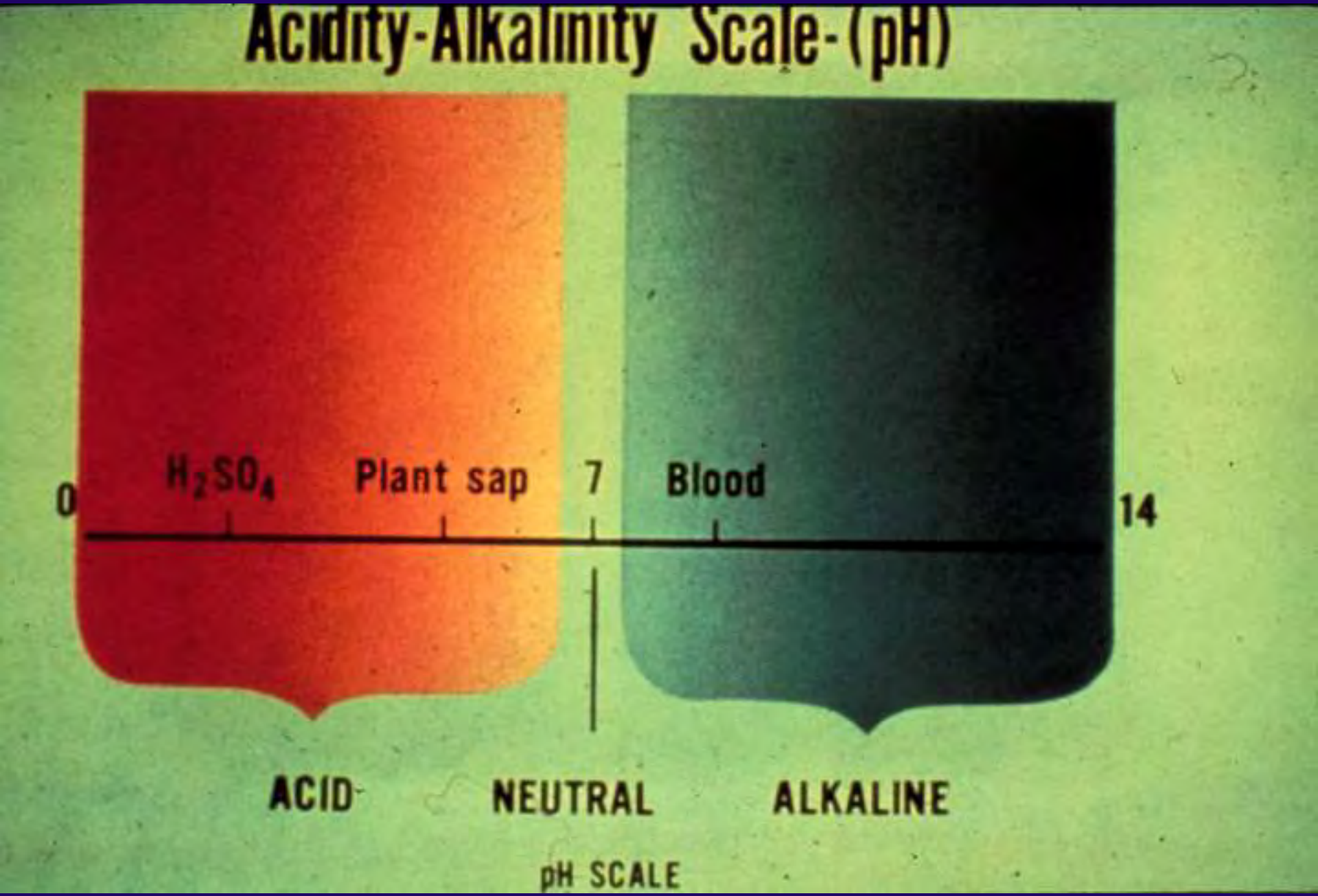
6.02×10^{20}

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

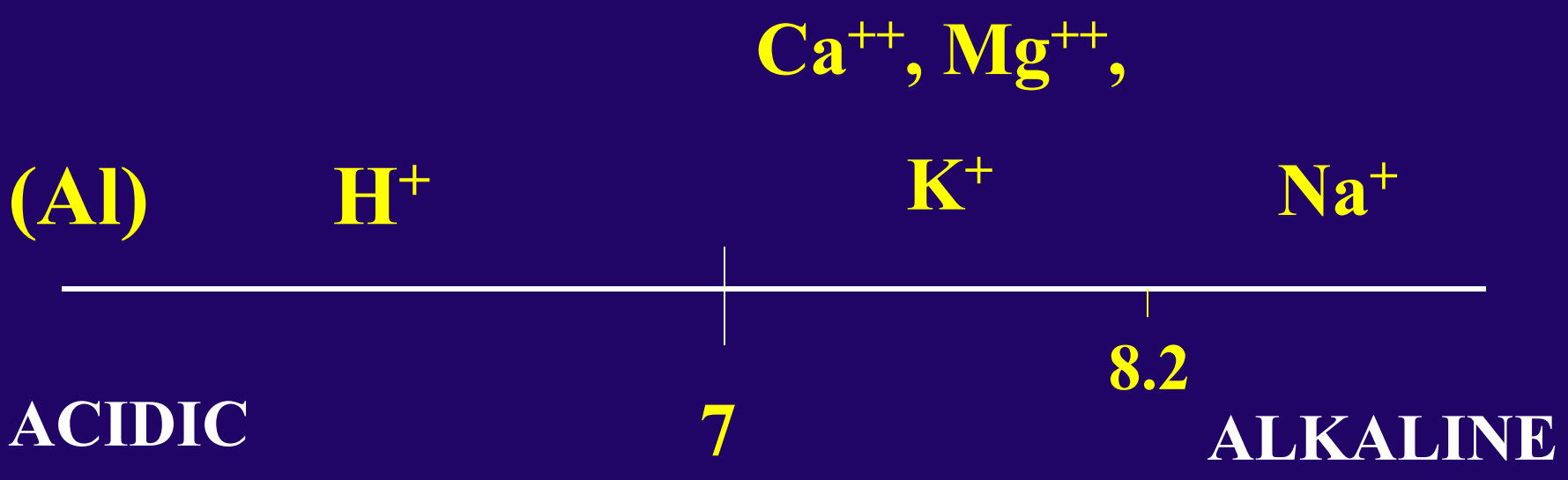
CATION EXCHANGE CAPACITY

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

pH


Acidity-Alkalinity Scale-(pH)
0
H_2SO_4
Plant sap
7
Blood
14
ACID
NEUTRAL
ALKALINE
pH SCALE

pH



HOW SOIL pH AFFECTS AVAILABILITY OF PLANT NUTRIENTS

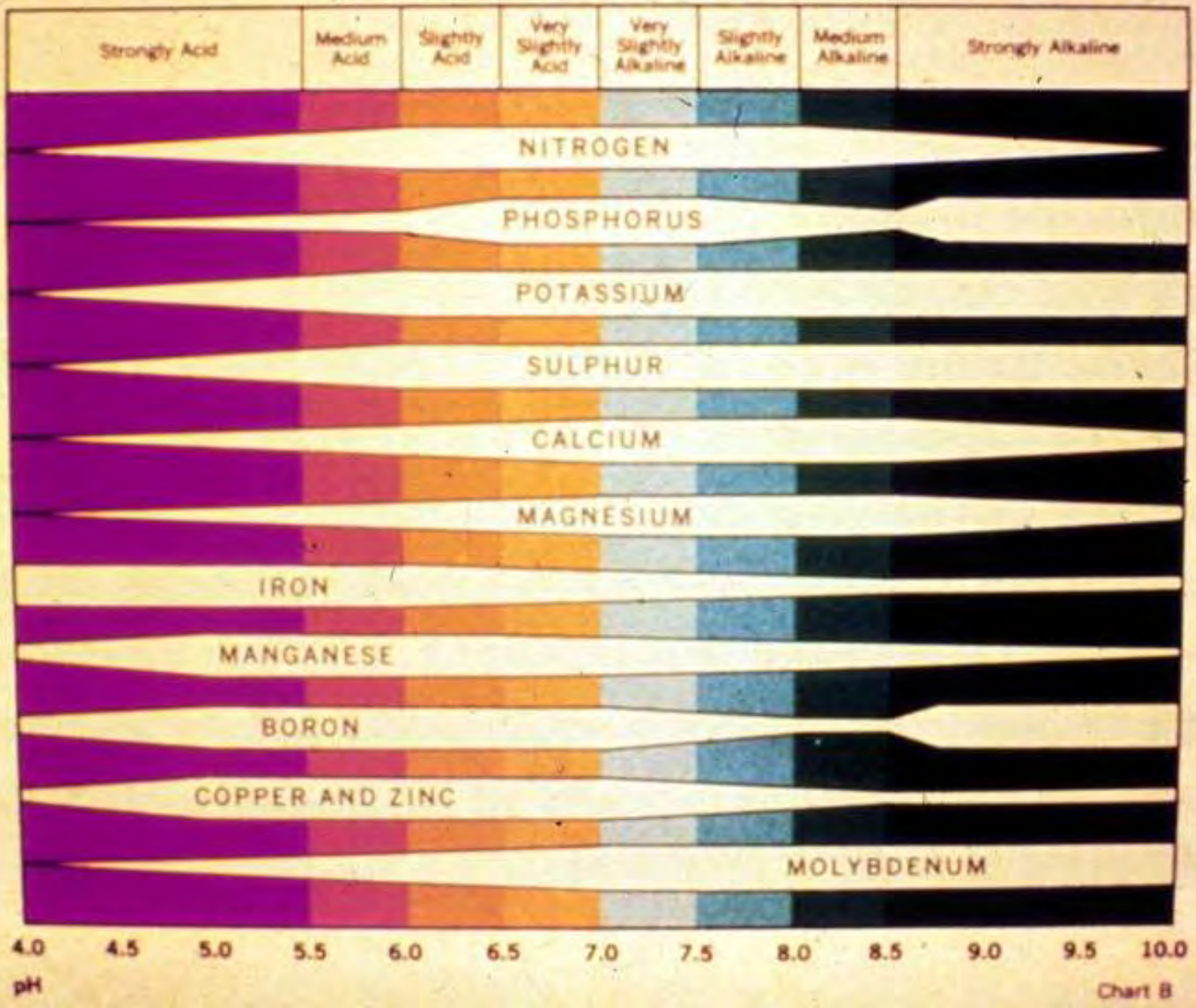


Chart B

LIMING

LIME

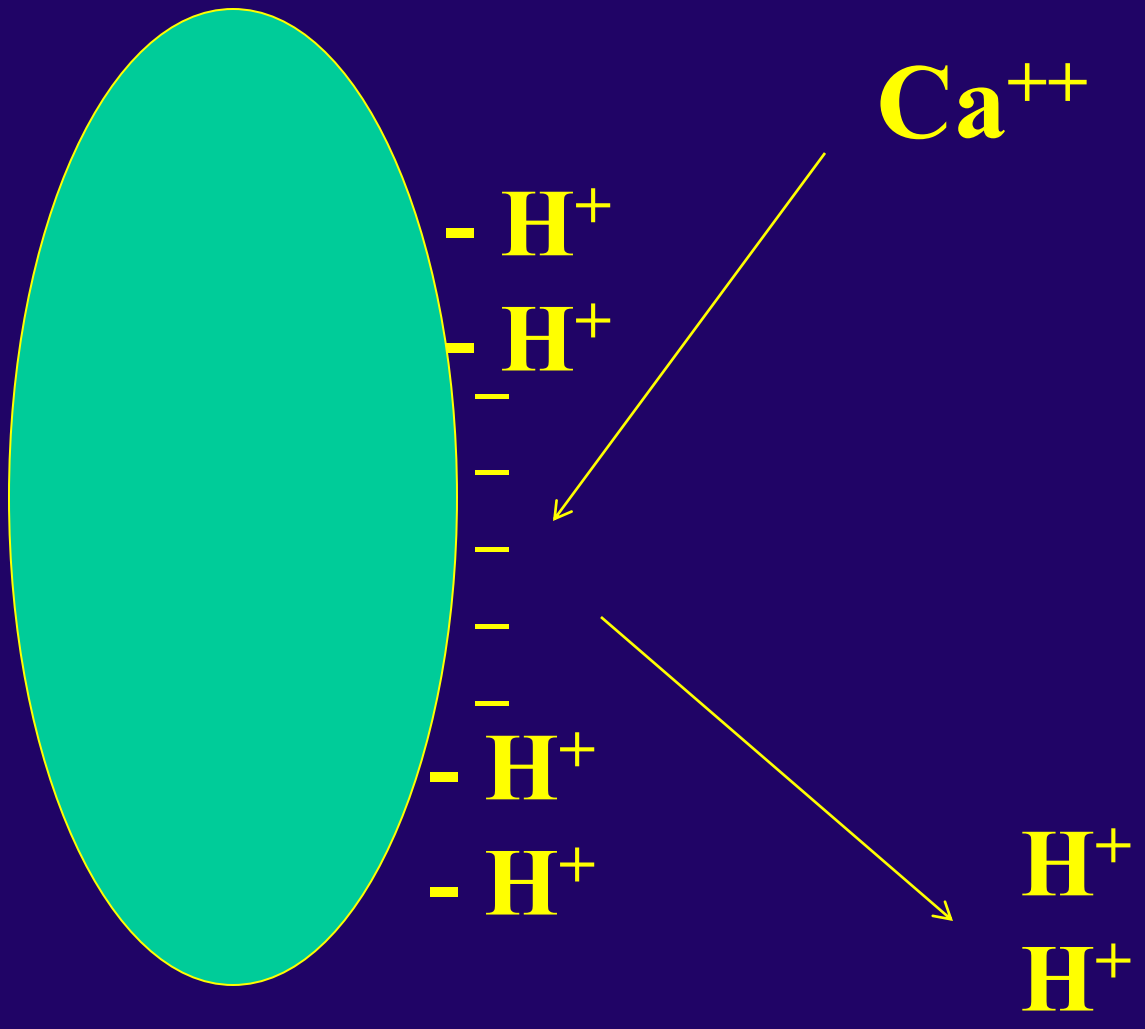
CALCIUM CARBONATE

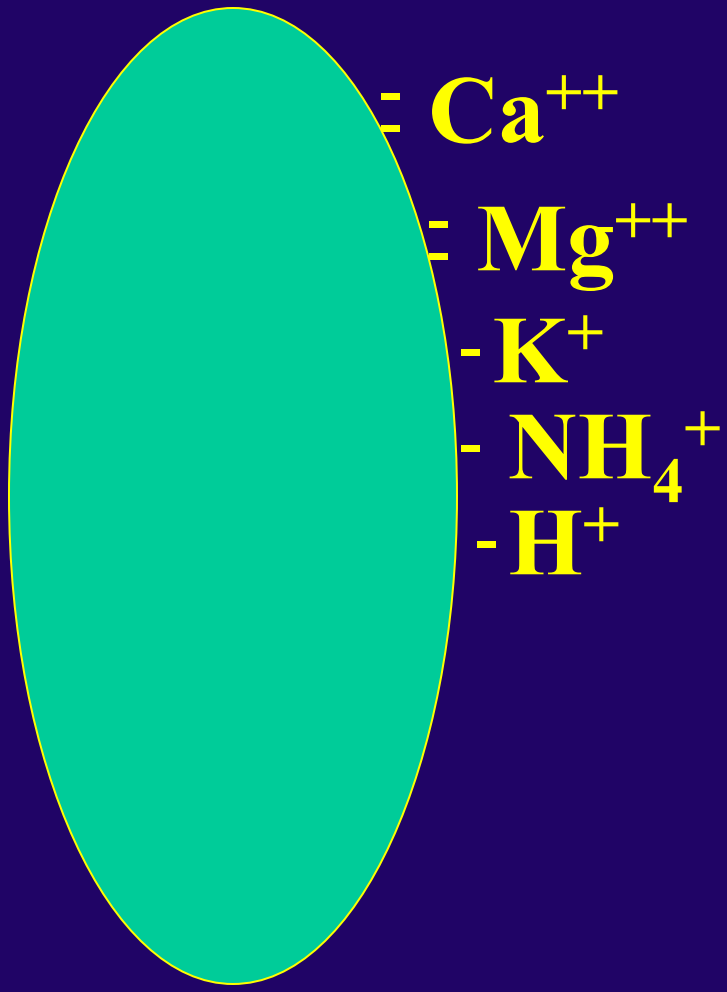
$CaCO_3$

LIME

RAISES

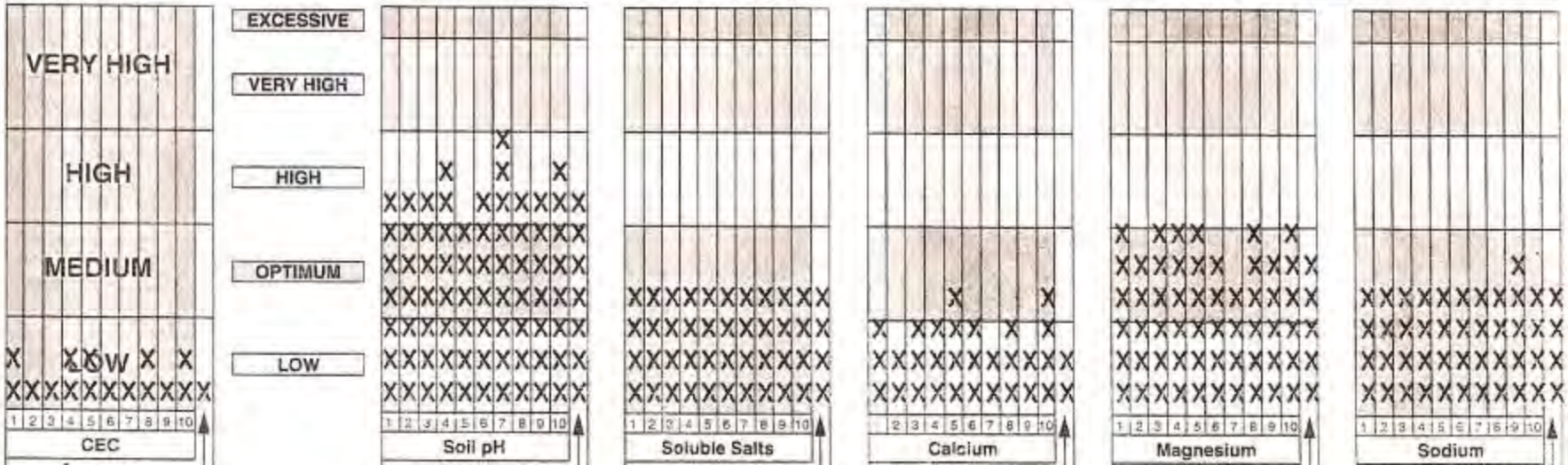
pH


Ca++
- H+
- H+
- H+
- H+
H+
H+


= Ca^{++}
= Mg^{++}
- K^{+}
- NH_4^{+}
- H^{+}

BUFFER pH

Sample Description	GRN11	GRN12	GRN13	GRN14	GRN15	GRN16	GRN17	GRN18	PG	WARMUP	
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



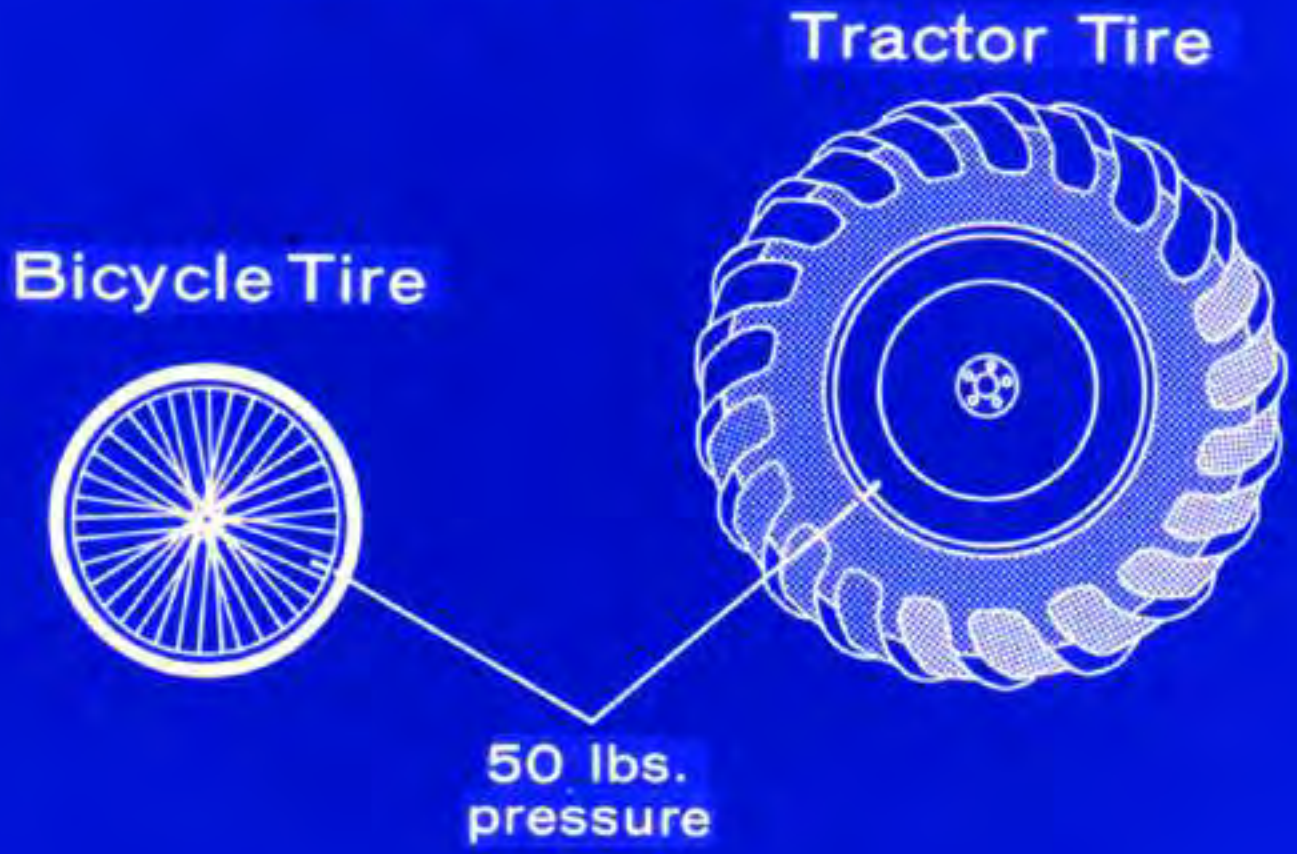
Plant Variety | Sample Nature

GART
GART
GART
GART
GART
GART
GART
GART
GART
GART

BUFFERING

RESISTANCE TO CHANGE

BUFFERING



pH

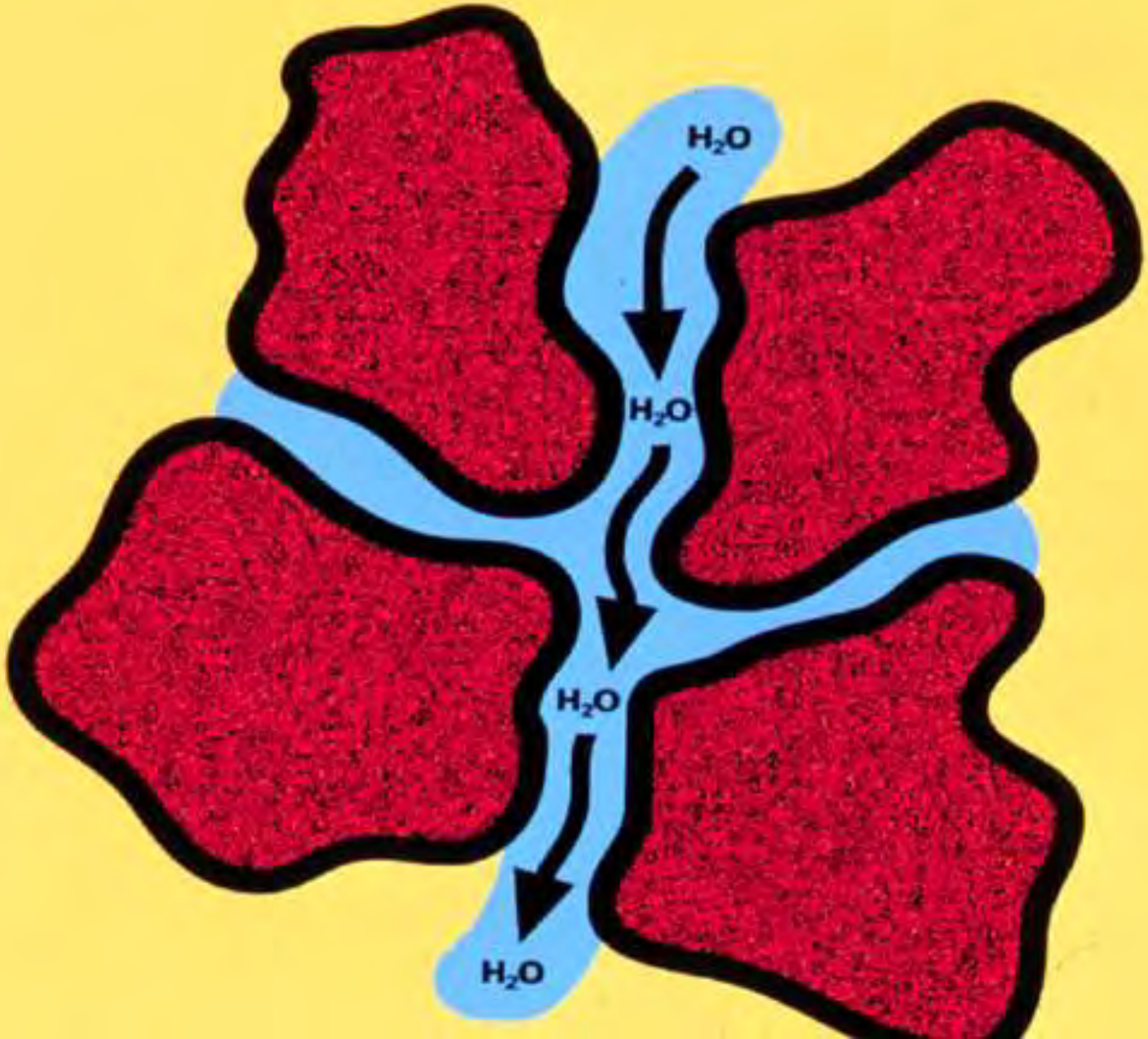
Table 7.3. Amount of $CaCO_3$, or its equivalent, in pounds per acre required to raise the pH to 6.5, based on the buffer pH.

	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

$CaSO_4$

Soil Aggregates

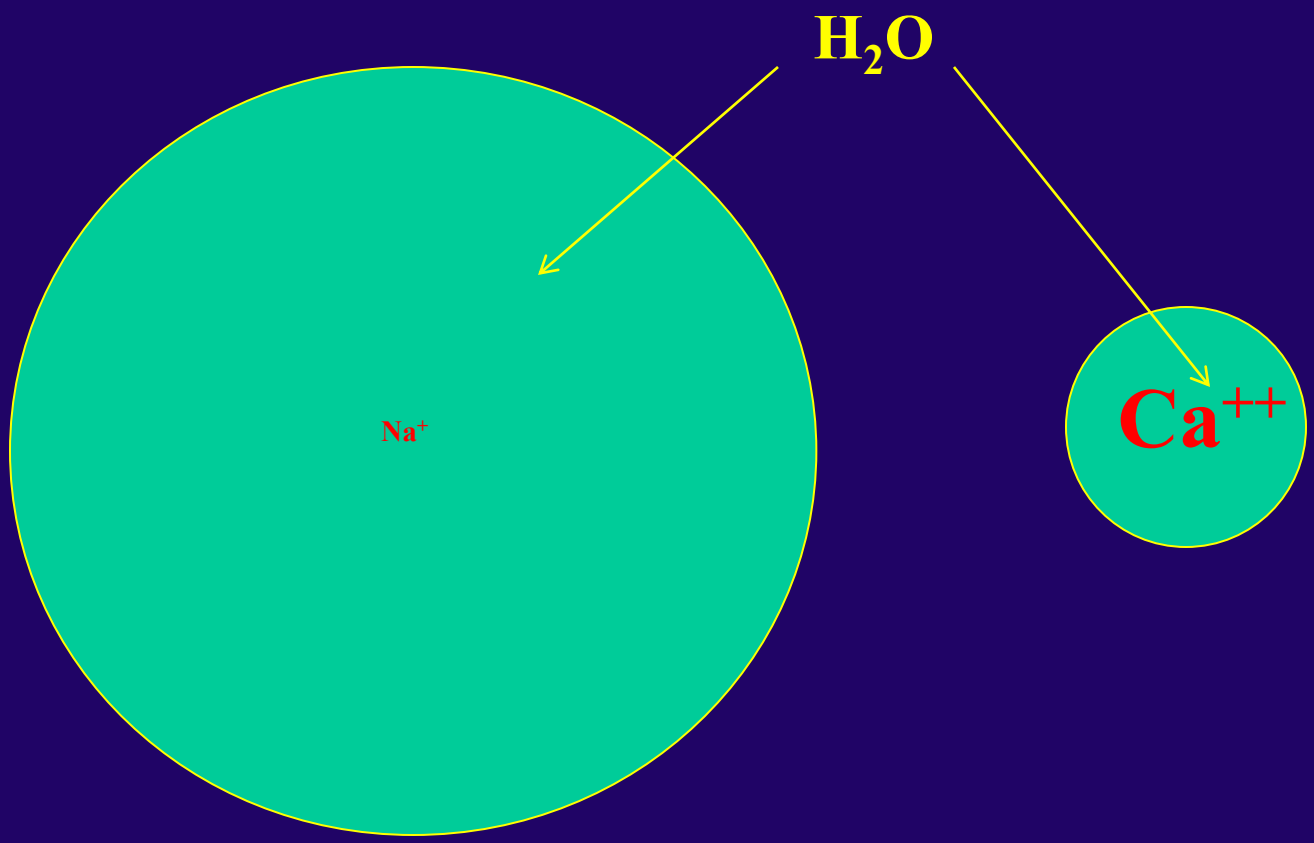


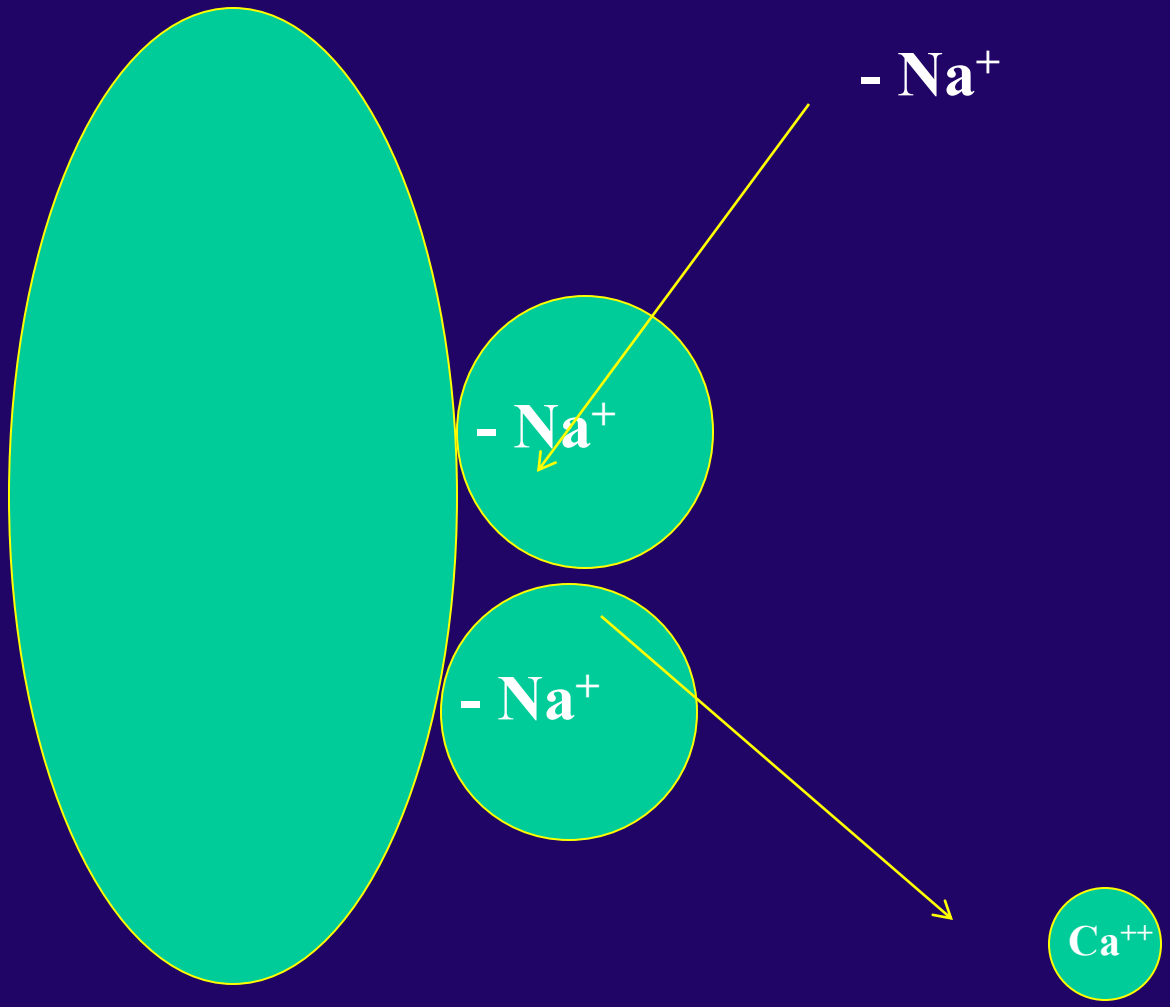
SODIUM Na^+

SODIUM

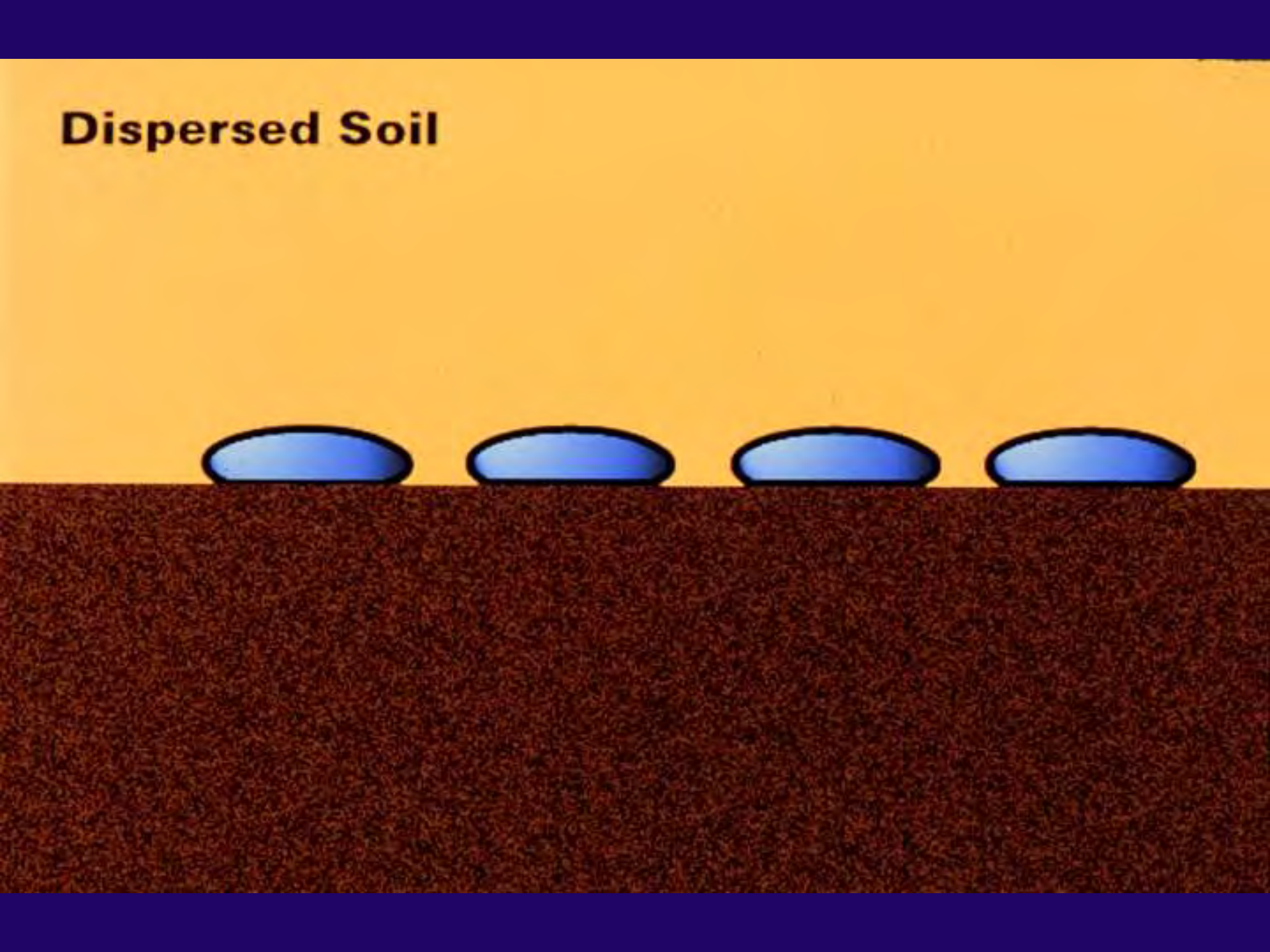
- NOT AN ESSENTIAL ELEMENT
- NATURALLY OCCURING
- SEWAGE EFFLUENT
- CAN DAMAGE PLANTS
- MONOVALENT (1+)
- LARGE HYDRATED SIZE
- CAN DAMAGE SOIL STRUCTURE

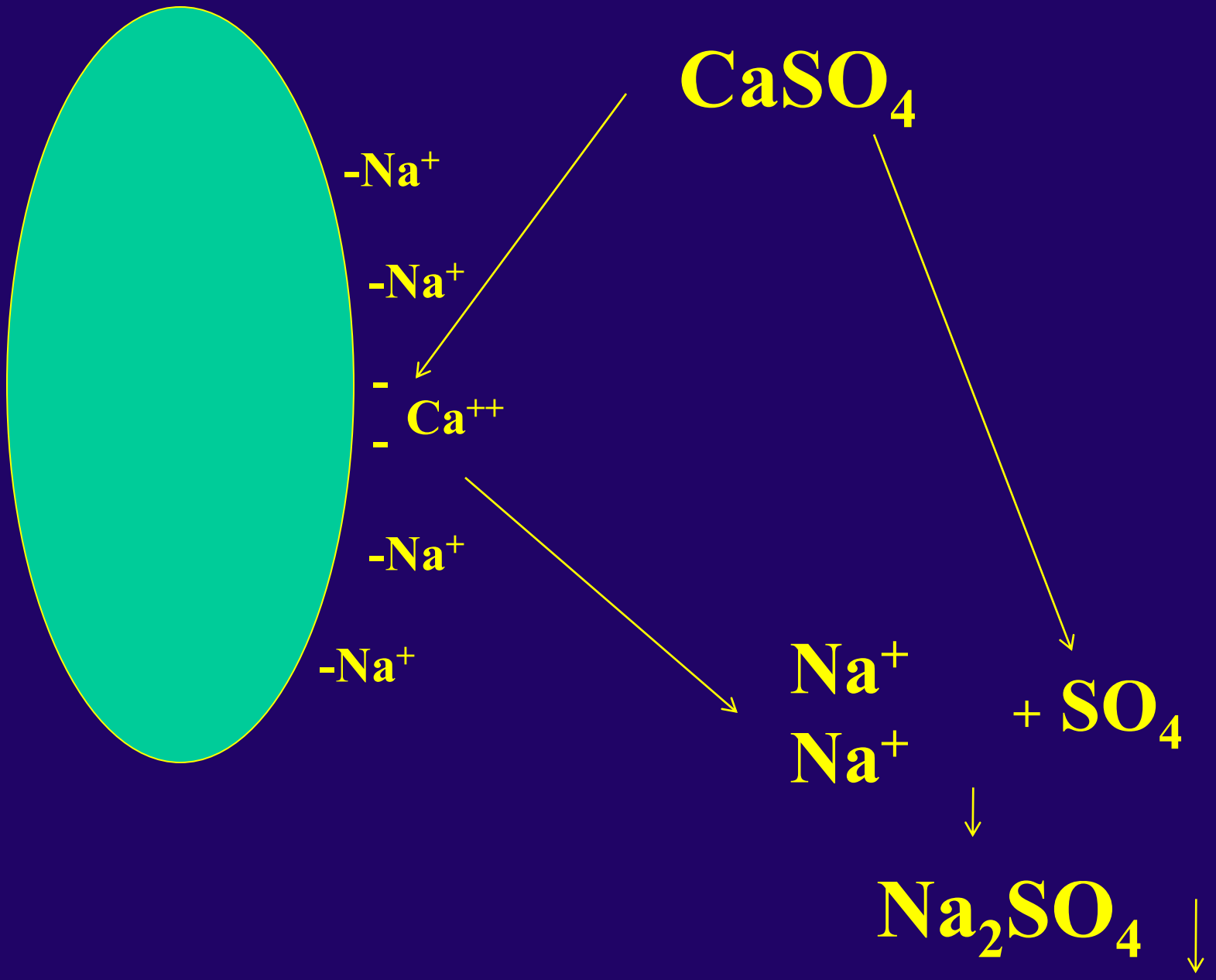
HYDRATED SIZE



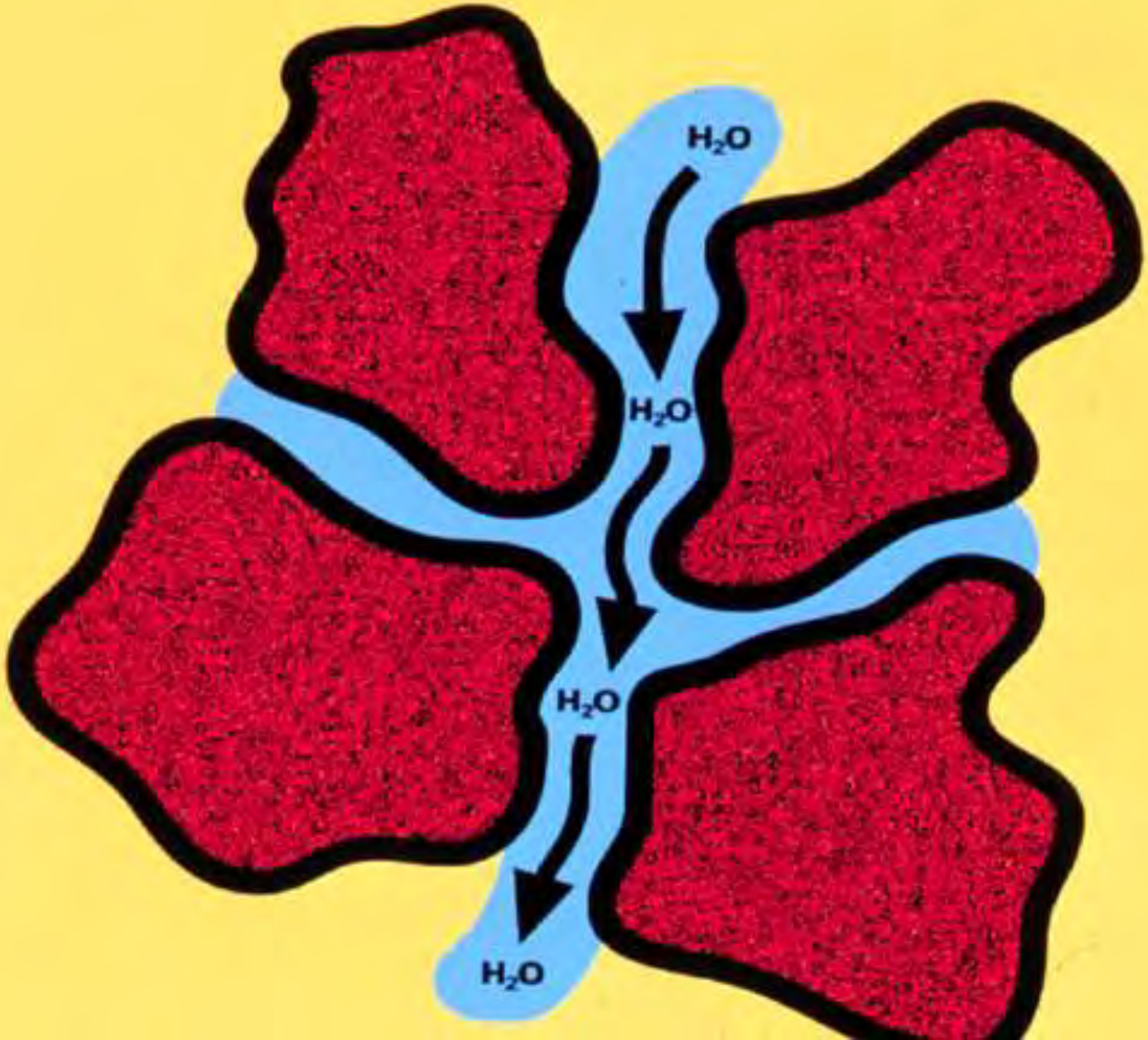

- Na^+
- Na^+
- Na^+
Ca^{++}

Dispersed Soil




$CaSO_4$
$-Na^+$
$-Na^+$
$-$
$-$ Ca^{++}
$-Na^+$
$-Na^+$
Na^+
Na^+
$+ SO_4$
Na_2SO_4

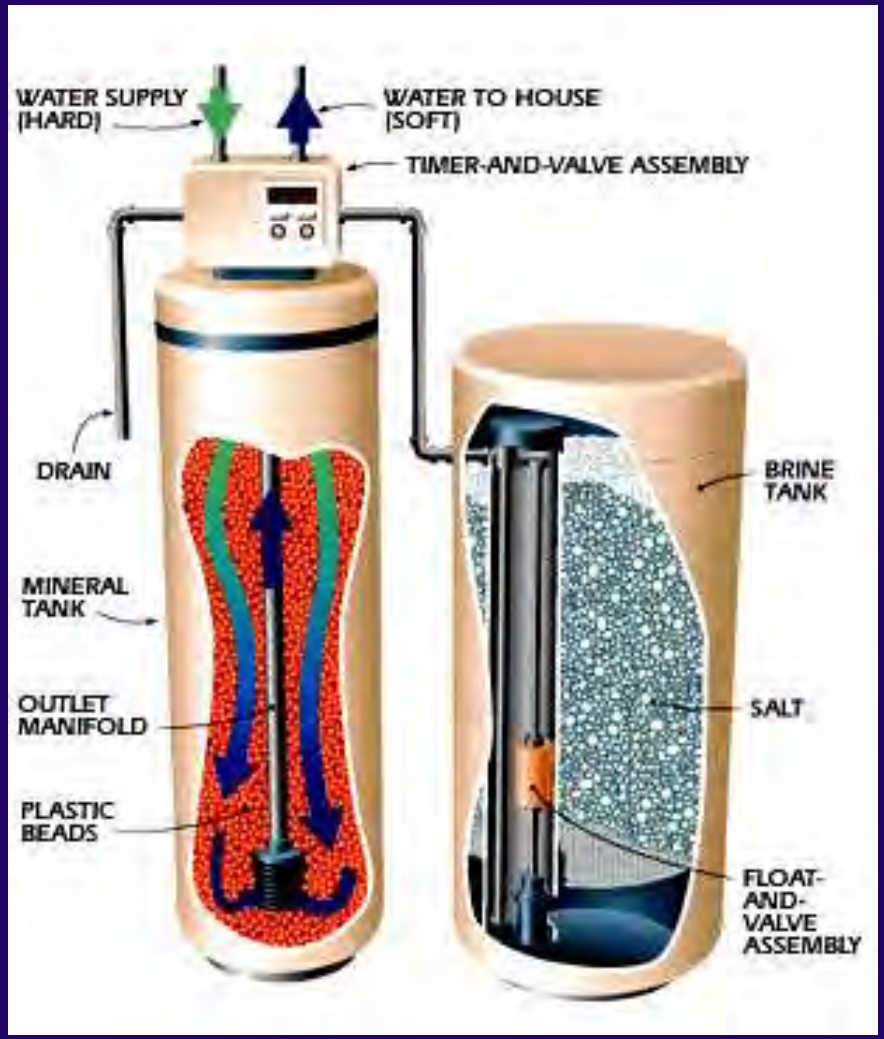
Soil Aggregates



GYPSUM

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

WATER SOFTENER



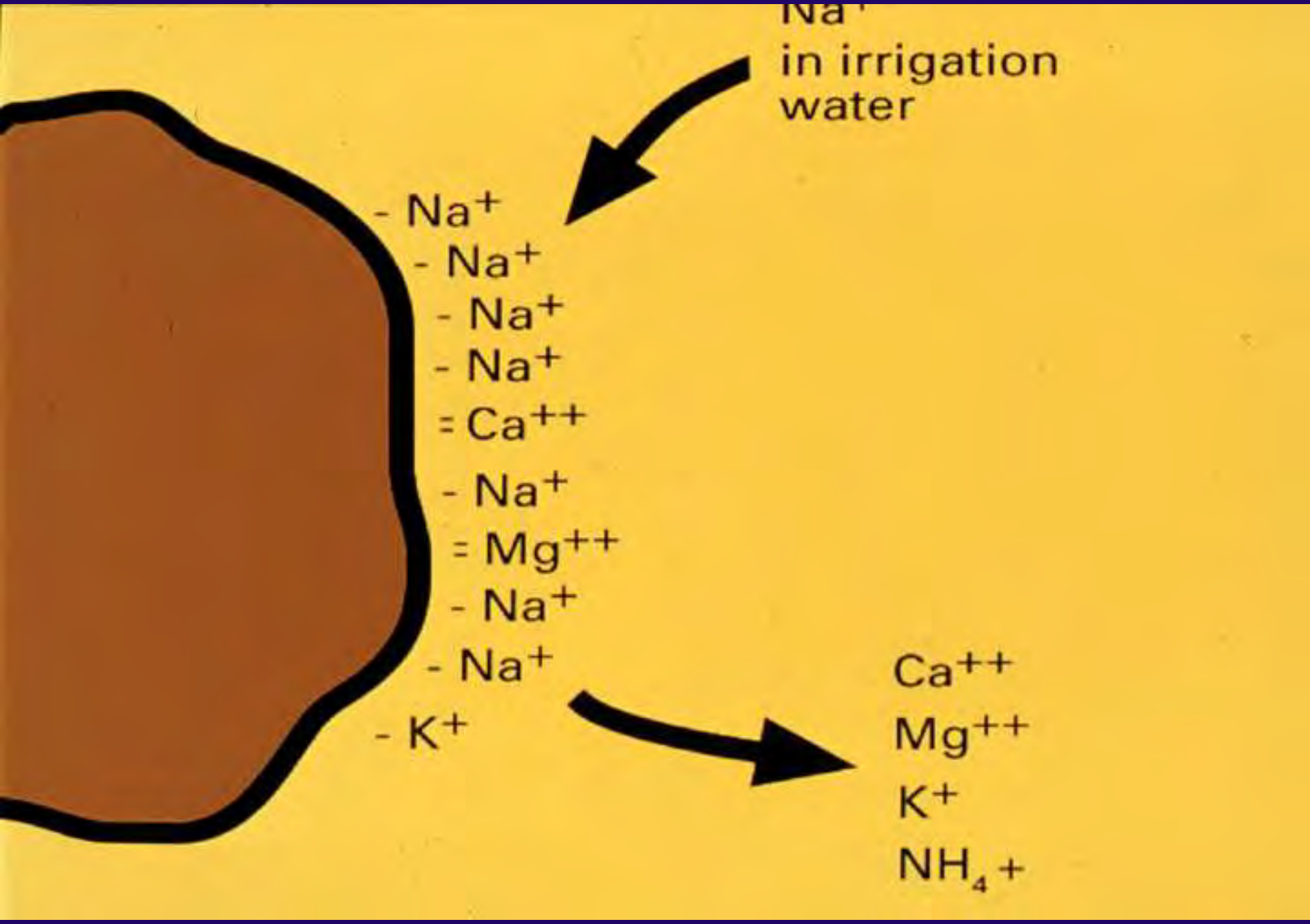
SODIUM ADSORPTION RATIO - SAR

- RATIO OF SODIUM TO CALCIUM AND MAGNESIUM
- ESTIMATE OF AMOUNT OF SODIUM THAT WILL ACCUMULATE IN IRRIGATED SOIL
- 5 TO 15 DEPENDING ON SOIL TYPE

SODIUM ADSORPTION RATIO

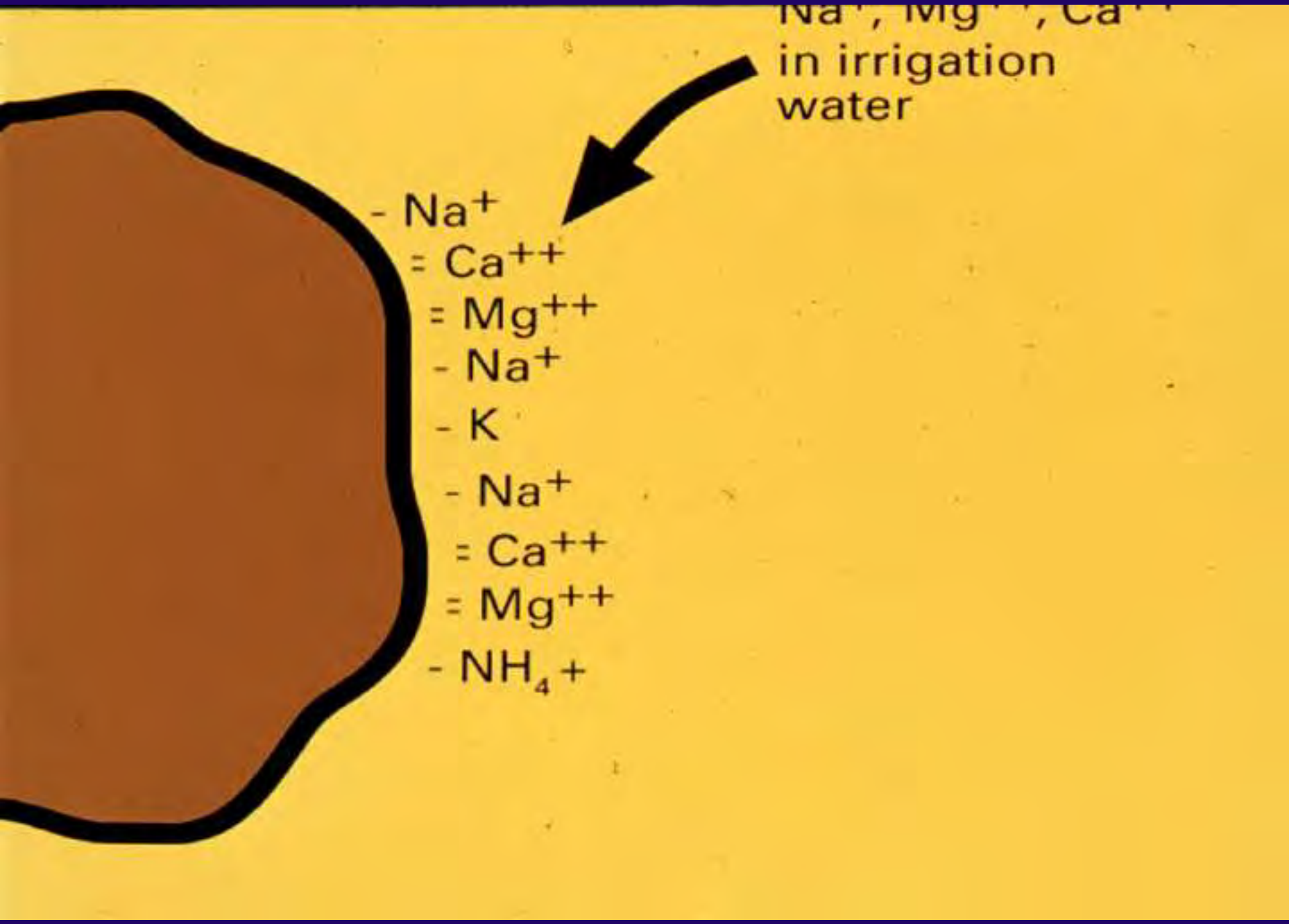
SAR

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$


Na+
in irrigation
water
- Na+
- Na+
- Na+
- Na+
= Ca++
- Na+
= Mg++
- Na+
- Na+
- K+
Ca++
Mg++
K+
NH4+

CALCIUM AND MAGNESIUM

- DIVALENT (++)
- SMALLER HYDRATED SIZE


Na^+, Mg^{++}, Ca^{++}
in irrigation
water
- Na^+
= Ca^{++}
= Mg^{++}
- Na^+
- K
- Na^+
= Ca^{++}
= Mg^{++}
- NH_4+

BICARBONATES

- CAN REACT WITH Ca and Mg
- RESULTS IN HIGHER SAR

ADJUSTED SAR -SAR_{ADJ}

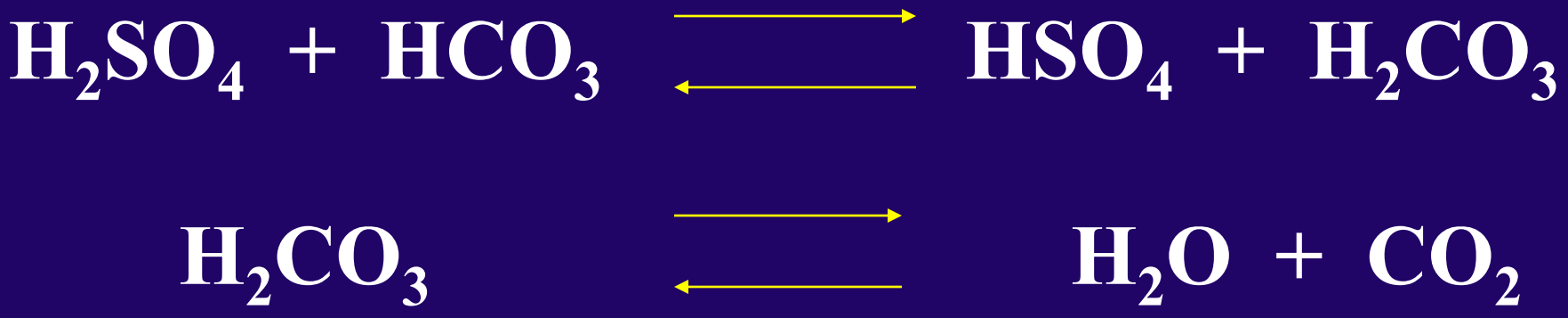
ADJUSTED FOR BICARBONATES

BICARBONATES REMOVE Ca and Mg

THE WIDER THE DIFFERENCE BETWEEN SAR AND SAR_{ADJ}, THE GREATER THE BICARBONATE PROBLEM

ACID INJECTION

SULFURIC ACID REACTS WITH BICARBONATES



ACID INJECTION

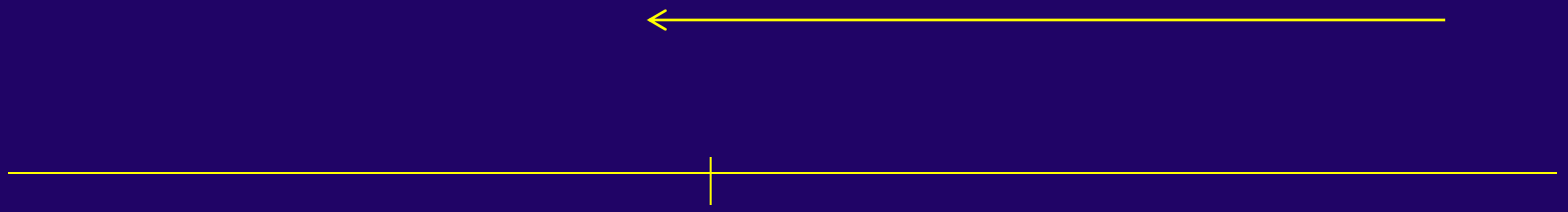
- SULFURIC ACID
- REACTS WITH CARBONATE AND BICARBONATE
- PREVENTS THE REMOVAL OF Ca AND Mg FROM SOLUTION
- PREVENTS INCREASE IN SAR

SULFUROUS GENERATORS

HOW ABOUT WHEN Na IS LOW AND Ca & Mg ARE PRESENT AND BICARBONATES ARE HIGH?

APPLICATION OF DRY SULFUR

ACIDIFICATION



7

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

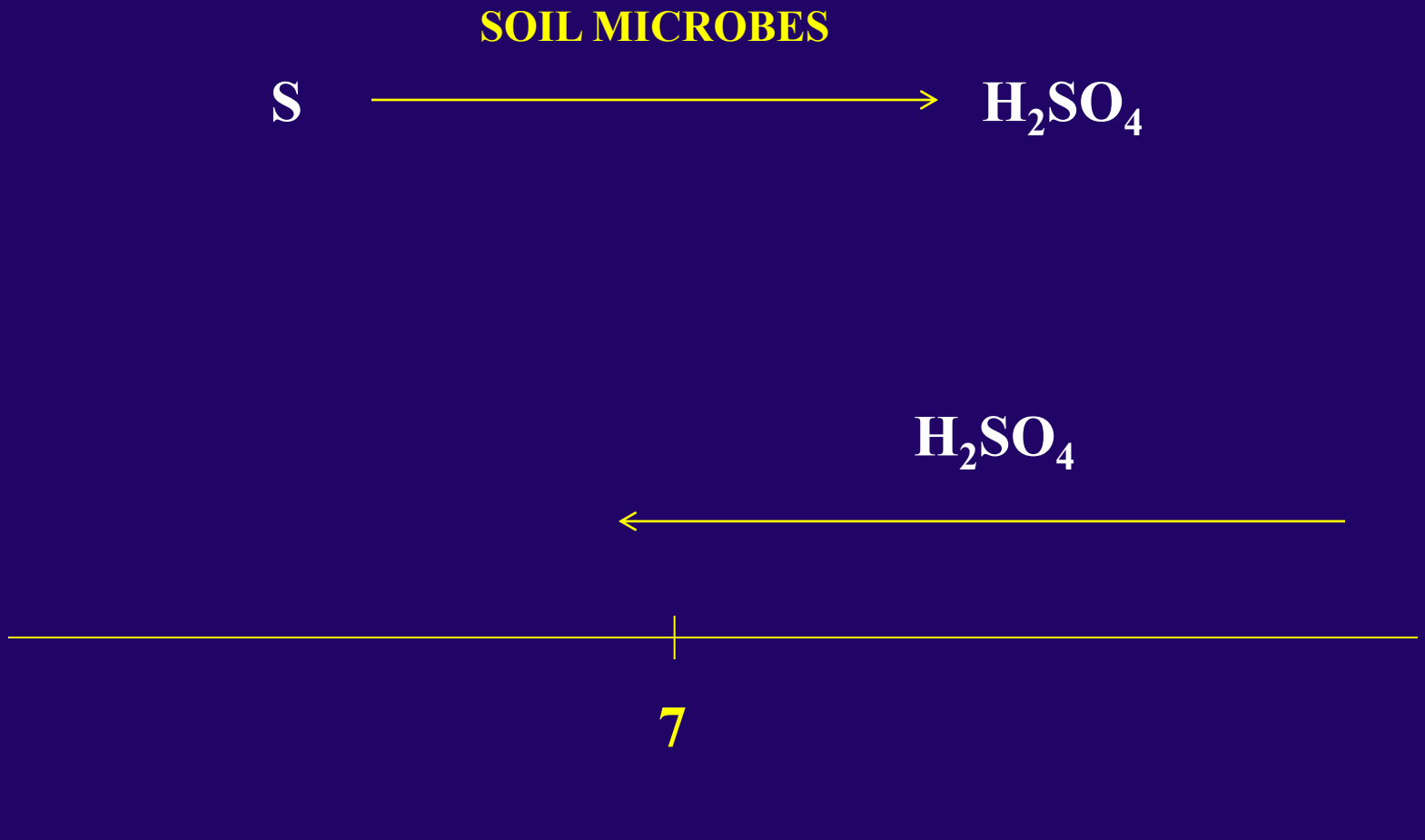
Sulfur From Precipitation in Midwest

12 - 15 lbs / Acre / Year

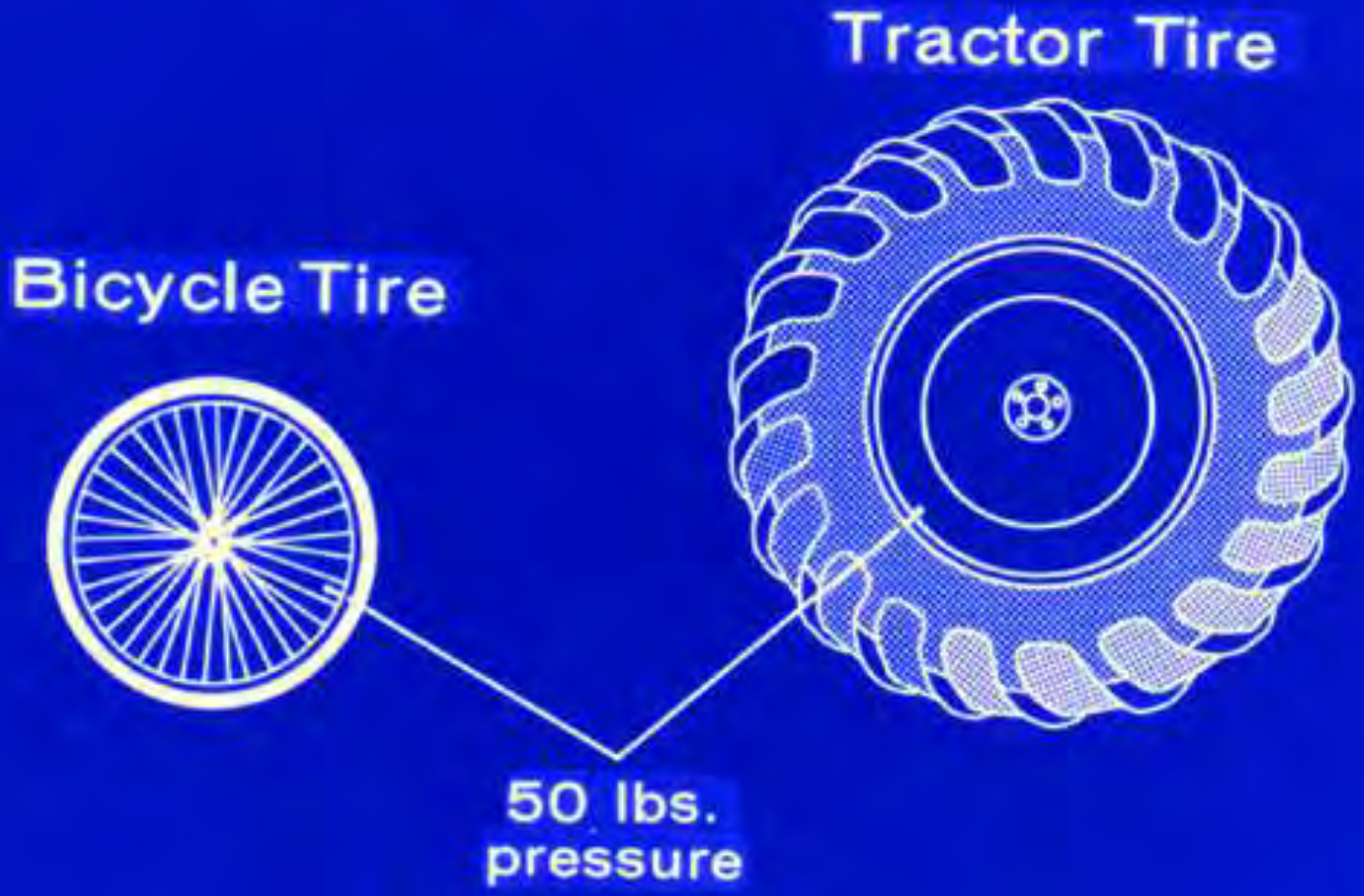
SULFUR

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

ACIDIFICATION



BUFFERING



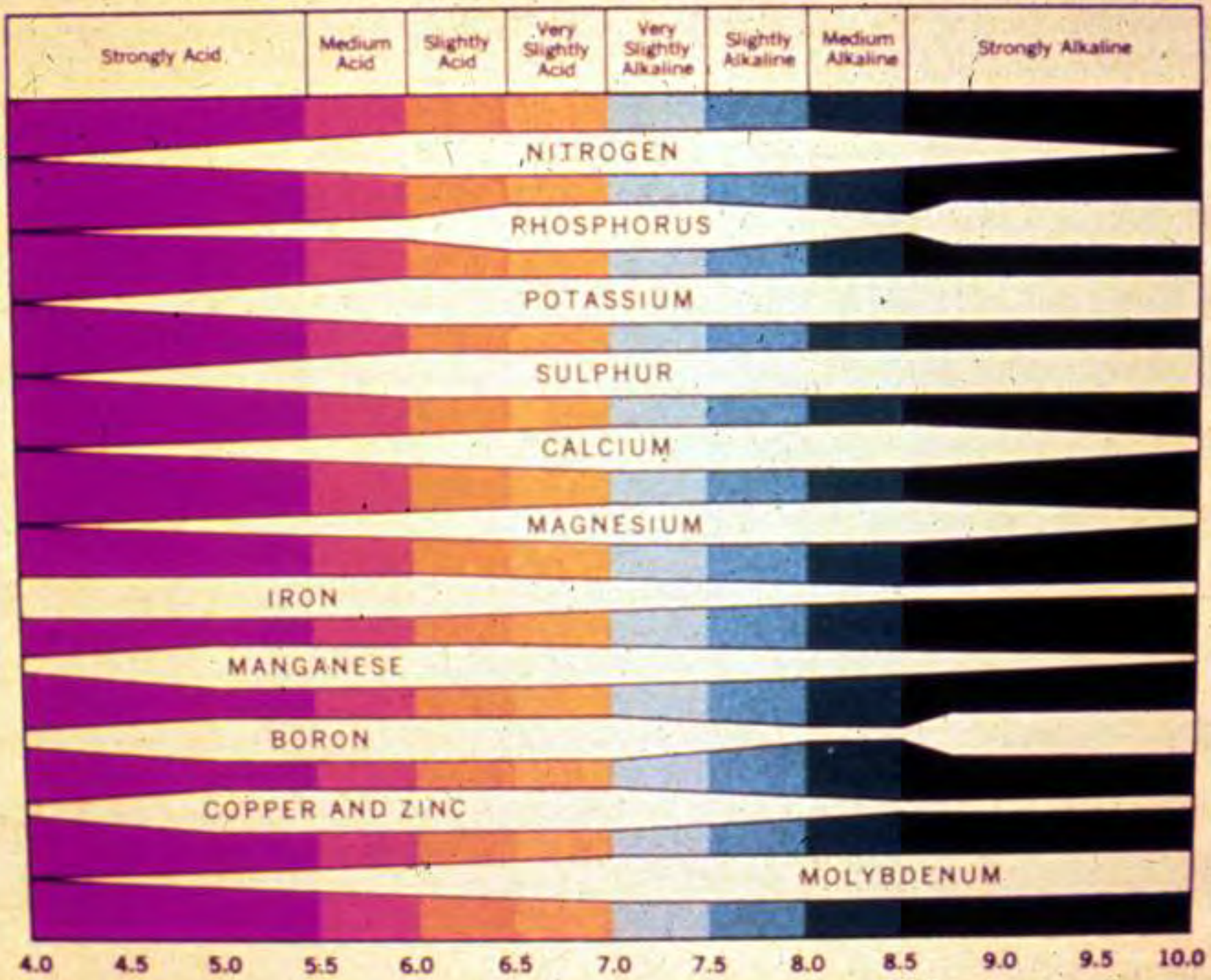
pH

Acidic — Basic

0 — 7 — 14

AGRONOMIC IMPLICATIONS

- MICRONUTRIENT DEFICIENCIES
  - IRON (Fe)


Strongly Acid
Medium Acid
Slightly Acid
Very Slightly Acid
Very Slightly Alkaline
Slightly Alkaline
Medium Alkaline
Strongly Alkaline
NITROGEN
RHOSPHORUS
POTASSIUM
SULPHUR
CALCIUM
MAGNESIUM
IRON
MANGANESE
BORON
COPPER AND ZINC
MOLYBDENUM
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0

SULFUR

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