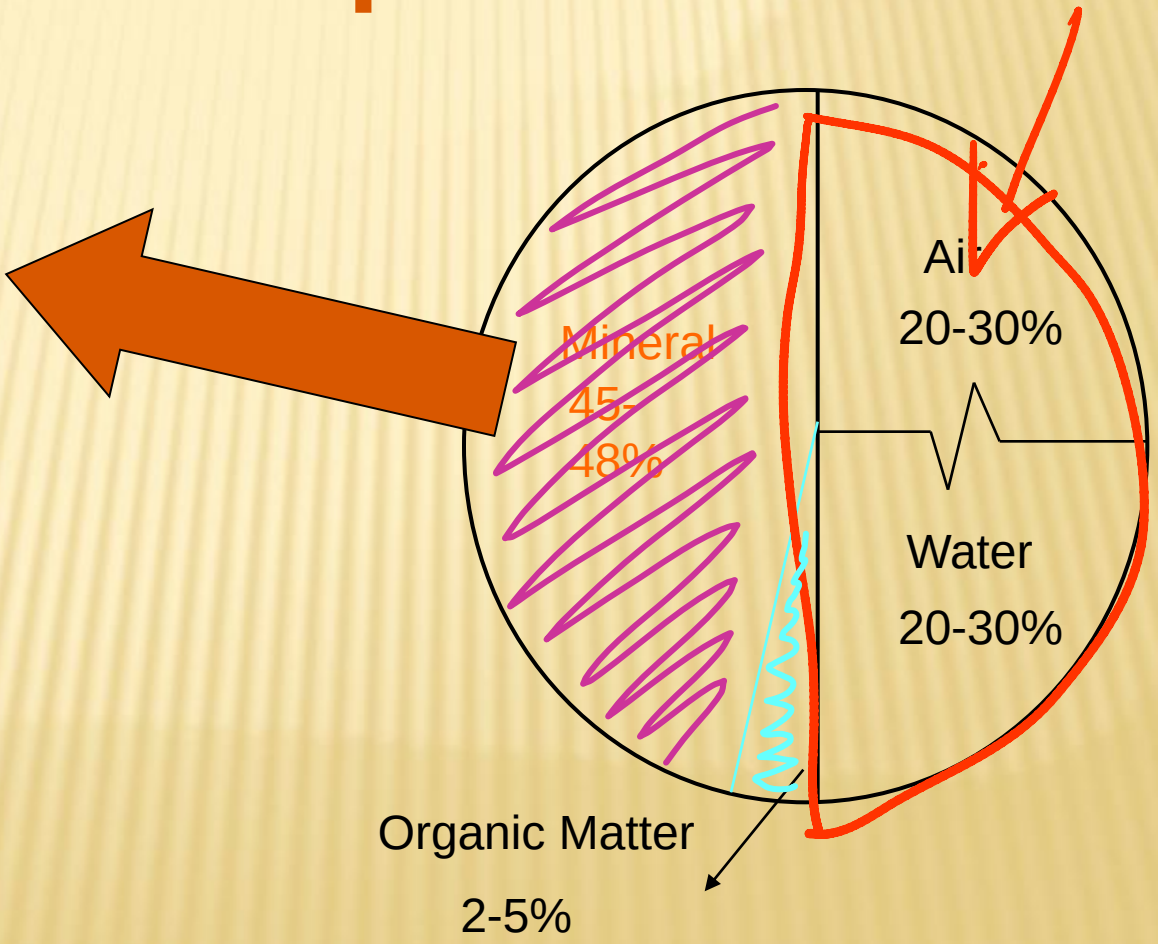
SOILS AND PLANT NUTRITION

WHAT IS SOIL?

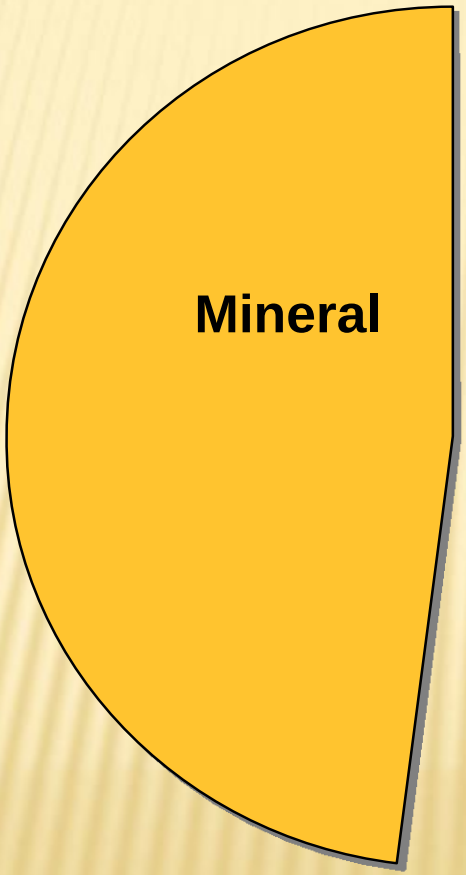
Soil is the medium in which plants grow - the basis for plant growth.

Four Major Components of Soil

- Sand
- Silt
- Clay



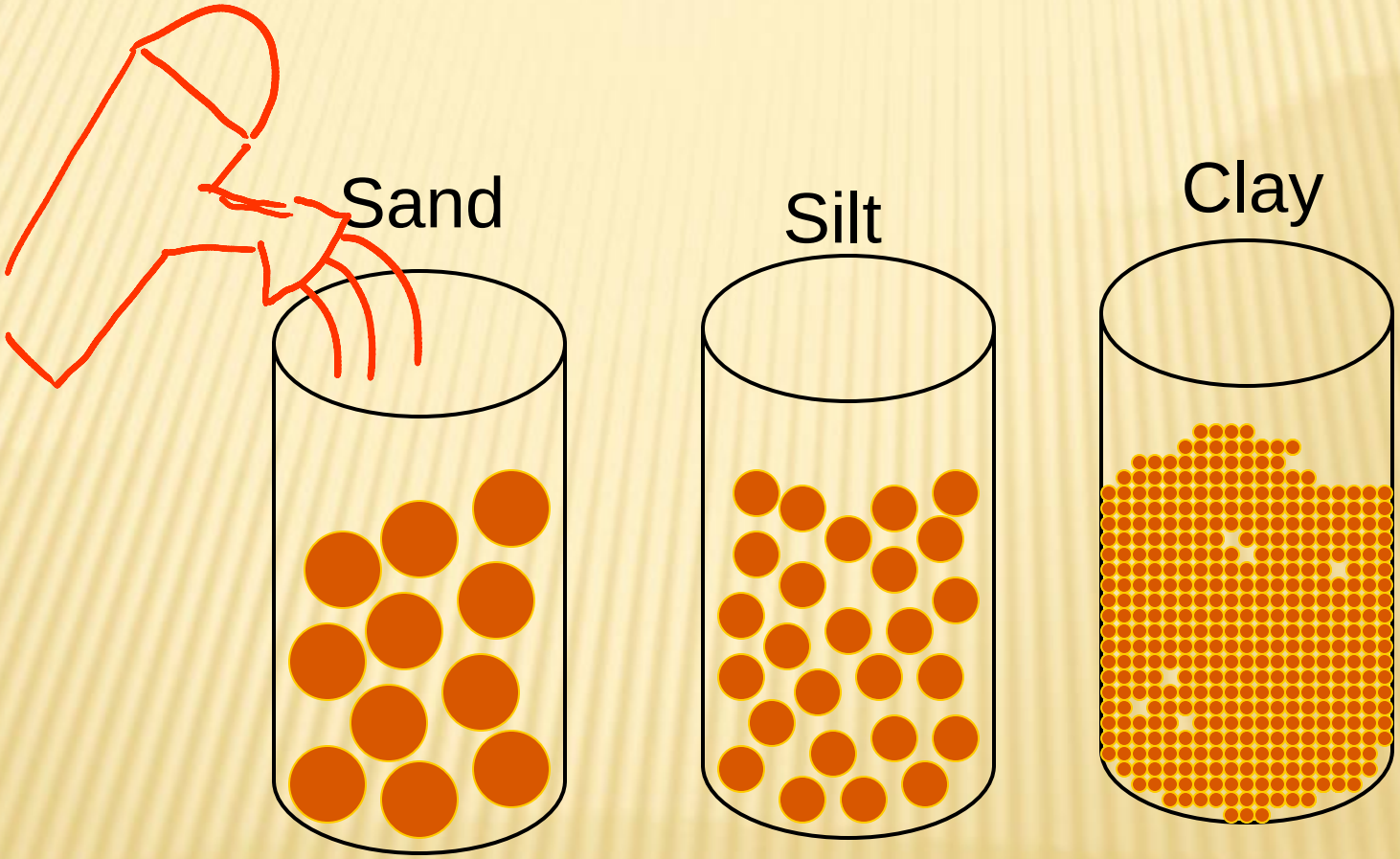
Soil Components



Sand = 2.0 to 0.05mm

Silt = 0.05 to 0.002mm

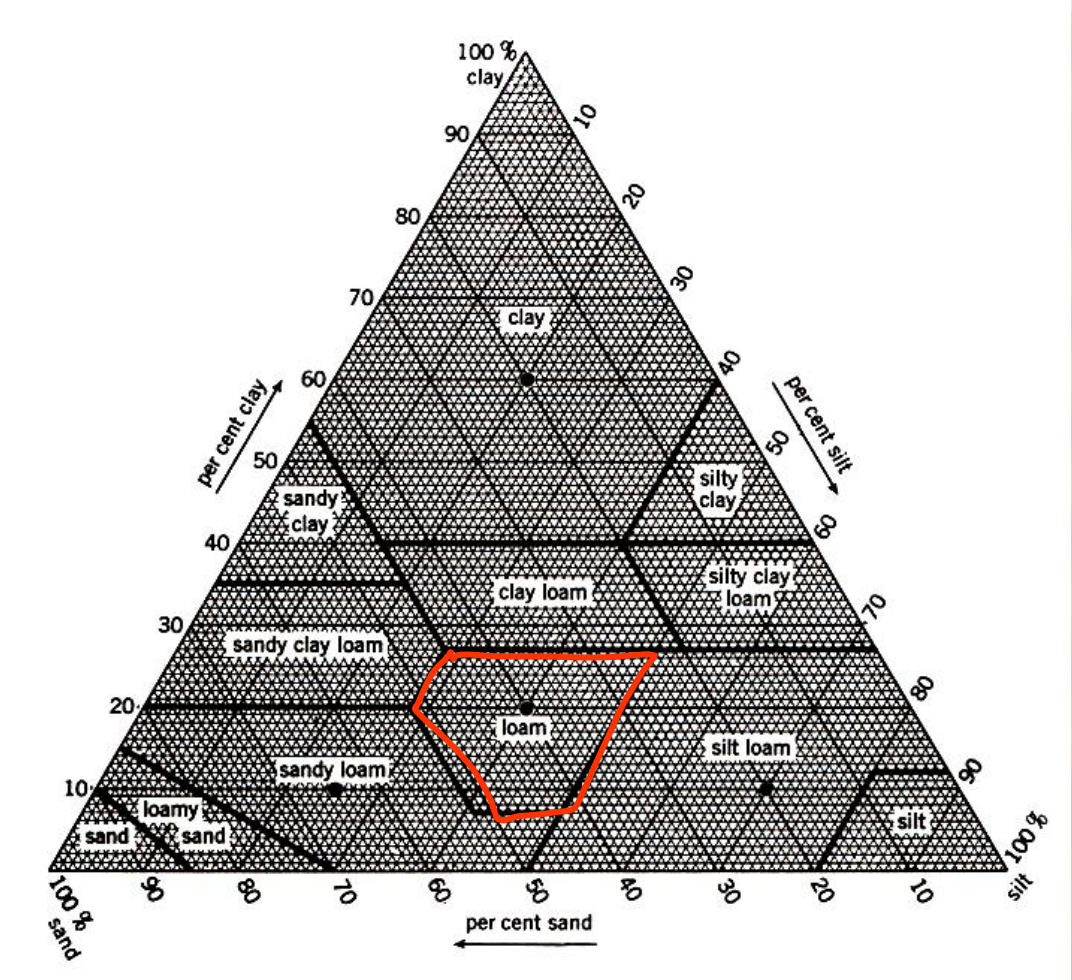
Clay = less than 0.002mm


Sand
Silt
Clay

The proportion of sand, silt and clay determine a soil's texture.

Adding sand to clay to change the soil texture is not practical

So what does help?



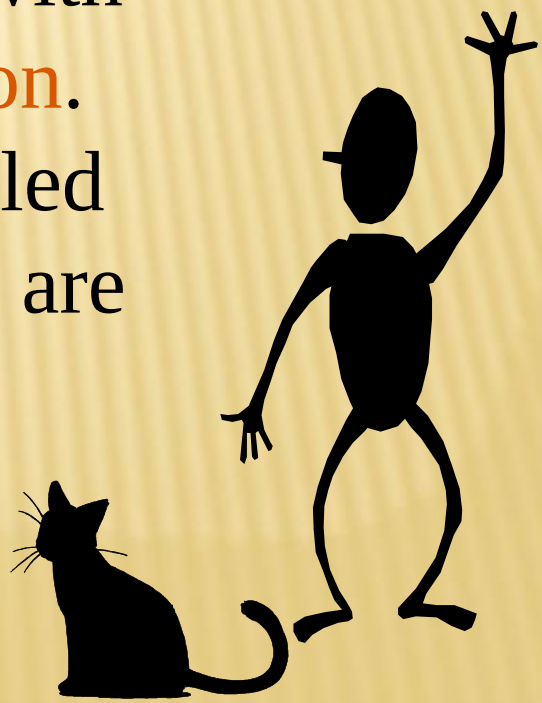
Five Things Organic Matter Does for Soil:

- Improves the soil's physical condition.
- Supplies plant nutrients.
- Increases water infiltration.
- Helps decrease erosion.
- Improves soil *tilth* (the soil's ability to resist compaction).

•••Bonus: It can reduce disease and nematode problems!

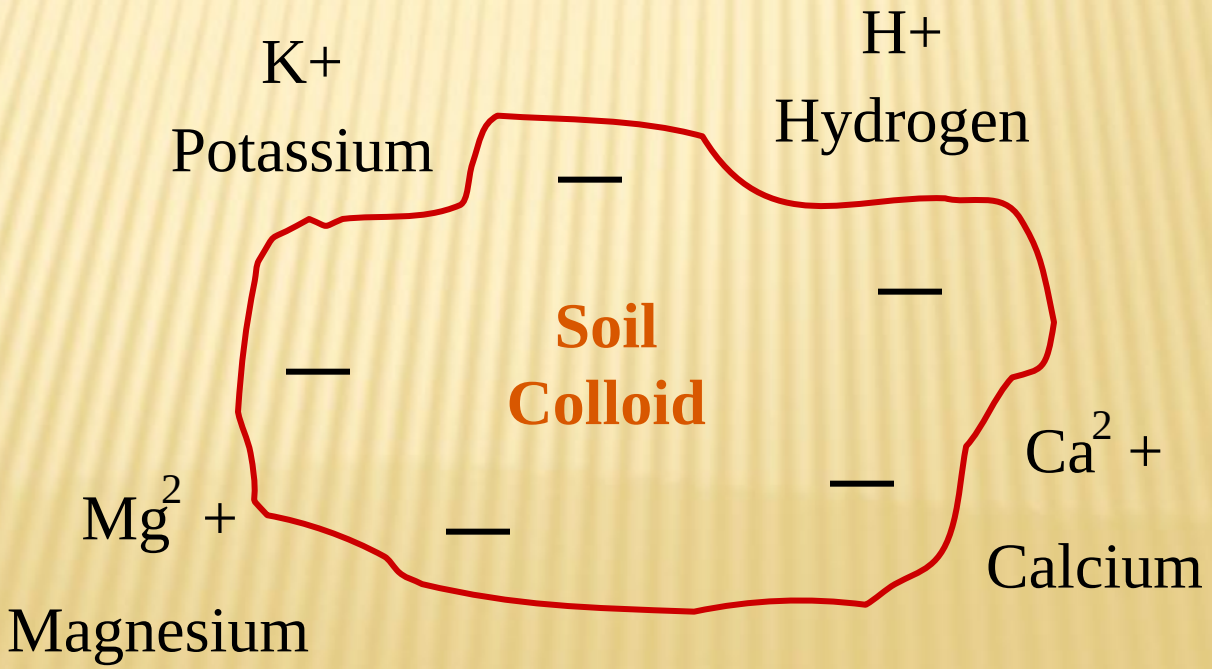
The smallest particles of soil are called colloids. Colloids have a negative charge so they attract positively charged particles. Colloids repel other negatively charged particles - like a magnet.

An element or group of elements with an electrical charge is called an ion. Ions with negative charges are called anions. Ions with positive charges are called cations. Many essential elements are cations.



Unlike a magnet, colloids can only hold a limited number of cations. The total amount of exchangeable cations a soil can hold (the amount of its negative charge) is called its **Cation Exchange Capacity or CEC**.

Organic matter can enhance the soils CEC as can Clay



Plant Nutrients

16 Nutrient elements are essential for plant growth and reproduction.

Plant Nutrients

C HOPKN'S CaFe Mg B Mn Cu Zn Mo Cl

See Hopkin's Cafe Managed By My Cousin Mo Clay

Which are needed in the largest quantities???

Carbon - Hydrogen - Oxygen

The three most abundant elements - plants obtain from water and air.

These three elements make up more than 94% of plant dry tissue. The remaining 13 elements make up less than 6% of plant dry tissue.

Macronutrients

Nitrogen

Phosphorus

Potassium

Sulfur

Calcium

Magnesium

Manganese

Iron

Boron

Zinc

Copper

Molybdenum

Chlorine

Micronutrients

Nitrogen . . . (N)

- **A nitrogen deficiency most limits plant growth**.
- Provides a visual *green* response in plants.
- Plants use large amounts of nitrogen.
- Older leaves may yellow when defecient
- Stimulates plant growth.
- Increases seed and fruit yield.
- Improves the quality of leaf and forage crops.
- Present in the soil in three forms.

Nitrogen is present in the soil in three major forms:

- Organic (amino acids and other complex molecules unavailable in this form but slowly converts to)
- Inorganic (usable forms such as ammonium, nitrate, and urea)
- Elemental (N2 is a gas in the atmosphere – legumes can convert)

NITROGEN DEFICIENCY

Phosphorus . . . (P)

- Also an essential part of photosynthesis.
- Responsible for utilization of starch and sugar.
- Often low on newly cultivated sites
- Often very high on old garden, pasture and crop areas – especially where lots of poultry litter has been used

PHOSPHORUS DEFICIENCY

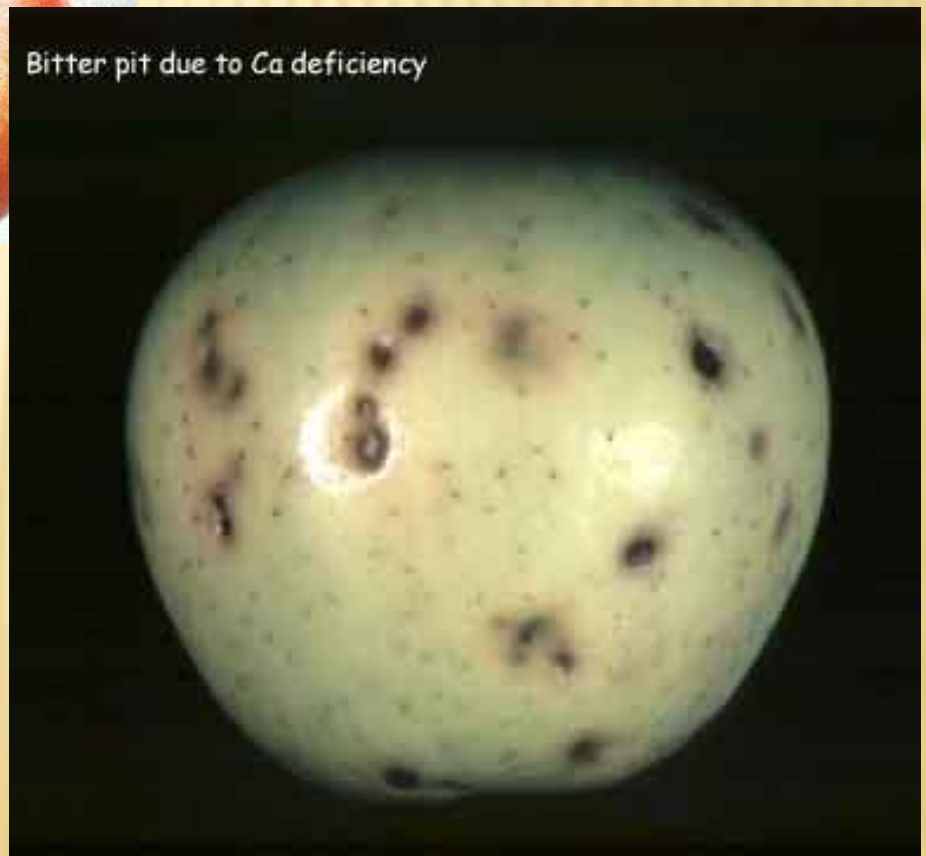
Potassium . . . (K)

- After nitrogen, plants use the largest amount of potassium.
- Plays an essential role in the metabolic process of plants.
- Plays a role in raising the disease resistance of many plant species.
- Excess K can cause Mg deficiencies
- Area between veins may turn yellow when deficient – general slow growth

Calcium . . . (Ca)

- An essential part of the wall structure and strength of plant cells.
- Provides for normal transport and retention of other elements.
- Does not move in plant, deficiency develops in new leaves
- Counteracts the effects of alkali salts and organic acids within the plant.

Blossom End Rot



Bitter Pit of Apple

Magnesium . . . (Mg)

- Is essential for photosynthesis.
- Makes up a part of the chlorophyll in green plants.
- Helps activate plant enzymes needed for plant growth.
- Dolomitic lime and epsom salts contain Magnesium (epsom salts seldom if ever needed if dolomitic lime is used and K levels are not excessive)

MAGNESIUM DEFICIENCY

Sulfur . . . (S)

- Activates plant enzymes.
- Is required for nodulation and nitrogen fixation of legumes.
- Present in glycosides which give the characteristic odors and flavors of mustard, onion and garlic.
- Seldom low near pollution sources of sulfur – as pollution is reduced soil sulfur levels is also reduced

WHAT ABOUT THE MICRONUTRIENTS

- They are just as essential as macronutrients
- They are needed in much smaller amounts
- Soil pH is the critical determining factor on micronutrient availability
- Adding micronutrients is not needed for most garden soils with a proper pH
- Container gardens may need additional micronutrients

NUTRIENT DEFICIENCIES

A note about nutrient deficiencies:

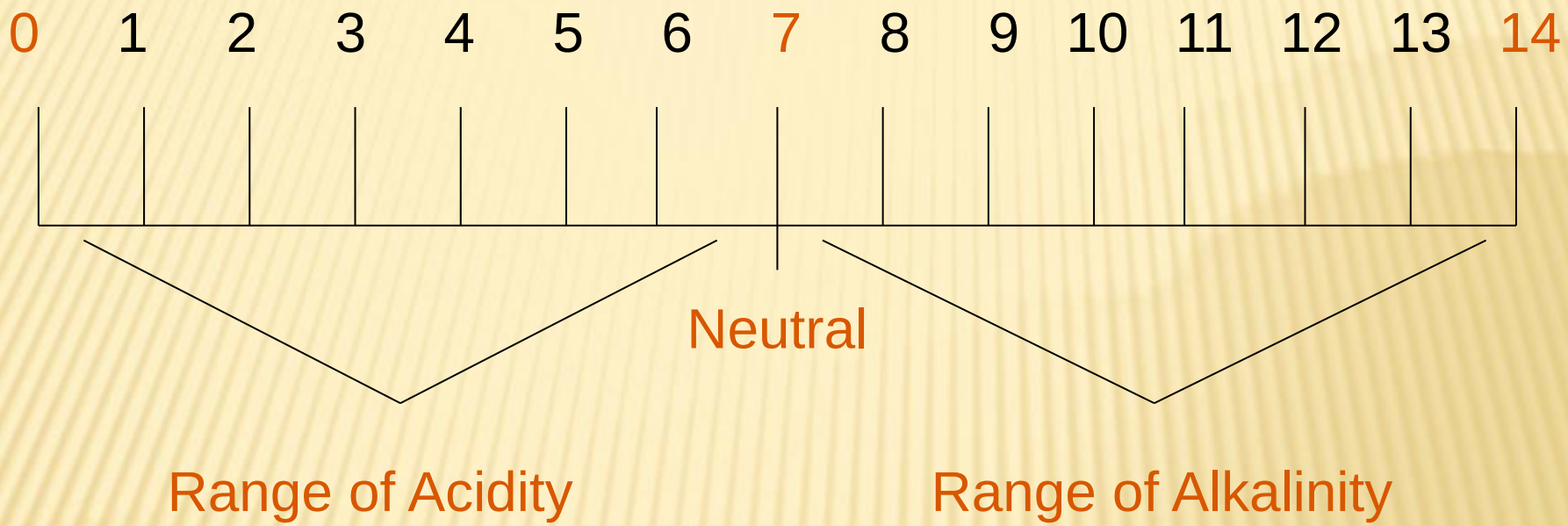
While many deficiencies show specific symptoms this is an inexact science at best.

Many of the symptoms overlap so the only way to be sure is with a combination of tissue analysis and soil sampling.

Soil pH is a measure of the hydrogen ion concentration in the soil.

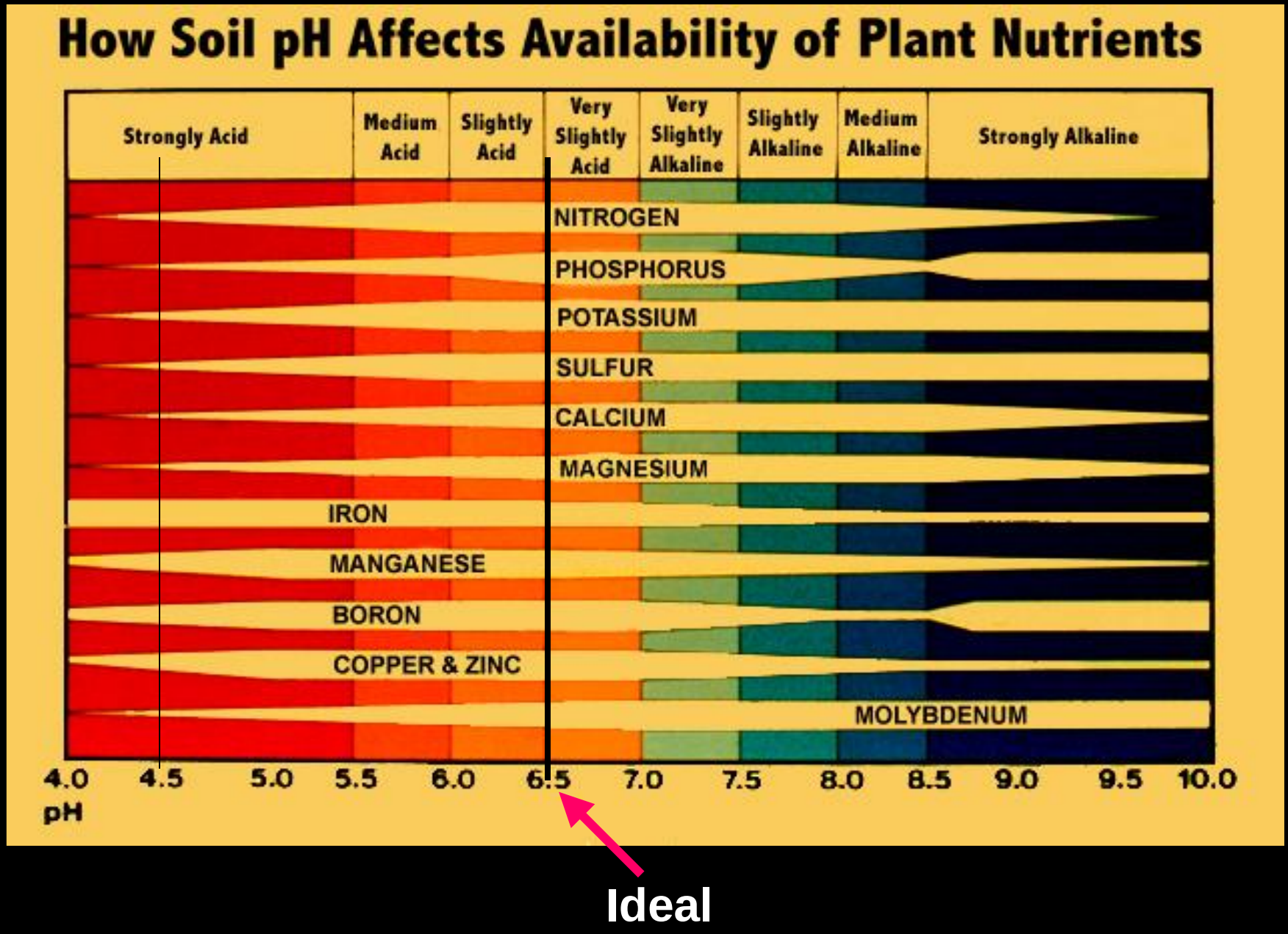
Buffer pH is the soil's ability to resist changes in pH.

pH Units



Optimum pH for most vegetable plants

6 to 6.5

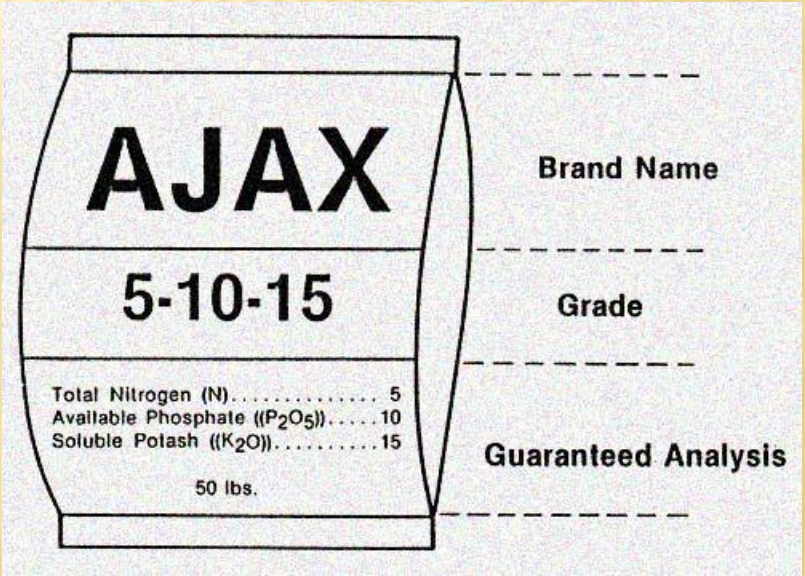

How Soil pH Affects Availability of Plant Nutrients
Strongly Acid
Medium Acid
Slightly Acid
Very Slightly Acid
Very Slightly Alkaline
Slightly Alkaline
Medium Alkaline
Strongly Alkaline
NITROGEN
PHOSPHORUS
POTASSIUM
SULFUR
CALCIUM
MAGNESIUM
IRON
MANGANESE
BORON
COPPER & ZINC
MOLYBDENUM
4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0
pH
Ideal

Liming Materials

- Calcitic Lime
- Dolomitic Lime
- Hydrated Lime
  (Use 75% of the above recommended amount)
- Wood Ashes
  (Use with caution!)

Fertilizer grade (or analysis) refers to how much of an element there is in a fertilizer based on percentage by weight.

Fertilizer ratio describes the relative proportions of N-P-K in a fertilizer.



Fertilizer is referred to as:

- Complete when it contains all three major plant nutrients.
- Incomplete when it lacks one of the major plant nutrients.
- Balanced when it contains *equal* amounts of N-P-K.
- Premium refers to fertilizers that contain the minor elements
- Slow release refers to fertilizers that release the elements slowly over time

LET'S DO SOME MATH

- Many fertilizer recommendation come as pounds of (insert element) per 1000 square feet.
- If you add that much product you will NOT get the right amount because the product contains only a percentage of the element.
- So now what do you do?

To determine the amount of ammonium sulfate a 5,000-sq ft area needs if it requires one lb of nitrogen per 1,000 sq ft...

Area: 5,000 sq. ft.

Fertilizer: Ammonium sulfate (21-0-0)

Rate of Application: 1lb of nitrogen per 1,000 sq. ft.

- Ammonium sulfate is 21% nitrogen.
- 21% is the same as 0.21 or 21/100.
- This means for every 100 lb. of fertilizer there are 21 lb. of nitrogen.
- We need 1 lb of nitrogen for every 1,000 sq. ft.

Using proportions, we can calculate the amount of ammonium sulfate needed to get 1 lb of N. "X" represents the unknown amount being calculated.

$$\frac{21 \text{ lb. N}}{100 \text{ lb. 21-0-0}} = \frac{1 \text{ lb. N}}{X \text{ lb. 21-0-0}}$$

QUESTIONS ABOUT SOIL OR FERTILIZERS