Fundamentals of Avocado Nutrition

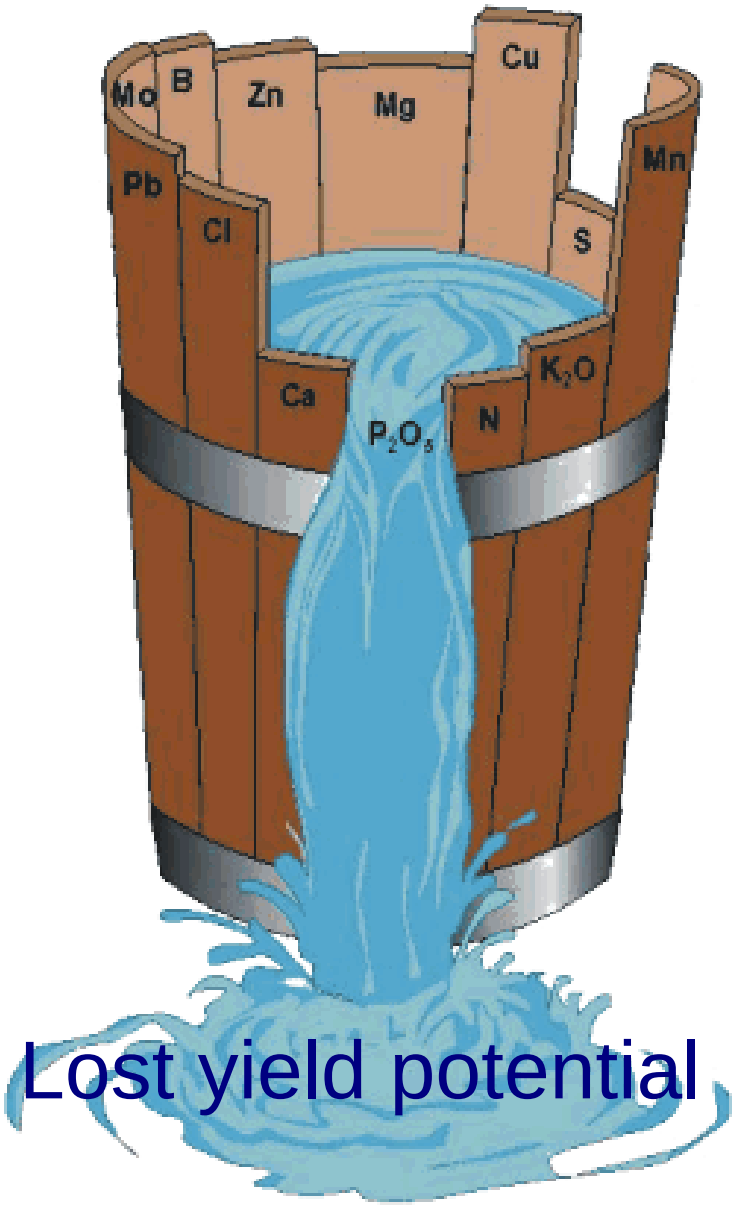
Guy Witney
Manager

PRODUCTION RESEARCH PROGRAM

Law of the Minimum - Liebig's Law

Justus von Liebig, generally credited as the "father of the fertilizer industry", formulated the law of the minimum: if one crop nutrient is missing or deficient, plant growth will be poor, even if the other elements are abundant.

Liebig likens the potential of a crop to a barrel with staves of unequal length. The capacity of this barrel is limited by the length of the shortest stave (in this case, phosphorus) and can only be increased by lengthening that stave. When that stave is lengthened, another one becomes the limiting factor.



Essential Elements

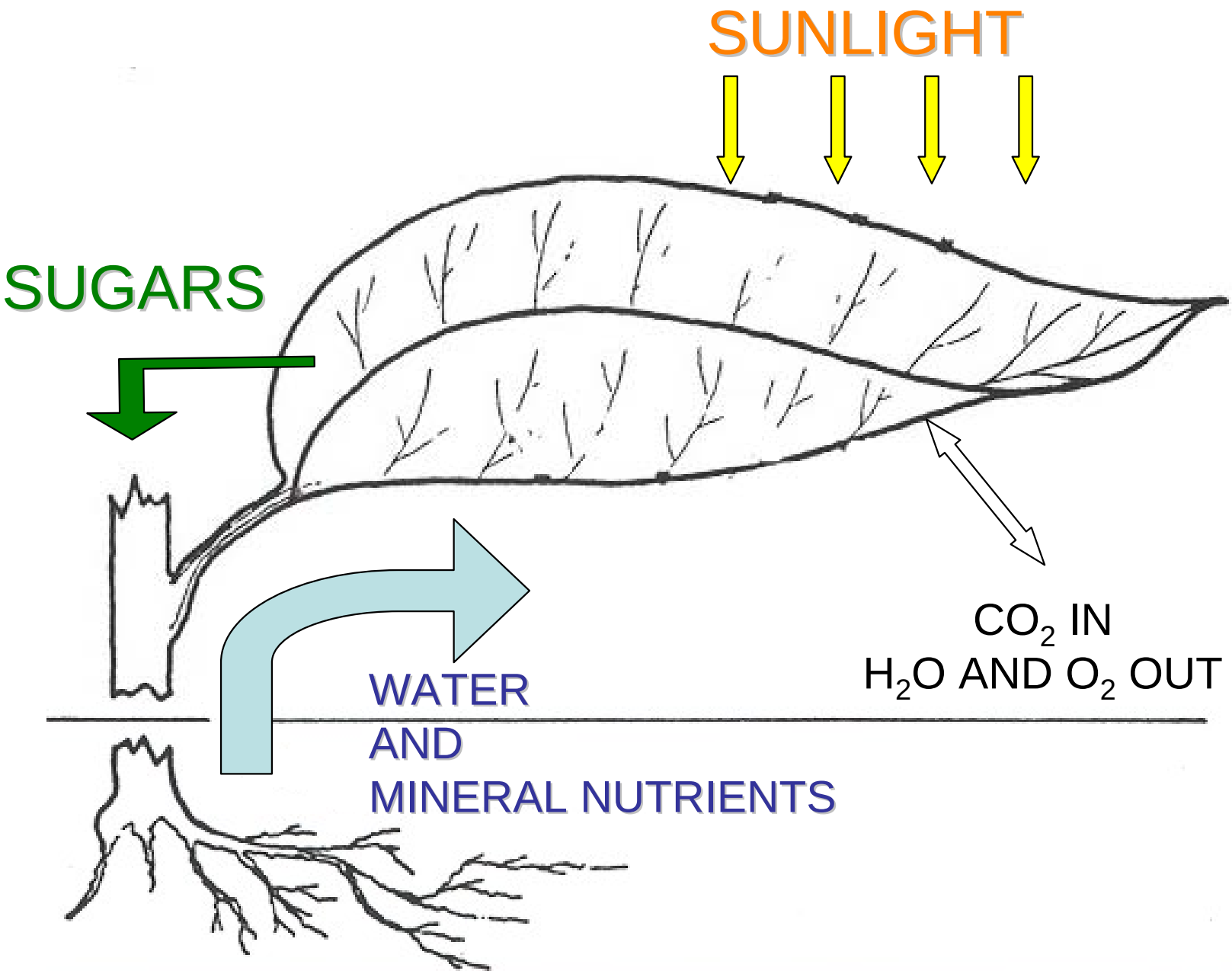
Seventeen chemical elements are known to be essential for avocado growth and production. The sixteen chemical elements are divided into two main groups:
non-mineral and **mineral.**

Essential Elements

Non-Mineral Nutrients are **hydrogen (H), oxygen (O),** & **carbon (C).**

These nutrients are taken up by the tree as air and water.

In a process called **photosynthesis**, avocado trees use **energy from the sun** to change **carbon dioxide** (CO_2 - carbon and oxygen) and **water** (H_2O- hydrogen and oxygen) into starches and sugars. These starches and sugars are the used for growth and fruiting (yield).


SUNLIGHT
SUGARS
CO_2 IN
H_2O AND O_2 OUT
WATER
AND
MINERAL NUTRIENTS

Essential Elements

There are 14 mineral nutrients, which come naturally from the soil or from fertilizers, and are dissolved in water and absorbed through the avocado tree's roots.

The mineral nutrients are divided into two groups: **macronutrients** and **micronutrients**.

Essential Elements

Macronutrients:

Macronutrients can be broken into two more groups: **primary** and **secondary nutrients**.

The **primary nutrients** are **nitrogen (N)**, **phosphorus (P)**, and **potassium (K)**. These major nutrients are often in commercial fertilizers because trees use large amounts for growth and production.

The s**econdary nutrients** are **calcium (Ca)**, **magnesium (Mg)**, and **sulfur (S)**. There are often enough of these nutrients in western US soils, so fertilization is not always needed.

Essential Elements

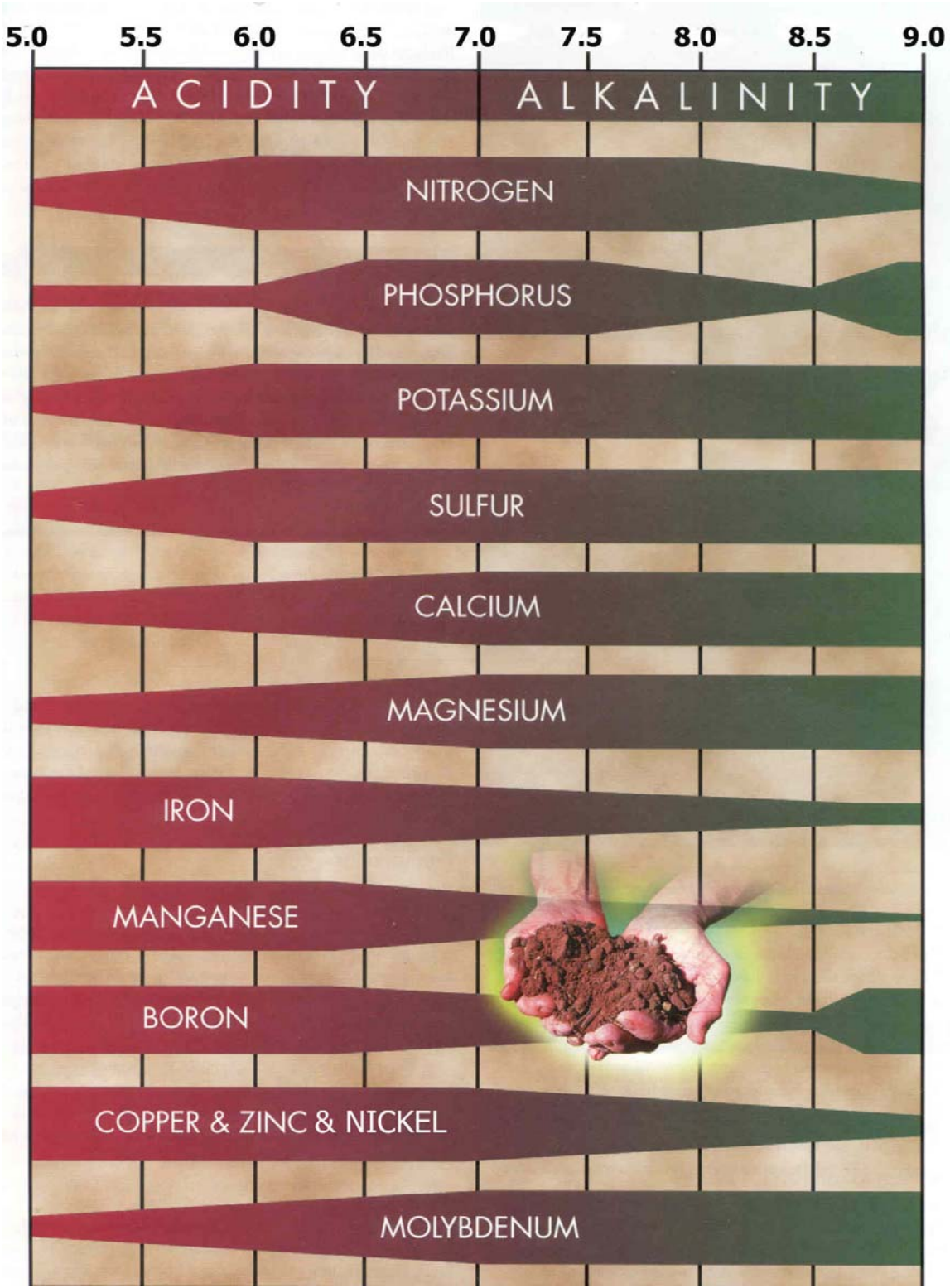
Micronutrients:

Micronutrients are those elements essential for plant growth which are needed in only very small (micro) quantities .

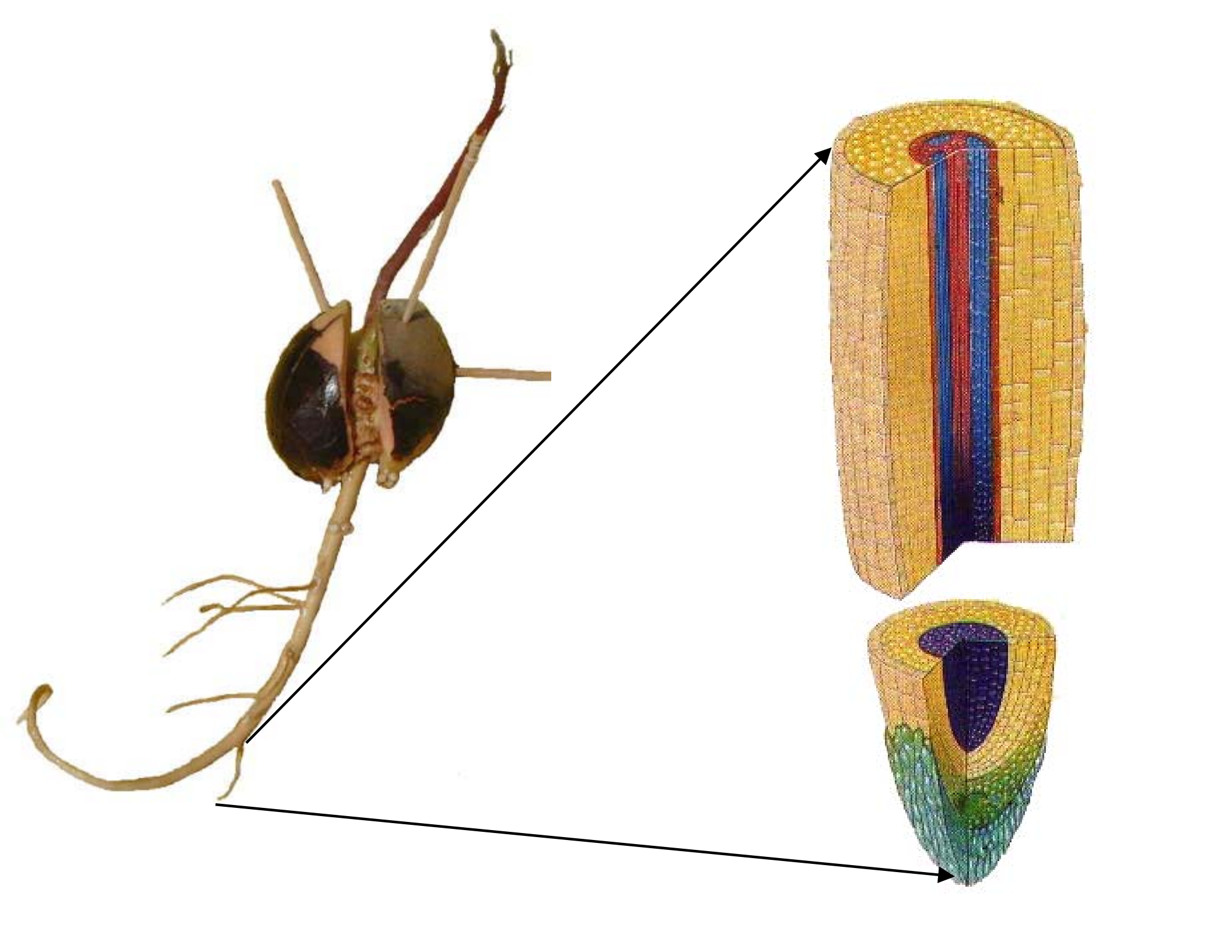
The micronutrients are **zinc (Zn)**, **boron (B), copper (Cu), iron (Fe), chloride (Cl), manganese(Mn), molybdenum (Mo)** and **nickel (Ni).**

(These elements are sometimes called minor elements or trace elements, but use of the term micronutrient is encouraged by the American Society of Agronomy and the Soil Science Society of America).

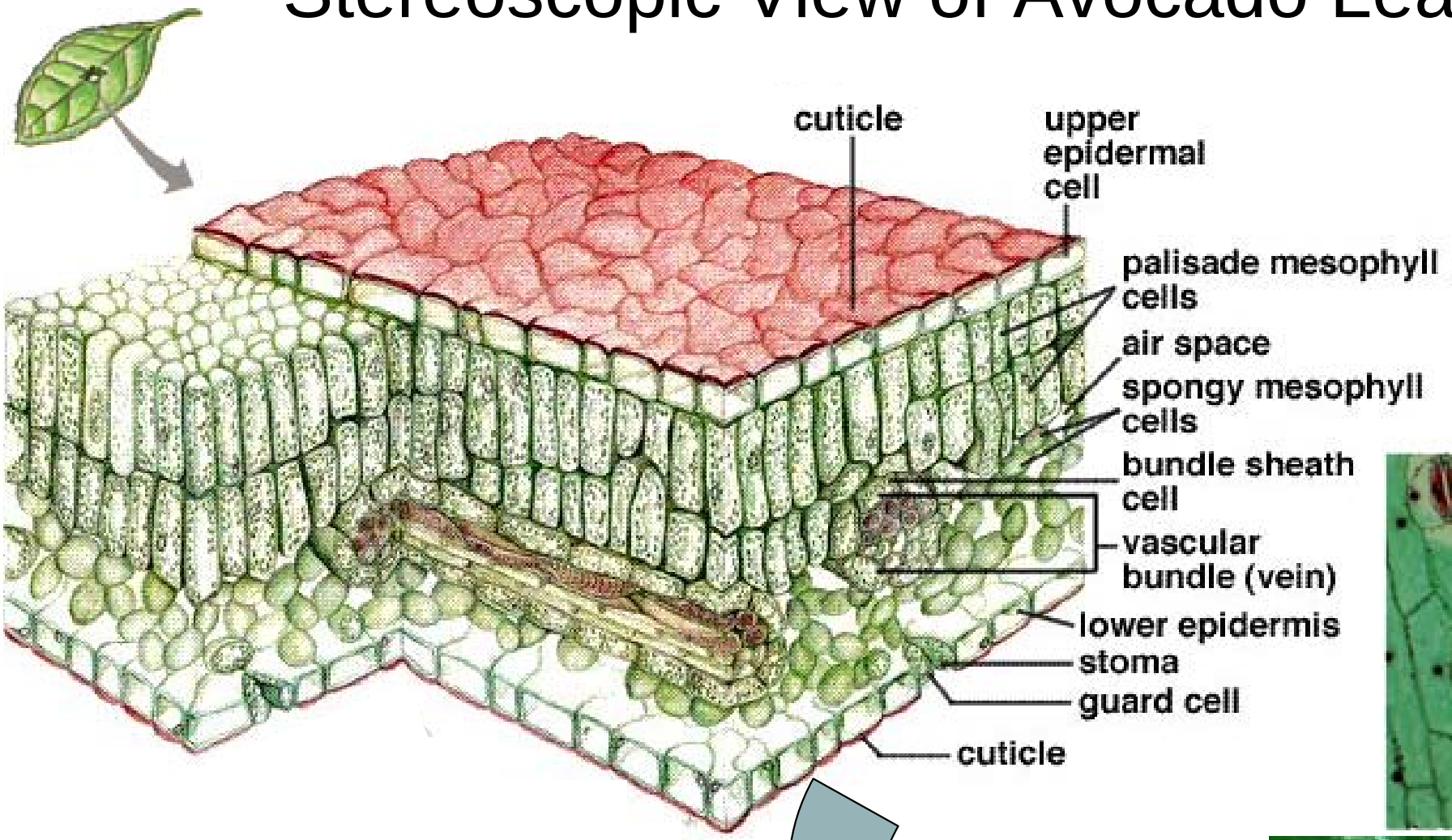
Soil pH has a profound influence on the availability of mineral nutrients - for avocado groves a pH of 6.5 is probably close to optimal.

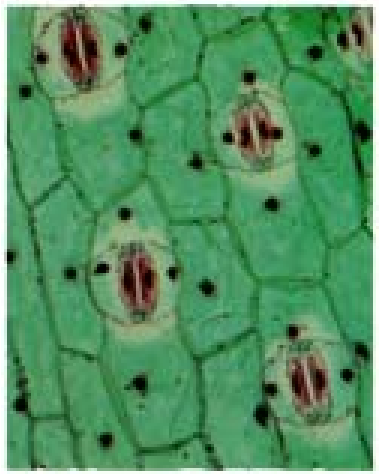



How are nutrients taken up
by avocado trees?



Stereoscopic View of Avocado Leaf



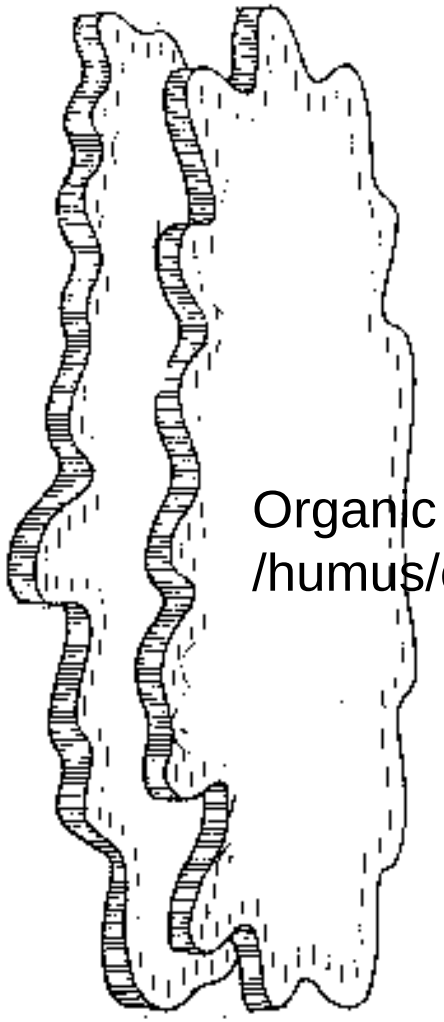


Cation Exchange Capacity (CEC)

Cation Exchange Capacity (CEC) is the ability of the soil to hold onto nutrients and prevent them from leaching beyond the roots.

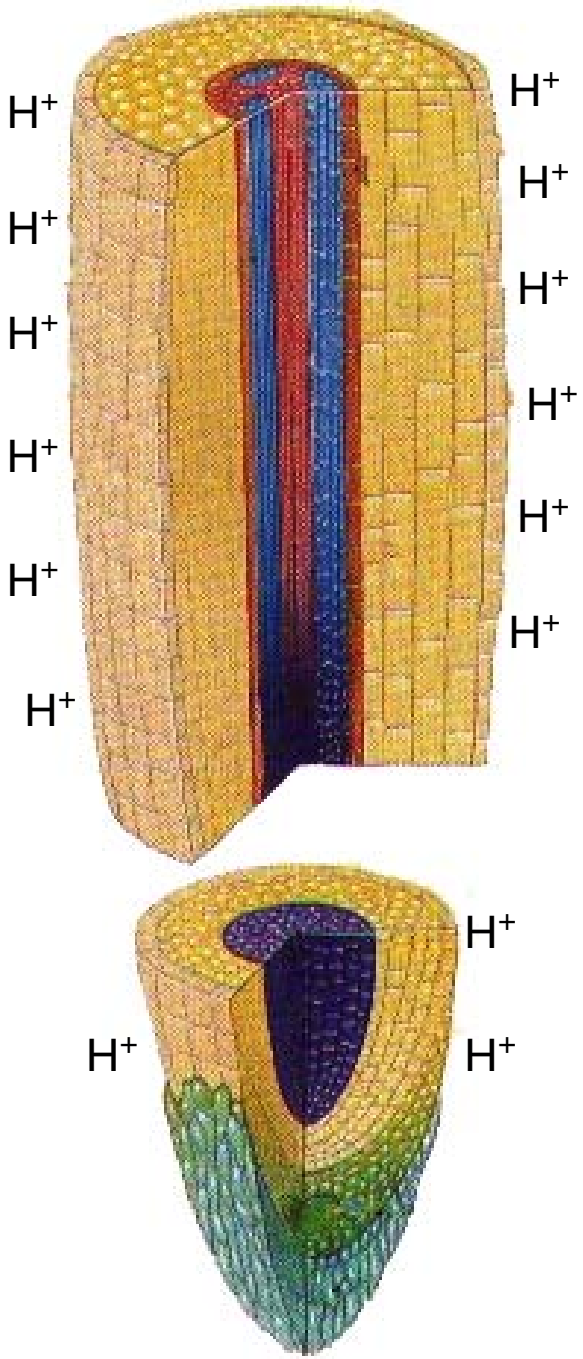
The more cation exchange capacity a soil has, the more likely the soil will have a higher fertility level.

When combined with other measures of soil fertility, CEC is a good indicator of soil quality and productivity.

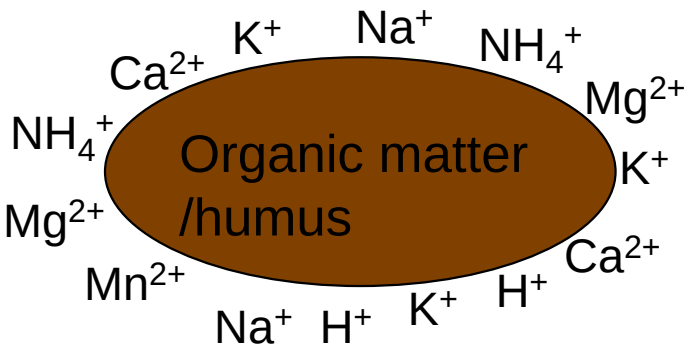


Strong adsorption » > Ca^{2+} > Mg^{2+} > K^{+} = NH^{4+} > Na^{+} >H^{+} » Weak adsorption

Growing root

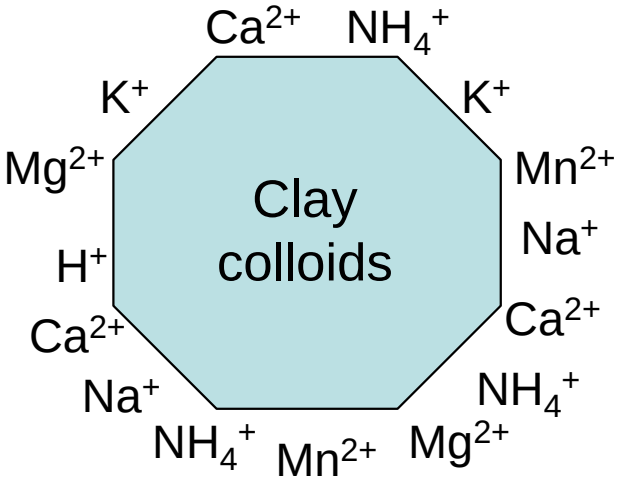


exchange



Region of intense biological activity

exchange



Soil Texture:

Relative Size Comparison of Soil Particles

Sand
(2.00 - 0.05 mm)

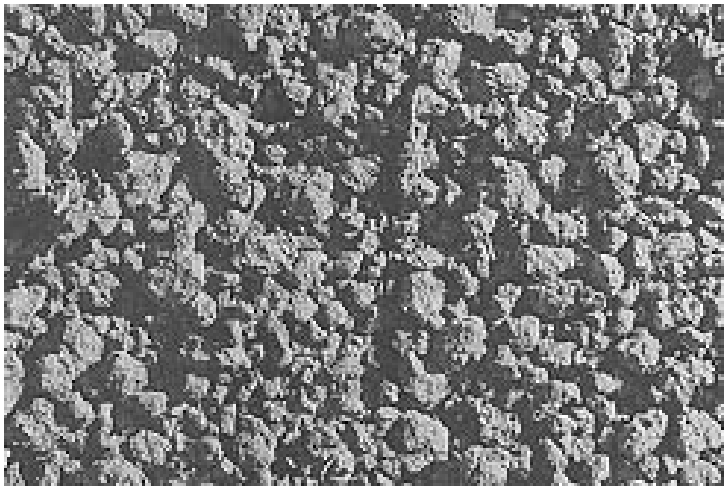
Silt
(feels floury)
(0.05 - 0.002 mm)

Clay
(feels sticky)
(< 0.002 mm)

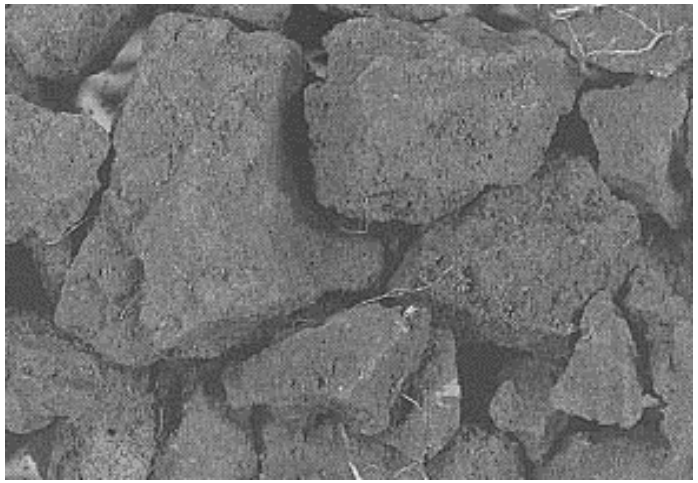
CEC & Soil Texture

Texture	Sand	LS to SL	Loam	Clay Loam	Clay
CEC MEQ/100g	0-3	3-10	10-15	10-30	>30

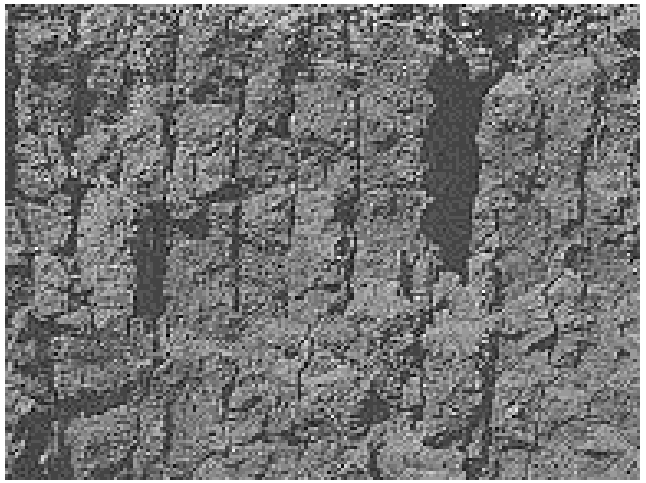
Soil Structure



Granular



Blocky



Prismatic

Columnar

Platy

Single grained

Fertilizer Analysis

Fertilizer analysis refers to a percentage which is based on weight for each nutrient.

The Nitrogen (N) analysis number represents the percentage of elemental Nitrogen (N).

The Phosphorus (P) analysis number represents the percentage of phosphoric acid (P_2O_5).

The Potassium (K) analysis number represents the percentage of soluble potash (K_2O).

Fertilizer Analysis