earthsmart

Our Company

Earth Smart offers innovative and eco friendly solutions that can meet the specific needs associated with a sustainable environment.

Earth Smart has a reputation for developing Earth friendly products using naturally occurring and sustainable sources.

Our line up of "all natural" products will sustain and enhance the health of eco systems and organisms from the smallest in the soil to human beings.

Earth Smart is quickly becoming the global leader in the supply of technically advanced bio based “green” products.

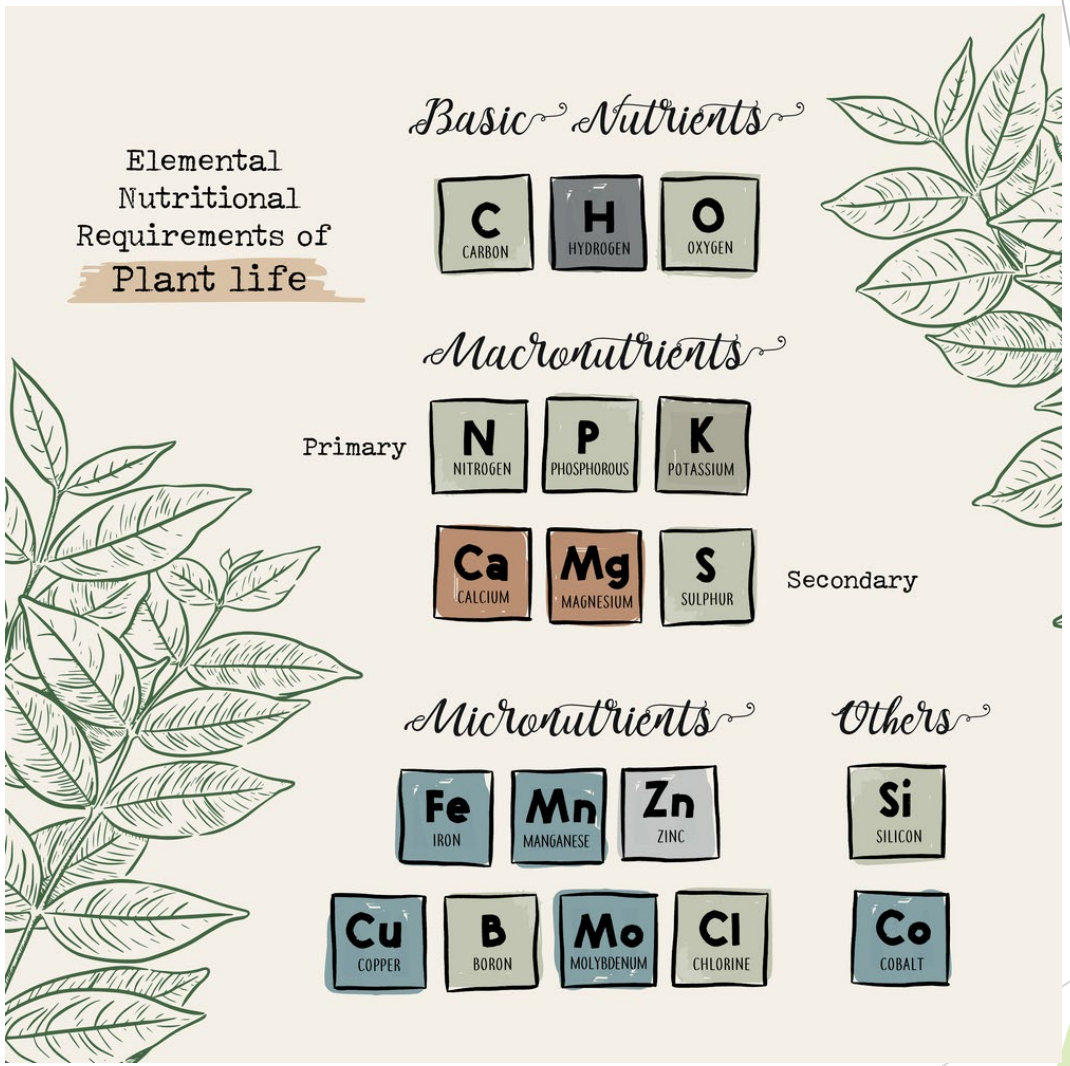
Our commitment to continuous product development using macro and micro-nutrients, enzymes, carbohydrates and amino acids will provide our customers with an innovative, premium product that will set the “responsible solution” standard for generations to come.

The Science

Essential Nutrients for Plants

- Carbon, Hydrogen, Oxygen
- Water
- Macronutrients: Nitrogen, Phosphorus, Potassium
- Secondary Macronutrients
- Micronutrients
- Plus additional vitamins, minerals and trace elements

The Science


Elemental Nutritional Requirements of Plant life
Basic Nutrients
C CARBON
H HYDROGEN
O OXYGEN
Macronutrients
Primary
N NITROGEN
P PHOSPHOROUS
K POTASSIUM
Ca CALCIUM
Mg MAGNESIUM
S SULPHUR
Secondary
Micronutrients
Fe IRON
Mn MANGANESE
Zn ZINC
Cu COPPER
B BORON
Mo MOLYBDENUM
Cl CHLORINE
Others
Si SILICON
Co COBALT

Our product formulations include:

- Macronutrients
- Micronutrients
- Natural Ingredients
- Amino Acids & Enzymes
- Bacteria & Fungi

The Science

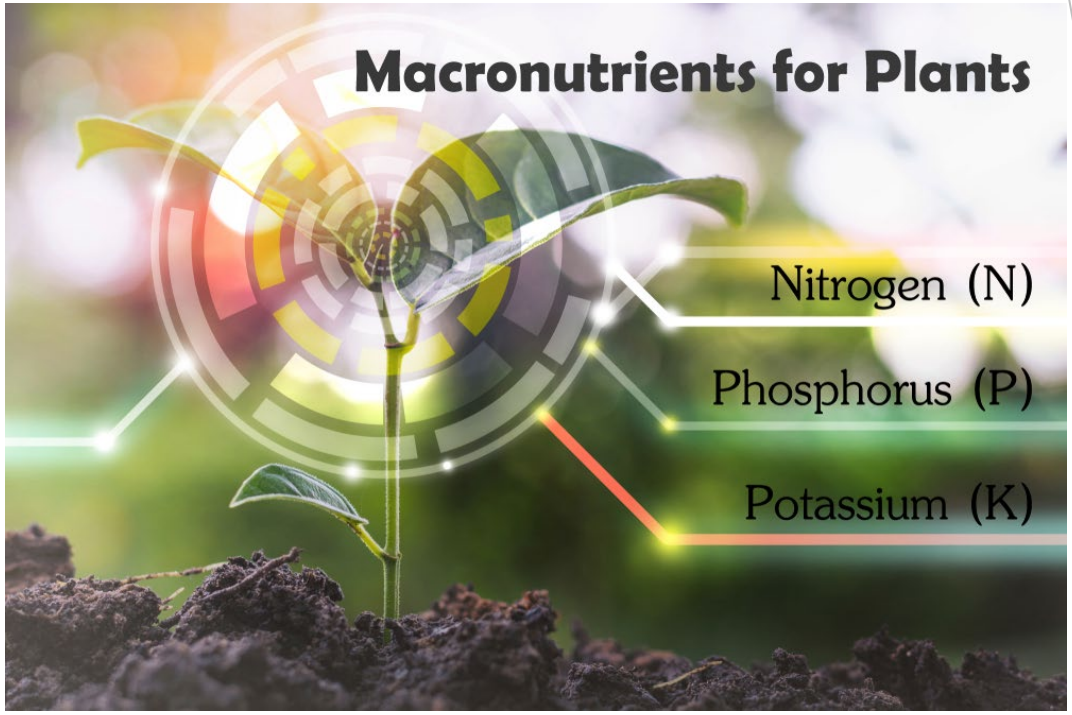
Bio-Stimulants

- Improve the uptake of water and minerals
- Stimulate the plant's natural resistance to pests and disease.
- Condition plants to handle stress
- Generally improve quality and yield

A Compatible Recipe

- The success of our collection of products for plants is based on a tailored blend of beneficial microbes, beneficial bacteria, amino acids and fungi that all play a role in the health of a plant throughout the plant's life and growth cycle.
- Microorganisms are vital for the bioremediation of pesticides existing in the environment
- Our assorted products include different blends of these ingredients in order to maximize plant potential throughout the various stages of the plant's lifecycle.
- A key role of these organisms is the construction of living soils that can break down organic matter and unlock nutrients already found in the soil.
- Having a prosperous blend of Rhizosphere inhabiting organisms depends on the compatibility between different strains of Rhizobacteria and fungi that work together to amplify plant and soil potential.

The Macronutrients



The Macronutrients

The primary nutrients needed for plant growth:

- Nitrogen (N)
- Phosphorus (P)
- Potassium (K)

Plants need macronutrients in large quantities to grow and thrive.

These 3 nutrients are required in larger quantities than other nutrients.

These major nutrients are usually the first lacking from the soil because plants use large amounts for their growth and survival and these elements can leach from soil naturally due to weather conditions, especially during rainy or hot seasons.

Nitrogen (N)

- 1 of the 3 macronutrients
- The growth element - the most important component for supporting plant growth
- Needed to make plant cells
- Promotes large, healthy foliage, absorption by roots and proper plant development
- Part of the chlorophyll molecule, which gives plants their green color and is involved in creating food for the plant through photosynthesis

Nitrogen (N)

- Nitrogen is a major component of amino acids, the building blocks of proteins. Without proteins, plants wither and die.
- Acts as a catalyst for the other minerals
- Aids in production and use of carbohydrates
- How to tell if you have a nitrogen deficiency: Nitrogen-deficient leaves will contain relatively little chlorophyll and tend to be pale green to yellow in color.
- Too much nitrogen can cause stability issues, leaching nutrients and over-stimulating top growth.

Potassium (K)

- 1 of the 3 macronutrients
- The Health Element. It improves the overall health of growing plants and helps them fight against disease and contributes to the quality of fruits and flowers more than any other element.
- It is also known as the "quality nutrient" because of its important effects on factors such as size, shape, color, taste, shelf life, fiber, vigor and other quality-related measurements.
- Enhances many enzyme actions aiding in photosynthesis, carbohydrate metabolism, protein creation and many other functions in plants.
- Assists with disease resistance

Potassium (K)

- Associated with the movement of water, nutrients and carbohydrates in plant tissue.
- Helps enhance translocation of sugars and starches.
- Increases root growth and improves drought resistance.
- Maintains turgor; reduces water loss and wilting.
- Aids in food formation.
- Reduces respiration, preventing energy losses.

Potassium (K)

- Produces grain rich in starch.
- Increases plants' protein content.
- Builds cellulose and reduces lodging.
- Helps retard crop diseases.
- Plants deficient in K are:
  - less resistant to drought, excess water, extreme temperatures and other stressors.
  - more susceptible to pests, diseases and nematode attacks.
  - Stunted in growth and produce reduced yields

Phosphorus (P)

- 1 of the 3 macronutrients
- Essential for all living organisms
- Plants must have phosphorus for normal growth and maturity.
- Phosphorus is essential for the general health and vigor of all plants.

Phosphorus (P)

- Phosphorus plays a role in photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement and several other processes in plants.
- Plants must have a steady supply of phosphorus from seed to harvest.
- Phosphorus is also required by seeds to germinate, as it is an essential element for plants to grow roots.
- Early rooting is the best time to add phosphorus as it energizes the rooting process for better establishment of the plant and for a stronger plant.

Phosphorus (P)

- Some specific growth factors that have been associated with phosphorus are:
  - Stimulated root development
  - Increased stalk and stem strength
  - Improved flower formation and seed production
  - More uniform and earlier crop maturity
  - Increased nitrogen N-fixing capacity of legumes
  - Improvements in crop quality
  - Increased resistance to plant diseases
  - Supports development throughout entire life cycle
- Phosphorus deficiencies usually manifest as a generalized under-performance of the plant—leaf development is stunted and bud size is reduced.

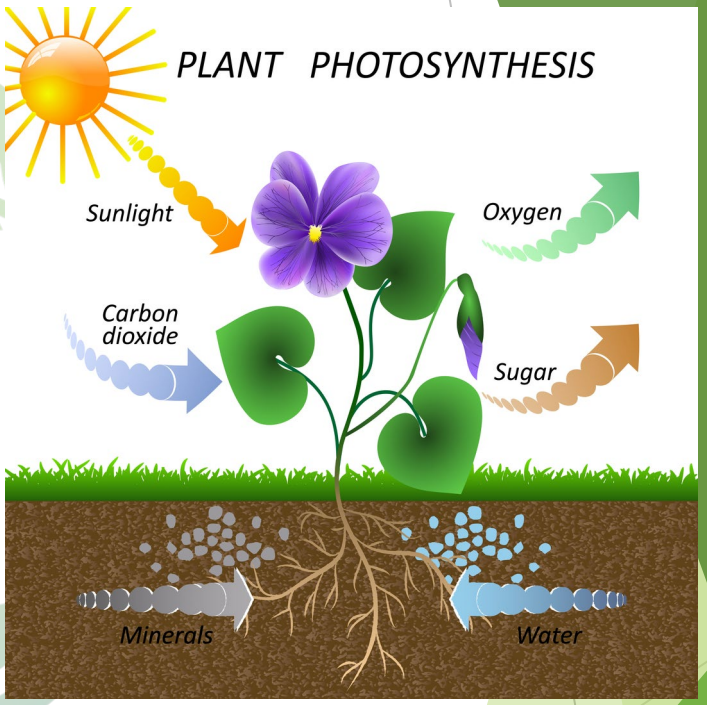
Secondary Macronutrients

Secondary macronutrients that we include in many of our formulations:

- Magnesium (Mg)
- Calcium (Ca)

Magnesium (Mg)

- Actively involved in photosynthesis, as included in each chlorophyll molecule is an atom of magnesium
- Aids in phosphate metabolism, plant respiration and the activation of many enzyme systems
- Acts as a phosphorus carrier in plants



Magnesium (Mg)

- Required for better root formation and thus for better nutrient and water efficiency in plants.
- Magnesium is mobile within the plant and moves easily from older to younger tissues.
- How to tell if you have a magnesium deficiency: When Mg deficiencies occur, the lower (older) leaves are affected first. The bottom leaves of your plant will start to yellow. The yellowing will be in the leaf tissue and the leaf veins will remain green.

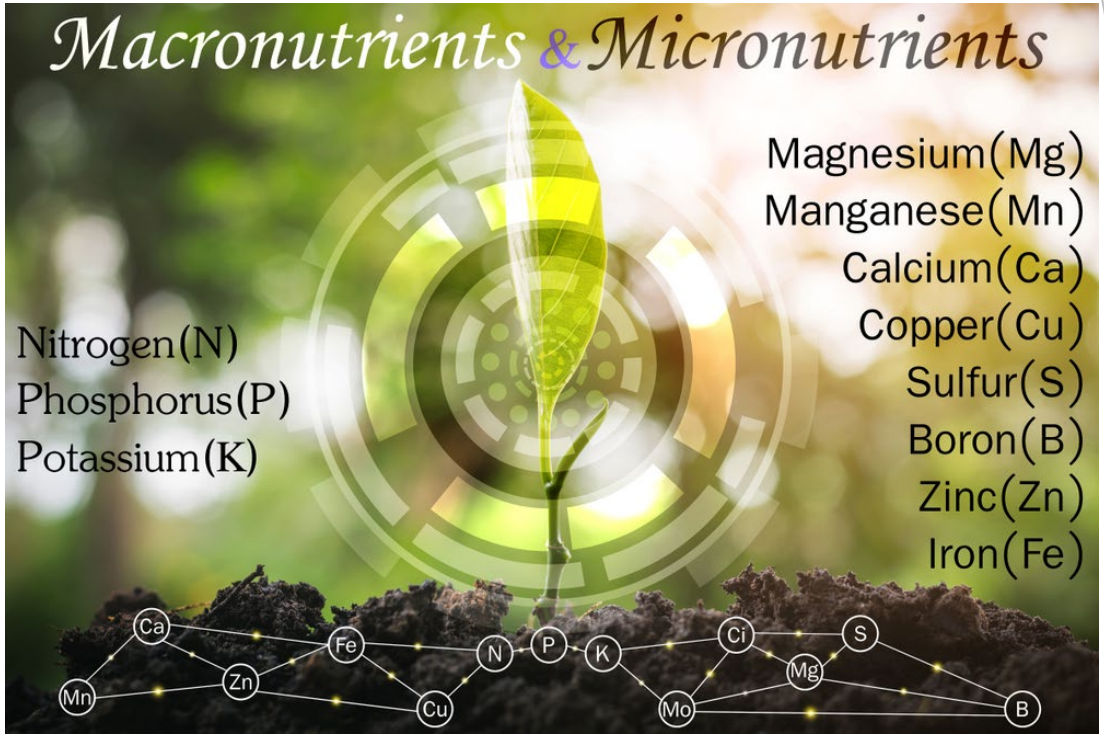
Calcium (Ca)

- Low-key essential nutrient that carries a heavy load in plant growth.
- Essential for microorganisms as they turn crop residue into organic matter, release nutrients and improve soil aggregation and water holding capacity.
- Calcium, along with magnesium and potassium, helps to neutralize organic acids, which form during cell metabolism in plants.
- Builds yield indirectly by improving root growth conditions and stimulating microbial activity, molybdenum (Mo) availability and uptake of other nutrients.
- Stimulates root and leaf development and affects uptake and activity of other nutrients.

Calcium (Ca)

- Calcium also plays a role in other key plant functions:
  - Improves the absorption of other nutrients by roots and their translocation within the plant
  - Activates a number of plant growth-regulating enzyme systems
  - Helps convert nitrate-nitrogen into forms needed for protein formation
  - Necessary for cell wall formation and normal cell division
  - Improves disease resistance.
- Calcium deficiencies occur most often in acidic, sandy soils from which calcium leaches via rain or irrigation water.

The Micronutrients



The Micronutrients

Micronutrients are essential elements that are required in smaller quantities than macronutrients.

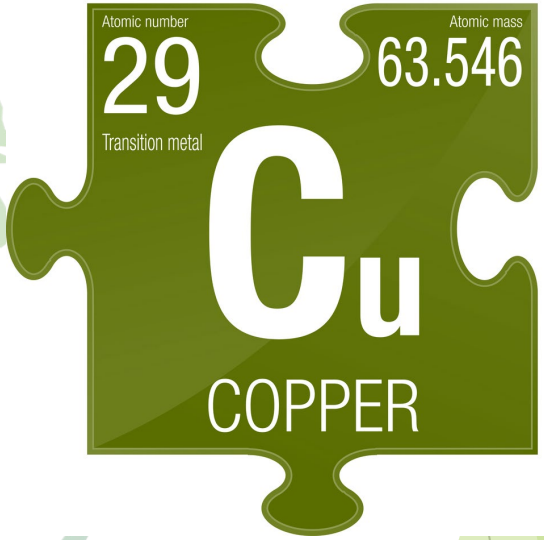
Micronutrients used in many of our products include:

- Copper (Cu)
- Boron (B)
- Iron (Fe)
- Zinc (Zn)
- Molybdenum (Mo)

Micronutrients are not of lesser importance than macronutrients as per the Law of the Minimum: *If any micronutrient is deficient, the growth of the entire plant will not reach maximum yield.*

Copper (Cu)

- Essential element for plant growth. Without adequate copper, plants will fail to grow properly.
- Key to the formation of chlorophyll and required in the process of photosynthesis.
- Essential in several enzyme systems
- Activates some enzymes in plants which are involved in lignin synthesis.



Copper (Cu)

- Essential in plant respiration
- Assists in plant metabolism of carbohydrates and proteins
- Plays an important role in nitrogen utilization
- Serves to intensify flavor and color in vegetables and color in flowers
- Peaty and acidic soils are most likely to be deficient in copper. Soils that already have high alkaline content (above 7.5), as well as soils that have had pH levels increased, result in lower copper availability.

Copper (Cu)

- Copper deficiency in soils has been correlated to lodging in cereal crops, mainly because copper is a nutrient involved in lignification or straw strength, which determines the standability of the plant.
- Low copper can also cause increased disease, increases in ergot and melanosis, twisted flag leaves and an increase of aborted seeds in the head.
- Inadequate levels of copper can lead to poor growth, delayed flowering, and plant sterility.

Iron (Fe)

- Of the micronutrients, iron is needed in the greatest quantity
- Iron is a constituent of several enzymes and some pigments.
- Plays a critical role in metabolic processes such as DNA synthesis, respiration, and photosynthesis.
- Many metabolic pathways are activated by iron and it is a prosthetic group constituent of many enzymes.

Iron (Fe)

- Iron plays a significant role in various physiological and biochemical pathways in plants. It serves as a component of many vital enzymes such as cytochromes of the electron transport chain, and it is thus required for a wide range of biological functions.
- In plants, iron is involved in the synthesis of chlorophyll and is essential for the maintenance of chloroplast structure and function. Without iron a plant can't produce chlorophyll, can't get oxygen and won't be green.
- Assists in nitrate and sulfate reduction and energy production and enzyme functions within plants
- Helps to carry important elements through a plant's circulatory system such as oxygen.

Iron (Fe)

- Iron’s availability is dependent on the pH of the growing medium.
- All micronutrients, except molybdenum, become less available as the growing medium's pH increases, but become more available as the growing medium's pH decreases. The ideal pH range for crops is determined primarily by their ability to acquire micronutrients.
- Soil that is alkaline or has had too much lime added often causes an iron deficiency in the plants.

Zinc (Zn)

- In plants, zinc is a key constituent of many enzymes and proteins.
- Crucial to plant development, as it plays a significant part in a wide range of processes such as growth hormone production and internode elongation.
- Zinc activates enzymes that are responsible for the synthesis of certain proteins.
- Used in the formation of chlorophyll and some carbohydrates

Zinc (Zn)

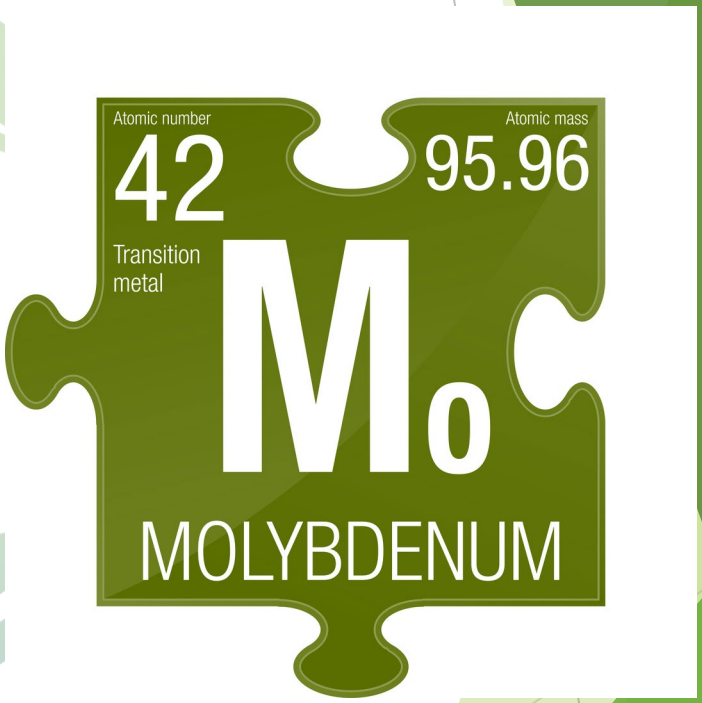
- Involved in conversion of starches to sugars
- Its presence in plant tissue helps the plant to withstand cold temperatures.
- Zinc is essential in the formation of auxins, which help with growth regulation and stem elongation.
- Zinc deficiency is probably the most common micronutrient deficiency in crops worldwide, resulting in substantial losses in crop yields and human nutritional health problems.

Zinc (Zn)

- Symptoms of zinc deficiency include one or some of the following:
  - Stunting - reduced height
  - Interveinal chlorosis
  - Brown spots on upper leaves
  - Distorted leaves
- Leaves discolor when the soil is deficient in zinc and plant growth is stunted. Zinc deficiency causes a type of leaf discoloration called chlorosis, which causes the tissue between the veins to turn yellow while the veins remain green. Chlorosis in zinc deficiency usually affects the base of the leaf near the stem. Chlorosis due to zinc deficiency begins on the lower leaves, while chlorosis due to a shortage of iron, manganese or molybdenum begins on the upper leaves.

Molybdenum (Mo)

- Molybdenum is the only micronutrient that is mobile within the plant.
- In plant growth, it helps in the nitrogen, oxygen and sulfur cycles.
- Molybdenum is an essential component in two enzymes important for nitrogen fixing and nitrogen reduction (nitrogenase and nitrate reductase), that convert nitrate into nitrite (a toxic form of nitrogen) and then into ammonia before it is used to synthesize amino acids within the plant.
- It is also needed by symbiotic nitrogen fixing bacteria in legumes to fix atmospheric nitrogen.



Molybdenum (Mo)

- Plants also use molybdenum to convert inorganic phosphorus into organic forms in the plant.
- In the absence of enough of the mineral, leaves turn pale and eventually die, flowers fail to form and some plant species experience malformed leaf blades in a condition called whiptail.
- Sandy soils and acidic soils contain less available molybdenum for plant growth.

Our product formulations include:

- Macronutrients
- Micronutrients
- Natural Ingredients
- Amino Acids & Enzymes
- Bacteria & Fungi

The Natural Ingredients

- Kelp
- Humic Acid
- Molasses
- Yucca

Kelp

- Completely natural, organic product and a source of over 70 vitamins and minerals, amino acids, trace elements and plant hormones
- Kelp has high levels of cytokinin, a natural growth hormone that promotes cell division in plants, resulting in:
  - root and shoot growth
  - improved photosynthesis
  - overall improvement in plant health
  - greater fruit and vegetable yield - healthier crop yields
- Aids in lateral root development when mixed with Auxins. More root mass means the plant takes up more water and minerals. As a Foliar it helps with lateral plant development.

Kelp

- Contains natural antibiotic properties that can suppress harmful bacteria while promoting the growth of beneficial bacteria.
- Additional benefits of kelp:
  - Effectively maximizes photosynthesis.
  - Promotes root stimulation causing crop enlargement.
  - Promotes flowering and fruit setting.
  - Supplies essential elements for crop growth.
  - Gives crops additional resistance during transport.
  - Maintains soil neutralization.
  - Promotes recognizable soil improvement.

Humic Acid

- Humic acid is a group of molecules that bind to, and help plant roots receive, water and nutrients.
- High humic acid levels can dramatically increase yields.
- Humic acid deficiency can prevent farmers and gardeners from growing crops with optimum nutrition.
- Main benefit of including humic acids in a liquid foliar application is that the plant will be able to uptake and utilize the nutrients in the solution many times more effectively than without the humates.
- In the soil, humic and fulvic acids are important chelators, combining minerals into organic compounds that are more available to plants.

Humic Acid

- Humic acid benefits:
- Increases nutrient uptake by making nutrients more available. Without humic acids present, some of the nutrients provided by fertilizers become inaccessible to plants.
- Decrease toxins. They tie up toxins, making them less available to plants. They chelate harmful toxins in the soil, preventing them from entering the plant. These pollutants degrade the soil quality, and without proper remediation, they continue to degrade crop health and volume. These toxic molecules are captured by humic molecules and locked up. Unlike nutrients, they're not uptaken by the plants, and eventually they're flushed away. This vital process keeps plants healthier in today's increasingly challenging growing environments.
- Increase the water infiltration and water-holding capacity of the soil. The negative charge of humic acids attracts positive ions, or cations, which stick to the humic molecule. These cations, in the presence of water molecules, move slightly away from the humic molecule and attach loosely to the oxygen end of water molecules. The hydrogen ends of those water molecules then attach to the hydrogen ends of other water molecules. This effect reduces water evaporation by up to 30%.

Humic Acid

- Improve microbial growth. Humic acids aid the growth of microbial populations by:
  - providing a source of carbon which serves as a food source for microbes.
  - due to their large size, they provide a source for microflora to colonize.
  - Humic acids provide food and shelter to beneficial microbes, which explains why microbial populations flourish in the presence of humic acids.
- Better overall soil structure. Although humic acid has a net negative charge, it carries both positive and negative charges. And it has a very large molecular size. Because of these properties, humic acids are able to bond to all soil particles, which creates necessary space for microbes and healthy root growth. This is especially noticeable in high-clay and compacted soils, where soil particles are bound tightly together. Humic molecules are even capable of standing clay particles on end, which allows more space and water penetration. Further, they remove salts from clay, which restores a negative charge from the clay particles, forcing them apart.
- Increase plant root growth and metabolism
- Enhance seed germination

Humic Acid

- Help improve plant's health and to deal with environmental stresses, making them more resistant to stress, grow larger in size and volume and have higher fruit production.
- Remove odours in slurry and compost piles
- Humic acids are extremely important as a medium for transporting nutrients from the soil to the plant because they can hold onto ionized nutrients, preventing them from leaching away.
- Humic acids are also attracted to the depletion zone of the plant root. When they arrive at the roots, they bring along water and nutrients the plant needs.

Molasses

- Molasses is the by-product of beating sugar cane, grapes or sugar beets into sugar.
- Molasses is full of vitamins and minerals and concentrated important trace elements.
- Using molasses in gardens has the additional benefit of fighting off pests. This is because molasses increases the overall vitality of plants, making pests less likely to attack your garden.

Molasses

- Using molasses as fertilizer provides plants with a quick source of energy and encourages the growth of beneficial microorganisms.
- Cane Molasses is an excellent source of carbon energy (food) for beneficial microbes. Microbes in the soil include bacteria, fungi and algae. Soil structure is built up over a long time and it is maintained by the microbes in the soil that digest the organic matter, mostly leaves, that cover the ground each fall. Microbes are responsible for building soil structure, ie making your soil better. The organic matter added to the garden is the food source for the microbes. The greater the amount of microbial activity in the soil, the healthier plants will be.
- Cane molasses feeds the microorganisms and microorganisms feed the plant

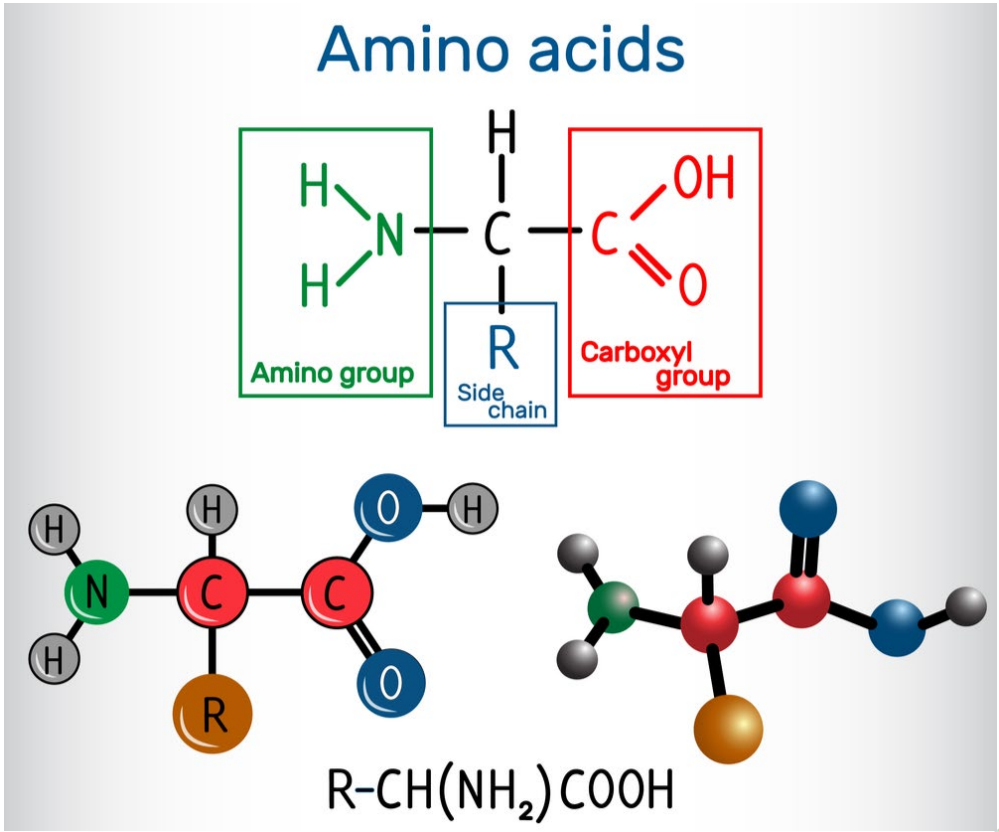
Yucca

- Natural wetting agent
- Keeps organic molecules and minerals in suspension with each other.
- Helps flush salts and other contaminants out of the root zone.
- When used on soil, it helps the bio stimulants and minerals move throughout the root zone to penetrate deeper and more evenly. Finer web of roots. Roots sponge.
- Releases the surface tension of water. Help spread water droplets across the leaf from or even absorption.

Our product formulations include:

- Macronutrients
- Micronutrients
- Natural Ingredients
- Amino Acids & Enzymes
- Bacteria & Fungi

Amino Acids

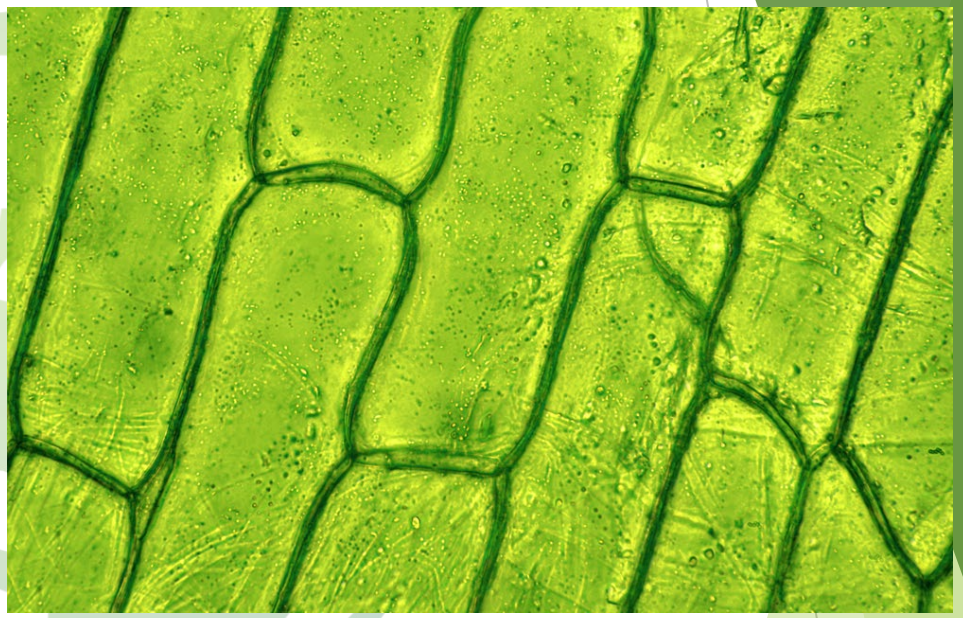

Amino acids
H
H
N
H
C
C
OH
O
R
Amino group
Side chain
Carboxyl group
H
H
N
H
C
C
O
H
O
R
R–CH(NH2)COOH

Amino Acids

- Plants can produce amino acids, but this synthesis is highly energy consuming. Therefore, the application of ready for uptake, amino acids allows plants to save energy and increase the pace of their development.
- Amino acids can play different roles in plants, such as stress-reducing agents, nitrogen source and hormone precursors.
- Better root growth favored by addition of amino acids can enhance the biologic nitrogen fixation, which leads to a greater production of ureides.

Amino Acids

- Helps to increase chlorophyll concentration in the plant leading to higher degree of photosynthesis.
- Increased plant yield when used in conjunction with humic acid extracts.
- Increases the nutrient uptake by plants from the environment.



The Enzymes

Plant Promoting Enzymes

- Enzymes
- Enzymes 1, 2, 3

Enzymes

- Almost all biochemical reactions in living cells require the participation of enzymes, biological catalysts which speed up reactions, by lowering the activation energy without becoming altered during the reaction.
- Enzymes in soil play a significant role in soil organic matter transformation and nutrient cycling.
- Agricultural enzymes are the catalyst that accelerate the chemical reaction that unblocks the nutrients present in the soil and makes it available to plant roots.
- They are also used for crop fertility and protection against various pests and diseases.

Enzymes 1, 2, 3

- Enhances crop growth
- Control agents of plant diseases
- Improves yield and nutritional content in crops
- Improves soil quality

Enzymes 1, 2, 3

- Plays a role in the degradation of decaying plant matter, helping micro-organisms unlock usable nutrients for improved plant growth.
- Increases digestibility of silage
- Improves nutritional properties of agricultural silage and grain feed.
- Used for fermentative composting

The Bacteria

Our products are formulating using a blend of various Bacillus, Pseudomonas, and Paenibacillus bacteria that work together to protect the plant, aid in growth and improve soil quality.

- Bacteria
- Bacillus
- Bacillus Spp. 1, 2, 3
- Paenibacillus
- Paenibacillus Spp. 1,2
- Pseudomonas
- Pseudomonas Spp. 1,2,3

Bacteria

- Plant Growth Promoting Rhizobacteria (PGPR) have the ability to elicit Induced Systemic Resistance (ISR) in plants, which triggers the plant's natural defense response prior to actually being affected by pathogens or infections, effectively reducing or eliminating the severity of disease on plants.
- Having a mixture of several strains of PGPR will result in a more stable Rhizosphere community.
- It has been found that by simultaneously applying nitrogen and phosphorus with rhizobacteria it was possible to improve growth, yield, and quality of crops.

Bacillus

- Several species of Bacillus (Bacillus Spp.) are used in our product formulations
- Each species of Bacilli plays a different role in plant health and soil vitality. Some of these roles include:
  - Increasing the availability of nitrogen in soil
  - Breaking down organic matter to create usable plant nutrients
  - Mineralizing the soil
  - Production of antibodies
  - Guarding plant roots from disease

Bacillus Spp. 1, 2, 3

- These species of Bacilli found in our agricultural products are capable of:
  - Combating bacterial and fungal root pathogens like Fusarium and Rhizoctonia
  - Shown to reduce the impact of abiotic stressors on plants, improving tolerance to drought and salty soils.
  - Enhancing availability of phosphates
  - Producing cell-wall-degrading substances, such as chitosanase, protease, cellulase, glucanase, lipopeptides and hydrogen cyanide causing damage and degradation to pathogenic bacteria, fungi, nematodes, viruses and pests.

Bacillus Spp. 1, 2, 3

- Significantly increases plant growth by enhancing the NPK and chlorophyll contents of plants
- Inhibitor of Sclerotinia Stalk Rot
- Promotes nutrient uptake in plant roots
- Enhances root hair
- Increases plant biomass

Bacillus Spp. 1, 2, 3

Improves water and nutrition absorption capacity during the early plant growth stages

- Colonization and protection of root systems
- Capable of inducing plants ability to produce insect toxins, neutralizing the effects of insect herbivores on plants
- Secretion of metabolites that trigger plant growth

Paenibacillus

- Closely related to Bacillus but in a sperate genus
- There are many species of Paenibacillus that are well known for their plant growth promoting abilities.
- Plays a key role in inducing a plants own resistance mechanisms and enabling it to produce its biocidal substances, effectively neutralizing phytopathogens and insect herbivores.
- Possesses extraordinary capabilities at fixing nitrogen in the environment.

Paenibacillus Spp. 1,2

- Capable of fixing atmospheric nitrogen
- Phosphate solubilization
- Can produce antibiotic compounds like polymyxin and antifungal compounds like fusaricidin that can suppress the growth of pathogens.
- Synthesizes phytohormones like indole-3-acetic acid (IAA) that are readily absorbed by plants, especially in the roots.

Paenibacillus Spp. 1,2

Produces exopolysaccharides which also protect the plants from pathogens.

- Releases siderophores, enabling the plant to acquire iron in the soil
- Induces systemic resistance
- Effectively maintains soil fertility

Pseudomonas

- The major benefit of utilizing Pseudomonas in our products is their innate ability to remove toxic pollutants like pesticide residues from soils that can reduce bio-activity in the rhizosphere.
- Suppressor of soilborne diseases
- Stimulates plant immune defences
- Pseudomonas are suitable for application as biological control agents due to their abundant population in natural soils and plant root system and their capability to utilize many plant exudates as nutrients

Pseudomonas Spp. 1,2,3

- Supports plant growth
- Known to quickly colonize the rhizosphere of plants thus outcompeting plant pathogens.
- Plant growth promoting traits such as nitrogen fixation, phosphate solubilization, iron chelation and phytohormone production.
- Siderophores are organic compounds produced by pseudomonas which sequester most of the available Fe 3+ in the rhizosphere and starve the pathogens for their iron requirement and thereby play a main role in defeating pathogens in the same ecological niche.
- Can produce cytokinins

The Fungi

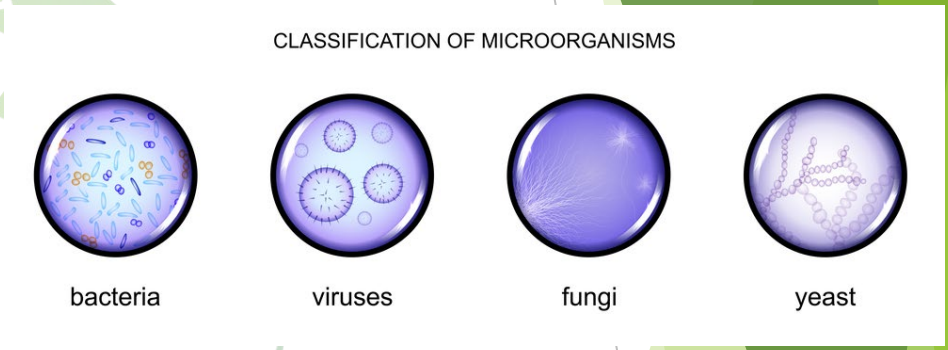
- Streptomyces Spp.1
- Trichoderma
- Trichoderma Spp. 1,2
- Glomus Spp,1,2

Streptomyces Spp.1

- Classified as a “actinomycetes” which are microorganisms intermediate in form and function between bacteria and fungi
- Out of all rhizosphere microbes, actinomycetes are regarded to be special in plant growth promotion because they exhibit many useful traits Their filaments and ability to sporulate help them cleave strongly to the rhizospheric soil particles forming a strong bond with the plants.
- The Streptomyces genus, which is the most abundant and arguably the most important actinomycetes, is a good source of bioactive compounds, antibiotics, and extracellular enzymes.

Streptomyces Spp.1

- Solubilizes phosphate in phosphate-deficient soils
- Directly promotes plant growth by the production of phytohormones (auxins, cytokinins and gibberellins)
- Can be used as an agent against fungal plant pathogens like Fusarium, Pythium, Phytophthora, Rhizoctonia and Verticillium



Trichoderma

Trichoderma fungi's main function is acting as a biocontrol agent. They protect the plant by:

- colonizing the soil and/or parts of the plant, occupying a physical space and avoiding the multiplication of the pathogens
- producing cell wall degrading enzymes against the pathogens
- producing antibiotics that can kill the pathogens
- promoting the plants natural development
- inducing the defensive mechanisms of the plant

Trichoderma

- Trichoderma fungi have also proven to promote non pathogenic bacteria and beneficial mycorrhizal bacteria that is naturally occurring in the plant habitat.
- Trichoderma strains act as bio fungicides against soil, foliar and vascular pathogens

Trichoderma Spp. 1,2

- Improves seed germination
- Increases plant size
- Increased augment of leaf area and weight
- Effective biocontrol agent for a number of plant fungal diseases
- Capable of systemically activating plant defence mechanisms including priming – that will anticipate pathogen attack

Trichoderma Spp. 1,2

- Can produce a variety of enzymes, including cellulases and chitinases which can degrade cellulose and chitin respectively.
- Biological control against plant pathogenic fungi
- Enhances the solubilization of mineral nutrients, to induce secondary metabolites production
- Produces growth-regulating compounds in plants

Glomus Spp,1,2

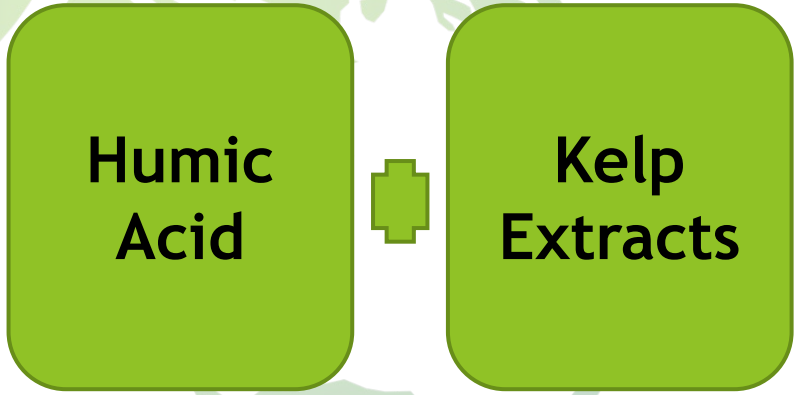
- Reduces salinity stress in plants, resulting in increased plant height, stem diameter, shoot, root and total plant biomass, photosynthetic rate, and transpiration rate.
- Can solubilize rock phosphate or the different poorly soluble inorganic forms of P in soil by the production of organic acids and acidic protons
- Protects the plants against the inhibitory effects of high concentrations of nickel, lead, and zinc found in some soils
- General increase in root hairs

L-Amino Acids

- Enzymatic hydrolysis of proteins
- Intermediate chelators
- Prevent lime scale. (Hydroponics)
- Open calcium ions channels.
- plan protection agent.
- Brix

Humic Acid + Kelp

- 5:2 ratio with kelp work 50% better than either alone.
- Improves the plants natural tolerance to stress.
- Use before stress to sponge free radicals.

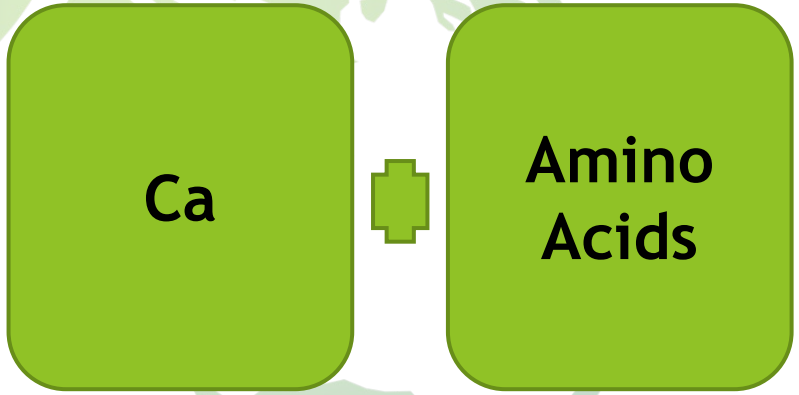


Humic and Fulvic Acids

- Intermediate chelators
- Humic acid large molecules.
- Fulvic acid small molecules.
- Make trace elements more available
- Buffer pH.
- Improves iron uptake.
- Improve flavor and nutrition
- 62 trace elements beneficial.

Amino Acids/Calcium

- Improve the uptake of calcium 1000x faster than simply osmosis.
- Glutamic acid and glycine stimulate root cells to open up calcium ion channels
- Calcium
- When taken up they react with pectic acid and create pectin. Pectin is the glue that cements the cell walls together.



B-Vitamins

- Applied at the roots stimulates Systemic Induced Resistance. This, puts the plant's immune system on high alert.
- Protects against pathogens.
- Kelp extracts have amino acids and B vitamins in them.
- Protect against stress
- Activates enzymes and stimulate cellular metabolism.
- Harley says B vitamins are the icing on the cake they don't work on their own but when combined with other bio stimulants they work together.

Carbohydrates

- Feeds the microbes. Microbes feed the plant.
- Plant can horde carbohydrates from the root zone during reproductive stages at the end of the growing season.
- Plant growth promoting rhizobacteria

Carbon and Soil Health

Helps build the House

- Better aggregate stability, soil tilth
- Improve porosity for optimal water drainage and aeration
- Increase water holding capacity

Assist the Root System

Increased root growth (length & number) observed after application

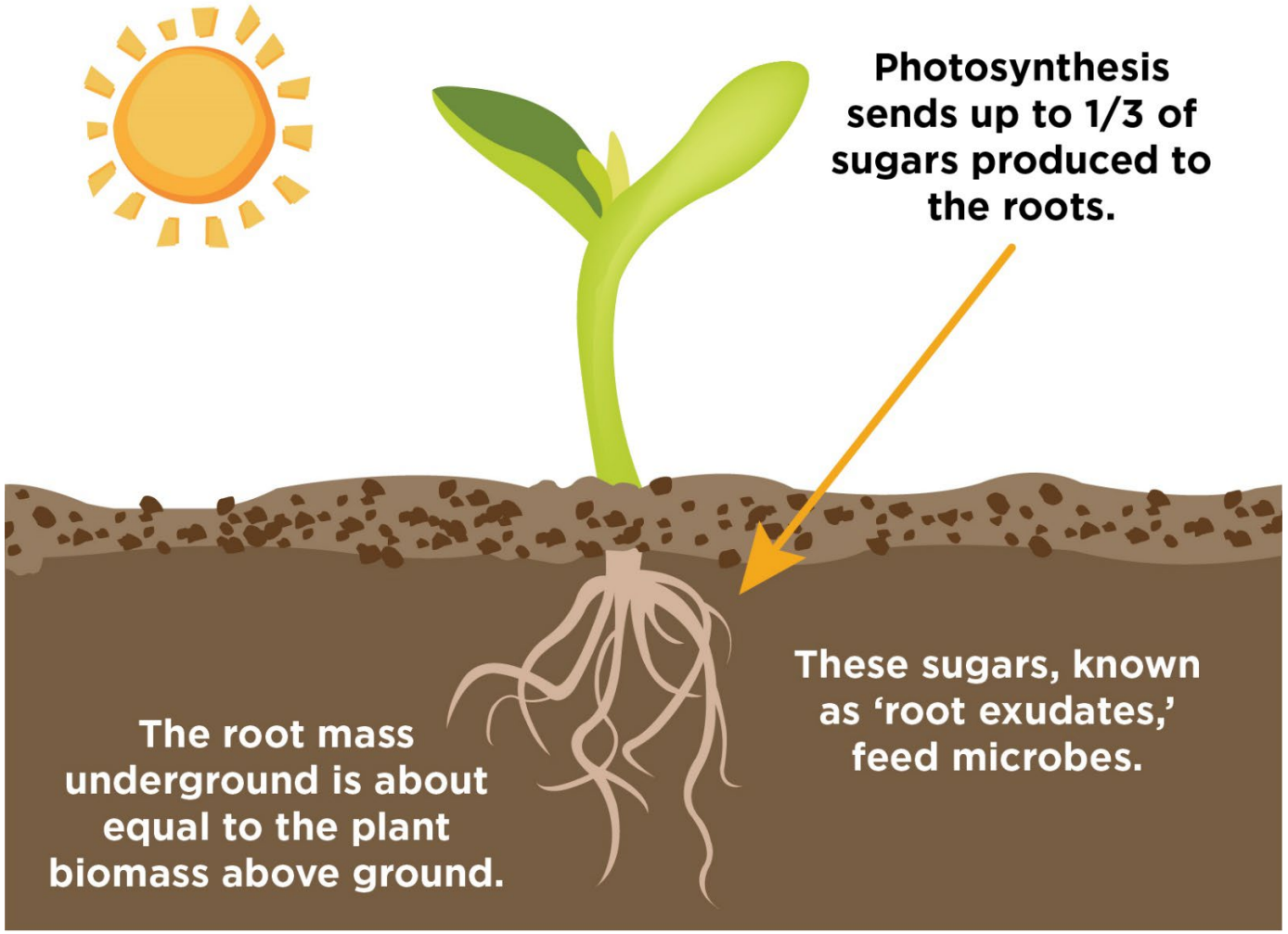
Feed Carbon

Food for Microbes

Chelate and increase nutrient retention

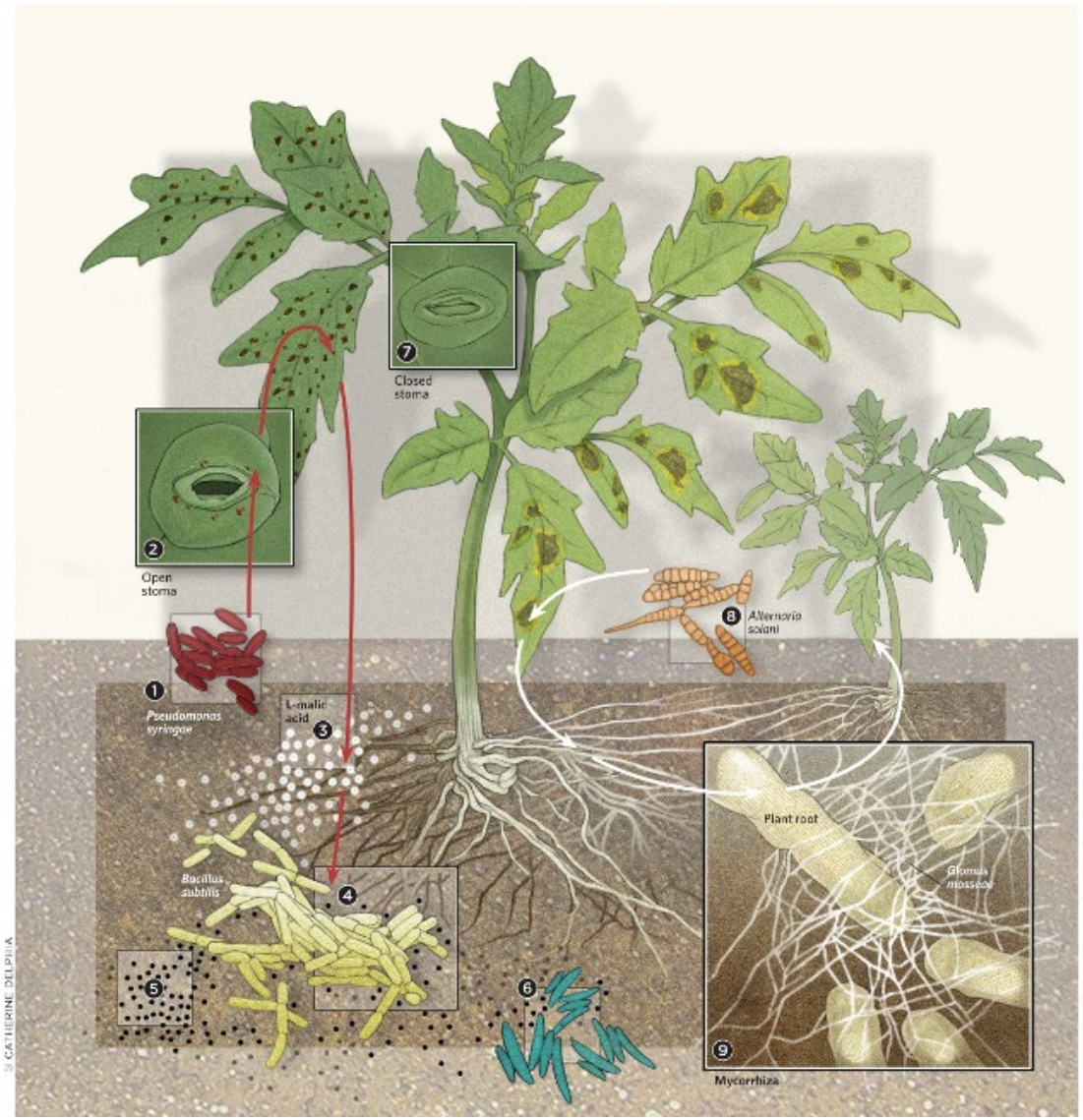
The Andersons

Carbon = food for microbes.

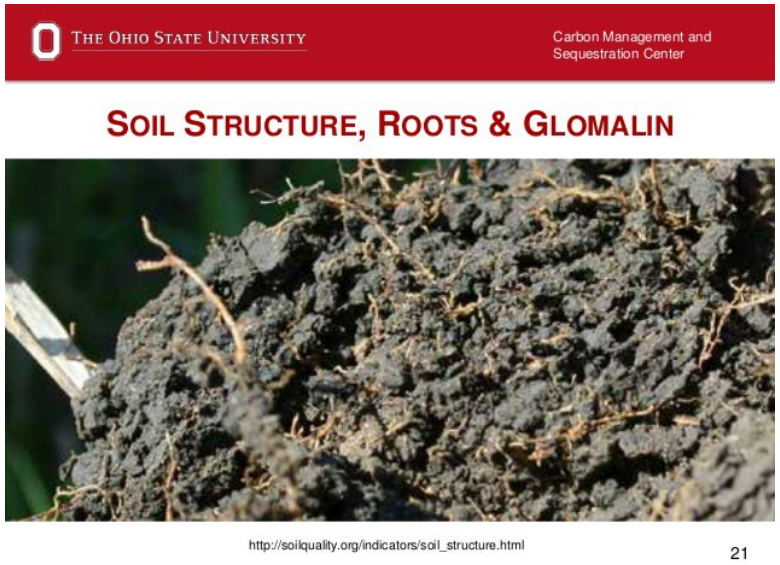


Nutrient Cycling 101

- Soil microbes control residue decomposition and nutrient cycling.
- Think of microbes as tiny soluble bags of fertilizer.
- Microbes have 4 needs
  - Food Source
  - Oxygen
  - Moisture
  - Temperature



Source: https://www.the-scientist.com/features/fighting-microbes-with-microbes-39995

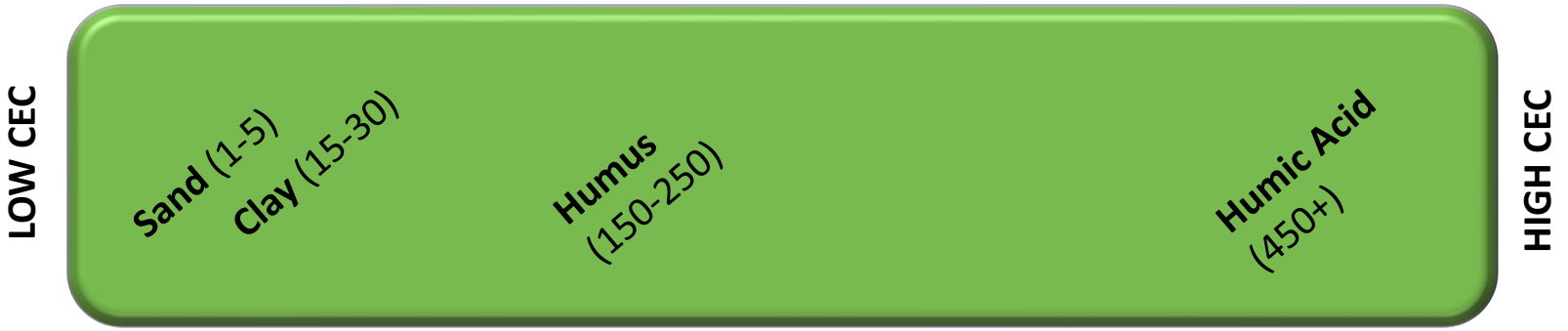


Carbon = food for microbes

- Microbes live in the “house”
- Microbes have 2 primary food sources, Carbon and Nitrogen. Carbon can come from
  - Sugar exudates from plant roots
  - Other sources: residue and green manures that break down into soil organic matter, or humic inputs.
- **Feed carbon because carbon is the dominant nutrient – more than nitrogen – in microbe body composition.**
- When microbes are fed and abundant, they hold mineral nutrition in stable forms (decomposed microbe bodies) and release it slowly.

Humates and Chelation Power

- Humates add cation exchange capacity
  - High CEC = higher nutrient retention and fertility



- Carbon chelation