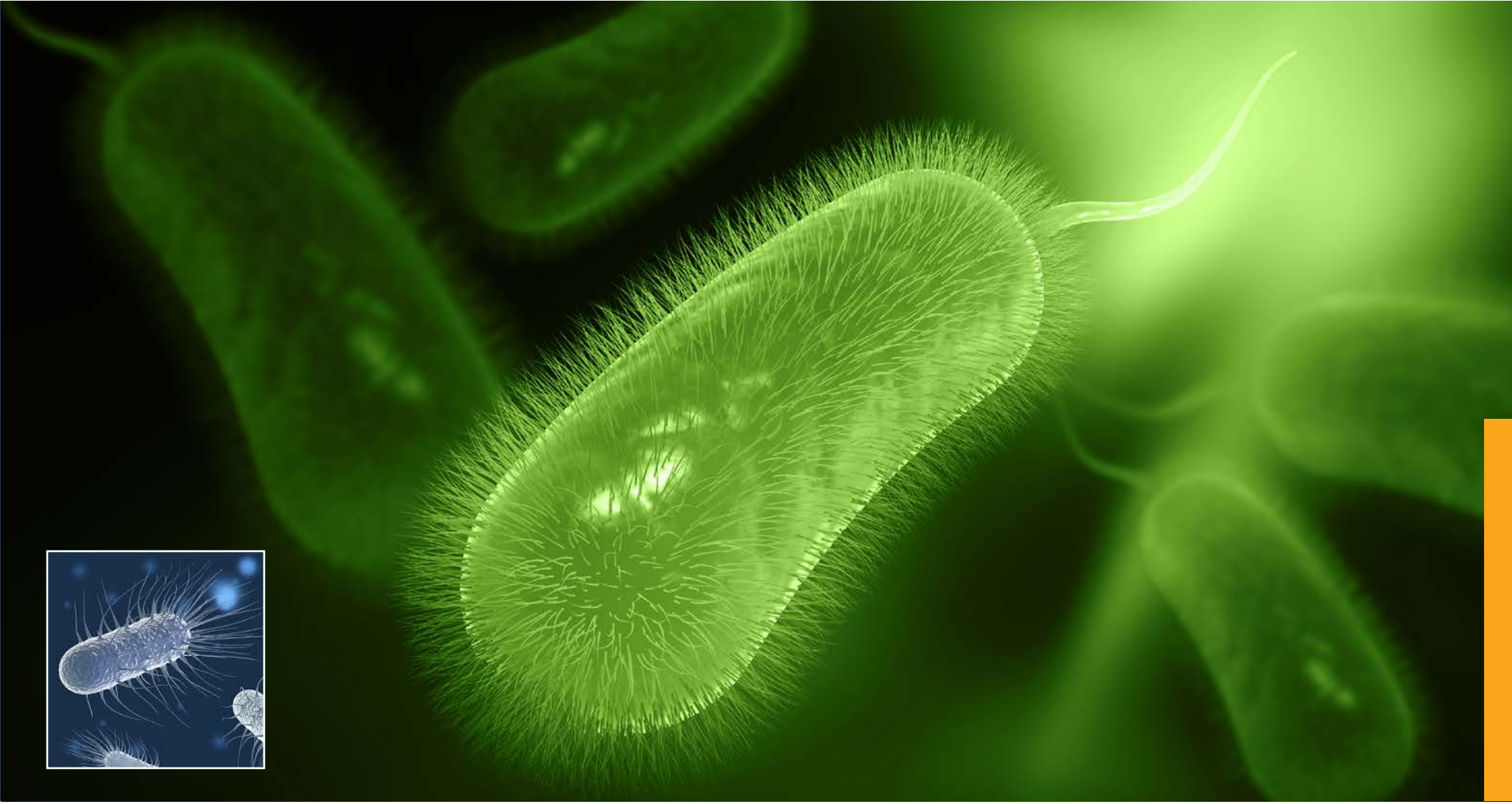
MicrobeBio®



MicrobeBio is a microbial technology company that specializes in identifying, selecting and producing specialty microbials for the agriculture and environmental industries through its novel biochemical screening platform.

WHAT ARE BACTERIA?

Bacteria are single celled microorganisms that lack a nucleus (prokaryotes). They may be shaped like spheres, rods or spirals

Bacteria are diverse in nature and are capable of metabolizing and living off of a variety of food sources.

The **Beneficial Agriculture Bacteria** source

INTRODUCING
MICROBEBIO MICROBIALS

MicrobeBio's microbials are a select combination of highly tested, functional, organic microbial enhancements containing soil and plant health promoting bacteria.

Further

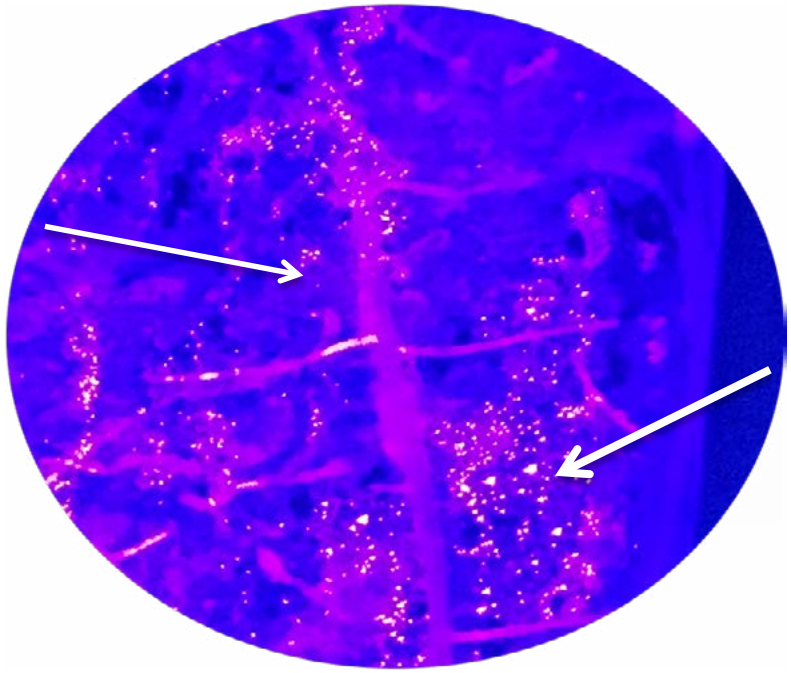
- Acts upon the plant rhizosphere to promote a healthy environment for meristem root growth.
- The increased biodiversity allows for accelerated organic mineralization, improved plant nutrient uptake, enhanced photosynthesis and an overall healthier plant.

CENTRAL DOGMA

AGRONOMY AND MICROBIOLOGY

OF UTMOST IMPORTANCE

Bacteria MUST colonize the root zone to stimulate Plant Growth Promotion and **mineralization.**

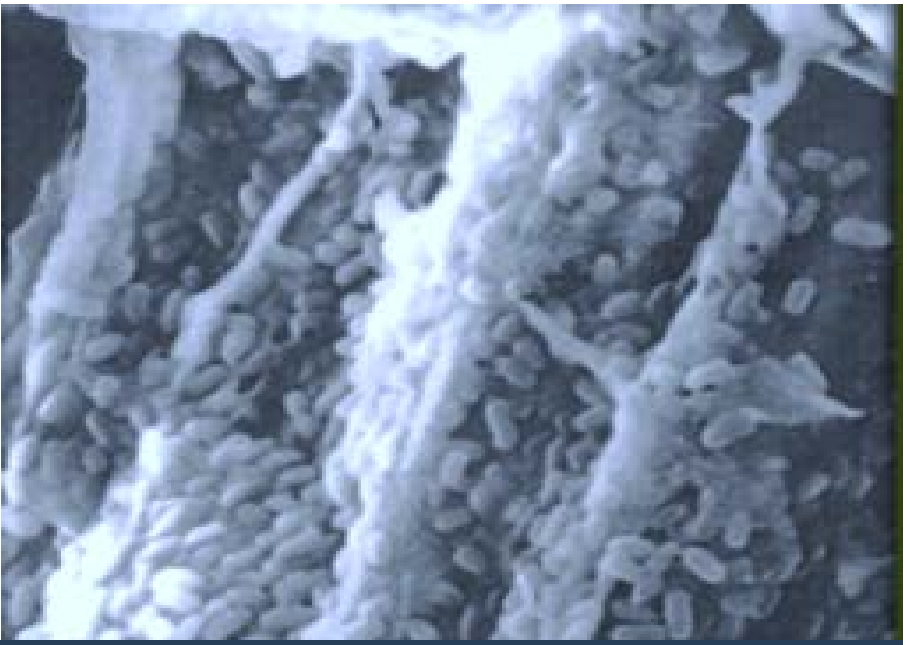


MicrobeBio Bacterial colonization at the root zone

Bioilluminated Image

Beneficial Bacillus Spores

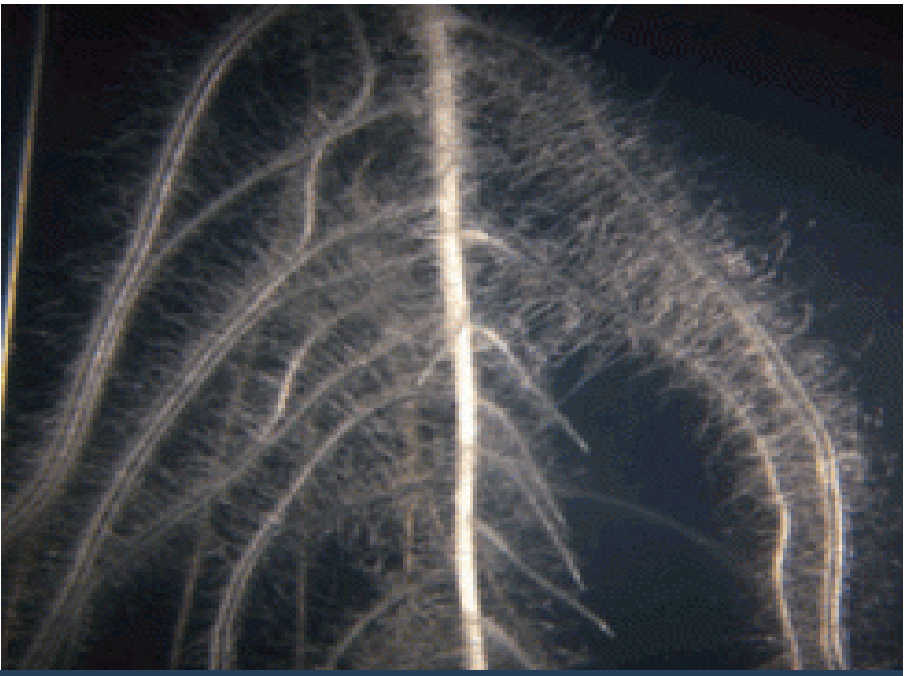
Strains in MicrobeBio's Products



Bacilli root associations protect the rhizosphere by the production of antibiotics and polysaccharides

All beneficial bacterial strains are **naturally derived** from agriculture sources worldwide

Microbebio's
Specialty Agriculture Microbials

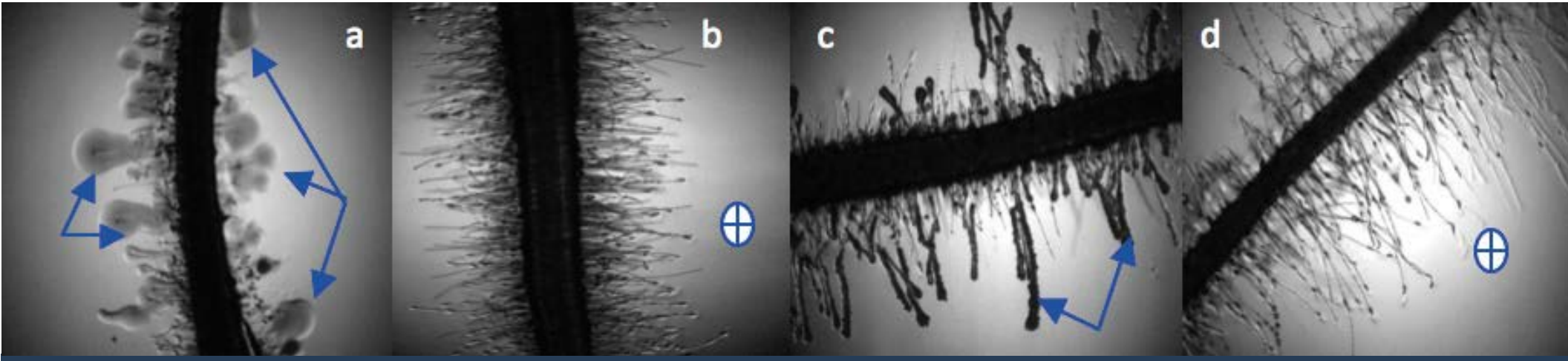


Root-associated Bacilli aids rapid nutrient uptake through root cells

Nature Vigor:

- >400 Billion CFU/Gram
- Ultra concentrate of Ag Bacillus spores
- High-throughput testing
- and validation
- Synergistic and effective
- Motile and chemotactic

Root Colonization by MicrobeBio Bacteria



Bacillus subtilis colonization and polyaccharide production

Mineral depletion from **1940** to **1991**

Substantial loss of nutrients in vegetables and fruits over time!

Vegetables

Lost **76%** of their copper content
Lost **49 %** of their sodium content
Lost **46%** of their calcium content
Lost **27%** of their iron content
Lost **24%** of their magnesium
Lost **16%** of their potassium

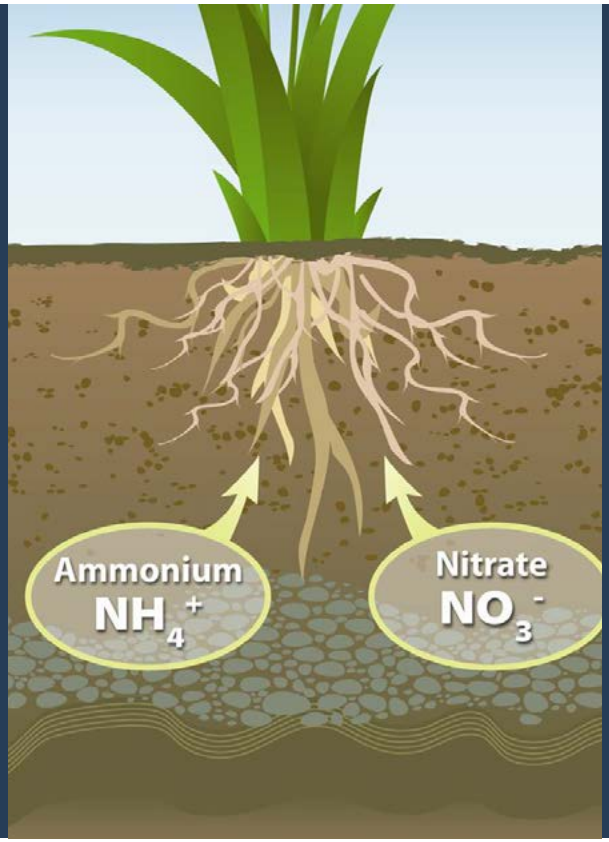
Fruit

Lost **19%** of their copper content
Lost **29%** of their sodium content
Lost **16%** of their calcium content
Lost **24%** of their iron content
Lost **15%** of their magnesium content
Lost **22%** of their potassium content

Source: USDA Soils

Mineralization and Nitrogen

Beneficial bacteria impacts



Beneficial bacteria fix nitrogen and rapidly mineralize nutrients into plant useable forms

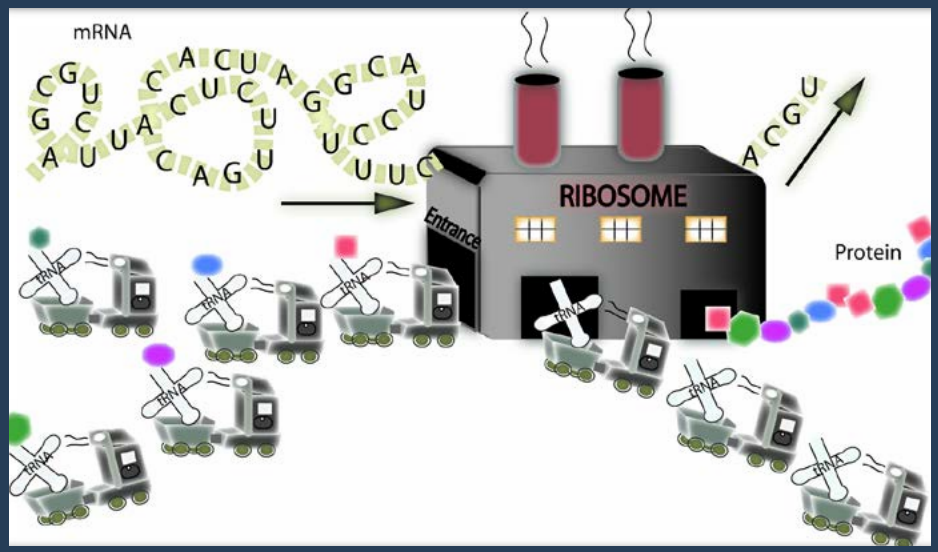
Beneficial bacteria

The key to soil health

Converting unusable nutrients into usable nutrients 24/7

Bacteria are Microscopic Jackhammers

Continually breaking down insoluble nutrients and ions into their free forms for plant use

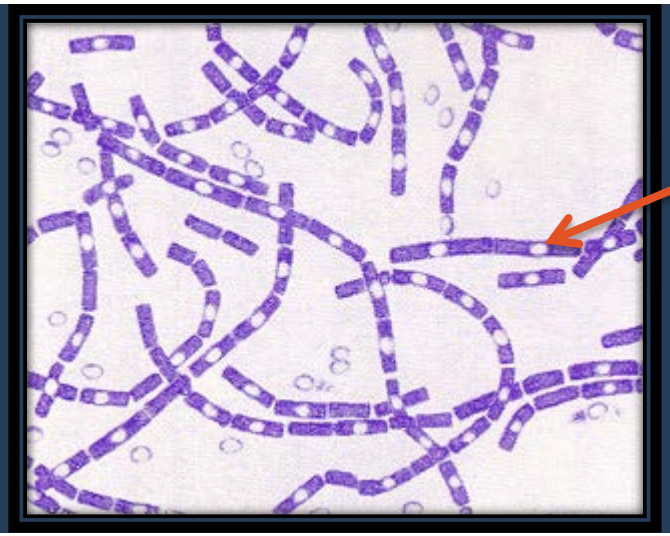


Bacteria are Microscopic Factories

Continually producing by products and Surfactants for greater nutrient uptake

Bacteria Survival, Shelf Life and Integrity

Bacillus bacteria form **endospores** to survive and cope with undesirable environment conditions such as temperature, salinity, pH, drought, abiotic and biotic factors.



MicrobeBio bacteria form endospores and are able to overcome temperature and environment extremes.

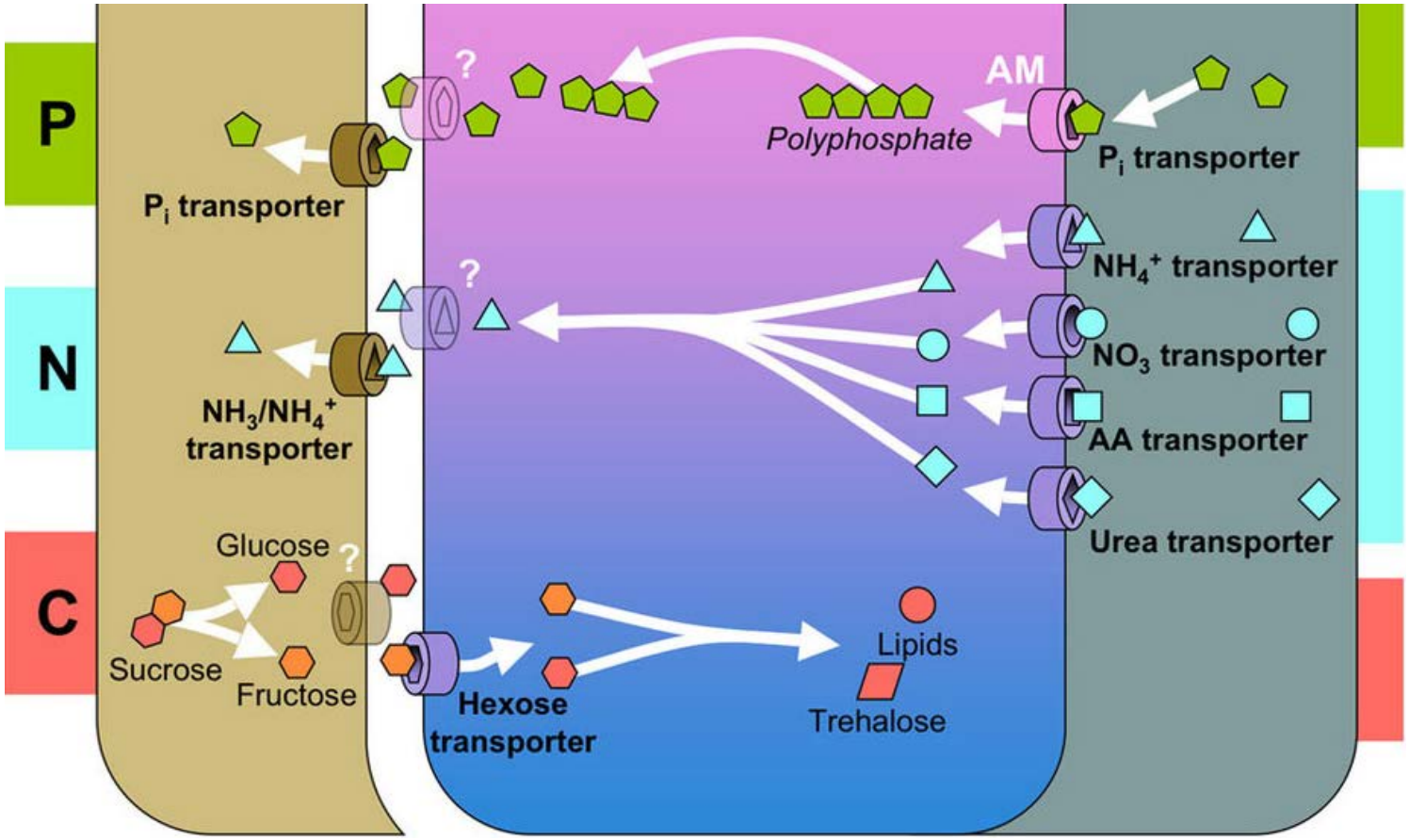
SHELF LIFE IS A MINIMUM OF 2 YEARS (LIQUID) AND 5 YEARS (POWDER)

Biological Herbicide
(Weed Control)

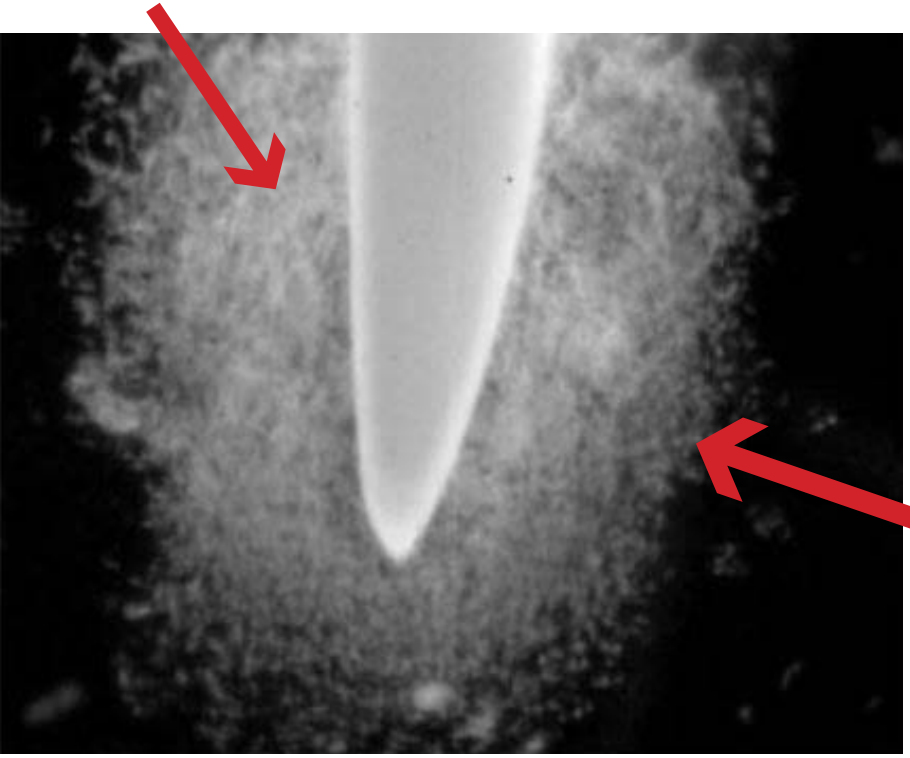
Streptomyces sp.
Phosphinothricin
Biological Herbicide

Plant Nutrient Uptake - Bacteria are Required

Plant ← Bacteria ← Soil



Root Hair Extension and Microbial Chemotaxis



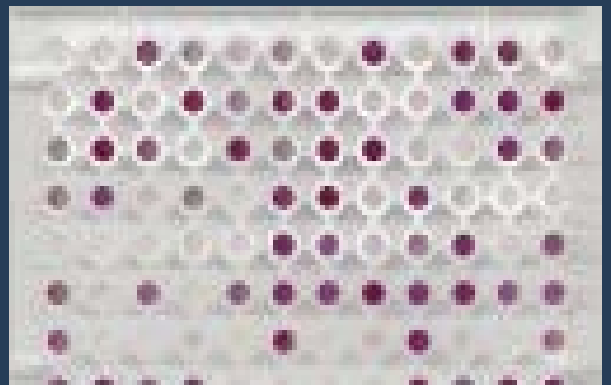
Microbes swiftly move towards root sugars and chemicals

CHEMOTAXIS IS THE MOVEMENT OF MICROORGANISMS TOWARDS ROOT EXUDATE CHEMICALS AND STIMULI

The MicrobeBio Difference

1000+ biochemical assays, all microbial strains extensively lab and field tested

- Over 1000+ metabolic challenge assays
- Proven metabolic diversity of complex polymers and sugars in the soil (lignin, chitin, cellulose, pectin, keratin, starch, dextrose, xylose, etc)
- Proven metabolic activity in divergent soil pH, osmotic salinities, phosphorus, sulfur and nitrogen
- Proven nitrogen fixation and assimilation
- Synergistic blend of Bacillus strains



What are beneficial soil bacteria… and why they are important

Beneficial Soil Bacteria

Microscopic Farmers

Bacteria break-up rock minerals tightly bound in soil

Minerals and nutrients are **abundantly present** as ion complexes in the soil…

- Yet, these elemental ions form rock complexes that are insoluble to water and unavailable to plants.
- Microorganisms function to continually release **unavailable** plant nutrients bound in soil, metabolically transforming them into plant **available** nutrients (P, K, Ca…)

BACTERIA PRODUCE LARGE VOLUMES OF ENZYMES AND BIO-SURFACTANTS THAT BREAK ION COMPLEXES IN SOIL TO RELEASE NUTRIENTS FOR PLANT UPTAKE.

Beneficial bacteria

The key to soil health

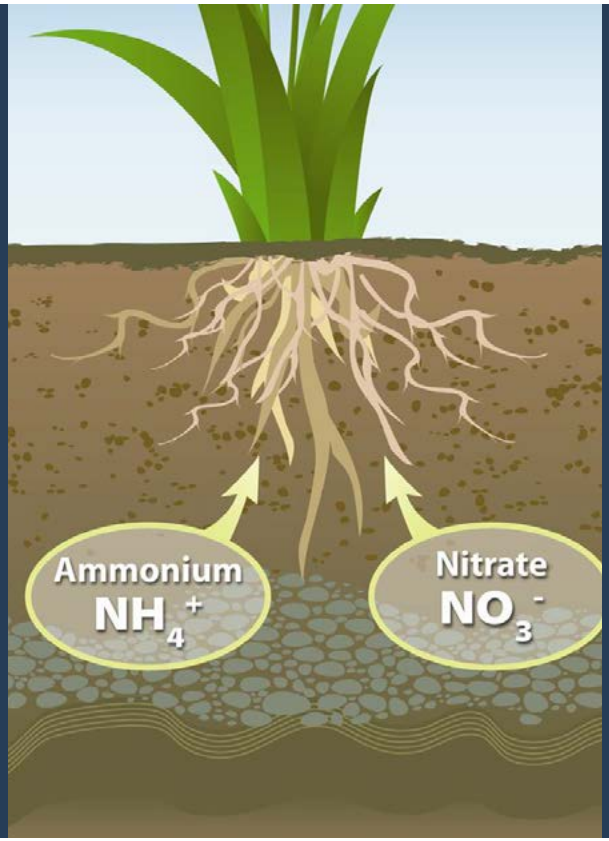
Converting unusable nutrients into usable nutrients

Beneficial bacteria continually produce essential enzymes, surfactants, polysaccharides and antibiotics essential for soil, root and plant growth

AG MICROBIALS WORK SYNERGISTICALLY WITH PLANT ROOTS TO PROMOTE SOIL HEALTH, PHOTOSYNTHESIS, PLANT VIGOR AND IMPROVE NUTRIENT UPTAKE

Mineralization and Nitrogen

Beneficial bacteria impacts



Bacillus bacteria fix nitrogen and rapidly mineralize nutrients into plant useable forms

BIOCHEMICAL SEQUENCE OF NUTRITION ON PLANTS

N Nitrogen

Mg Magnesium

Ca Calcium

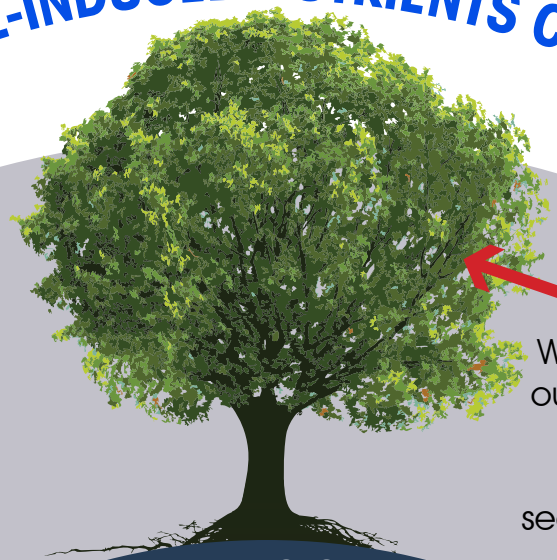
P Phosphorus

to form amino acids, DNA and cell division. Amino Acids form proteins such as Chlorophyli and tag trace elements.

MICROBIAL-INDUCED NUTRIENTS CASCADING

Si Silicon

C Carbon



B Boron

K Potassium

When soils are out of balance of nutrients, the above sequence is less efficient

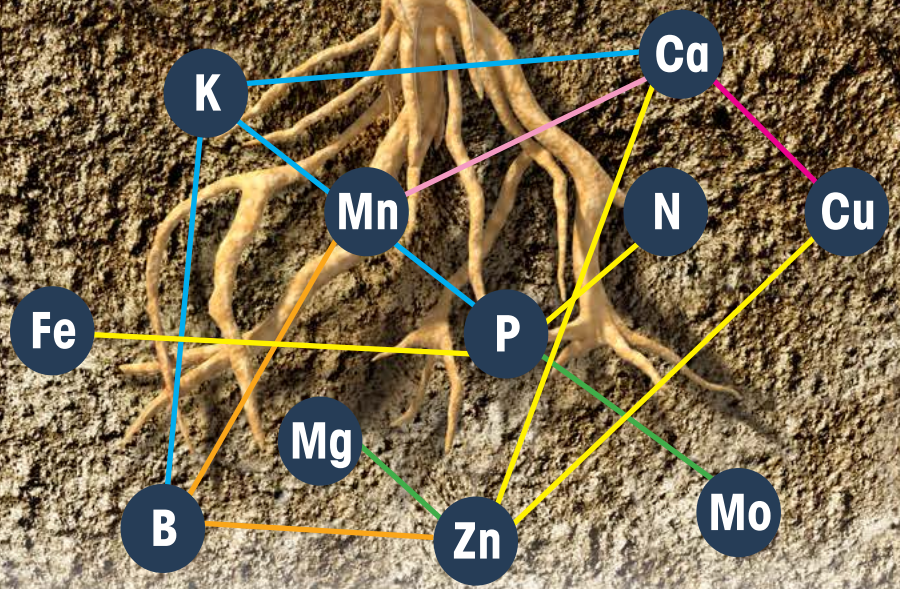
BASIS OF PLANT GROWTH

ELEMENT AVAILABILITY THROUGH MINERALIZATION

NUTRIENTS RELATIONSHIP TO EACH OTHER

Illustration of a growing seedling emerging from the soil surface. Below ground is an extensive network of beneficial and symbiotic microorganisms that play roles in plant development.

Chief among them are beneficial bacteria that promote essential nutrient and physiological developmental pathways



What's the Problem?

And is Feeding the Existing Microbials in Soil Enough?

The Challenge…

Nutrient and microbial imbalance will not self-correct

Phytophthora capsici infecting pepper

The **micro and macro biome** in soil work cohesively with one another…
Yet, over time and due to conventional farming and tilling practices, soils begin to **suffer from a nutrient and microbial imbalance** that cannot be self remedied without intervention.

Feeding Existing Microbials is Not Enough

Feeding existing microbial communities will not improve soil and plant health

Microbial communities in the soil that have been stressed through **abiotic (drought, pH, high salinity) and biotic (pests, disease)** challenges become stripped of their essential life-giving components.

Through the natural law of competition, the stressed areas of soil are occupied, often by pathogenic fungi, in space left open by beneficial microbes.

SIMPLY FEEDING THE SOIL WITHOUT ADDED BENEFICIAL BACTERIA FEEDS THE PATHOGENS, ALLOWING THEM TO FURTHER FLOURISH WITH LITTLE COMPETITION.

So, what's the bottom line?

The impact of imbalance and loss of soil health

What's the Bottom Line?

The indigenous soil bacteria are simply not enough to promote optimal plant health, solve crop nutrient deficiencies and soil pathogenesis… if it were, there would be no soil health problem.

Since an imbalance in soil bacteria exists, then a boost of the correct microbials is required to fundamentally alter the soil microbiome. NLBS introduces microorganisms capable of correcting deficiencies in the soil.

Nematode BioControl Tests

NEMATODE	Disease Reduction vs. Control (In-Furrow Treatment)	Disease Reduction vs. Control (Seed Treatment)	Average Microbiology Change vs. Control
Root Knot Nematode	↓86%	↓91%	↑1,330,000 CFU/Gm
Soybean Cyst Nematode	↓84%	↓88%	
Sting Nematode	↓93%	↓96%	↑950,000 CFU/Gm
Lance Nematode	↓81%	↓94%	↑950,000 CFU/Gm


What can be done to create a beneficial environment for plant health and crop growth?

The Solution…

Improving crop nutrients, crop health, and much more

So, what is the solution?

Treating soils with **beneficial Ag bacteria** allows microbials to physically occupy space that is critical to out-compete and **eliminate pathogenic microorganisms.**

Promoting critical microbial populations enables **healthy mineralization, metabolic cycling, nitrification and nutrient uptake.**

Bacillus and Beneficial Soil Bacteria

Direct and Indirect Benefits on Plant Growth Promotion

Direct Mechanism	Effects on Plant Growth
Nitrogen fixation on or in root or shoot tissue	Increased plant biomass or nitrogen content
Production of plant growth regulators (i.e., auxin, cytokinins, giberellins)	Increased root or shoot biomass or root branching; induction of reproduction cycles
Inhibition of ethylene oxide synthesis in inoculated plants	Increased root length
Phosphorus solubilization content	Increased plant biomass or phosphorus
Sulfur oxidation	Increased plant biomass or foliar sulfur content
Increased root permeability	Increased plant biomass & nutrient uptake
Increased nitrate reductase activity and assimilation	Increased plant biomass or nitrogen content

Table 1: Direct mechanisms involved in plant growth promotion by Bacillus and soil bacteria.

Bacillus and Beneficial Soil Bacteria

Direct and Indirect Benefits on Plant Growth Promotion

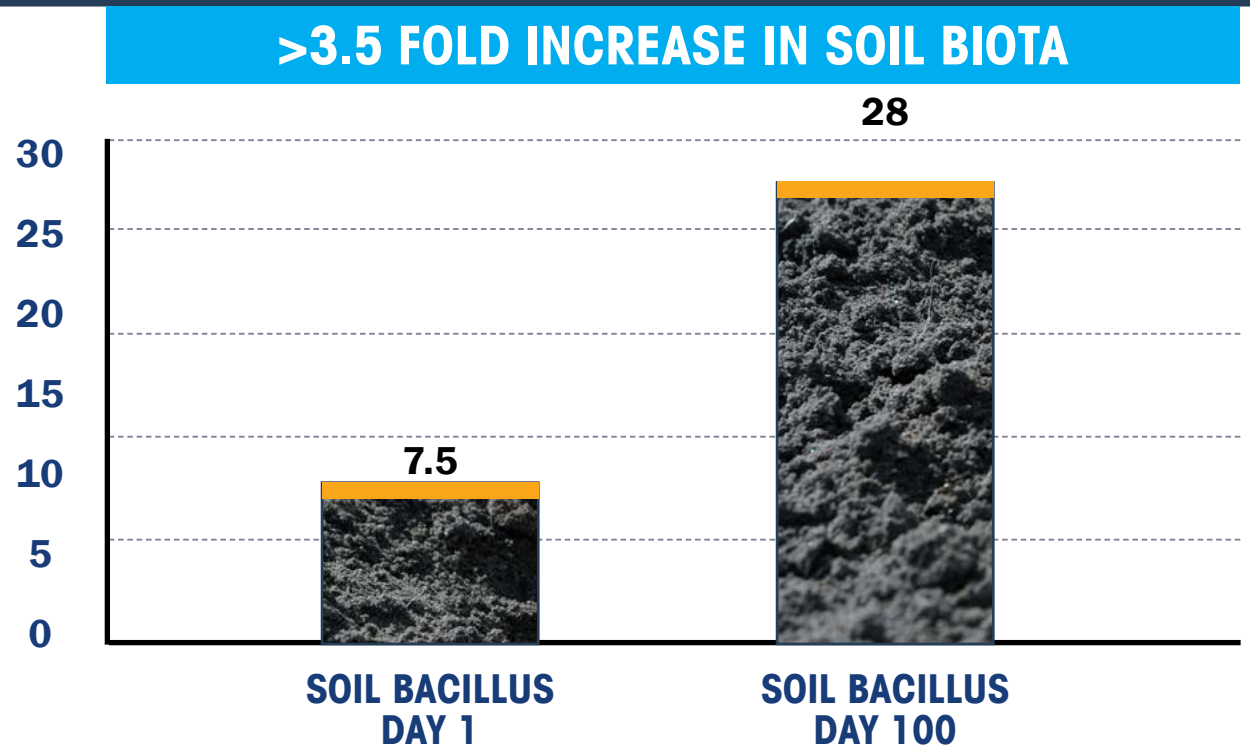
Indirect Mechanism	Effects on Plant Growth
Increased root nodule number or size on legumes or actinorhizal plants	Increased plant biomass, nitrogen content or yield
Increased infection frequency or efficacy by mycorrhizal fungi	Increased plant biomass
Suppression of disease pathogens	Increased plant biomass and reduced incidence of disease and plant mortality
Induction of plant systemic resistance to pathogens	Increased plant biomass and reduced incidence of disease and plant mortality

Table 2: Indirect mechanisms involved in plant growth promotion by Bacillus and soil bacteria.

Bacillus Content in Soil

(Consistent Improvements)

Soybean and Corn Soil Tests



Beneficial Bacteria

Enhances Plant Growth, Soil Health and Mitigates Environmental Stress

- Improves nutrient uptake
- Improves water uptake
- Improves root growth
- Improves plant growth yield
- Induces phytohormones

Note greater decomposition of pith of treated residue treated late fall 2015, pic 8/10/16

MicrobeBio®

MICROBEBIO MICROBIAL TECHNOLOGY

Beneficial. Microbial. Soil. Enhancements