BEAUTIFUL PLANTS BEGIN IN THE SOIL

Great results *above* the ground begin under the ground.

On The Surface

- Most people think of plants as only taking up nutrients
- During Photosynthesis in the leaves, energy is produced which the plant utilizes to produce chemicals they secrete through the roots

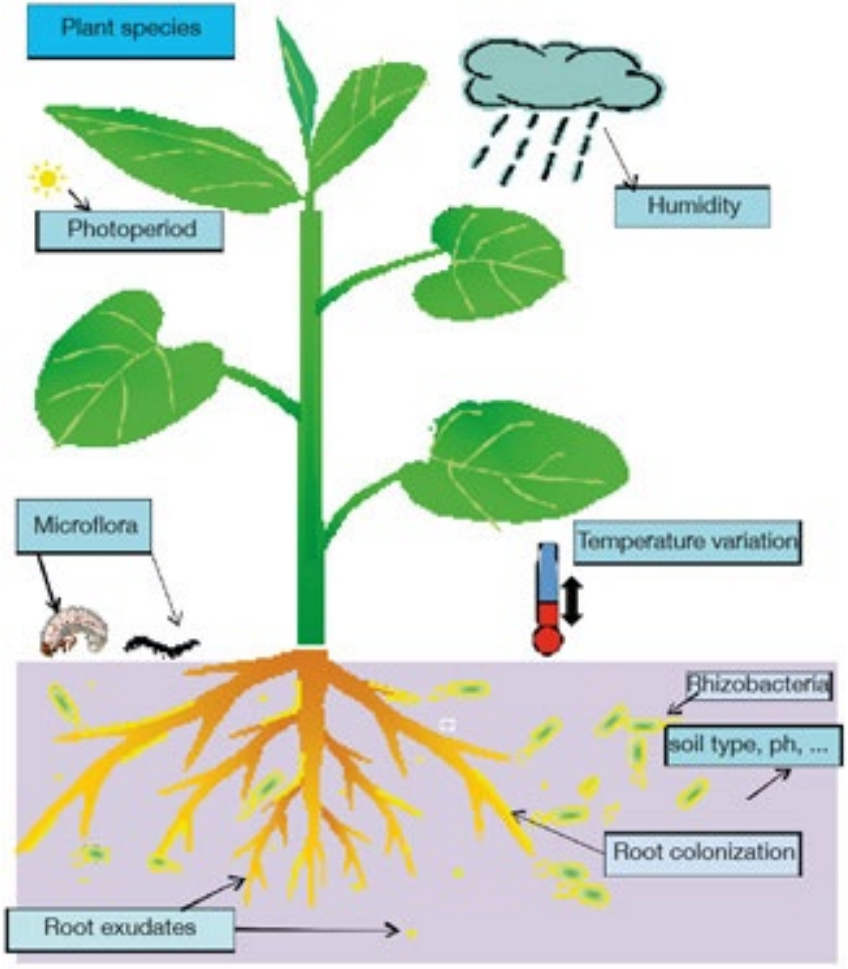


Figure 1. Ecological factors influencing the root exudation process and thereby rhizosphere colonization by beneficial rhizobacteria — *Facteurs écologiques influençant le processus d'exsudation racinaire et par conséquent, la colonisation de la rhizosphère par les rhizobactéries du sol.*

Chemicals secreted though the roots

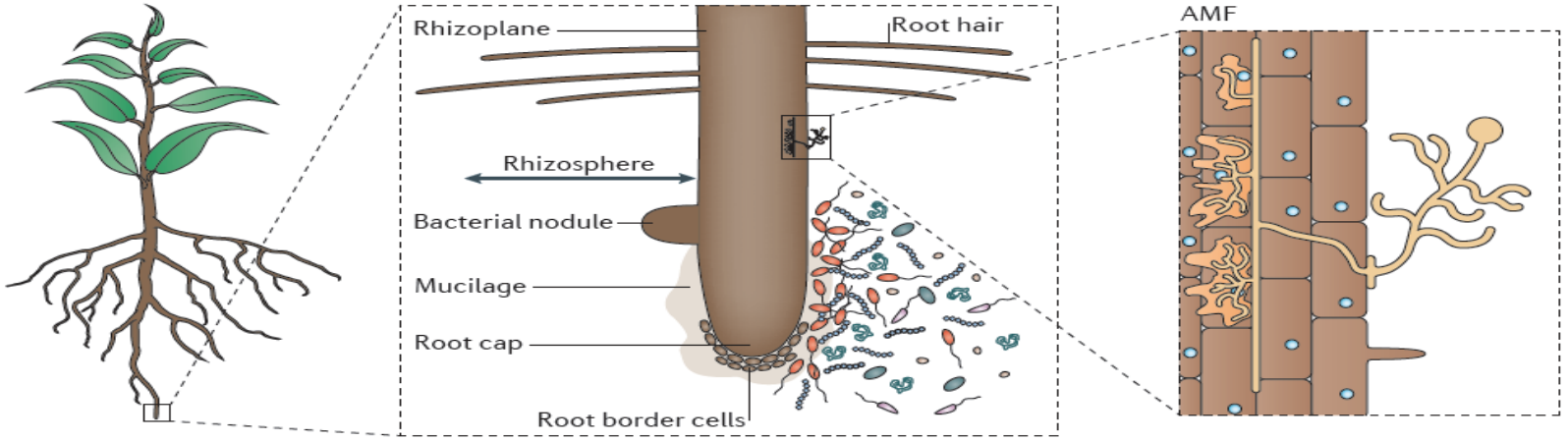
(Exudates)

The deposits discharged from the roots into the soil include:

- Amino Acids
- Proteins
- Organic Acids
- Carbohydrates
- Sugars
- Vitamins
- Mucilage - thick gluey substance which provides a large amount of fixed carbon

CARBON

- Most microscopic organisms need energy to survive, that energy is carbon
- The plant by way of photosynthesis releases this carbon through the roots
- Carbon attracts Bacteria and Fungi which use the carbon in their metabolic functions to survive

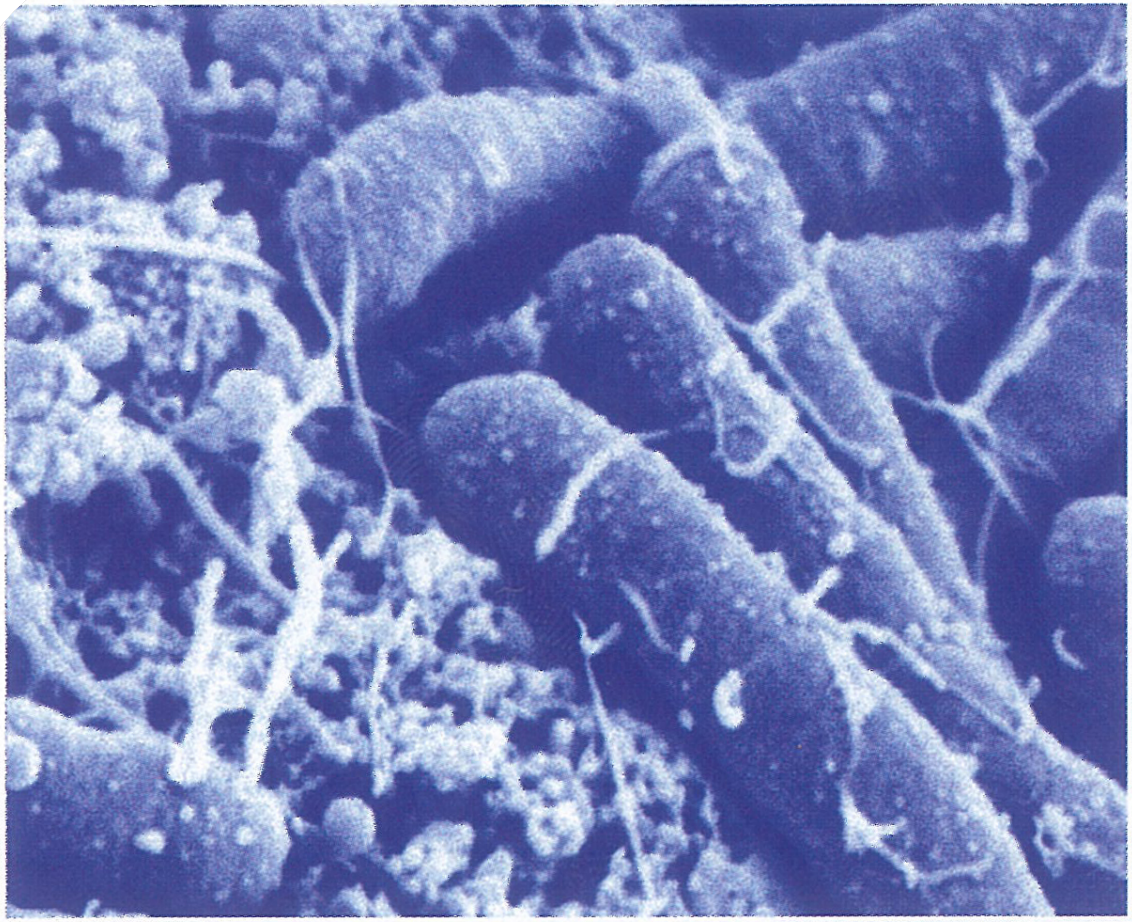


Chemicals Released By The Root Attract Microbes

- The assortment of Chemicals released by the roots determines what kind of Microbes surround the root,
- These Chemicals are released into an area called the Rhizosphere – extending out about a tenth of an inch around the root
- The Rhizosphere contains Bacteria, Fungi, Nematodes, Protozoa, and other soil organisms

"SUNNY SUNDAYS"
Colonial District members trophy winning entry 2016

BACILLUS BACTERIA



The rhizosphere is an area of interaction between the surface of a plant root and the area surrounding it. Bacteria and other micro-organisms as well as soil debris fill the area. 10,000×. Photograph by Sandra Silvers, USDA-ARS.

BACTERIA

- One teaspoon of soil holds one billion microbes or more
- Bacteria need to stick to things or they will wash away, so they produce a slime
- After the bacteria, fungi, protozoa, nematodes and others are eaten in the soil, the left over or waste is then taken up by the plant as nutrients

Bacillus & Paenibacillus

- Enhance Plant Growth
- Decompose Organic Matter and Pesticide Residues
- Nutrient Cycling
- Increase Resistance to Environmental Extremes
- Solubilize Minerals for Plant Availability
- Produce Natural Plant Growth Hormones
- Improve Soil Structure
- Enhance Seed Germination

NITROGEN FIXING BACTERIA

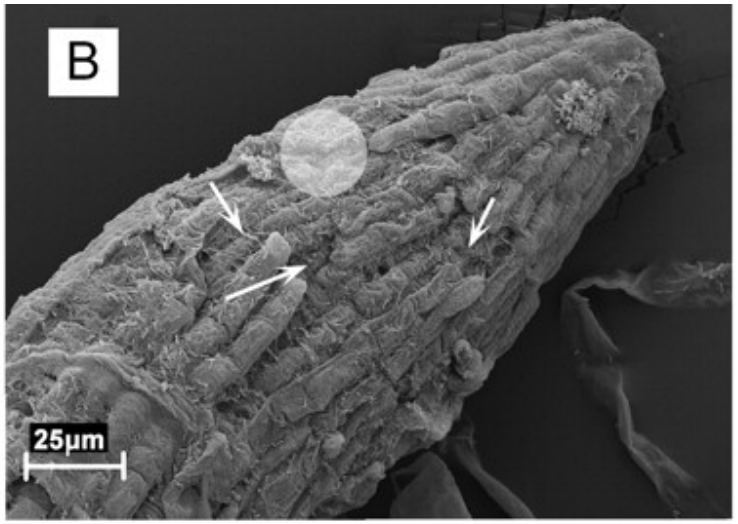
- Nitrogen Fixing bacteria transform atmospheric nitrogen into plant available nitrogen.

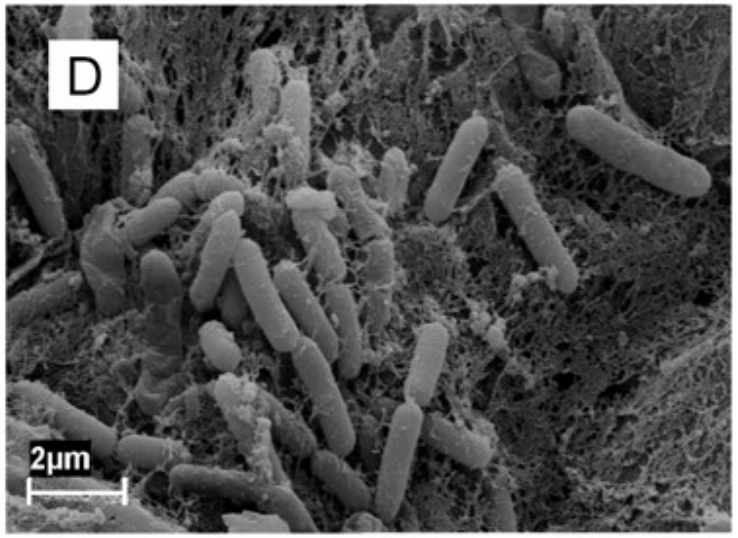
- There are two types of Nitrogen Fixing bacteria. They invade the root hairs of host plants where they multiply enlarging the plant cells and bacteria in an intimate association. The bacteria convert the Nitrogen into Ammonia which is used by the host plant.

“RANDY SCOTT”
National Queen of Show 2011

CROWN ROT DISEASE

- Affects Vegetables, Trees and Shrubs
- Caused by a soil born fungus
- Favored by wet conditions and heavy soils
- The plant will begin to wilt and then quickly die





PAENIBACILLUS

- Paenibacillus forming a bio-film around the root tip
- This action prevents crown rot disease on peanuts

“NICHOLSON PERPETUAL CHALLENGE BOWL”
Winning Entry 2011

PSEUDOMONAS BACTERIA

Pseudomonas Fluorescens

PSEUDOMONAS BACTERIA

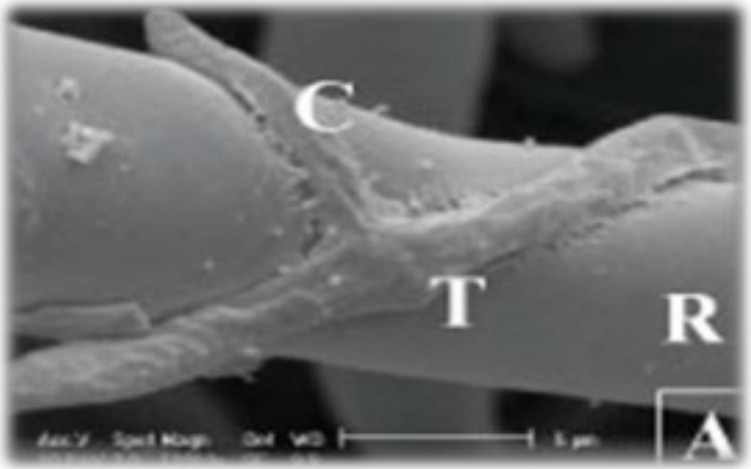
- Produce Natural Plant Growth Hormones
- Enhance Seed Germination
- Prevents the Growth or Establishment of Plant Pathogens
- Biodegrades oil
- Makes it’s own anti-biotic
- Helps plant absorb nutrients more effectively
- Helps prevent mildew
- Eliminates some Nematodes

Rhizoctonia Fungal Root Rot

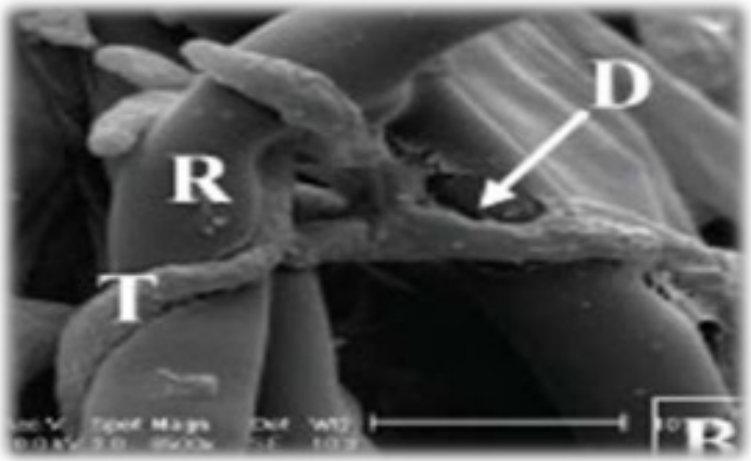
TRICHODERMA FUNGI

Trichoderma coils around, penetrates, and kills other fungi that are pathogenic (*i.e.* cause disease) to crops. It can digest their cell walls

A clear view with an electron microscope



Trichoderma spp. (T) fungal strands coil (C) around the *Rhizoctonia* (R)



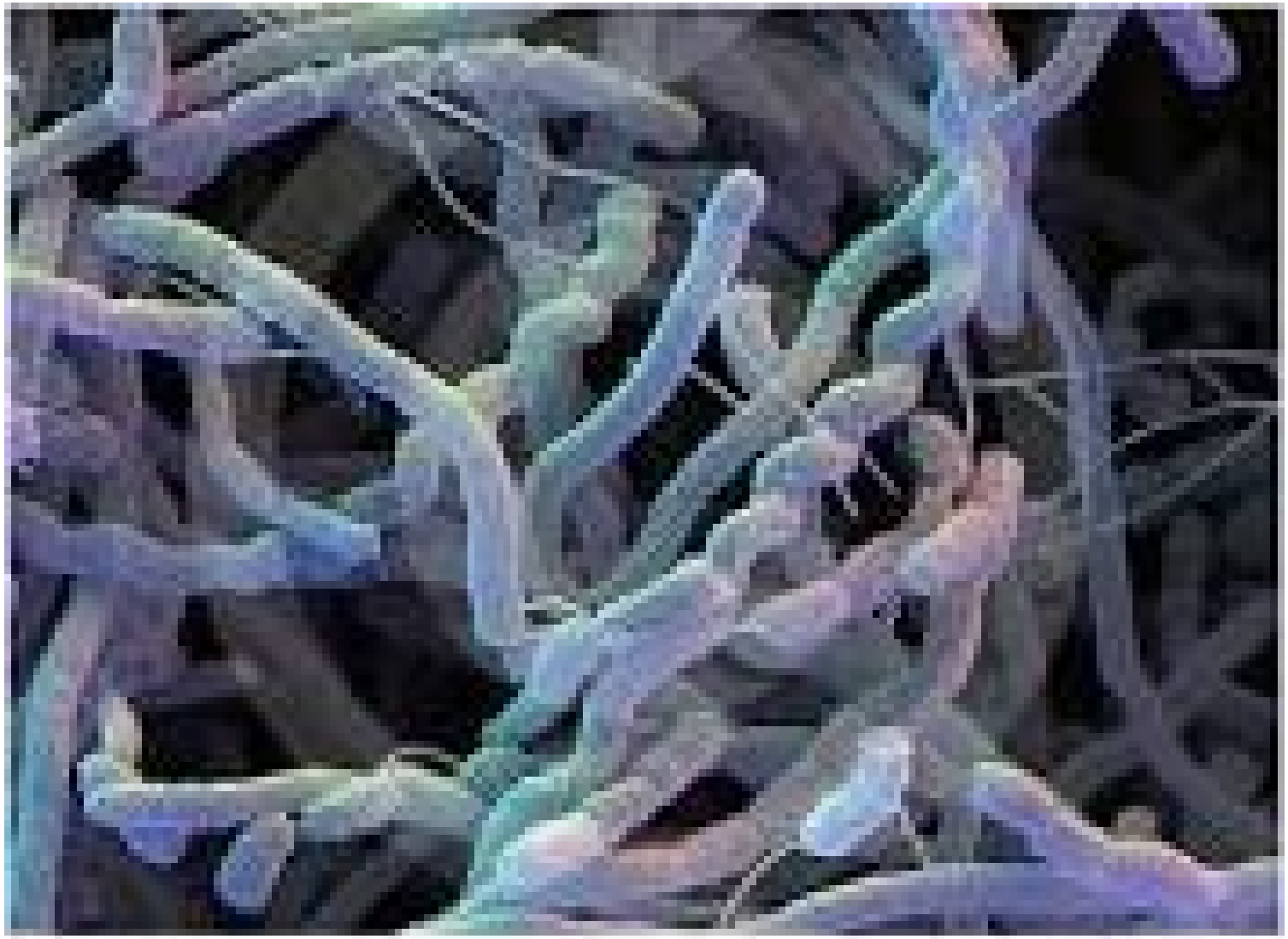
Initial stages of degradation (D) as a result of *Trichoderma* generated enzymes.

T: Trichoderma R: Rhizoctonia

TRICHODERMA FUNGI

- Produce Natural Anti-Biotics
- Kills Fungus Around the Roots
- Can Be Effective Killing Fungus on Leaves
- Reduces Risk of Infection in Plants
- Increases Absorption of Nutrients
- Absorb Nutrients through Cell Wall

Streptomyces (Actinomyces)



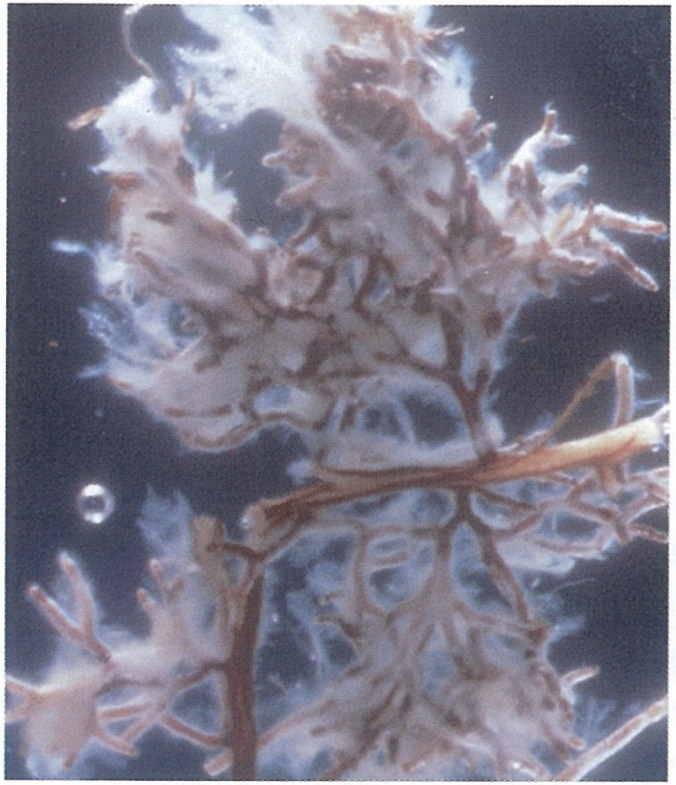
STREPTOMYCES (Actinomyces)

- Produce Over Two Thirds of the Anti-biotics of Natural Origin
- Produce Enzymes Decompose Organic Matter Material like Chitin and Lignin
- Improve Soil Structure
- Kill Fungus Around the Roots
- Promotes Plant Growth
- Kills fungus on leaves
- Induces plant immunity against the invading pathogen

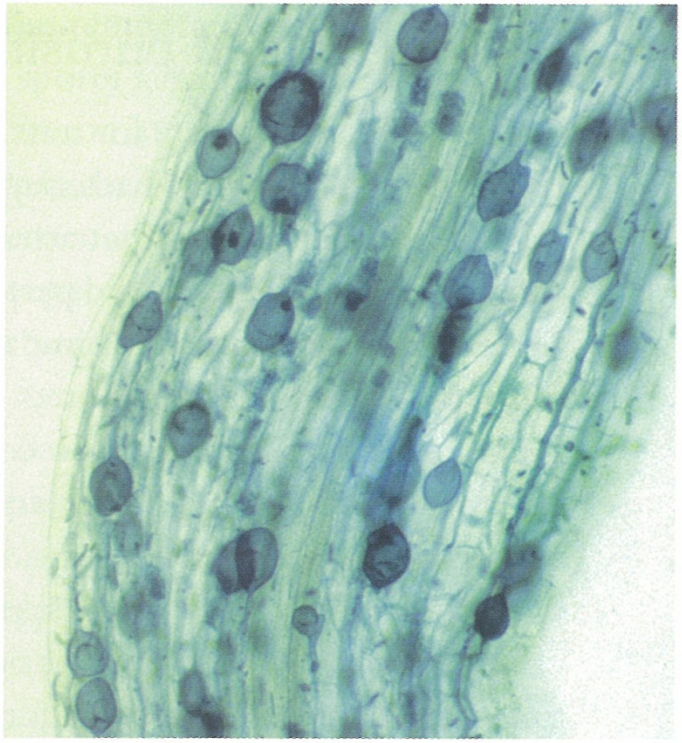
NATIONAL HERB SWIM MEMORIAL TROPHY

Winner 2011

Mycorrhizal Fungi



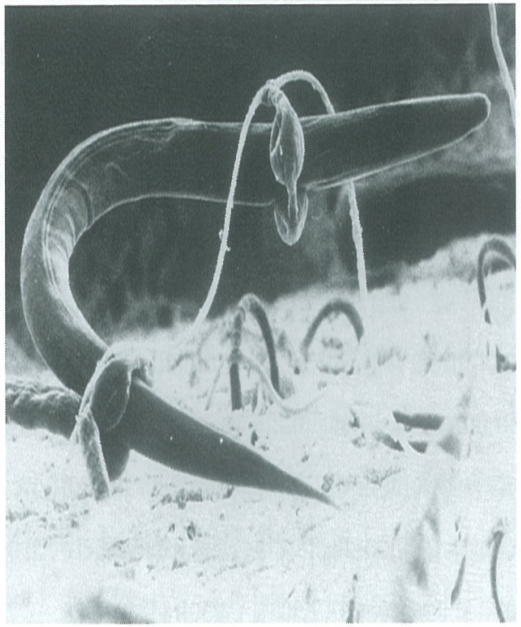
Ectomycorrhizal fungi forming a dense white net around roots. Courtesy Mycorrhizal Applications, www.mycorrhizae.com.

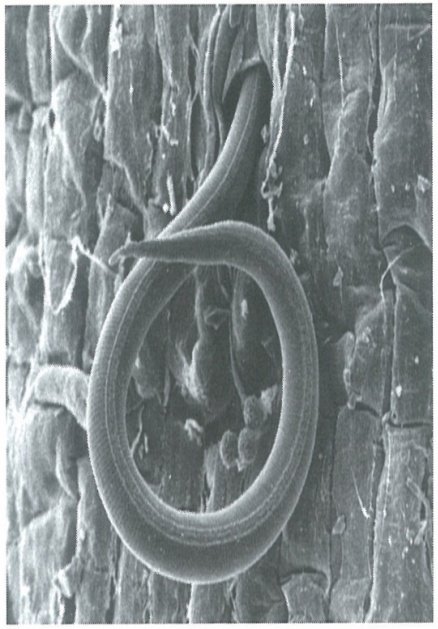


Endomycorrhizal fungi penetrating roots. Courtesy L. H. Rhodes. Reprinted, with permission, from http://www.apsnet.org/, American Phytopathological Society, St. Paul, Minnesota.

MYCORRHIZAL FUNGI

A foraging, root-eating nematode, trapped by a fungal hypha. Courtesy H. H. Triantaphyllou. Reprinted, with permission, from http://www.apsnet.org/, American Phytopathological Society, St. Paul, Minnesota.





With no fungal hyphae barring the way, a nematode penetrates tomato root to feed. Photograph b William Weryin and Richard Sayre, USDA-ARS.

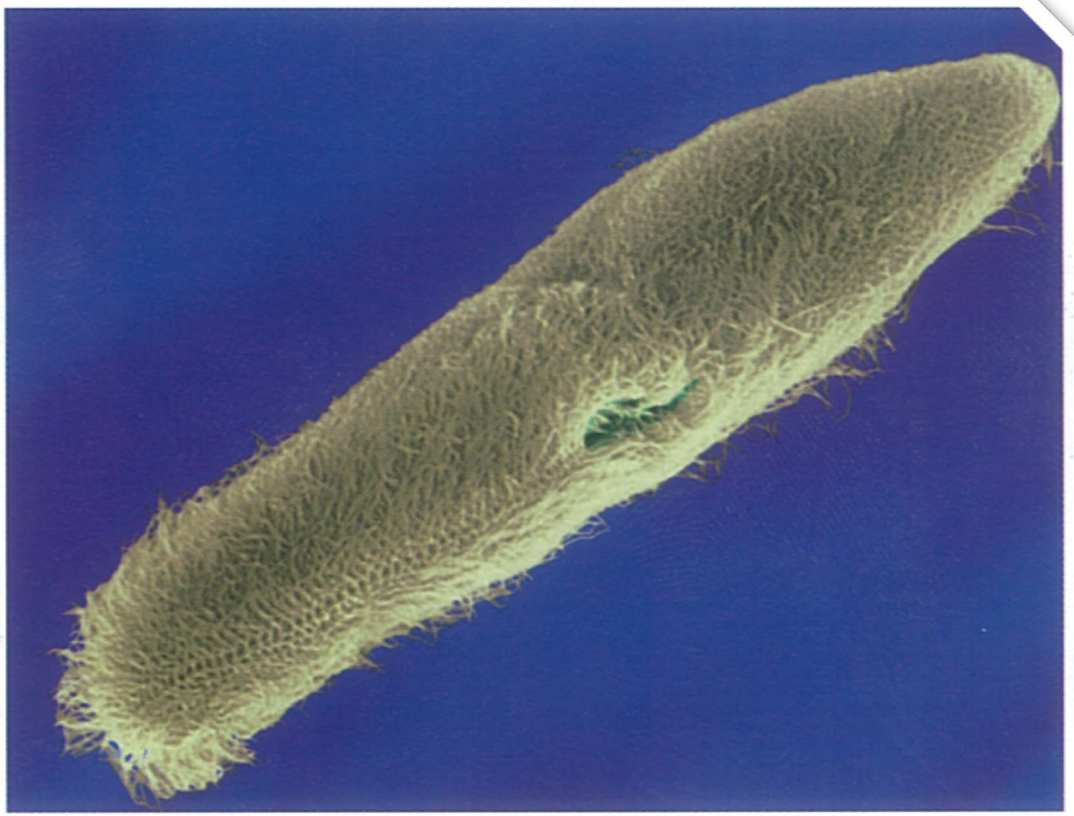
MYCORRHIZAL FUNGI

- Gives Plants Greater Access to Nutrients
- Pulls Nutrients into the Plant
- Consumes Food for the Plant Especially Phosphorous Preventing Nematodes from Consuming It
- Protects the Roots from Nematodes and Pathogens

- High Levels of Phosphorous during planting can inhibit the Growth of Mycorrhizal Fungi

PROTOZOA

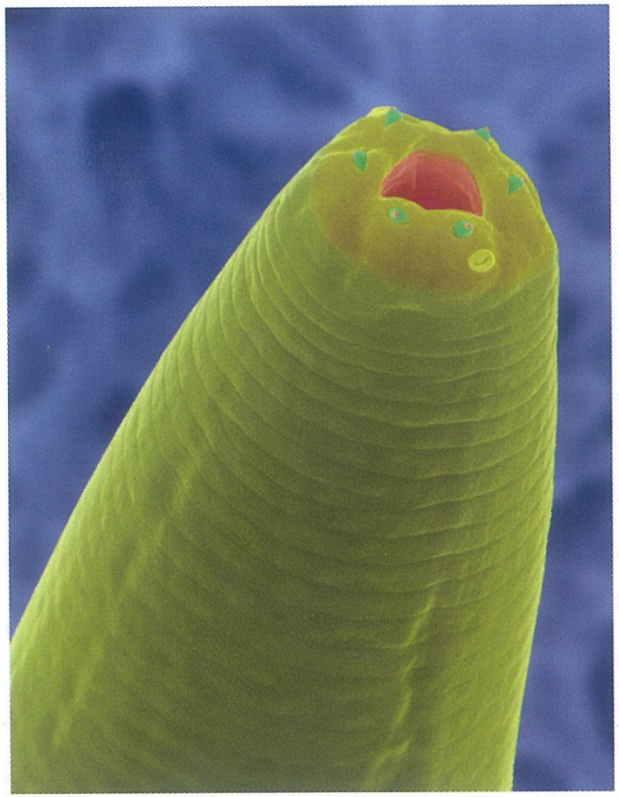
Paramecium as seen through an electron microscope, 130×. Image copyright Dennis Kunkel Microscopy, Inc.



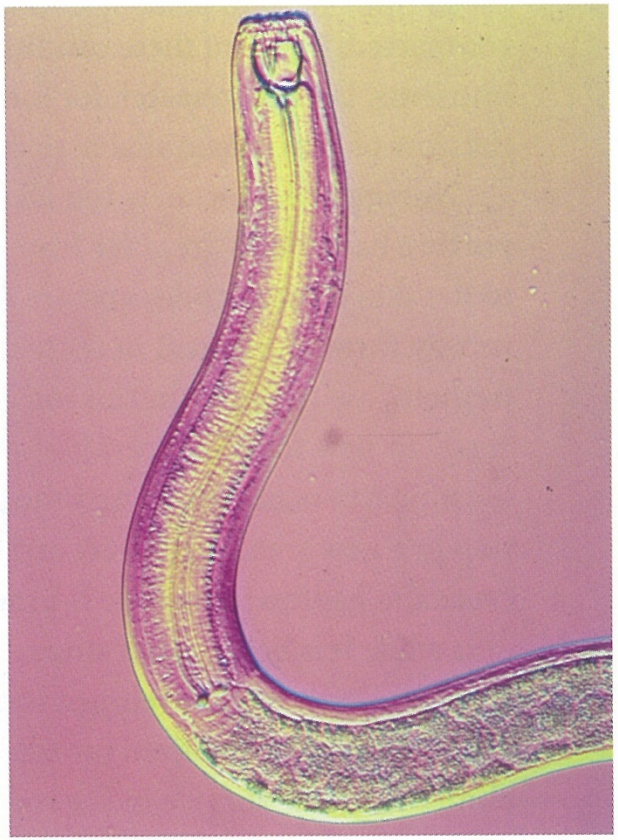
PROTOZOA

- Primarily Consume Bacteria
- Release Nutrients that can be Consumed by Plants

NEMATODES



An SEM image of the stylet end of a fungi-eating nematode. Image copyright Dennis Kunkel Microscopy, Inc.



A typical predatory nematode. Photograph by Bruce Jaffee, UC Davis.

NEMATODES

- Three Types – Fungal, Bacteria or Root Feeders
- Eat other Nematodes, Bacteria, Fungi
- Convert Nutrients to Plant Available Form by Consuming Fungi or Bacteria
- Food Source for Larger Organisms
- Also Consume Disease Causing Organisms
- Contribute up to 19% of Nitrogen to the plant by grazing on decomposed microbes and other means

TEST SEEDLINGS SILVER RUN ROSES

If you replenish the soil with microbes your plants will respond.

Without Microbes | With Microbes

Tomato Plants after (2) Weeks

Without Microbes | With Microbes

Pepper Plants after (2) Weeks

Without Microbes | With Microbes

Pepper Plants after (4) Weeks

Auburn University

If you replenish the soil with microbes you will have **bodacious** blooms.

Dianthus (3) Weeks After Transplanting

Auburn University

If you replenish the soil with microbes you will reduce disease and plant mortality.

Without Microbes | With Microbes

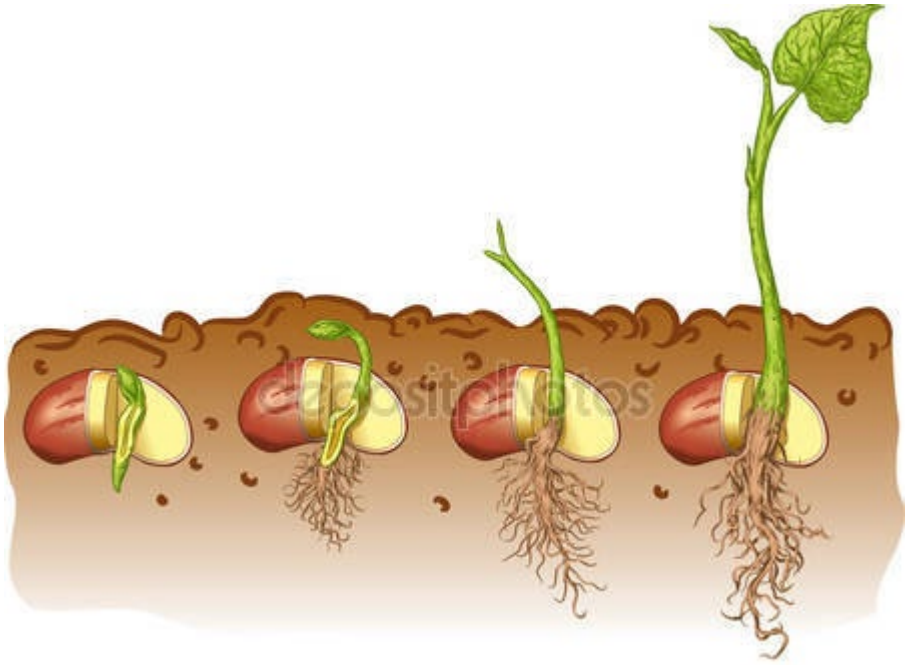
Auburn University

NOTE: The snapdragons were obtained from a local, commercial greenhouse. Root disease was observed starting at one week after planting.

Of the plants treated with the control, 50% died.

Of the plants treated with the microbial product, 100% lived.

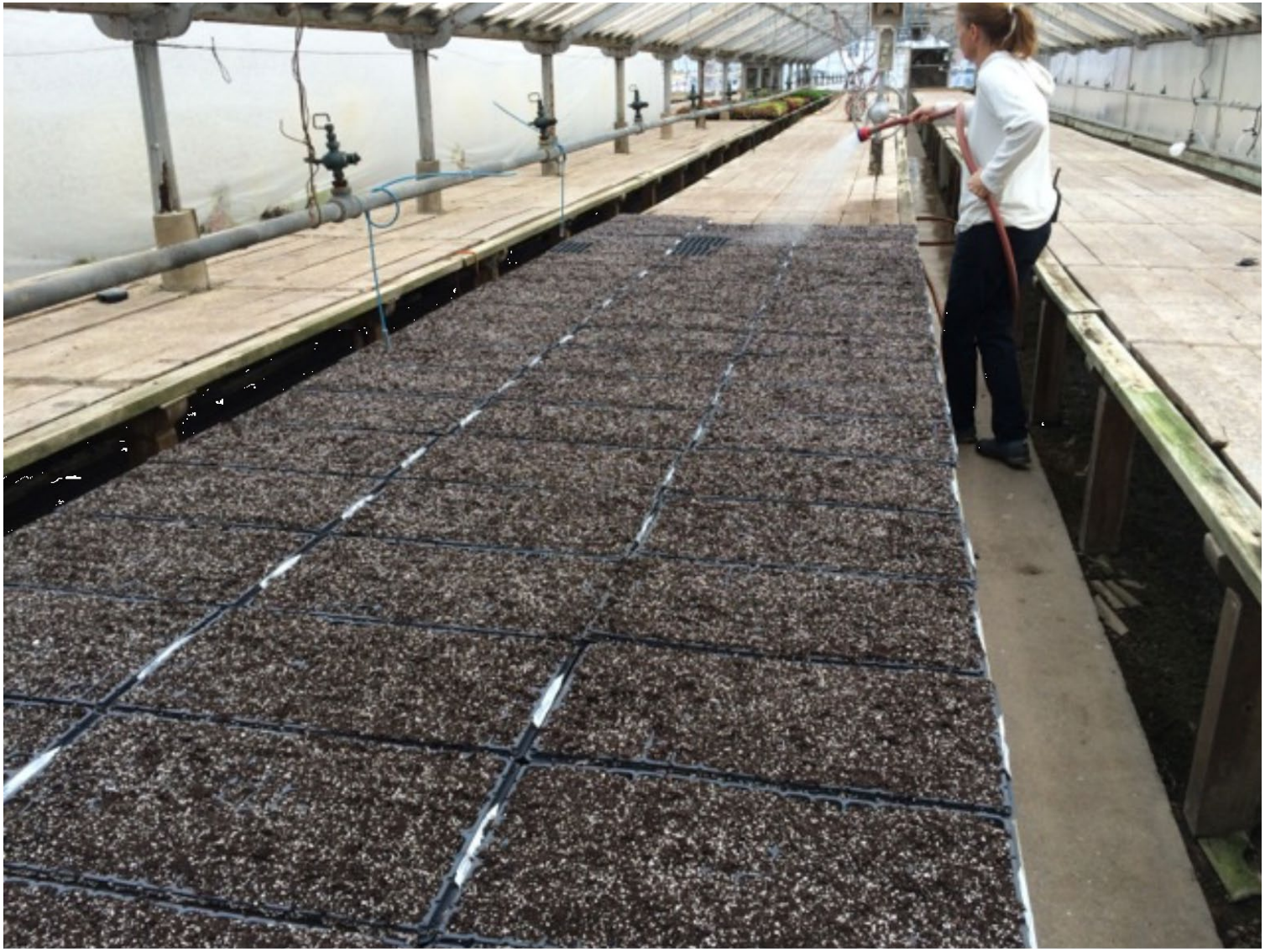
COLONIAL DISTRICT J. HORACE MCFARLAND TROPHY
Winning Entry 2015



SEED GERMINATION

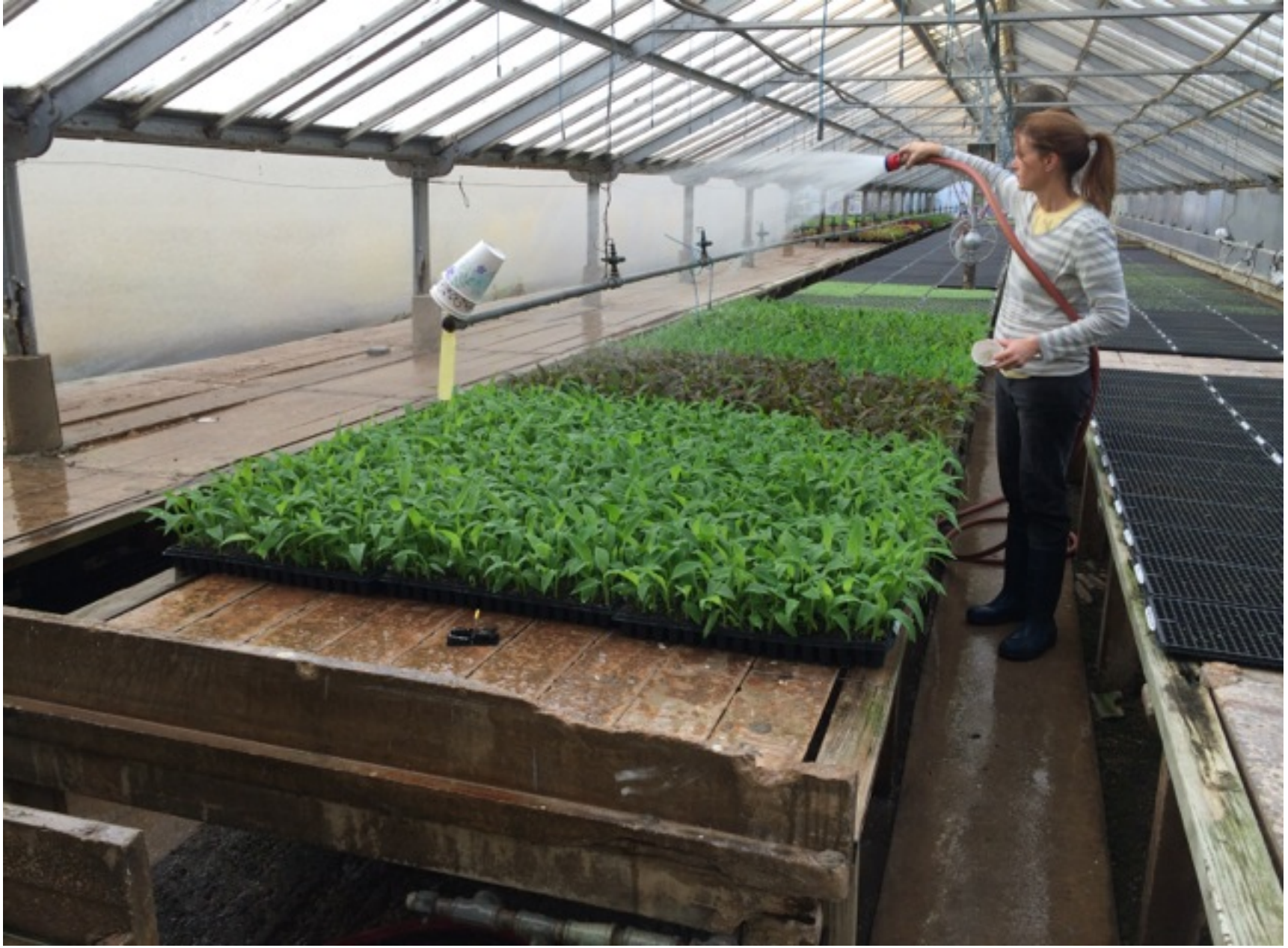
- Important factors for seed germination - temperature, depth of seed, water, oxygen and sunlight
- Microbes accelerate seed germination by stimulating cell division and cell elongation
- Microbes suppress fungal diseases around the seeds

Canna Seed grown in 2015 without using Microbes.
Around a 55% germination rate.



Baltimore Grower spraying Microbes on Canna Seed. The Cana Seed said on the package, it averaged a 73% germination rate, (Ball Seed).

Canna Seed after 7 days spraying with Microbes



Canna Seed after two weeks using Microbes

Canna Seed Lilies

Baltimore Grower – “Using Microbes not only improved germination and reduced loss, but the final crop in a 1 gallon container is beautiful.”

Andrew Hearne Marigolds

Guess which one he did not use MICROBE REMEDY on?

Asclepias tubersosa cells
Seed sown week 1 of 2019
Seed & Plant Starter applied week 6
Microbe Remedy applied week 11
Pictures taken week 13

BEGONIA TRIALS
USING MICROBIAL SCIENCE LABORATORIES
SEED & PLANT STARTER

SEED & PLANT STARTER WAS APPLIED VIA AN INJECTOR WHEN INITIALLY WATERING IN THE SOWING.
THIS GROWER ALWAYS HAD ISSUES WITH GETTING CONSISTENT GERMINATION.
TOP 10 GROWER IN THE TOP 100 LIST

Easter Lilly Trial

Easter Lilly grown using 60 strains of beneficial microbes.

LIME THYME TRIAL

Equal amounts of Lime Thyme Cuttings were planted in the two trays above. The same type and amount of media and fertilizer were used in both trays. Seed & Plant Starter was added to the tray on the left after the Cuttings were planted. This picture was taken after approximately three weeks.

PRODUCTS FOR SUCCESSFUL GROWNG AND WINNING TROPHIES

USED BY PROFESSIONAL NURSERY GROWERS

CONTAINS ENDO & ECTO MYCORRHIZAL FUNGI

•Enhances Seed germination, promotes plant establishment, and facilitates uptake of water and nutrients

CONTAINS PHOSPHATE SOLUBILIZING & PHOSPHATE MINERALIZING BACTERIA

•Provides increased phosphorous availability, enhances seed germination, flowering process, promotes root growth

CONTAINS PLANT GROWTH PROMOTING RHIZO-BACTERIA

•Hormones produced by bacteria enhances seed germination and increase yields

CONTAINS FREE LIVING NITROGEN FIXING BACTERIA

•Nitrogen fixation increases plant available nitrogen, promotes vegetative growth

CONTAINS L-AMINO ACIDS

•L-Amino Acids enhance seed germination, maximizes yield, increases resistance to stress

CONTAINS KELP EXTRACT

•Enhances seed germination, stimulates vegetative growth, enhances flowering-fruiting process, stimulates root growth, increases resistance to stress

CONTAINS CALCIUM

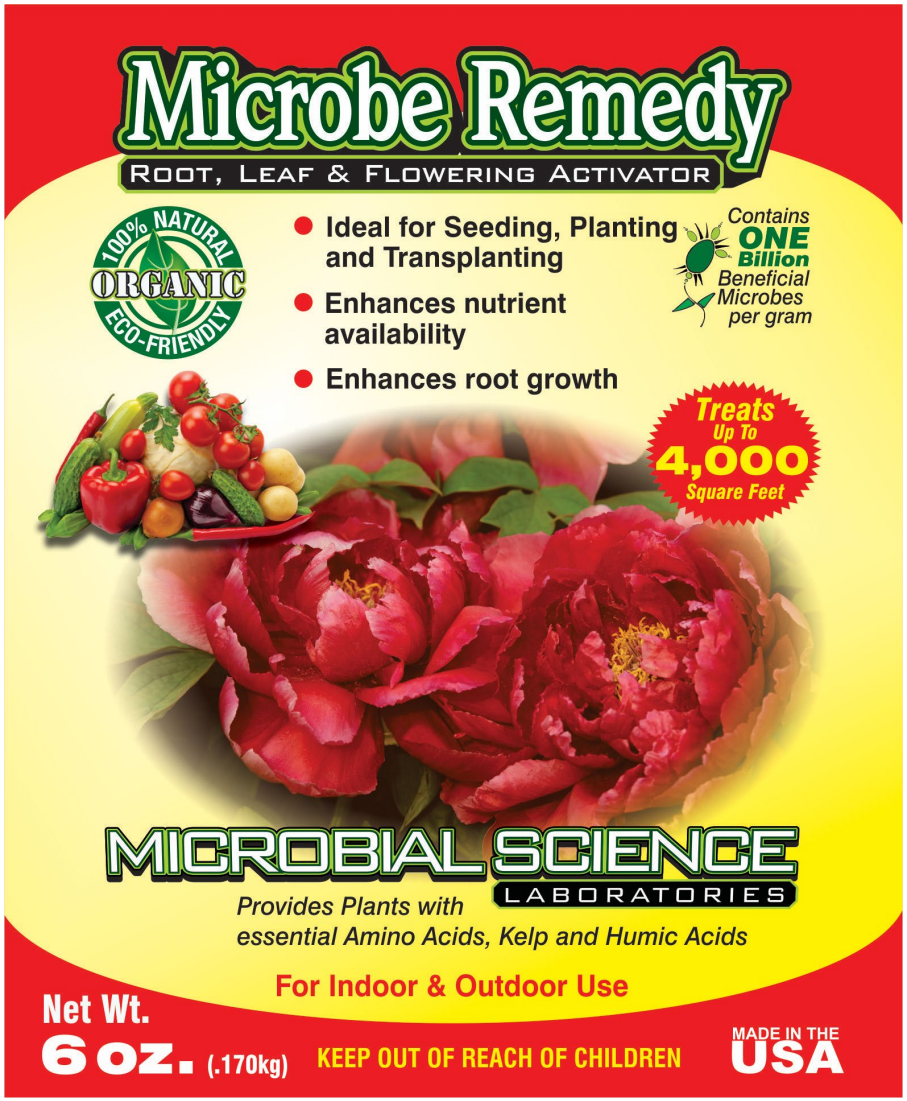
•Supports flowering process, enhances cell wall development

CONTAINS HUMIC ACID

•Improves nutrient efficiencies, enhances flowering mechanism

SEED & PLANT STARTER IS AVAILBALE IN:

2oz., 8oz., 5lb & 25lb.



USED BY PROFESSIONAL GROWERS

MICROBE REMEDY – Contains sugars

- contains 1 Billion Beneficial Microbes per gram.

CONTAINS PHOSPHATE SOLUBILIZING & PHOSPHATE MINERALIZING BACTERIA

- Provides increased phosphorous availability, enhances seed germination, flowering process, promotes root growth

CONTAINS PLANT GROWTH PROMOTING RHIZO-BACTERIA

- Hormones produced by bacteria enhances seed germination and increase yields

CONTAINS FREE LIVING NITROGEN FIXING BACTERIA

- Nitrogen fixation increases plant available nitrogen, promotes vegetative growth

CONTAINS EXTRACELLULAR ENZYME PRODUCING BACTERIA – FUNGI

- Promotes decomposition, transformation, and cycling of nutrients

CONTAINS KELP EXTRACT

- Enhances seed germination, stimulates vegetative growth, enhances flowering-fruiting process, stimulates root growth, increases resistance to stress

CONTAINS HUMIC ACID

- Improves nutrient efficiencies, enhances flowering mechanism

MICROBE REMEDY IS AVAILBALE IN:

6oz., 1lb., 5lb & 25lb.

USE AT TIME OF SEEDING OR PLANTING AND AS A MONTLY MAINTENANCE

USED BY PROFESSIONAL GROWERS

- Increased root mass, root growth and root development
- Promotes lateral bud development, increases flowering, fruiting and bud set
- Improves chlorophyll production
- Enhances and intensifies plant coloration
- Increases resistance to environmental extremes, heat, cold drought
- Enhanced plant growth and development via cell division
- Accelerates seed germination and increases percentage of seeds germinated
- Increases shelf life of edibles
- Provides plants with essential amino acids, vitamins, enzymes and trace elements

Available in: 6oz., 1lb., 5lb & 25lb Powder
Available in: 5 Gallon Liquid

FOR BEST RESULTS:
SPRAY OR POUR OVER PLANTS MONTHLY

CONTAINS L - AMINO ACIDS (NITROGEN)

- L – Amino Acids enhance plant metabolism & increase metabolic efficiencies which is essential for healthy plant growth and serves as a readily available nitrogen source for the plant

CONTAINS PHOSPHOROUS

- Essential for bud formation, bud set and flowering process
- Essential for photosynthesis, which is critical for flower development
- Promotes root growth and root formation

CONTAINS POTASSIUM

- Potassium is essential for photosynthesis and carbohydrate metabolism which both influence the flowering process

CONTAINS BORON

- Boron is essential for pollen tube growth and development
- Boron enhances calcium absorption
- Boron is essential for functionality of guard cells which ultimately regulates stomata

Contains: Sulfur, Iron, Manganese, Zinc and Magnesium

Available in a 1lb. size

L – amino acids

- Derived entirely from plant proteins
- Essential for healthy plant growth
- Metabolic Processes include:
    - Protein synthesis
    - Stress reduction
    - Photosynthesis
    - Stomatal regulation

(Regulates release of water to take in Carbon Dioxide)

    - Facilitates translocation in the leaf
    - Source for readily available Nitrogen

CONTAINS L – AMINO ACIDS (NITROGEN)

- Contains free L – Amino Acids derived from plant proteins
- L – Amino Acids enhance plant metabolism and increases metabolic efficiencies essential for healthy plant growth

CONTAINS PHOSPHOROUS

- Essential for bud formation, bud set and flowering process
- Essential for photosynthesis, which is critical for flower development
- Promotes root growth

CONTAINS POTASSIUM

- Potassium is essential for photosynthesis and carbohydrate metabolism, which both influence the flowering process

CONTAINS KELP EXTRACT

- Contains plant growth hormones, amino acids, vitamins and micronutrients
- Stimulates flowering process and root growth

CONTAINS BORON

- Boron is essential for pollen tube growth and development
- Boron enhances calcium absorption
- Boron is essential for functionality of guard cells which ultimately regulates stomata

CONTAINS DEXTROSE – simple sugar

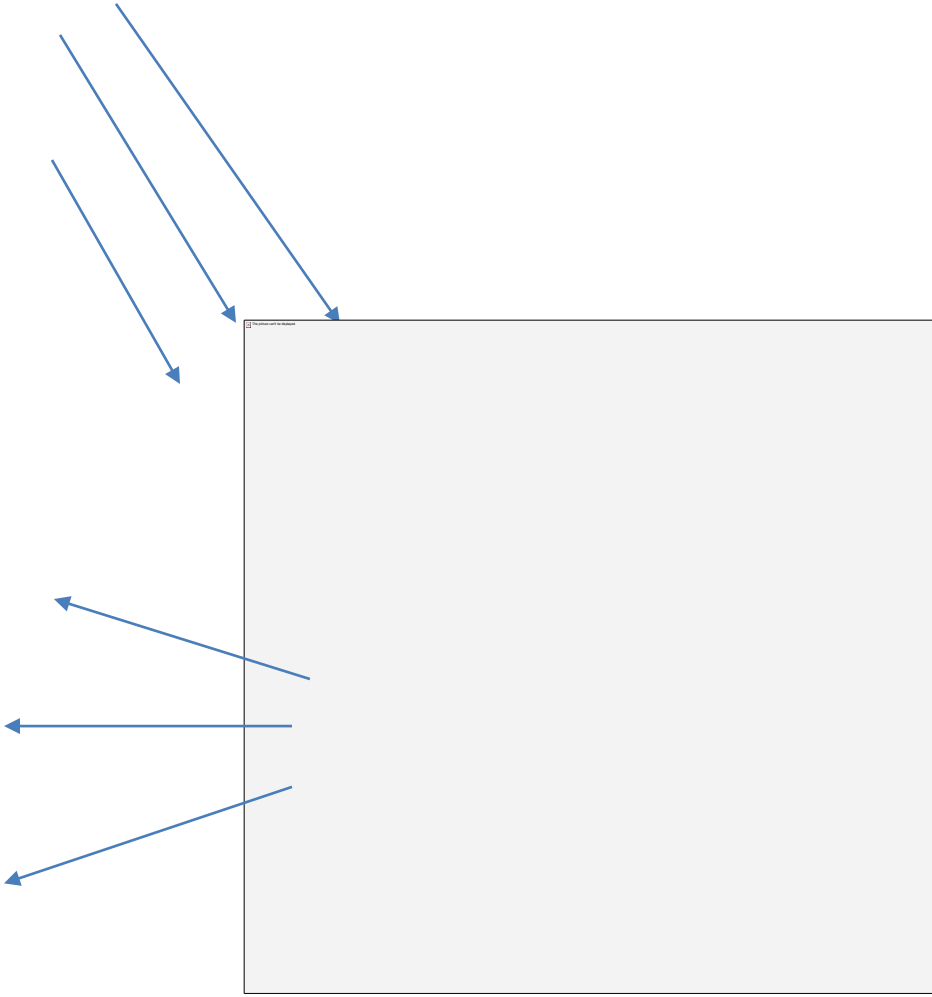
- Increased metabolic requirements during the pre -flowering and flowering stages

Available in a 1lb. size

Use when buds first appear

Seed & Plant Starter

Microbe Remedy



RECOMMENDED ROSE TREATMENT

Mix Microbe Remedy

- 4 Tablespoons of Microbe Remedy into one gallon of warm water, not hot water (One gallon should treat 100 Plants) and shake or stir until dissolved

- Pour mixed gallon of water into Ortho Dial and Spray or similar hose end product – set sprayer at 1oz if it has a setting – shake gallon again and refill hose end sprayer as needed

- Drench leaves and soil minimum of 1” soil drench

- Spray Spring, Summer and Fall or as needed
  (Use if plants are stressed with summer heat)

- The more you use Microbe Remedy the healthier your plants will be (some Rosarians use it monthly)

- Microbe Remedy has a 3 year shelf life in the jar – once you mix it apply it within 48 hours or the bacteria start to die off

Pepper field after using Microbes at the time of seeding, two weeks later and then spraying the leaves in the field with Microbes. Picture was taken in late July.

GROWN WITH MICROBES & FERTILIZER

4’ x 8’ tomato plants in Lancaster, Pennsylvania

AZALEA’S IN THE SPRING USING MICROBE REMEDY AND BUD & BLOOM FERTILIZER

THE END