This presentation premiered at WaterSmart Innovations

watersmartinnovations.com

watersmart
INNOVATIONS

New and Effective Technologies for Biological Water Treatment Systems and Methodologies

"Microbial Soil and Water Inoculants: The Future of Water Resource Management"

WaterSmart Innovations Conference
October 8 – 10, 2008
Las Vegas, Nevada

Mark J. Krupka – Ecological Laboratories, Inc.

G. Brian Wheeler, CNU, RLA – Genesis Group

Louise B. Ambrose, Esq. – Genesis Group

Microbial Soil Inoculants

Thomas A. Selvig, CA
Applied and Experimental Microbiology, Inc.

Dr. Richard I. Leavitt, PhD

Overview

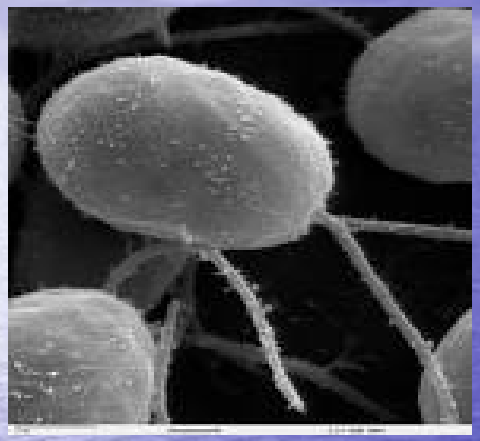
I. Introduction to photosynthetic microorganisms

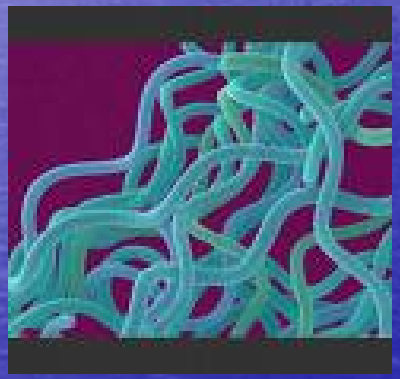
II. Primary Benefits
   a. Nitrogen Fixation
   b. Oxygen Release and Carbon Sequestration
   c. Water Management

III. Secondary Benefits
   a. Pathogen Suppression

IV. Application and Dosing

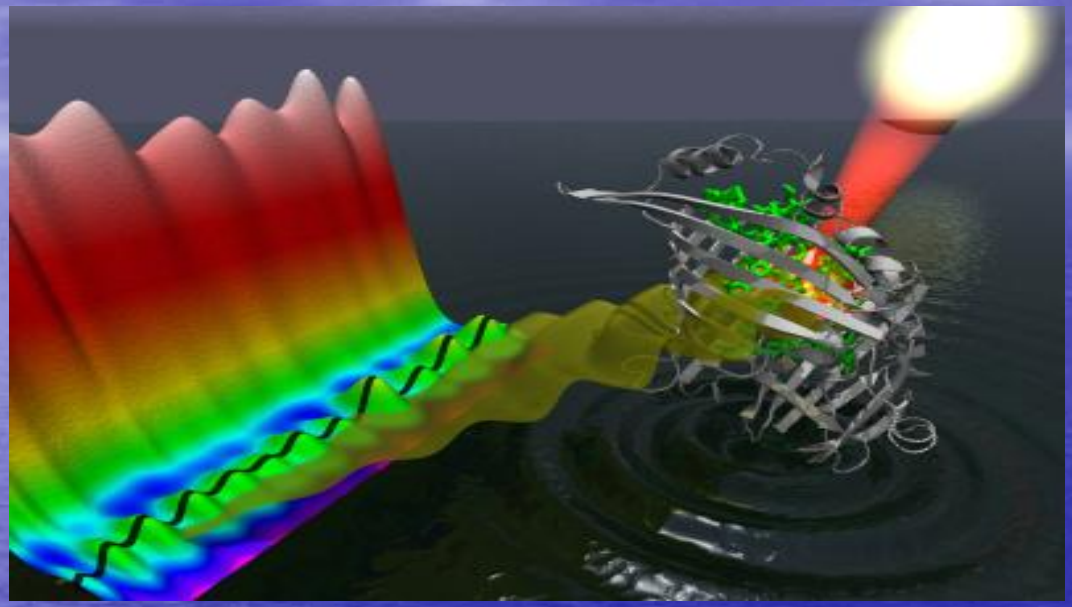
Photosynthetic Microorganisms





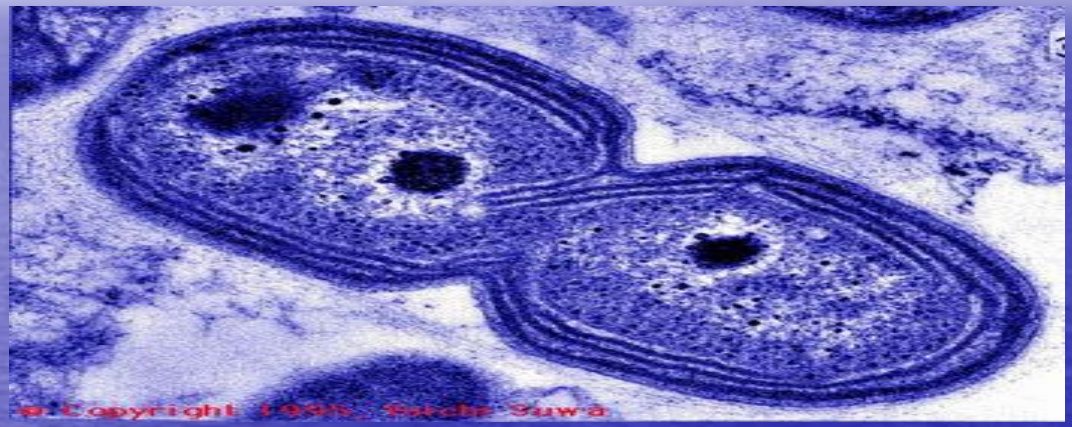
A close-up of photosynthetic microorganisms

Light to Energy



- Photosynthetic microorganisms absorbing a photon.
- Applied Physics.
- Plants require not just food, but energy. Photosynthetic microorganisms provides energy.
- E=MC2

Reproduction



- Reproduction (Binary Fission) – Photosynthetic microorganisms.
- The microorganisms double in population approximately every five minutes.
- Many pathogens double in population every 48 to 72 hours.
- Photosynthetic microorganisms and pathogens desire the same growing conditions. Many times, photosynthetic microorganisms prevail.

Resultant Benefit of Photosynthetic Nutrient Transfer and Storage

- These microorganisms consume organic pollutants, CO_2 and atmospheric nitrogen.
- The microorganisms degrade and aid in detoxifying many pollutants.
- The microorganisms store CO_2 and nitrogen in the form of sugar and protein.
- Photosynthetic microorganisms are the foundation of a healthy food chain.

Nitrogen Fixation

Rhodospirillum rubrum

“Purple Sulfur Photosynthetic Bacteria

Have been unequivocally established as Nitrogen fixing organisms.”

E.E.Lindstrom, PhD

Study funded by The Rockefeller Foundation and the United States Atomic Energy Commission Data provided by The University of Wisconsin. Nitrogen fixation,

Confirmed via: Kjeldahl and Radioactive Isotope Assays

Nutrient Transfer

0 ppm 40 ppm 80 ppm

Nitrogen Only (N)

0 ppm 40 ppm 80 ppm

N + Photosynthetic Microorganisms

Turf

- The Old Collier Golf Course in Naples, FL is The Audubon Gold Course
- Paspalum turf watered with salt water

- Turf on the left is: “Control” Growers best practice
- Turf on the right is: inoculated with photosynthetic bacteria

Pine Trees

- Seedlings treated at a commercial nursery in Georgia.
- Seedling on right treated with photosynthetic microorganisms.
- The visual evidence would indicate root mass increase on photosynthetic microorganism treated tree is greater than 25%
- Numerical quantification and qualification of these effects are being validated at Auburn University, and North Carolina State University.

Oxygen Release and Carbon Sequestration

Rhodospirillum rubum

"Purple Sulfur Photosynthetic Bacteria constitute a group of versatile organisms, that can grow as photohetertrophs, photoautotrophs, and chemoheterotrophs- switching from one mode to another, dependant on conditions."

$CO_2 + 2H_2O = CH_2O + H_2O + O_2$

John Lindstrom, PhD

John's

Bacteriology 102

Water Management

"Photosynthetic bacteria
are known to carry out the reaction
$2H_2 + CO_2 (CH_20) + H_2O$"

E.E. Lindstrom, PhD
University of Wisconsin

Flowers

- Picture 1 – Initial picture before watering or inoculation.
- After the picture, the Vinca on the right was given water and photosynthetic bacteria. The Vinca on the left received just water.

Flowers cont.

- (6 Days Later) No additional water or photosynthetic microorganisms for either plant.
- The Vinca on the right with Photosynthetic microorganisms is still healthy and the pot is heavy with retained water.
- The Vinca on the left is in decline caused by drought.

Water Retention

Growers Best Practice with photosynthetics (right sample)
and without (left sample)

Pictures from
The Old Collier Golf Course,
An Audubon Gold Course
Located in Naples, Florida

Pathogen Suppression

Gause's Law of Competitive Exclusion

"Two species competing for the same resources, can not stably coexist.

Either of the two competitors will always take over the other, which leads to the extinction of one of the competitors."

G.F. Gause, M.D.

Nematode Suppression

Control	December	February	March	April	May	June
Spiral	1069	0	0	0	839	989
Lance	53	117	113	149	54	146
Sting	0	11	12	38	61	5
Root knot	0	0	0	0	0	0
Ring	0	0	0	0	0	142
Sheathoid	0	0	0	0	0	239
Stubby root	0	133	68	163	106	11
Photosynthetic microorganisms	**December**	**February**	**March**	**April**	**May**	**June**
Spiral	1069	0	0	0	922	1195
Lance	53	0	0	0	0	0
Sting	0	0	26	0	15	0
Root knot	0	0	0	0	0	0
Ring	0	0	0	0	0	63
Sheathoid	0	0	0	0	0	296
Stubby root	0	0	49	0	0	0

The Old Collier Golf Course **Assays provided by Dr. Crow, University of Florida**

Application and Dosing

Directly into irrigation system, mechanical or hose end sprayer, or simply apply using the old watering can.

- 1 gallon covers 1 surface acre as a topical spray.
- 2 oz per gallon of water as a drench.

Frequency – initial planting and quarterly and/or continuous, low dose applications every time you irrigate.

Reminder – Photosynthetic microorganisms contain no supplemental fertilizer. Frequent low dose application provides greatest performance.