



# Soil Amendments and Soil Biology

**Lynne Carpenter-Boggs**

**Dept. Plant Pathology**

**Washington State University**

- **Soil Amendments**
  - **To affect crops, their pests, diseases, nutrients**
  - **To affect soil biota**

# Fertilizer = #1 Soil Amendment

- Feed plants
- Enhances crop growth
  - Potential increased substrate
- Reduces need and ability to have symbionts



# Fertilizer = #1 Soil Amendment

- Substrate for some microbial activities (nitrification), reduces others
- Often reduces pH
- Reduces need for organic inputs



# Lime, pH neutralizers

- **Usu. increases plant and soil biotic growth**
- **Increases nutrient availability**
- **Reduces pH stress**



# Agricultural - cides

- **Herbicides**
  - Reduced substrate diversity
  - Total plant biomass may  
↑ or ↓
- **Insecticides usually affect entire order**
  - Many insects have soil-inhabiting stage
- **Some enhance bacteria**



# Agricultural - cides

- **Fungicides, nematocides reduce pathogens as well as beneficials**
- **Novel compounds degraded by novel genes / enzymes**



# What amendments can change the enhance the soil community?

- **Inoculants may directly change certain populations**
  - **Will be short-lived without proper environment**
- **Habitat-enhancers**



# **SOIL**

**is likely the most diverse,  
complex, and poorly understood  
habitat on earth.**

**No organism can persist without  
appropriate habitat and niche.**

# Niche

- **Correct symbiont of crop**
  - Mycorrhizal fungi
  - N-fixers (Rhizobium)
- **Successful competitors**
  - Efficiency
  - Antibiotics
  - Stimulants, signals
- **Specific predator or substrate-degrader**



# Soil as Habitat

- **A mollic topsoil with 5 % SOM contains ~7.5 tons of organisms / ha**
  - **6 tons of this is microbial:**
    - **bacteria, actinomycetes, fungi, algae**
- **Biodiversity depends on habitat & substrate amount & diversity**

Schroeder, 1978

# Soil as Habitat

- **Organic Matter (SOM) is KEY**
- **Build it (soil) and they (microbes) will come**
  - **SOM = food for the bugs**
  - **SOM = habitat**
  - **SOM = bio-chemical-physical buffer**

# Sources of OM

- **Rotation, continuous cropping**
  - increase soil protection, OM amount & diversity
- **Legumes, grasses**
  - root-intensive crops, multi-year
- **Highly productive crops**
  - increase residue production
  - **BUT NOT by OVER-fertilization**

# Sources of OM

- **Manure, sludge, biosolids**
  - Variable longevity in soil
  - High bacteria / fungi
  
- **Compost**
  - slow-release fertilizer, partially humified
  - more likely to BUILD OM
  - may decrease specific or general diseases

# Sources of OM

- **Peat, lignified materials**
  - very low nutritive value
  - may/may not be stable
  - less chemical or biological benefit
- **Humic acids**
  - very small amounts of C, N, etc.
  - may serve as catalyst for further humification, soil building

# Sources of OM

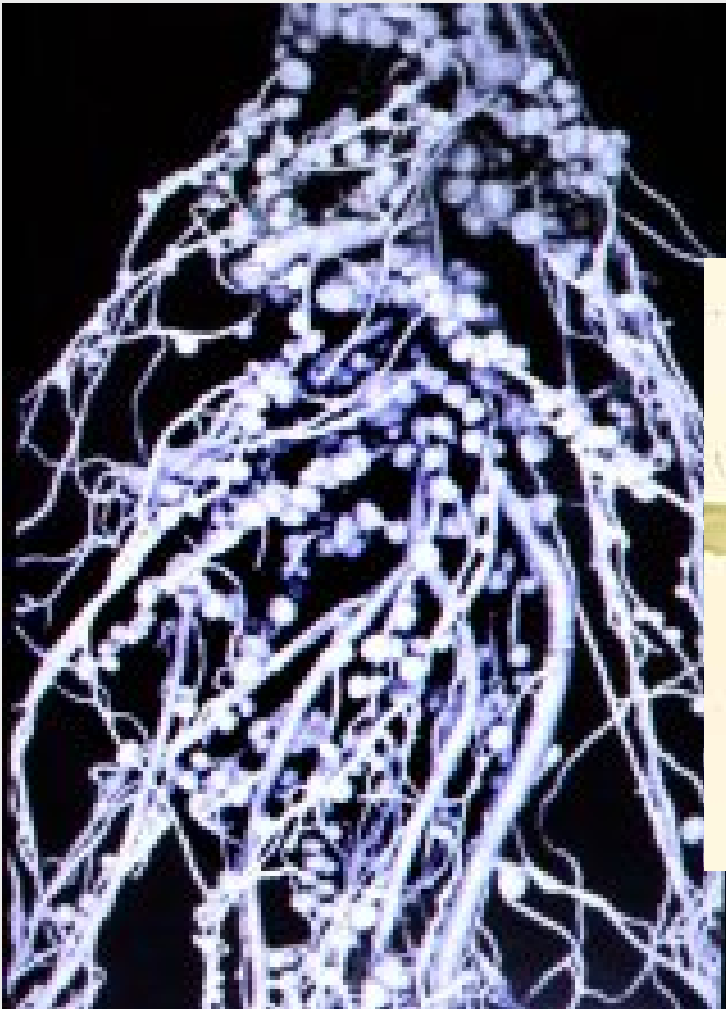
- **Living biomass**
- **Temporary nutrient storage:**
  - **Much of the N and P available in soil passes through microbial biomass**
  - **Key is to support STABLE biomass**



# Soil Inoculants

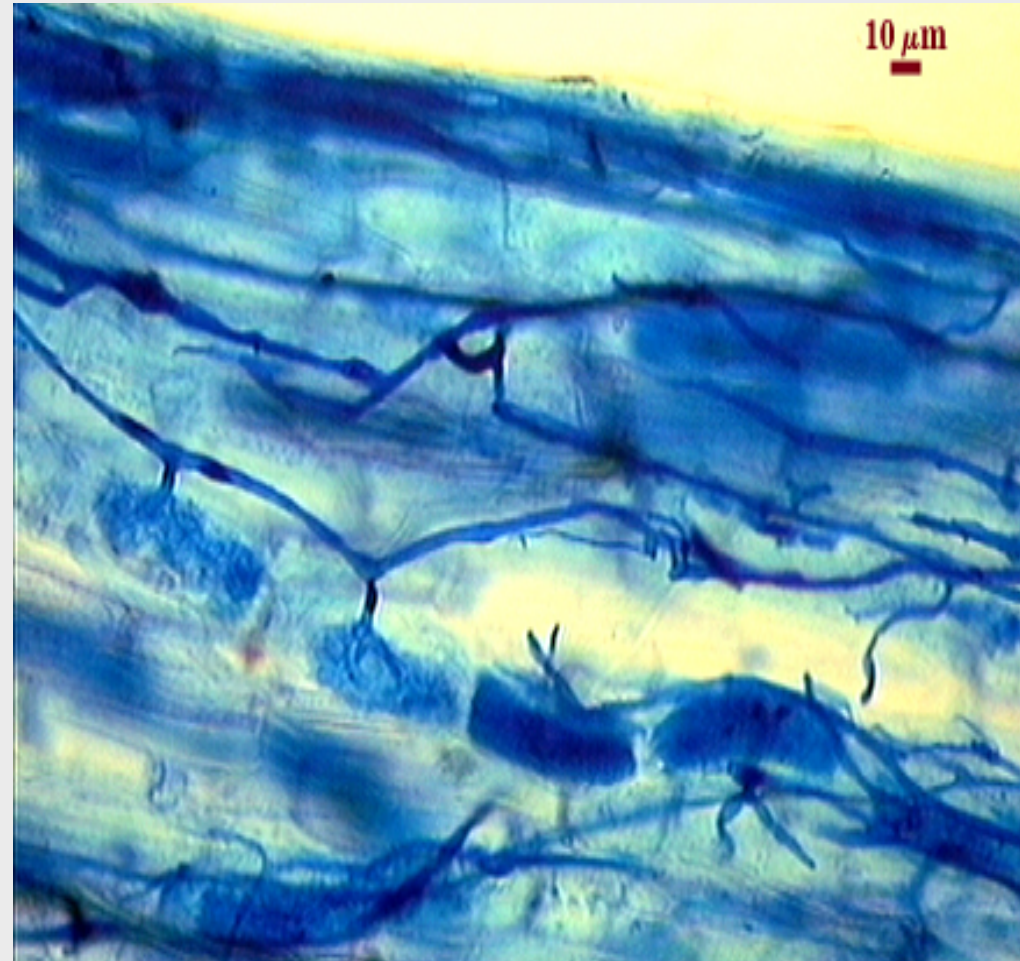
- **Rhizobium/ Bradyrhizobium**
- **Mycorrhizal fungi**
- **Plant growth promoting rhizobacteria (PGPR)**
- **Biocontrol agents**

# Symbiotic N-fixers are host-species specific



# “Eight Good Reasons ... to use BioVam” (BioVam has beneficial mycorrhizae and helper bacteria. )

1. Helps plants resist pests, diseases.
2. Helps aeration, infiltration.
3. Improve soil structure.
4. Increase root biomass.
5. Increase nutrient uptake.
6. Decompose OM, transport nutrients to plants.
7. Protect roots from stresses and transplant shock.
8. Increases plant yields, flavor and quality.



# Commercial / Proprietary Soil Inoculants

- **EM (Effective Microorganisms)**
- **Bio-Life**
- **Dr. Earth Organic Fertilizer**
- **SC27**
- **Petrik Labs products**
- **... Many many more**
- **Biodynamic Preparations**

# Petrick Labs: Microbiology Used

**Agrobacter**

**Cryptococcus**

**Rhizopus**

**Arthrobacter**

**Enterobacter**

**Saccharomyces**

**Aspergillus**

**Lactobacillus**

**Streptomyces**

**Bacillus**

**Nitrobacter**

**Thiobacillus**

**Candida**

**Nitrosomonas**

**Clostridium**

**Penicillium**

<http://www.petriklabs.com/PUBLIC/about/certs.htm#OrganicProducts>

# SC27 (Martin Marietta Corp.)

- **Combination of 27 naturally occurring soil microorganisms**
- **“Agricultural universities and private research firms have examined SC27's effect on a wide range of crops, including ...beans, corn, cotton, grapes, ... potatoes, tomatoes, trees, turf, wheat ...”**

[http://www.martinmarietta.com/corpsite/about\\_mmm/technologies/sa\\_sc27.asp](http://www.martinmarietta.com/corpsite/about_mmm/technologies/sa_sc27.asp)

# SC27 Research Results

- **“Results have shown that SC27 may increase crop growth, increase root mass, increase crop yield and improve crop quality.”**
- **“Please note: Crop responses to SC27 Soil Inoculant will be different in different situations. Crop production is based on managing a diverse set of inputs in varying environmental conditions. The crop response to SC27 Soil Inoculant in any particular situation may vary.”**


# Problems

- **Most not independently tested**
- **Many trials with poor or no controls**
- **Products may contain micronutrients**
- **Benefits variable or temporary due to improper environment**
- **Increased yield may not = increased profit**



# Others

- **Compost tea**
  - Homegrown or commercial
  - Fertilizer and inoculant
- **Hay infusions for protozoans**
- ...

A photograph of three people crouching in a lush green field, examining the soil. In the background, there is a blue barn and a silo, with rolling hills under a clear sky. The text is overlaid on the left side of the image.

**Building inherent soil fertility is key to controlling inputs and maintaining high yields. Sustainable soil fertility is dependent on sustained activities of beneficial soil organisms. “Feed the soil.”**