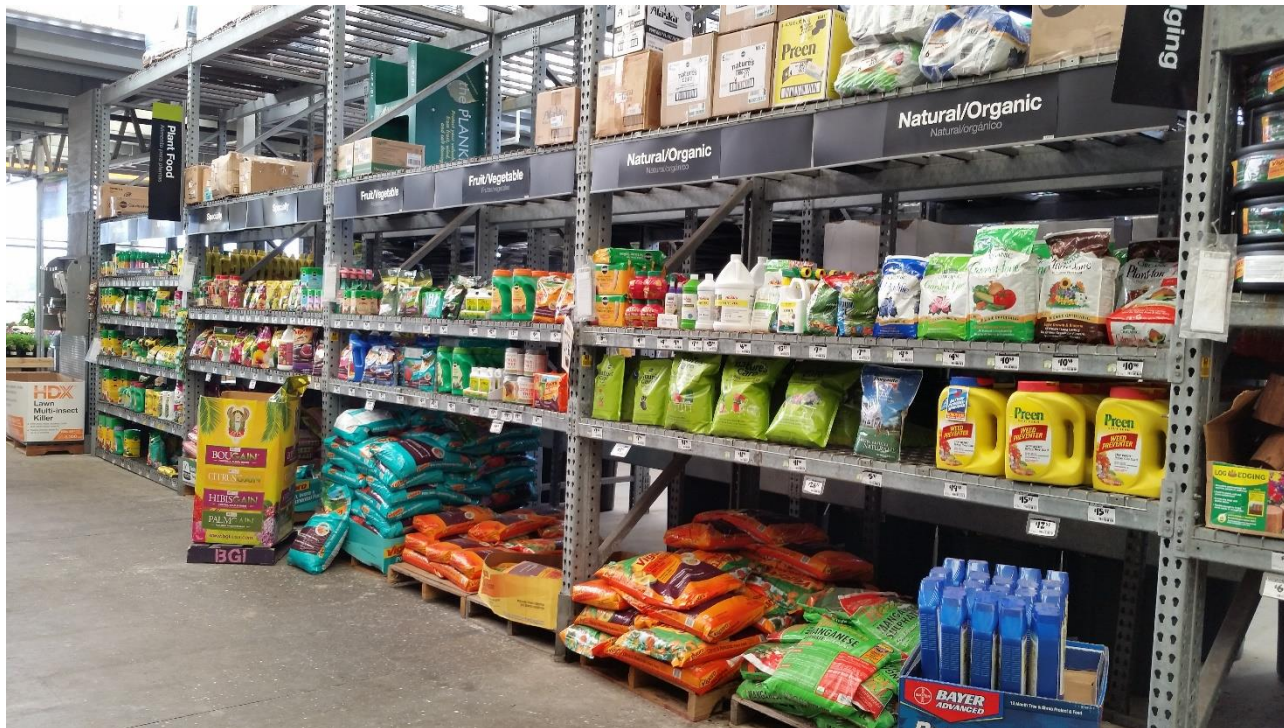


Gardening Really is All About the Soil: Always Was & Always Will Be!

Presented by: Sally Scalera
Urban Horticulture Agent/MG Coordinator

Present Day Gardening!



I found an insect, what to do?



Typical thought is.....

* I should I
spray
something



Are Pesticides the Answer?

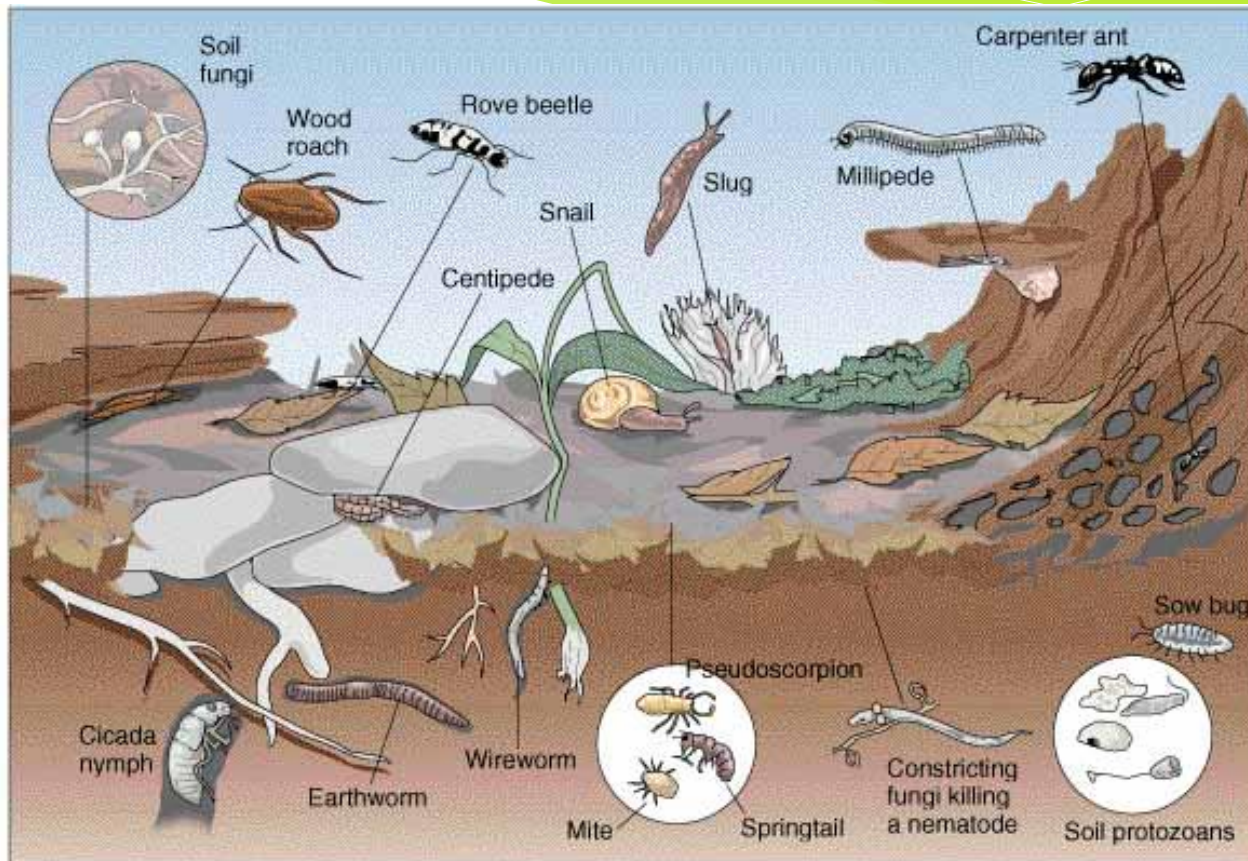
- * Pesticides, at best, are just a Band-Aid. At their worst, they kill the good guys!



How Does Nature Grow Healthy Plants?



The Answer is in the Soil!



That is, a biologically active soil!

What do I mean by “Soil”?

- * According to the (ii) definition of soil by the USDA soil is -- The unconsolidated mineral or **organic material** on the surface of the Earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects), and macro-and microorganisms acting on parent material over a period of time.

Emphasis on Organic Matter



The soil must have organic matter for the soil organisms...

What lives in the Soil?

- * A variety of micro and macro-organisms which eat and/or are eaten by each other! That is what we refer to as the **Soil Food Web**.

Soil Food Web, Who eats whom?

The consumed

- plants
- mosses
- algae
- lichen
- some bacteria

(photosynthesizers)

Primary consumers

- slugs
- nematodes
- insects
- bacteria
- fungi

Secondary consumers

- bacteria
- fungi
- centipedes
- mites
- spiders

Tertiary consumers

- beetles
- earth-worms
- ants
- birds

The Main Players:

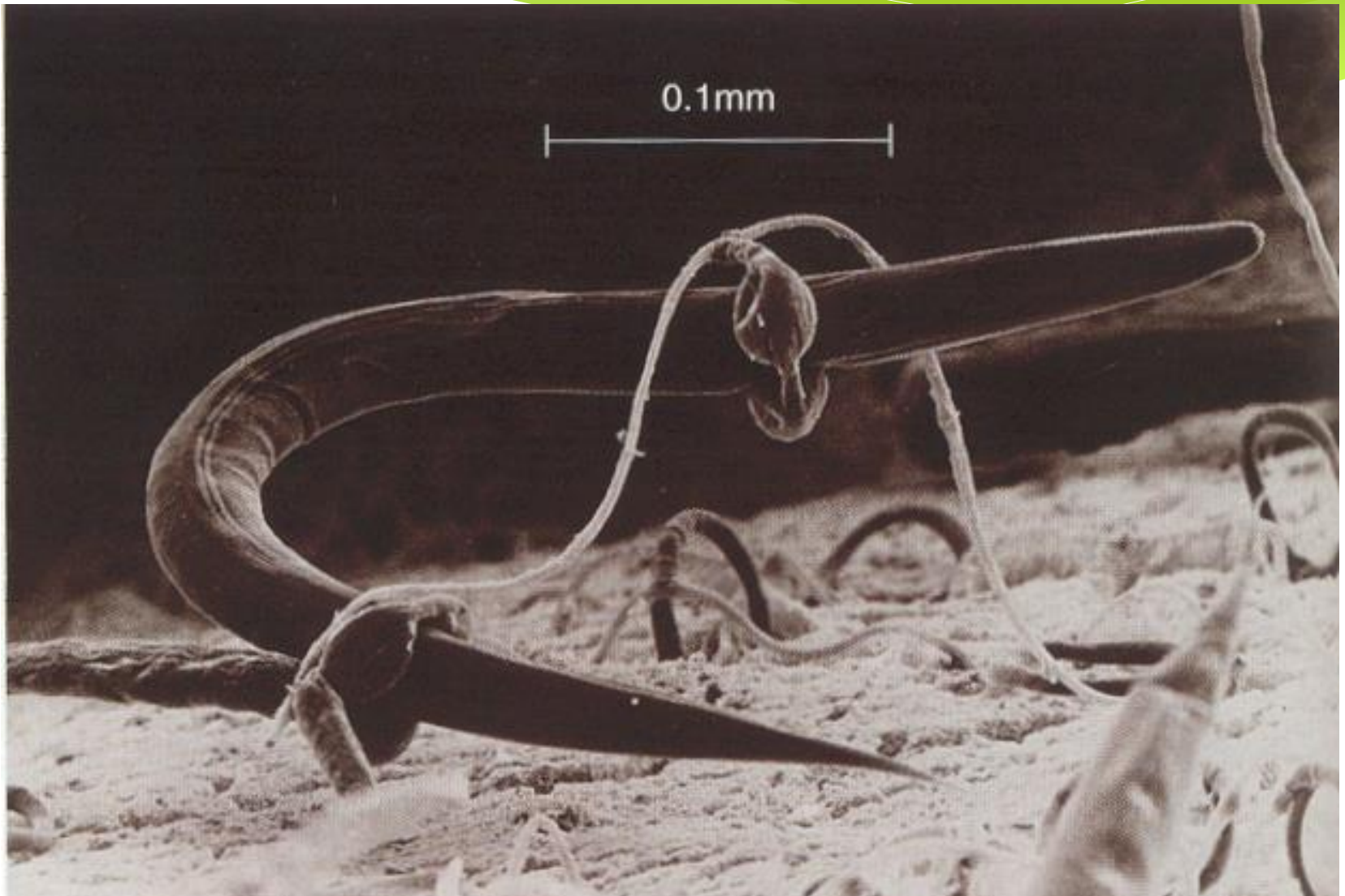
- * Fungi
- * Bacteria
- * Arthropods
- * Nematodes
- * Protozoa
- * Earthworms



Fungi

- * Majority of biomass in soil is typically fungi.
- * Hyphae help to improve soil structure
 - * Soil aggregation
 - * Important to water holding capacity and aeration
- * Fungi active in decomposition of plant material.
 - * Decompose lignin with extracellular enzymes
 - * Lignin peroxidases
 - * Provide small “bite size” chunks of molecules for bacteria.
- Hyphae help to improve soil structure

Nematode-Eating Fungus



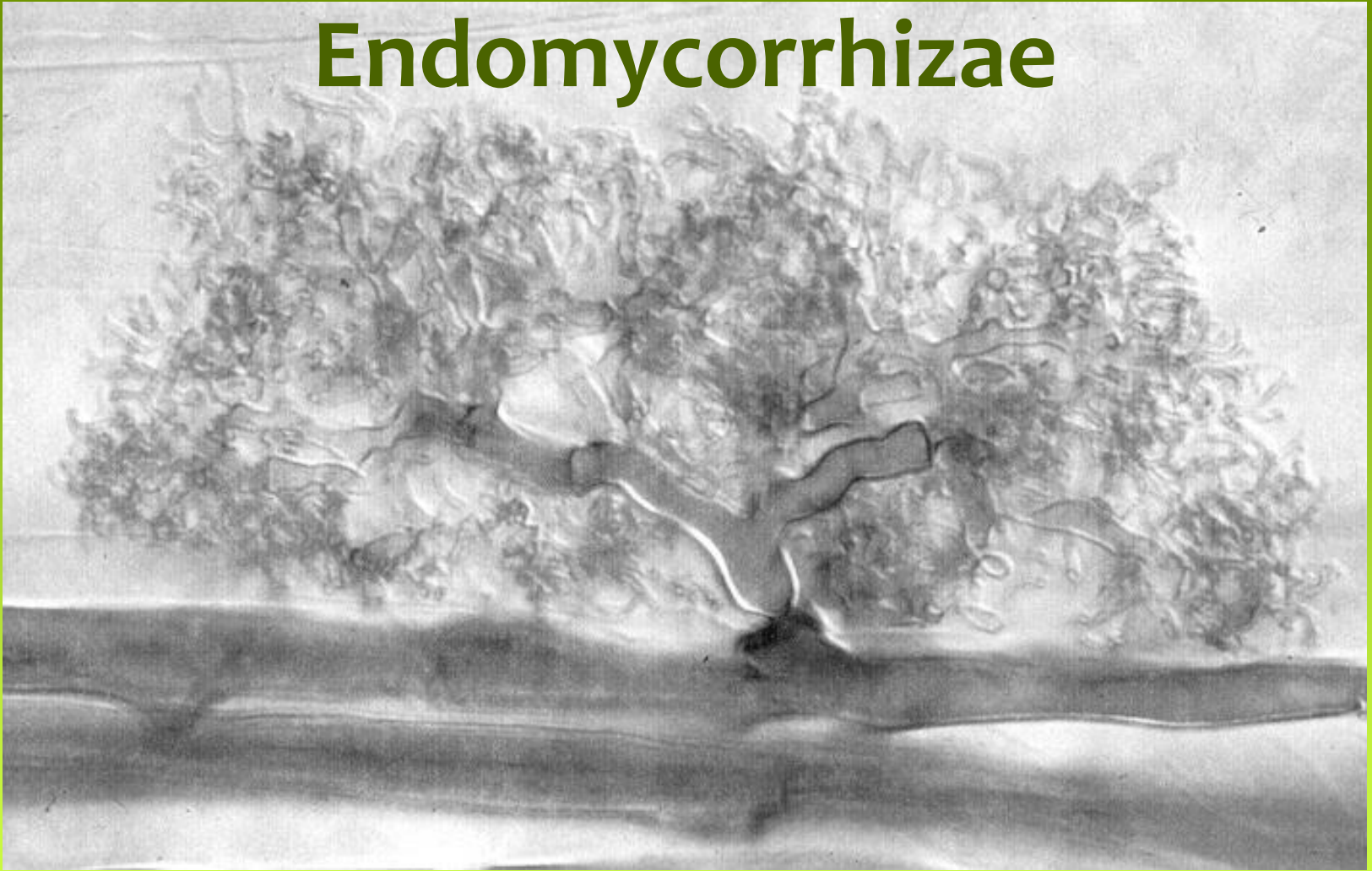
Fungi usually get a bad wrap but here is a good guy in action!

Mycorrhizae – A Gardener's Friend

- * Mycorrhizal (myco=fungus, rhizal=root) fungi
- * Extend root systems of plants
 - * ~90% of all land plants colonized
- * Symbiosis based on phosphorus transfer from soil to plant
- * Key factor in the initial colonization of land by plants
- * Corn is colonized by 80% of the mycorrhizae
- * Spores are produced in the soil

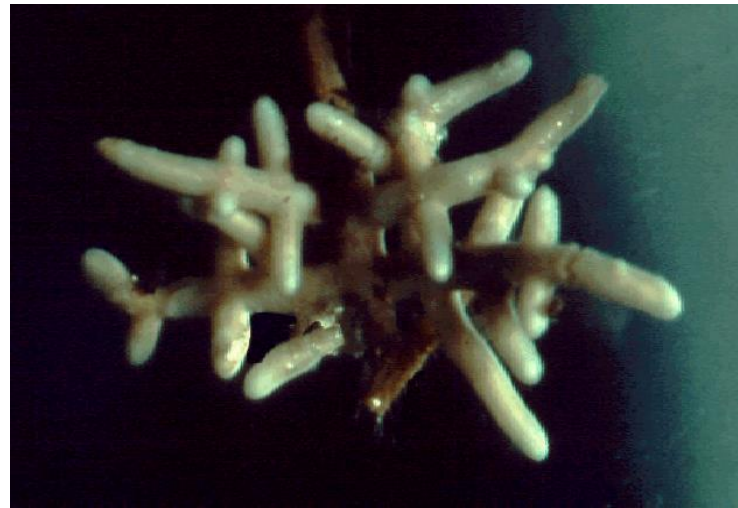


Endomycorrhizae



Vesicular-arbuscular (VAM) penetrates inside the cell and are the most abundant in systems where phosphorus is limited and in warmer or drier climates

Ectomycorrhizae



These can actually form a physical barrier to protect the roots

Benefits Ascribed to Mycorrhizae

- * Improved nutrient uptake
- * Increase tolerance of
 - * Drought
 - * Salts
 - * Heavy metals
 - * Pathogens
- * Enhanced soil stabilization



Soil Bacteria

- * Complex communities
- * Over one billion bacteria per gram of soil
- * Much more metabolically diverse than fungi
- * Perform the most biogeochemical cycling of nitrogen, sulfur, and carbon of all microbes
- * Biodegrade toxic chemicals
- * Can fix nitrogen in legumes
- * Can quickly create new biochemical pathway through genetic exchange!

Arthropods

- * Animals with an exoskeleton
- * Insects, crustaceans & arachnids
- * Shred organic material which stimulates microbial activity
- * Stimulate microbial activity
- * Cycle nutrients
- * Herbivores & Predators



Nematodes

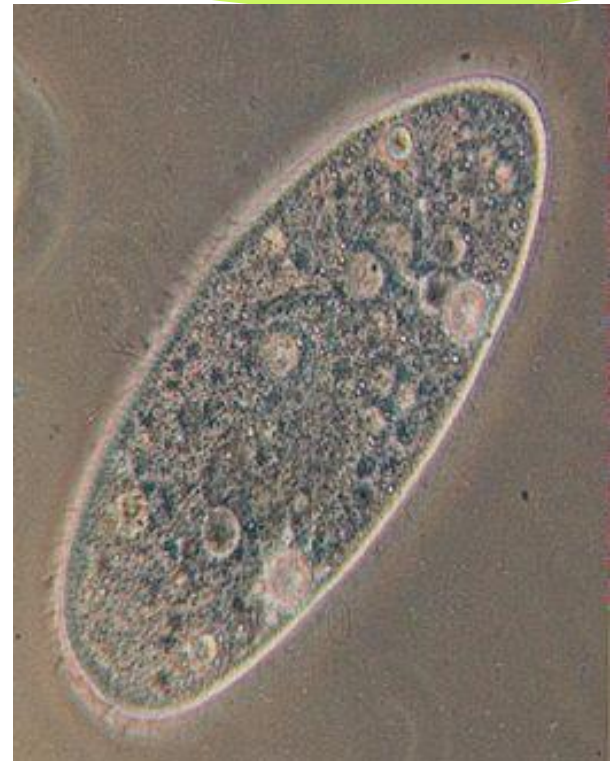
- * Microscopic
- * Non-segmented
- * Cycle nutrients
- * Act as food source
- * Root feeding type cause disease
- * Some eat bacteria or fungi (suppress disease!)



Credit: USDA-ARS

Protozoa

- * Single-cell & larger than bacteria
- * Mobile
- * Cycle nutrients (N when feeding on bacteria & other protozoa)
- * Regulate bacteria populations
- * Impacted by soil moisture for feeding & movement + type & size
- * Active near plant roots
- * Populations can reach 1 million per tsp in highly fertile soil



Earthworms

- * Indicator of soil quality
- * Burrowing mixes soil
- * Ingestions of soil material
 - * decomposition of plant residues
 - * nutrient cycling
 - * Castings create aggregates



Credit: L.M. Bugallo Sánchez

Why is the soil microbial
community so important to
ecosystem function??

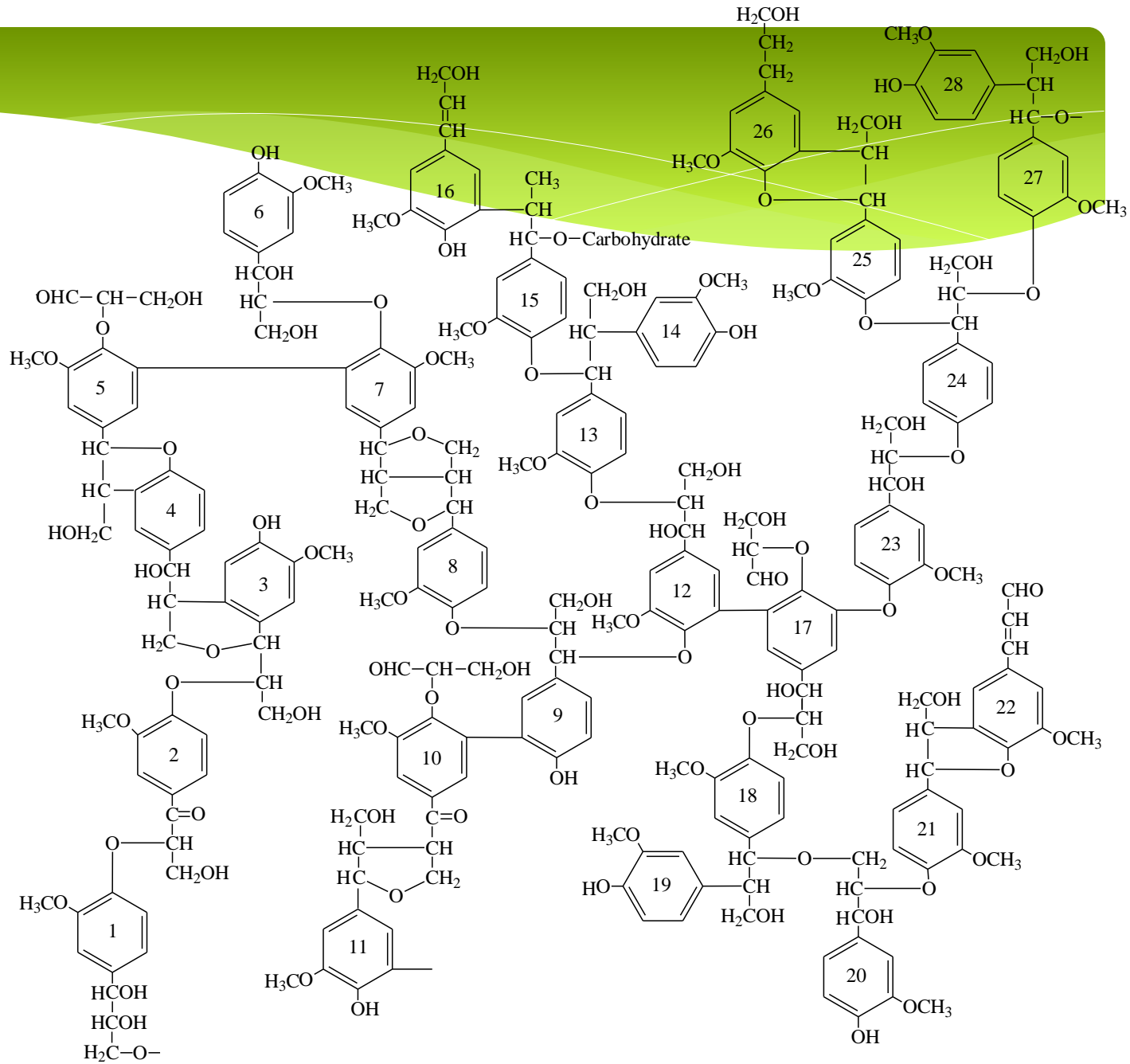
Nutrient Cycling!

- * Carbon, nitrogen, phosphorus are essential nutrients for all life.
- * Carbon, Nitrogen, Phosphorus, etc are converted from inorganic to organic forms, and back to inorganic forms again.
- * Key links in cycles performed by soil microorganisms.

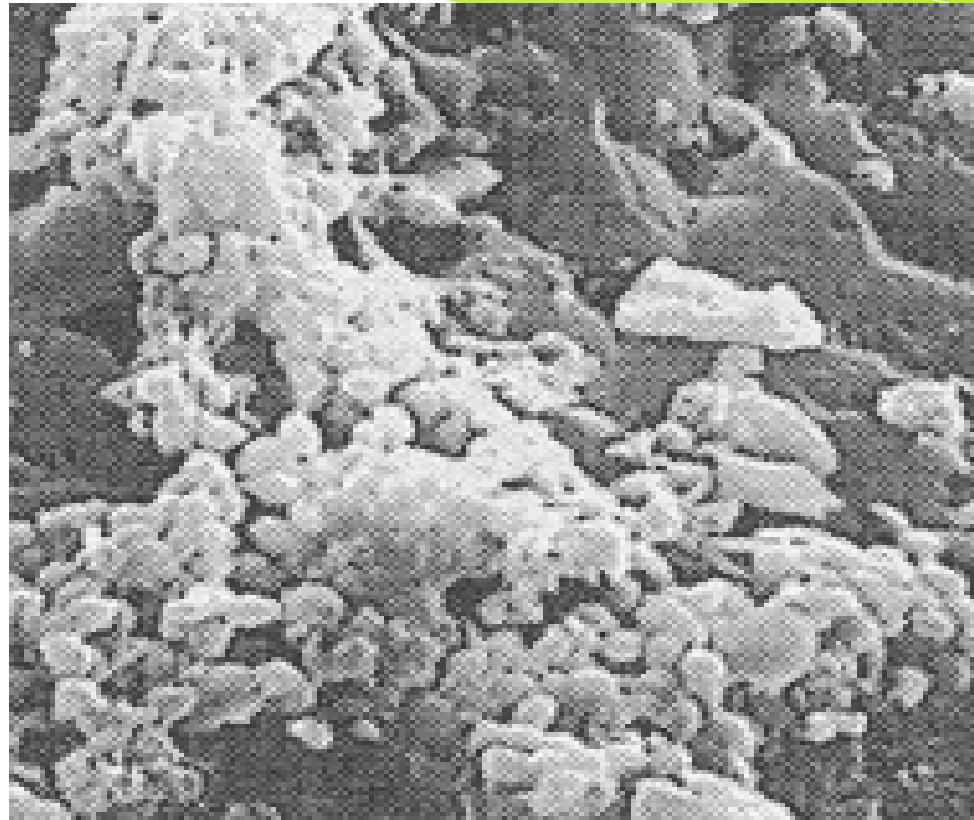
Fungal Degradation of Wood



Proposed structure of lignin



... and bacteria mop up



Healthy Soil = Healthy Plants



Healthy Soil & Plants Need Nutrients

- * Supplied by air & water - **Hydrogen (H)**, **Carbon (C)** and **Oxygen (O)**
- * Supplied in fertilizer - **Nitrogen (N)** for foliage, **Phosphorus (P)** flowers/fruit, and **Potassium (K)** roots
 - * **Calcium (Ca), Magnesium (Mg) and Sulfur (S)*** - * Needed in smaller amounts & can be supplied by fertilizer, gypsum, limestone, dolomitic limestone and Epsom salts.
- * 7 referred to as **micronutrients**; **Iron (Fe)**, **Manganese (Mn)**, **Zinc (Zn)**, **Copper (Cu)**, **Molybdenum (Mo)**, **Boron (B)**, and **Chloride (Cl)**.
(needed in trace amounts & may be supplied by a fertilizer, liquid seaweed or microbial activity.)
- * Other beneficial elements include; **Cobalt (Co)**, **Nickel (Ni)**, **Sodium (Na)**, **Silicon (Si)** and **Vanadium (V)**

The Four Stages of Plant Growth



<http://www.advancingecoag.com/> leading regenerative farming

The Ultimate Gardeners Goal

- *To create a soil that **builds organic matter** to support a healthy soil food web!
Yep, it's that simple.

Research at The Morrow Plots

- * Research at the Univ. of Illinois has shown that the use of synthetic fertilizers does not build soil organic matter!



Gardening Practices to Build OM

- * Add organic matter (OM)
 - * Use as mulch around plants
 - * Topdress turf with ¼-1/2 ”
- * Use organic fertilizers
 - * Jobe’s Organic has bacteria and mycorrhizae microbes
- * Use biostimulants on the plants and soil
 - * Liquid seaweed
 - * Milk
 - * Molasses
 - * Humic acids, etc.



Gardening Practices to Build OM

- * Re-mineralize the soil
 - * Sea minerals (i.e. SEA-90)
 - * Rock powder (i.e. Azomite)
- * Minimize soil disturbance
 - * No regular tilling
 - * Chop & drop
- * Cover the soil
 - * Cover crops
 - * Mulches



Gardening Practices to Build OM

- * Increase biodiversity above ground to increase biodiversity below ground
- * Amend the soil with biochar (also called bio-carbon or fixed carbon)
- * Add soil organisms (worms and soil microbes) Many organic fertilizers include soil microbes



Summary

- * Biologically active soil produces healthy plants that don't require pesticides!
- * Organic matter is food for the soil food web.
- * Supply of nutrients allows plants to achieve stage 4 growth
- * Insects & diseases are a sign of plant stress which are often caused by a lack of nutrient(s)
- * *Thank you to Andy Ogram, UF Professor Soil & Water Science Dept. & Amy Shober previously at UF IFAS Gulf Coast REC*

Any questions?

TIGER by Bud Blake

