

# **Chapter 2**

# **The Benefits of the Soil Food Web**

Lecture 8 – Disease Suppression

# A Healthy Food Web Will:

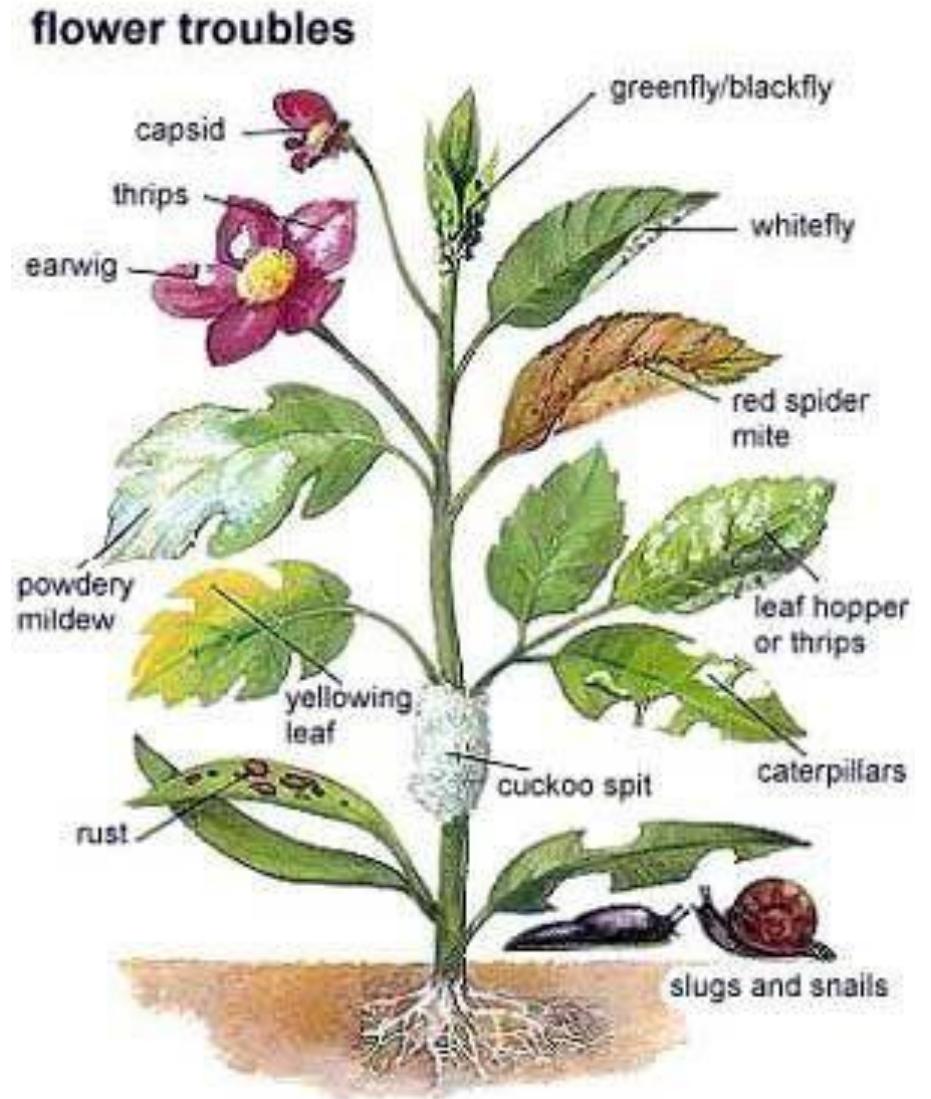
- Make Nutrients Available at rates plants require (eliminate fertilizer) leading to flavor and nutrition for animals and humans
- Retain Nutrients (stop run-off, leaching)
- Suppress Disease (competition, inhibition, consumption; no more pesticides!)
- Build Soil Structure (reduce water use, increase water holding capacity, increase rooting depth, create aerobic conditions)
- Decompose Toxins

# Plant Stress

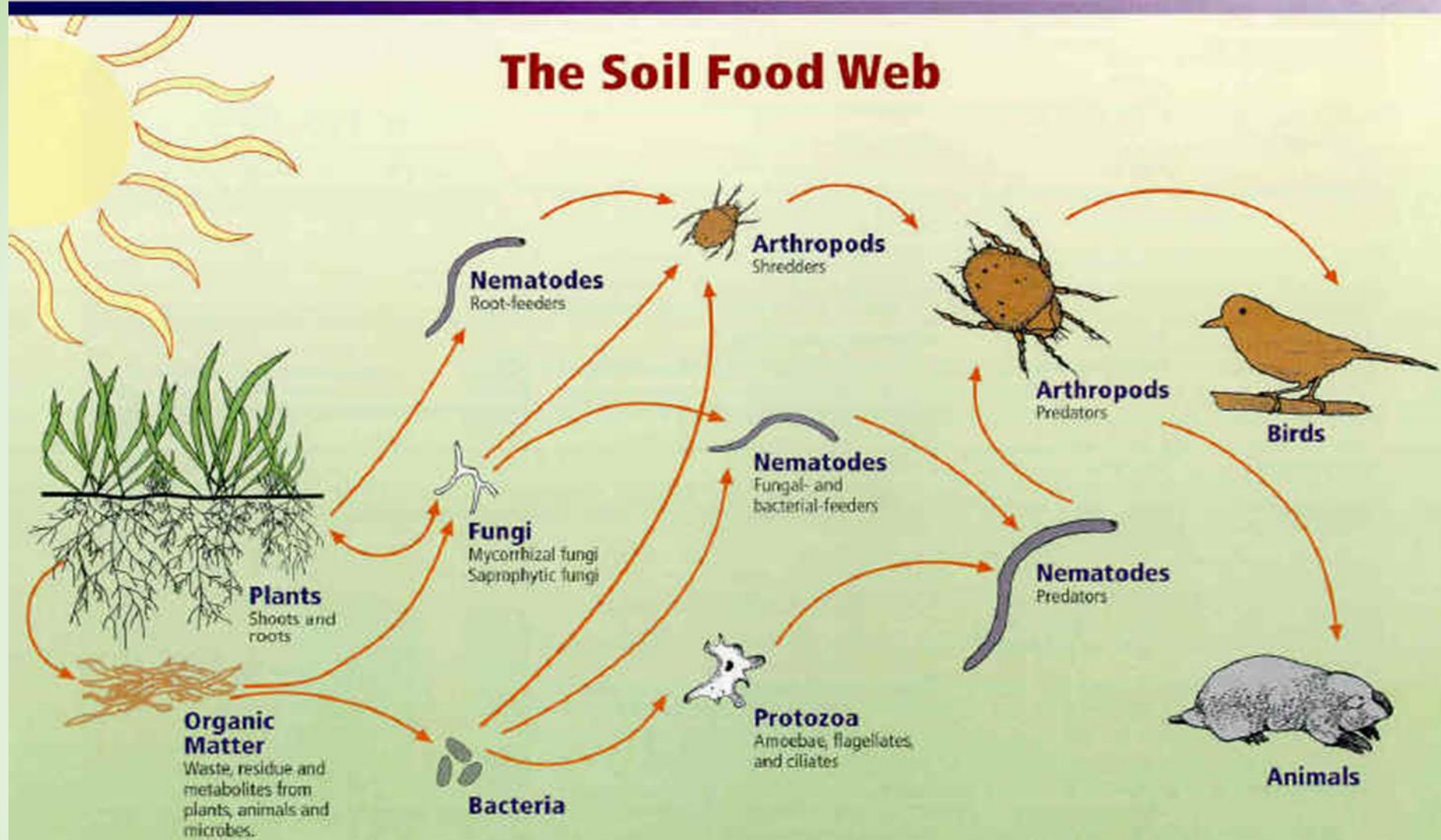
Why do diseases and pests attack plants?

What is causing this stress?

Roots?



# The Soil Food Web



**First trophic level:**  
Photosynthesizers

**Second trophic level:**  
Decomposers  
Mutualists  
Pathogens, parasites  
Root-feeders

**Third trophic level:**  
Shredders  
Predators  
Grazers

**Fourth trophic level:**  
Higher level predators

**Fifth and higher trophic levels:**  
Higher level predators

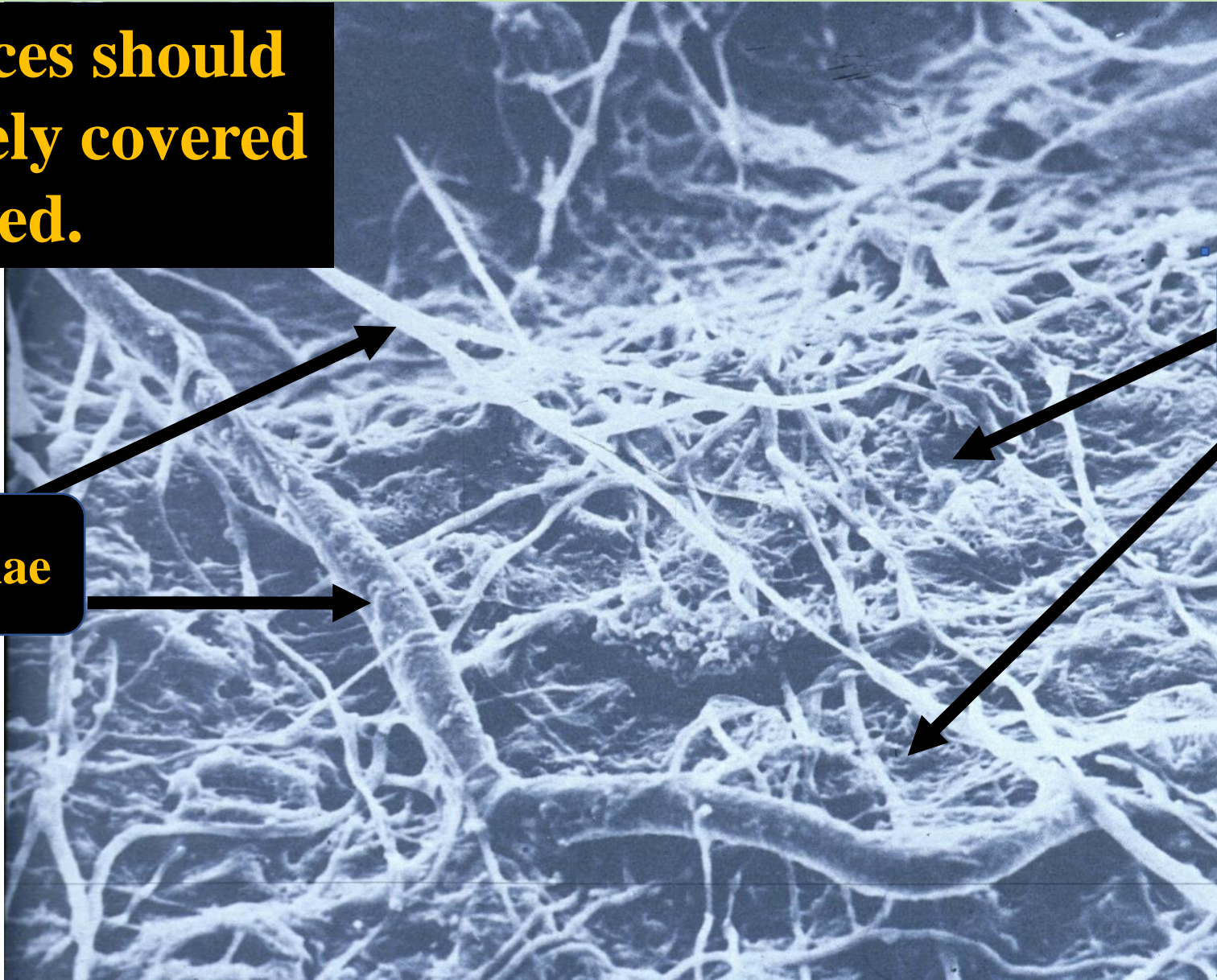
# Dealing with Diseases and Pest

Protective layers of beneficial microbes need to be present on all plant surfaces.

Exudates from the plant maintain the protective layer of beneficials, but there's another very important thing to remember!

# The Castle Wall

**Plant surfaces should be completely covered and protected.**



**Fungal Hyphae**

**Bacterial  
Glues**

# Dealing with Diseases and Pest

Why does a layer of bacteria and fungi protect all surfaces of the plant?

**Competition**

**Consumption**

**Inhibition**

# Dealing with Diseases and Pest

**Competition** - beneficials will always outcompete diseases and pests in aerobic conditions for space on the plant surface (glues), and for nutrients (enzyme pathways).

The two “tricks” to preventing diseases and pests:

- Keeping conditions aerobic and
- Making sure the beneficials are home!

**Don't be killing your beneficials!**

# Dealing with Diseases and Pest

**Consumption** – the aerobic predators will track down and consume diseases and pests often to the exclusion of other prey choices.

Again, the two “tricks” to preventing diseases and pest:

- Keeping conditions aerobic and
- Making sure the predators are present.

**Don't be killing your predators!**

# Dealing with Pests and Diseases

**Inhibition** – Certain species of bacteria and fungi produce antibiotics to chemically prevent competition from other organisms. But these interactions are on very small scales (micrometers) in soil or on plant surfaces.

Release of the inhibitory compound is very specific as well, but can shut down diseases and pests, thus protecting the plant.

# How do protective organisms get moved to where they are needed?

There are many “taxi-cabs” in the soil that carry the beneficial bacteria and fungi to all roots, and to the above ground parts of the plant.

# Dealing with Diseases and Pest

- Organisms need food (exudates).
- Conditions must be aerobic
- Beneficials have to be present!

If any part of this is forgotten, hope that nutrient cycling organisms in the soil are working overtime.

# Define Aerobic, Facultative, and Anaerobic

**Aerobic:** Energy-efficient decomposition enzymes.

Enzymes require oxygen above 6 milligrams/gram.

**Facultative:** Not energy-efficient, requires a set of anaerobic and another set of aerobic enzymes to be able to exploit shifting oxygen conditions.

**Anaerobic:** Energy efficient decomposition enzymes.

Enzymes require oxygen below 4 milligrams/gram to function.

# Dealing with Diseases and Pest

Check the life cycle of the pest (internet).

There are four places in life cycles that are good to reduce the population.

1. Where are the eggs laid?
2. When do the eggs hatch?
3. Where do larval stages hang out?
4. When do larvae molt into adults?

Now, disrupt one or all of these points.

# Dealing with Diseases and Pest

Why would pests and diseases be attracted to stressed plants?

Are the pests really attracted to a stressed plant? Or is it the sick, unhealthy plants that allow the diseases and pests access?

Sick plants aren't protected, no coverage.

# Dealing with Diseases and Pest

When a disease or insect is seen on plants, take a close look at the field conditions. Why is a disease here?

Look at the leaf with a microscope. Serious pathogen?  
A mite, or thrips?

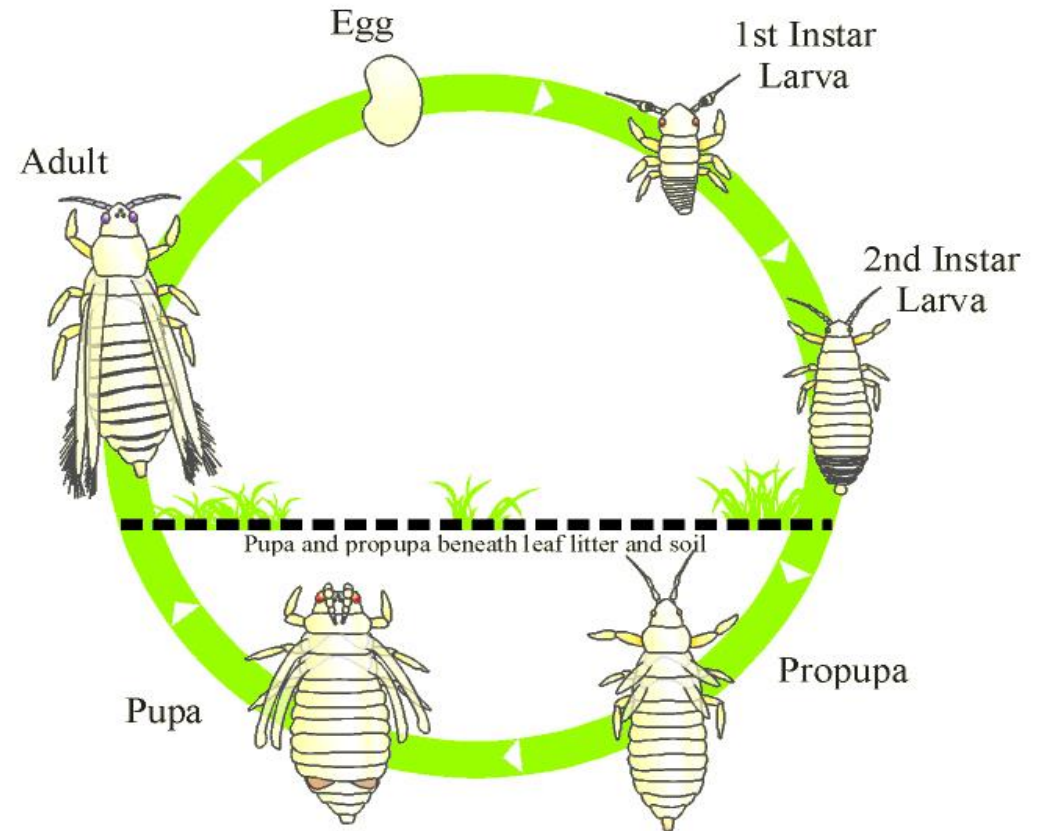
Keep a close watch on the fields to see if more disease or pest shows up.

# Thrips Lifecycle Example

Thrips: Eggs inserted into leaf tissue.  
Hatch in 3 days.

Larvae feed on plant tissue for 4-5 days, drop to soil surface, one day in each of 2 pupate stages, adult emerges from the soil, rasps leaves and sucks plant fluids, stippling and silvery, webby tissue remains. Virus transmitter.

So, how to deal with this problem?



# Dealing with Diseases and Pest

1. The eggs are protected inside leaf tissue. Coat the leaves with fungi and bacteria that will attach to the nymphs as they leave the plant tissue.
2. During the 4 to 5 days of feeding, apply already-germinating fungal spores that will turn the nymphs into a fungal ball within days.

# Dealing with Diseases and Pest

3. Once the nymphs drop to the soil, drench soil with fungi and bacteria that decompose the pupae. Apply predators where the pupae are feeding.
4. Add just-germinated spores of Beauveria, Milky spore, or other local species of fungi that will attach itself to the insect, grow into and decompose the insect.

# Dealing with Diseases and Pest

5. Apply just-germinated decomposer fungi that can decompose the just-hatched adults when the adults begin to fly.
6. And of course the best thing to do is to get the biology back into the soil so the plant is healthy and will not be subject to insect or pathogen attack.

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