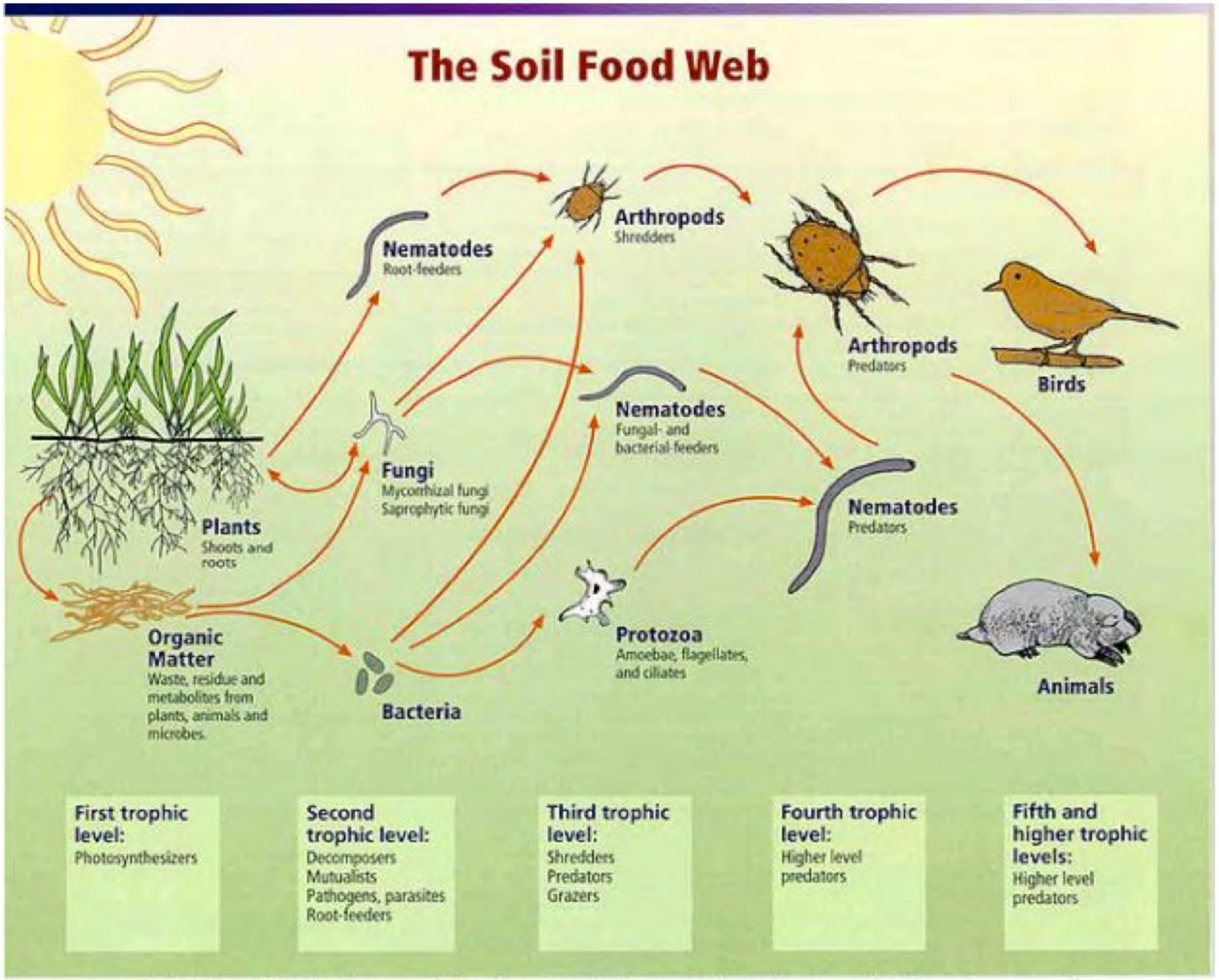
Growing Microbes for Gardens & Permaculture



Relationships between soil food web, plants, organic matter, and birds and mammals
Image courtesy of USDA Natural Resources Conservation Service
http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html.

What About Microbes?

- Soil microorganisms (microbes) digest organic material in the soil.
- Soil microbes exist in large numbers in the soil as long as there is a carbon source for energy and moisture.
- Microbes help retain water in soil and conserve nutrients.
- There are more microbes in a teaspoon of soil than there are people on the earth..
- While most microbes live in the soil and on roots of plants, others live on the leaves.
- The top 6” of healthy soils contain about 8 to 15 tons of bacteria, fungi, protozoa, nematodes, earthworms, insects and other arthropods in each acre.

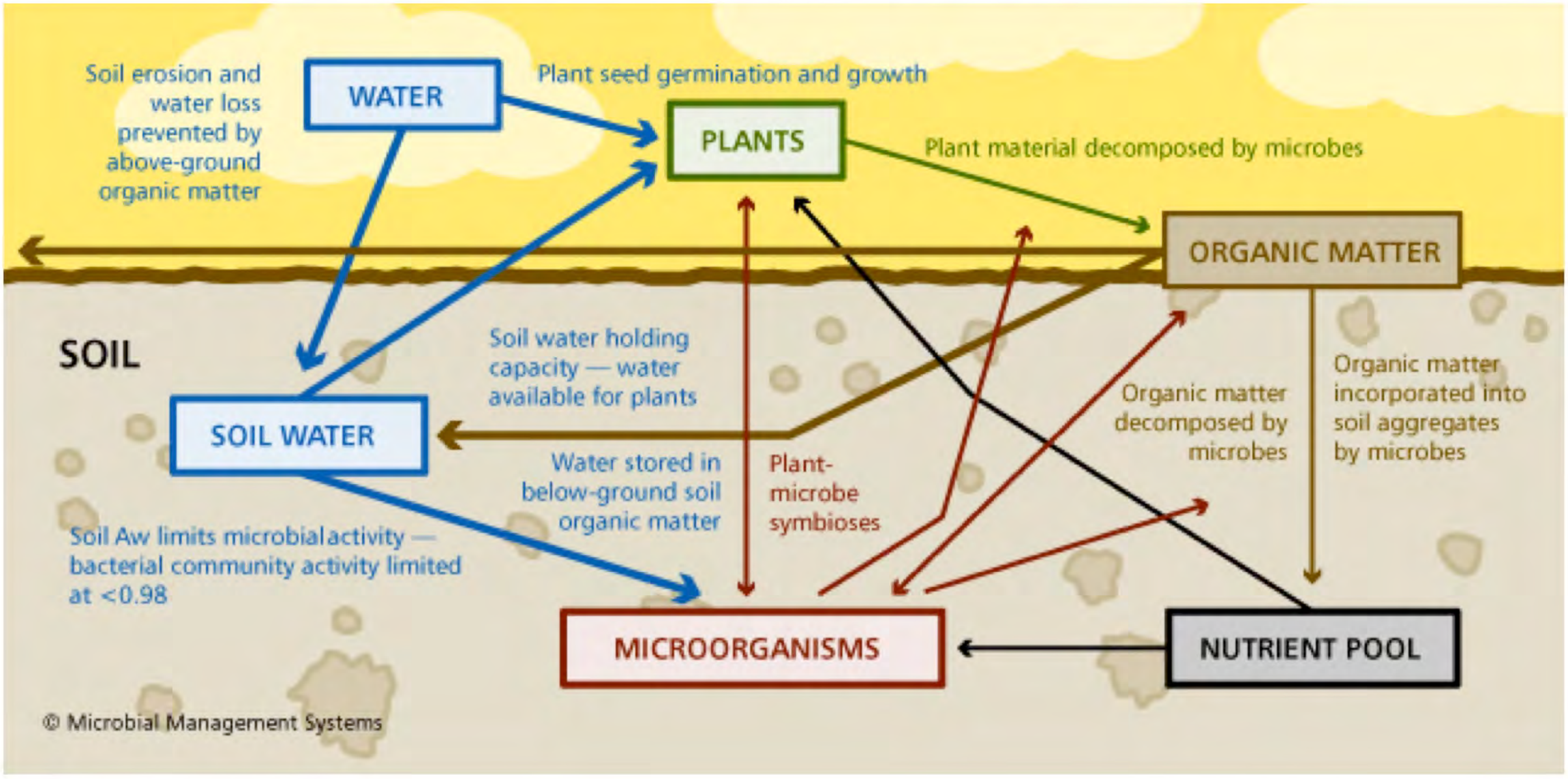
Source: http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

What Are the Kinds of Soil Microbes and Where Do They Live?

1. **Tilled soils** (disturbed land)
   - Bacteria—small biomass, small size
   - Actinomycetes—smaller in numbers, larger size, equal in biomass to bacteria
   - Protozoa, foundational single cell creatures that are neither plant nor animal
2. **Untilled soils** (grasslands--undisturbed land)
   - Fungi—smaller numbers, but they dominate the soil biomass when the soil is not disturbed (cryptobiotic soil)
   - Nematodes, a form of worms, mostly microscopic to 2.5mm long

Source: http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

Environmental Effects of Soil Microbes



What is SOM-Soil Organic Matter?

Soil organic matter (SOM) is basically all the organic substances (anything with carbon) in the soil, both living and dead. SOM includes plants, blue green algae, microorganisms (bacteria, fungi, protozoa, nematodes, beetles, springtails, etc.) and the fresh and decomposing organic matter from plants, animals, and microorganisms.

SOM is mainly carbon and oxygen with some hydrogen and nitrogen and small amounts of phosphorus and sulfur.

Source: http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

Why Do We Need Organic Matter in Soil?

Organic matter decomposition serves two functions for the microorganisms

1. Provides energy for growth
2. Supplies carbon for the formation of new cells.
3. Retains water

Soil organic matter (SOM) is composed of

1. "living" (microorganisms)
2. "dead" (fresh residues)
3. "very dead" (humus) fractions. The "very dead" or humus is the long-term SOM fraction that is thousands of years old and is resistant to decomposition.

http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

Where is Most Soil Organic Material Found?

Eastern woodlands' organic material takes long to decompose due to high lignins in trees and leaves, so it is low in SOM

Western deserts have little organic material to decompose (restore the grasslands)

Grasslands contain high levels of organic material that decompose regularly under the right conditions and have the highest levels of SOM

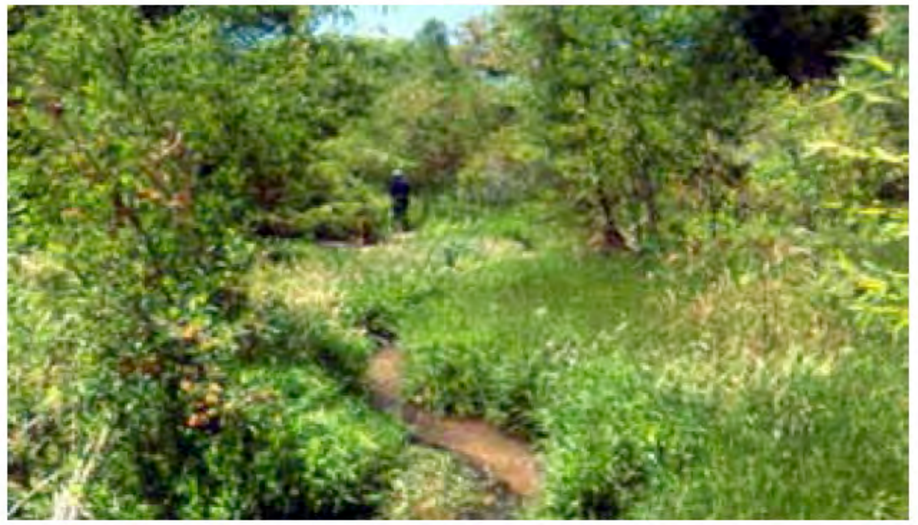
Source: http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

How Can Organic Material Break Down Faster?

1/3 of the earth's surface is grasslands. Loss of grasslands leads to climate change, floods, droughts, famines and global poverty. Traditionally large herds of ruminants trampled dead plants, primarily grasses, defecated and urinated on the crushed organic material breaking it down and feeding microbes. They did not return to the same area for 1 yr. This kept the environment in balance.

See The Savory Institute video **SAVORY INSTITUTE HOLISTIC PLANNED MANAGEMENT** **Source: http://savory.global/institute**

Grasslands Restored Through Proper Use of Grazing



Source: http://savory.global/institute

What is the Importance of Restoring the Microbe Balance?

Research has shown that microbes on plant leaves are taken up by winds into the air where moisture condenses on them and forms clouds bringing rain.

Source: http://arstechnica.com/science/2013/01/the-clouds-are-alive-as-microbes-fly-unfriendly-skies/

Photo of stream in Wyoming taken moments apart standing on a bridge.

Right: Downstream Land – Managed conventionally

Left: Upstream Land- Properly managed using Savory Holistic Management with150% increase in livestock numbers

Source: http://savory.global/institute

What do Microbes Need to Thrive in the Soil?

Microbes need regular supplies of active Soil Organic Matter (SOM) to survive in the soil. **Long-term no-tilled soils have significantly greater levels of microbes, more active carbon, more SOM, and more stored carbon than conventional tilled soils. A majority of the microbes in the soil exist under starvation conditions and thus they tend to be in a dormant state, especially in tilled soils.**

Microbes both in the soil and on leaf surfaces increase faster by feeding with adequate nutrients:

1. Soil Organic Matter (SOM)
2. Water
3. Carbohydrates (sugars)

Source: http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

What Affects SOM in the Soil?

- SOM is affected by **climate and temperature**. Microbial populations double with every 10 degree Fahrenheit change in temperature. If we compare the tropics to colder arctic regions, we find most of the carbon is tied up in trees and vegetation above ground in hot, wet regions.
- In the tropics, the topsoil has very little SOM because high temperatures and moisture quickly decompose SOM.
- Moving north or south from the equator, SOM increases in the soil.
- The tundra near the Arctic Circle has a large amount of SOM (think peat bogs) because of cold temperatures. Freezing temperatures change the soil so that the more SOM is decomposed then the less those soils are subject to freezing.

Source: http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

What Affects SOM Decomposition?

- Moisture
- pH
- Depth
- Particle size

Hot, humid regions store **less organic carbon** in the soil than dry, cold regions due to increased microbial decomposition. The rate of SOM decomposition increases when the soil is exposed to cycles of drying and wetting compared to soils that are continuously wet or dry.

MULCH stabilizes soil moisture and conserves SOM, soil organic matter.

http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

How does pH Affect SOM?

Soils that are neutral to slightly alkaline in pH decompose SOM quicker than acid soils; therefore, liming the soil in acidic areas enhances SOM decomposition and carbon dioxide evolution. In desert soils we may need to add acidifying agents like **manure, compost, vermicast (worm liquid or castings) coco-peat and sulfur** to grow non-native food plants. All will lower the soil pH and improve its structure at the same time

Source: http://ohioline.osu.edu/sag-fact/pdf/0016.pdf

Growing Microbes in Compost and Manure Tea

Growing Microbes in Compost and Manure Tea

Additions to increase AEROBIC microbes quickly

- Manure -- 5gal. To 25/30 gal water
- Blackstrap Molasses -- ¼ to ½ C. in 25 gal.
- Kelp --1-2T.
- SEA-90 agricultural salt -- 1 tsp. per gallon
- Raw Milk -- very small amount—less is better
- Fish Liver Oil—very small amount
- AIR – without added oxygen aerobic microbes die after a few days and anaerobic ones take over (they stink)

Source: Charla Shamhart

Manure

Molasses

Kelp

SEA-90

Raw Milk

Cod liver/fish oil

Aerorator Pump

How Can I Encourage Microbe Growth On and Around My Plants?

- **Mulch**– keeps soil moist and microbes growing so they do not die or become dormant
- **Kelp**--Seaweed contains a huge supply of natural hormones, and these hormones when applied to the leaves will cause increased growth rates, plant health and increased fruit or flower size.
- **Molasses**– increases BRIX (sweetness) which pests do not like, so it acts as a natural, beneficial pest control. Results of these studies appear to show that the lowest application rates work best for fungi and cellulose utilizers, while some bacteria showed the opposite response, with activity increasing as the application rate increased. I use 2T to 5 gal of water.
- **Oxygen**—feeds AEROBIC microbes to introduce into soil or on foliage

Source: Charla Shamhart

Soil and Foliar Feeding of Microbes on Plants

SEA-90 sea minerals can be used alone and/or mixes well with most water soluble fertilizers. It can be added to any foliar spraying program as a mineral and trace element source, organic insecticide and fungicide. SEA-90 is a natural surfactant, and adding it to your foliar spray will assist in spreading and absorption of the minerals and trace elements. Add fish emulsion as a nitrogen source, humic or fulvic acid, and one half pound cane sugar per acre to increase effectiveness. A rancher in Broken Arrow, OK said when he sprayed his grasslands with SEA-90 that hay production increased 300%.

Source: seaagri.com
Charla Shamhart

RAW MILK and/or COD LIVER OIL--

- Field trials show that applying at a rate of 2-3 gal. per acre increases soil and leaf microbes, increases BRIX (sugar levels in plants) and reduces soil compaction.

Nutrient levels in the plants increased dramatically due to greater uptake of minerals.

Porosity of the soil increased from 6” to 24”.

Pests such as grasshoppers left, as insects favor plants with lower BRIX (sugar levels).

Cows self-selected the grasses sprayed with raw milk and their milk production increased dramatically in an experiment by David Wetzel who owns Green Pasture, a company that makes fermented cod liver oil.

This data was compiled by University of Nebraska Extension scientists . Source: http://issuu.com/stewardculture/docs/stewardculture_no1

- Microbes thrive under **no-till conditions (PERMACULTURE)** and rainy season grass cover crops. Cover crops, mulch, manure and other supplements can be used to feed soil microbes and recycle soil nutrients.
- In the desert we could mimic nature and plant fast growing grasses during the wet season. As soil microbes decompose organic residues, they slowly release nutrients back into the soil for the winter cover crops or for the preceding crop.
- Grasses prevent nutrients from being lost through soil erosion, leaching, volatilization (loss through air), or denitrification (loss of nitrogen).
- Desert Panic Grass has the potential to help restore rainfall in the deserts, although herds of ruminants properly managed may need to again become part of the picture.

Source: http://www.open-access-biology.com/biofilms/biofilmsch12.pdf
Charla Shamhart

Take care of the environment.

Grow healthier plants.

Feed the microbes!

Restore the climate.

Sources:

- http://ohioline.osu.edu/sag-fact/pdf/0016.pdf
- http://www.open-access-biology.com/biofilms/biofilmsch12.pdf
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- http://www.seaagri.com/
- http://savory.global/institute