Soil Biology Workshop

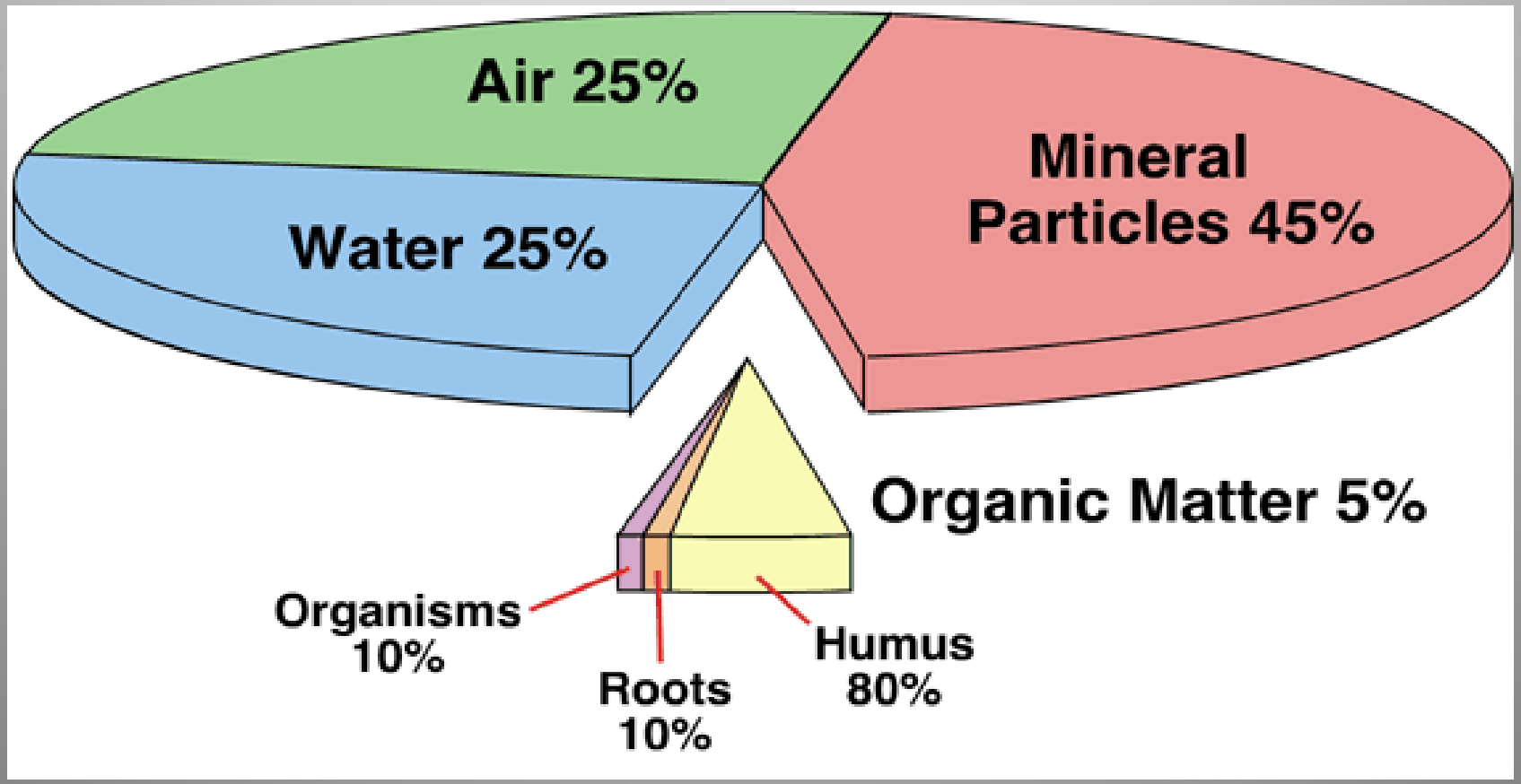
Welcome to Landsave Organics.

Are you ready to be inspired?

Presented by Brent Burns.

WHAT ARE **SOILS** MADE UP OF

Minerals consist of predominantly weathered rock
Organic matter consisting of dead and decaying plants
Macro and **Micro** Organisms
Air and **Water**



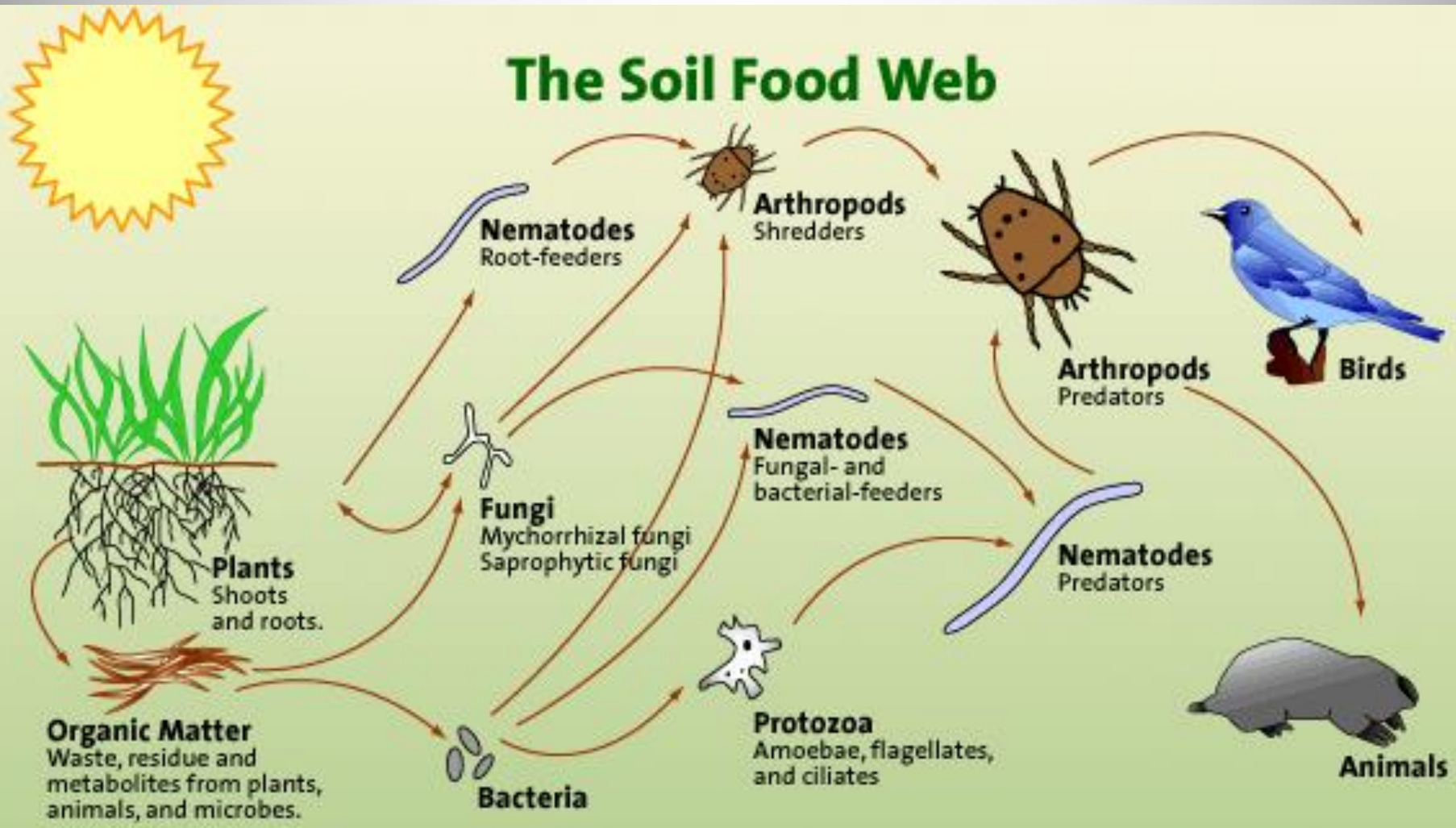
PLANT PHOTOSYNTHESIS

- Plants are *autotrophic* which means "self-feeding", derived from the Greek word autos "self" and "trophe" meaning "nourishing".

Photosynthesis

- Plants need three things: **Carbon Dioxide**, **Water,** and **Sunlight**.
- By taking in water (H2O) through the roots, carbon dioxide (CO2) from the air, and light energy from the sun plants then release oxygen to the atmosphere. Plants perform *photosynthesis* to make predominantly glucose (sugar) and other components, in order to self feed.
- the plant secretes root exudates (glucose, proteins, carbs) around the root zone, the soil microbes then trade minerals for the glucose and other exudates.

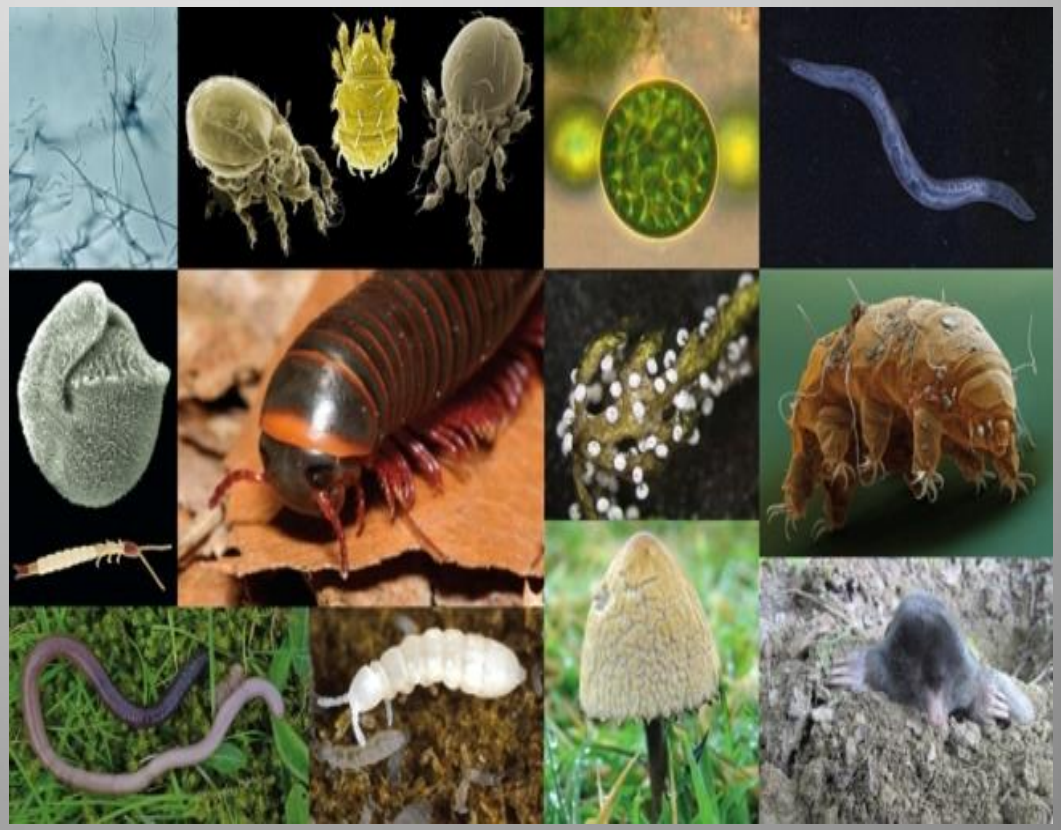
The Soil Food Web



First trophic level:	Second trophic level:	Third trophic level:	Fourth trophic level:	Fifth & higher trophic level:
Photosynthesizers	Decomposing Mutualists Pathogens, Parasites Root-feeders	Shredders Predators Grazers	Higher level predators	Higher level predators

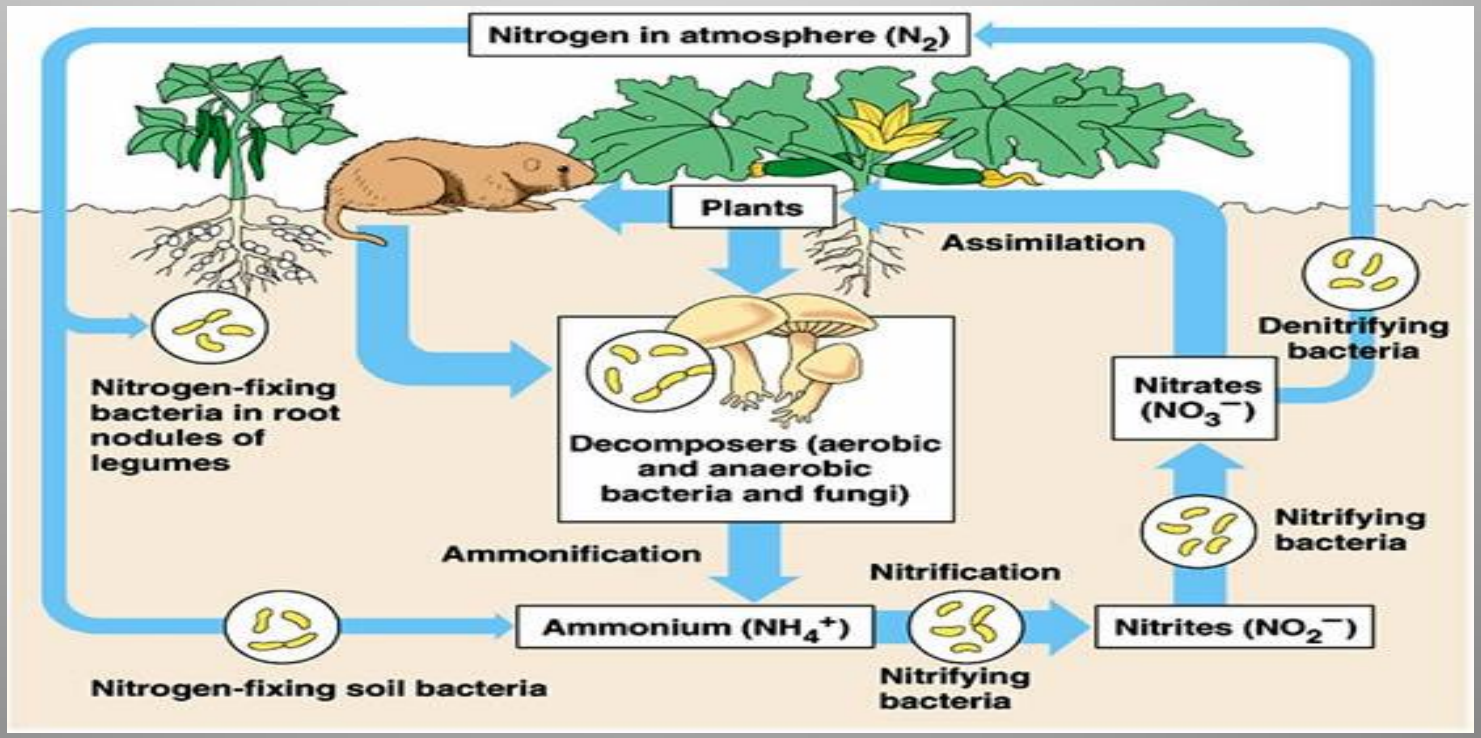
WHAT ON EARTH ARE THE NUMBERS

- In one teaspoon of healthy soil there can be more soil organisms than there are humans on earth.
- In 1 Hectare:
  - 900kg worms
  - 1500kg bacteria
  - 2400kg fungi
  - 150kg protozoa
  - 50kg Nematodes



THE ROLE OF SOIL BACTERIA

- Degrades organic matter
- Fix N- and other steps of the N cycle
- Nitrogen fixation (Rhizobium)
- Nitrification (Nitrosomonas) (Nitrobacter)
- The Organisms with vital functions may be lower in numbers
- The Organisms present will depend on the Available Nutrients, Soil moisture and Ph



THE ROLE OF PROTOZOA

Protozoa play an important role in the structure of the soil food web. Protozoa concentrate around the root zone and eat bacteria in which they release nitrogen and other plant available nutrients in their Poo.

Ciliates

Amoeba

Flagellates

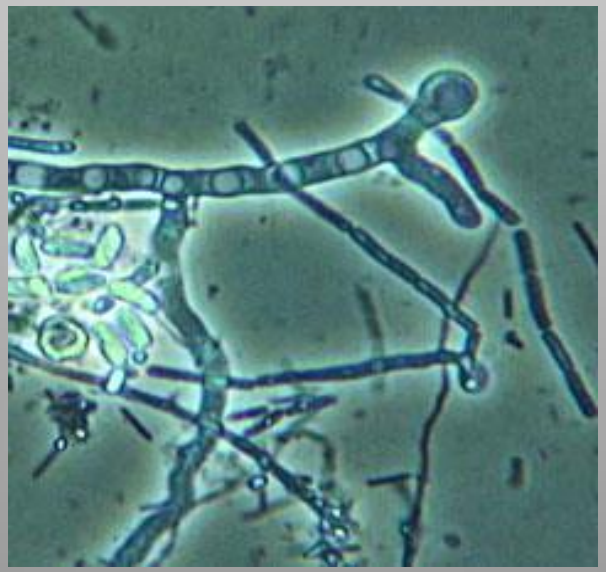
THE ROLE OF FUNGI

Fungi are **heterotrophs** meaning an organism that cannot manufacture its own food derived from the Greek word “hetro” meaning different and “ troph” meaning "nourishing heterotrophs obtain food and energy by absorbing organic substances, usually plant or animal matter. All animals, protozoans, fungi, and most bacteria are heterotrophs.

Saprobic Fungi - absorbs nutrients through a complex chain of enzymes
Mutualistic Fungi - absorbs nutrient's via a host organism, they reciprocate this function that benefits each other
Parasitic Fungi - absorb nutrients from the cells of a living host

Fungal Hyphae

Fungi Mycorrhizae



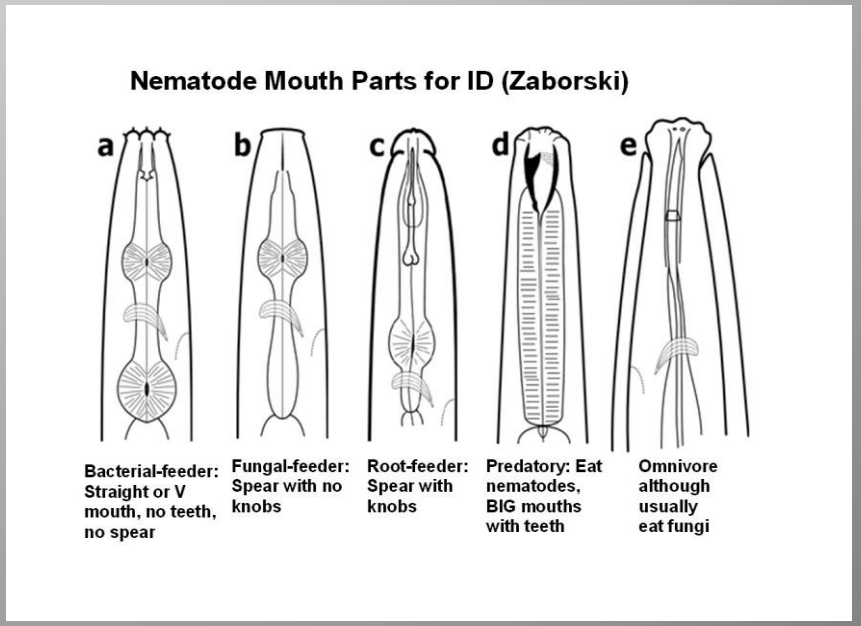
Fungi Arthrobotrys

THE ROLE OF NEMATODES

Nematodes feed on the decaying plant material along with organisms such as fungi and bacteria.

Many species of **nematodes** are 'free-living', living in soil, sea and freshwater. These feed on bacteria, fungi, protozoans and even other **nematodes**, and play a very important **role** in nutrient cycling and release of nutrients for plant growth.

Other **nematodes** attack **insects,** and help to control insect pests. This aids in the dispersal of organic matter and the soil decomposers



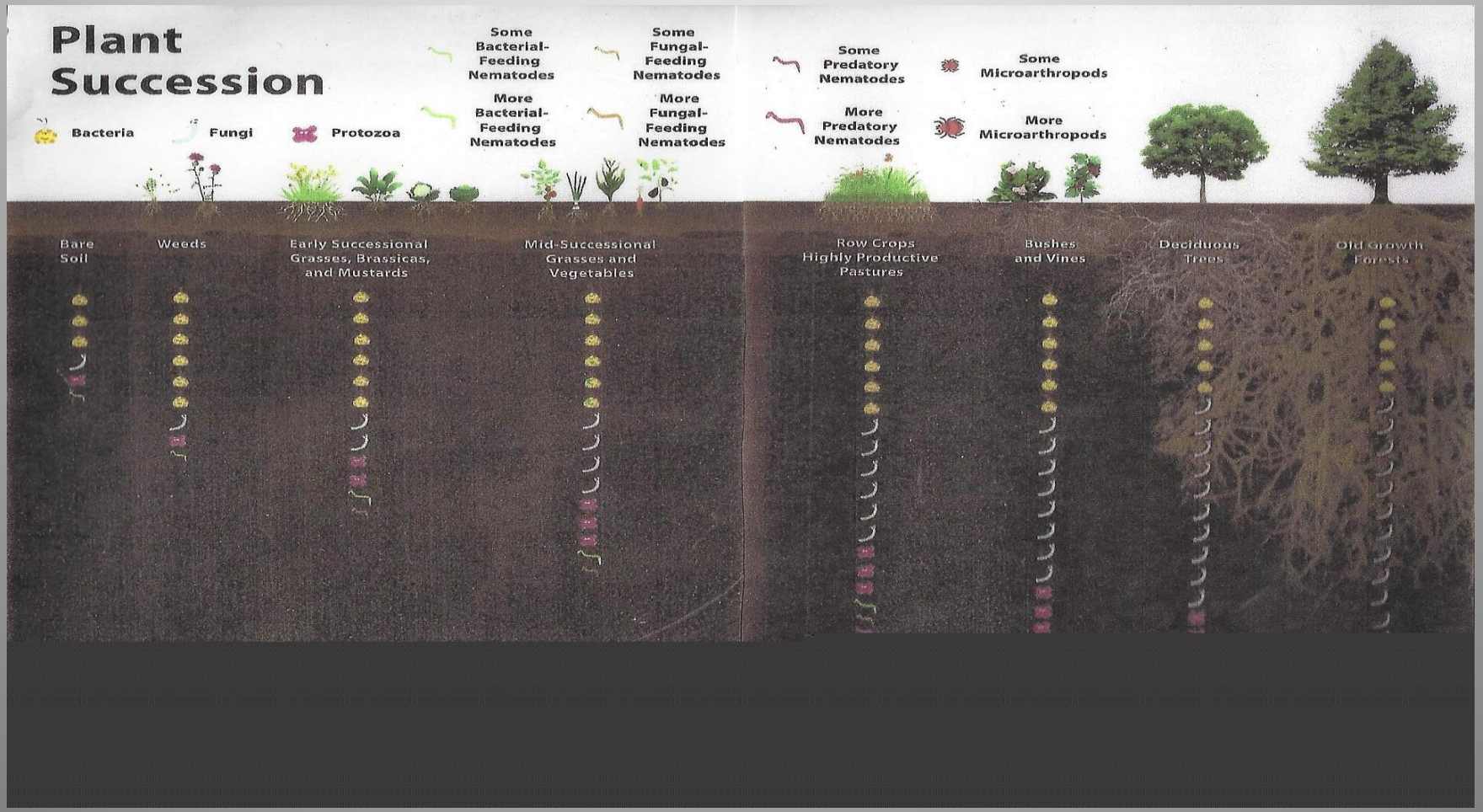
PLANT SUCCESSION & F:B RATIO

Bacterial-dominated plants

Lawn grass	0.5 to 1.0
Carrots	0.5 to 0.8
Lettuce	0.5 to 0.8
Turf	0.9 to 1.5
Broccoli	0.3 to 0.7
Wheat	0.8 t o 1.0

Fungal-dominated plants

Grape	3 to 5
Apple (orchard)	10 to 50
Deciduous trees	10 to 100
Pine	50 to 100
Conifer	100 to 1000



WHAT ON EARTH

- Many conventional inputs have detrimental effects on soil biology.
  - Pesticides
  - Herbicides, Fungicides,
  - Soluble Fertilisers.
- These effects are cumulative and have long term implications on soil health and humus development.

WHAT IS HUMUS

- Humus is fertile rich soil formed from organic materials such as decaying plants and animals
- Predominantly made up of a colloidal form resembling clay, which is the main chemically active fraction of the soil……
  - Humus is 5 times as effective as clay in nutrient exchange.
  - It holds on to both cations and anions (P, N, S)
  - Is the storehouse for nearly all nitrogen in soil.
    - Plus most P, S, K and Traces.
  - Rich in humic substances that can dramatically affect CEC.
  - Act's as the glue in crumb structure.
  - Significantly influences soils ability to store water.
  - Storehouse for microbes, nutrients and water.

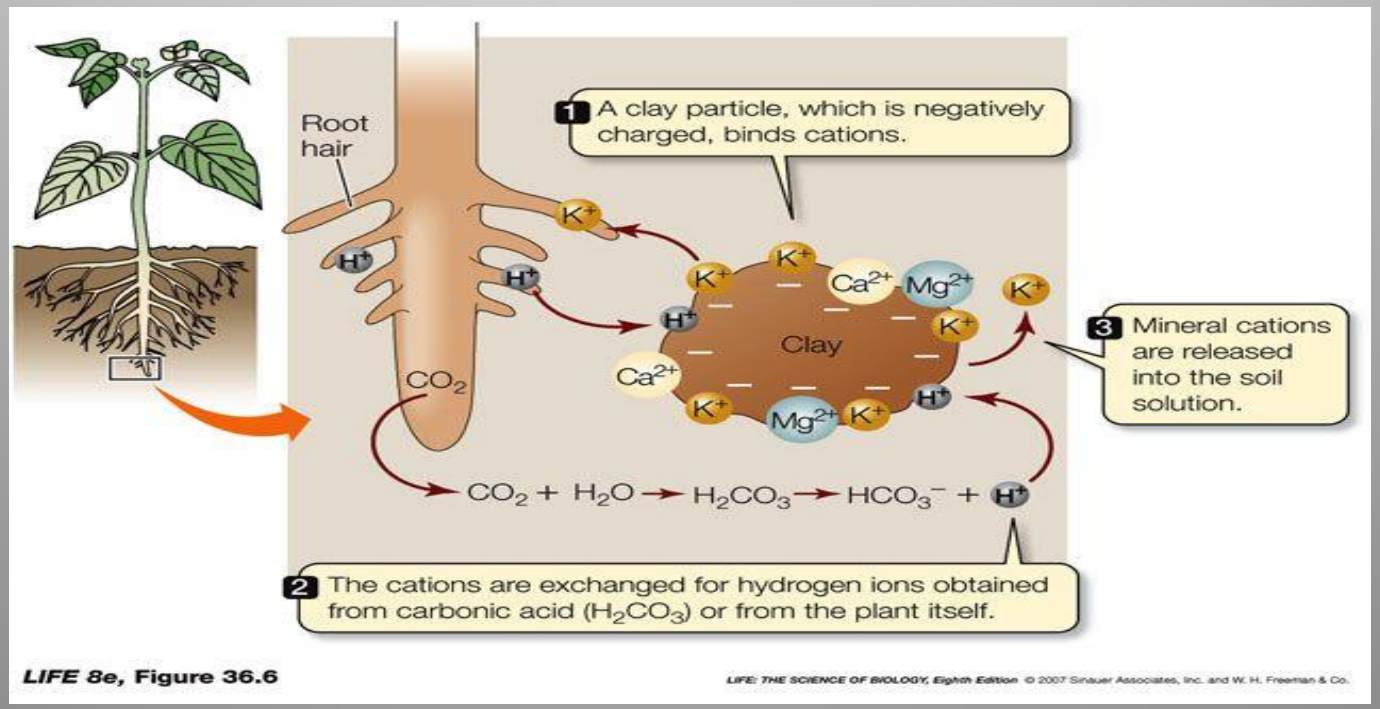
WATER EFFICIENCY IN HUMUS

Soil OM	Litres / Ha water retained
0.5 %	80 000
1 %	160 000
2 %	320 000
3 %	480 000
4 %	640 000
5 %	800 000

Humus is the most important component of Organic Matter and has the most significant impact on increasing water efficiency.

CEC (CATION EXCHANGE CAPACITY)

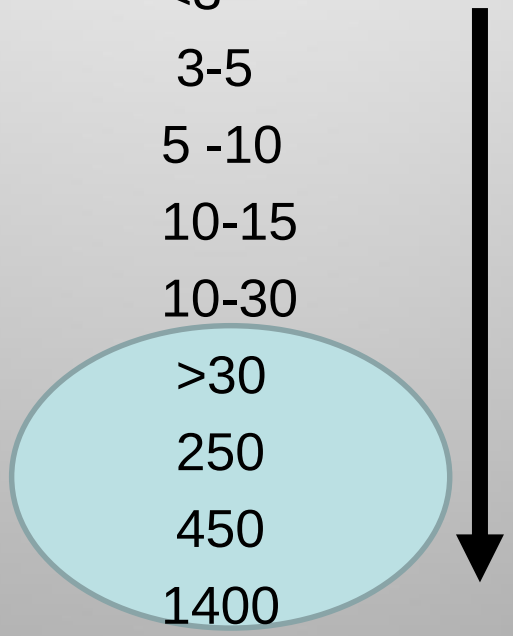
- The CEC is the amount of exchangeable cations in the soil
- CEC is the extent to which the negative charges on the clay/humus in the soil can exchange nutrient cations at the roots of the plant.
- Plant roots exchange H+ ion for a nutrient cation.
- Cations are positively charged ions Ca++, Mg++, K+ & Na+ are most abundant. Hydrogen H+ & aluminium Al+++ also significant.
- Traces – Mn++, ZN++, Cu++, & Fe++
- The larger the CEC value, the more cations the soil can absorb and make available to the plant.



CEC (CATION EXCHANGE CAPACITY)

The CEC is measured in milliequivalents /100gm (meq/100g)
The larger the number, the more cations the soil can hold.

• Sand	<3
• Loamy Sand	3-5
• Sandy Loam	5 -10
• Loam	10-15
• Clay Loam - Clay	10-30
• Clay – Heavy Clay	>30
• Humus	250
• Humic Acid	450
• Fulvic Acid	1400



Increase ability to absorb nutrients.

WHAT IS COMPOST

Compost is organic material that has undergone controlled biological and chemical decomposition, resulting in a stable humified substance that is resistant to further decay.

Types of Composting

- Static (anaerobic)
- Thermal (aerobic)
- Vermi Compost (worm farming)
- Controlled microbial composting (low temp 55 to 60 degrees)

HUMIFIED COMPOST

NOT ALL COMPOSTS ARE THE SAME.

The aim is to produce or purchase a finished product that is both rich in humus and beneficial microbes.

Quality Compost will:

- Increase soil biology
- Induce disease suppression
- Stimulate roots development
- Increase water holding capacity
- Increase CEC
- Reduce nutrients leaching.

HUMIFIED COMPOST APPLICATION RATES

- Horticultural: 4-20 m^3/Ha
- Broadacre: 1-5 m^3/Ha
- Home Garden: ½ to 2 litres/m^2
- Apply in Autumn & Spring to meet season.
- Incorporate when planting.
- Follow-up with teas, extracts, bio stimulants.

AERATED COMPOST TEA

What are they

- **Liquid compost brew contains billions of soil dwelling microorganisms including bacteria, fungi, nematodes and protozoa.**
- **Soluble nutrients / micronutrients.**
- **Microbial by-products (humic and fulvic acids, plant-growth regulators, etc.)**
- **Totally dependent on the source compost, quality vermi compost preferred.**
- **Used both soil and foliar.**
- **Disease control..**

AERATED COMPOST TEA

Important principles

- **Quality compost – must have the organisms.**
- **Quality water aerated for 30 mins if contaminates are present eg (chlorine, anaerobic smell).**
- **Maintain elevated dissolved Oxygen - >6ppm**
  - **Molasses**
  - **Fish emulsion**
  - **Kelp**
  - **Humic Acid**
- **Limited shelf life as organisms are active.**

LIQUID COMPOST EXTRACTS

What are they

- **More compost used per batch.**
- **No Air.**
- **No Food.**
- **Humus extraction.**
- **Longer shelf life.**
- **Very quick. Multiple loads in a day.**
- **Add food source when applying.**
- **Better suited to broad acre & pasture.**

TYPES OF BIO-STIMULANTS

- A plant **bio-stimulant** is any substance or micro-organism, applied to plants, seeds or the rhizosphere with the intention to stimulate the natural processes of plants benefiting in the uptake of nutrients.

Bio-Stimulants include

- Composts inoculates soil with biology and humic substances.
- Compost Teas and Extracts
- Rock Mineral blends
- Seaweed/Kelp extracts
- Fish Hydrolysate
- Humates
- Fulvates

WHY GREEN MANURE

Green manures recycle nutrients and organic matter to the soil.
Protect and enhance the soil biological activity by providing nutrition for the soil organisms.
Legumes fix atmospheric nitrogen via biology from the air to the plant.
Cover crops aerate and improve soil structure in the soil.
Control weeds and provide a habitat for pollinators and other beneficial insects.

Thank you