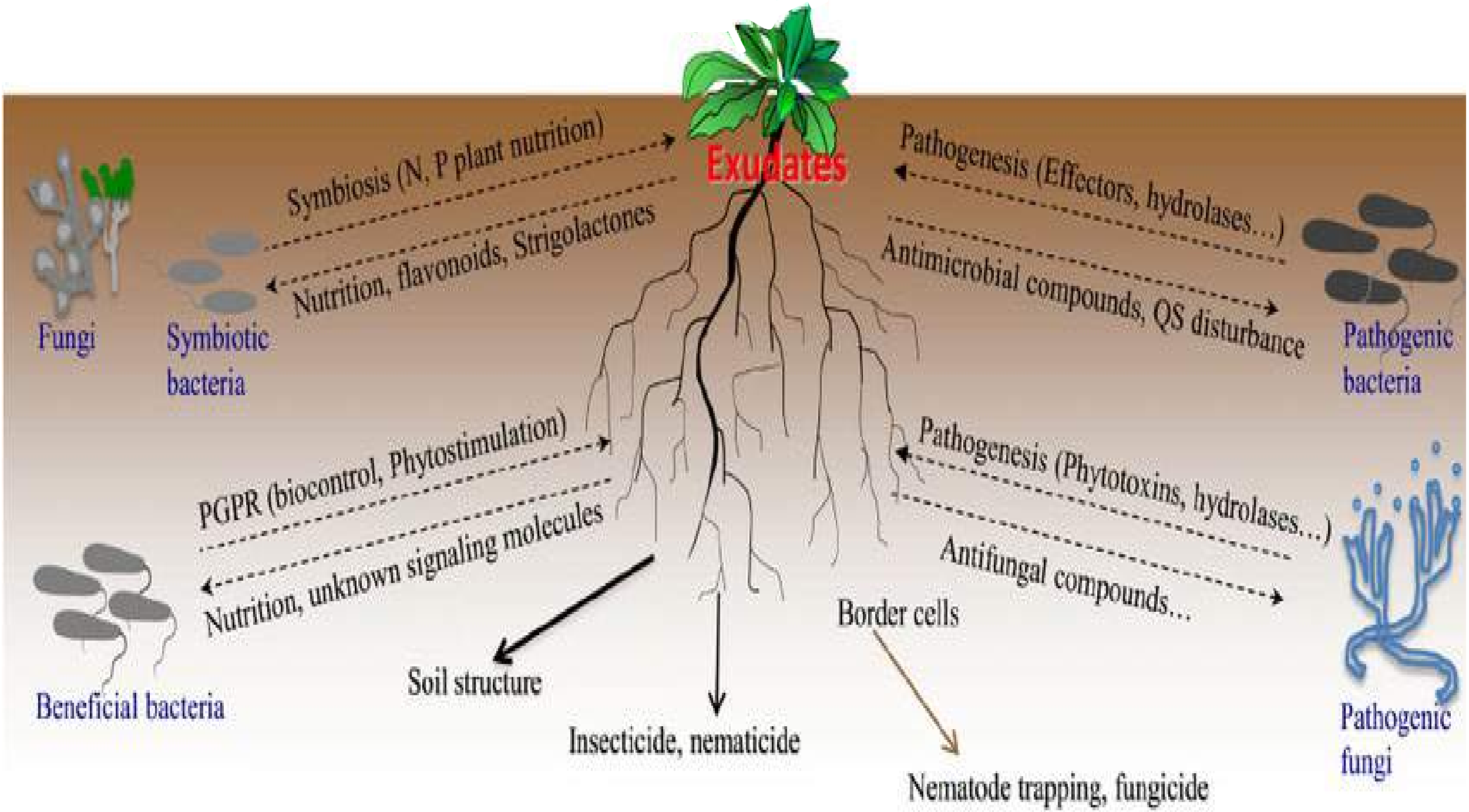
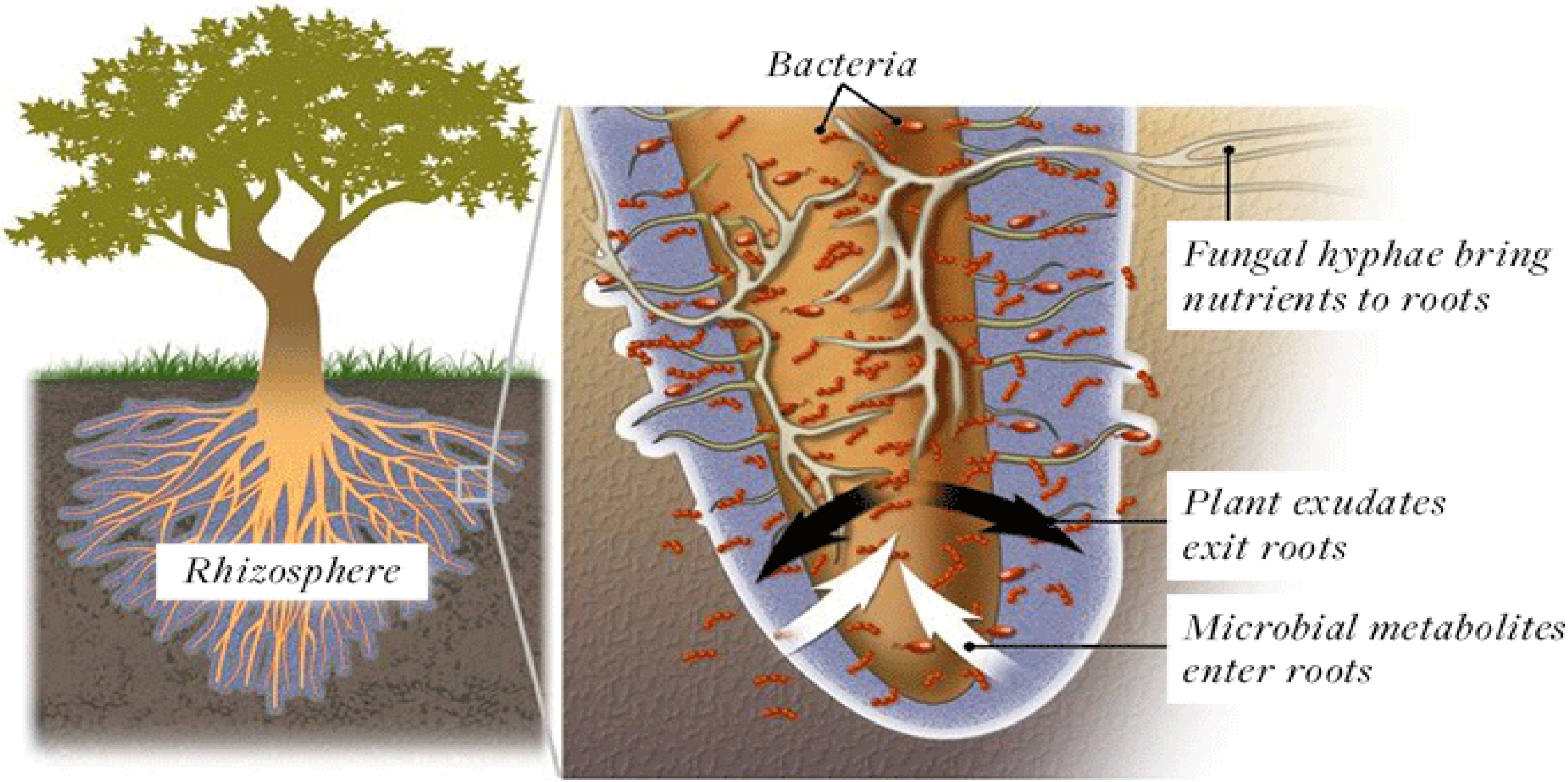
The Role of Soil Nourishment in Nutritional Quality of Indigenous Foods

Scott Goode, BS
Nourishing Systems

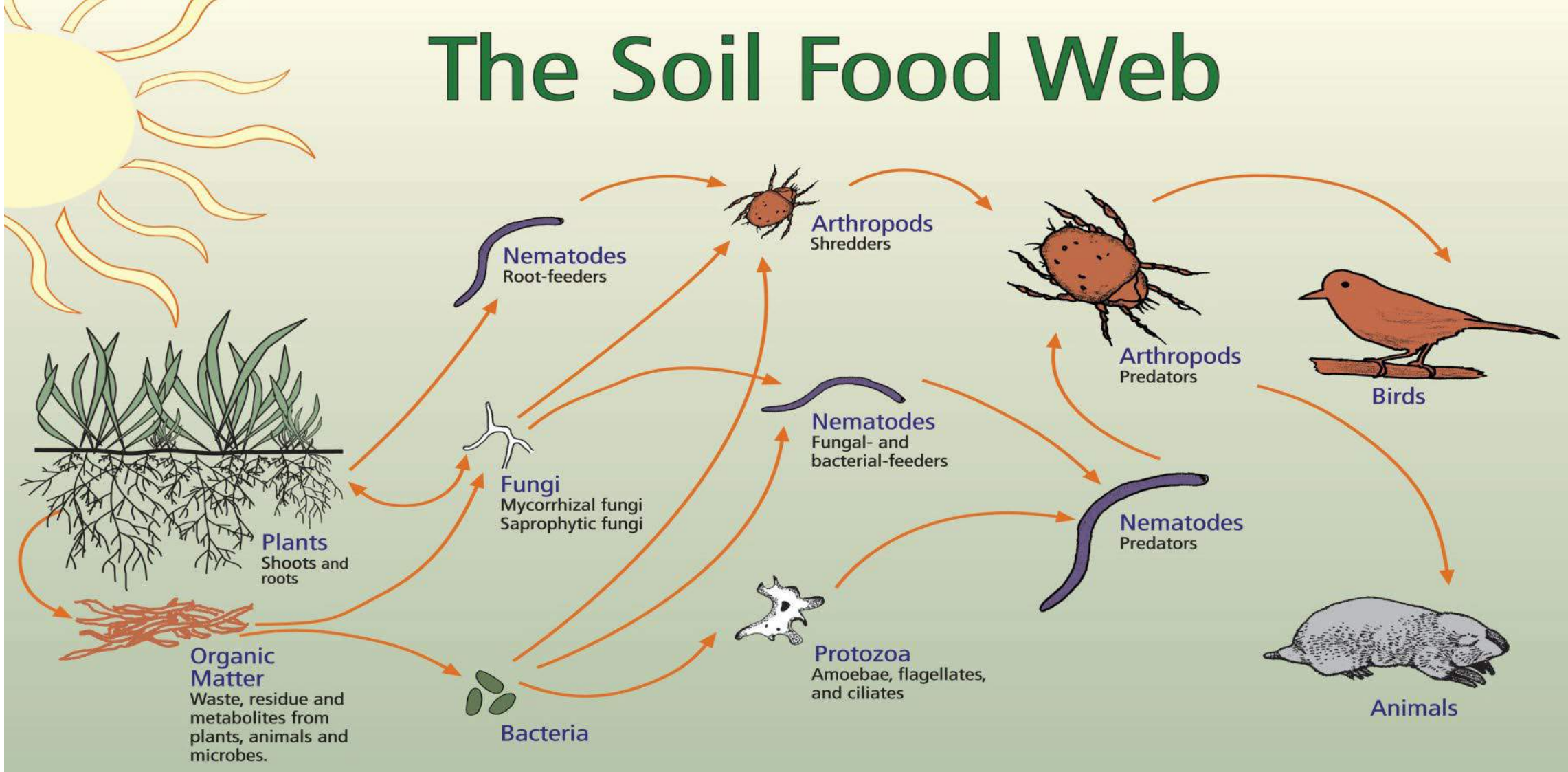
Lichens, a symbiosis between algae and fungus, were among the very first land plants.
Algae provided sugars from photosynthesis and fungi transformed the minerals in rock into critical micronutrients.


Exudates
Symbiosis (N, P plant nutrition)
Nutrition, flavonoids, Strigolactones
Pathogenesis (Effectors, hydrolases…)
Antimicrobial compounds, QS disturbance
Fungi
Symbiotic bacteria
Pathogenic bacteria
PGPR (biocontrol, Phytostimulation)
Nutrition, unknown signaling molecules
Pathogenesis (Phytotoxins, hydrolases…)
Antifungal compounds…
Beneficial bacteria
Soil structure
Insecticide, nematicide
Border cells
Nematode trapping, fungicide
Pathogenic fungi



By Anne Biklé & David R. Montgomery, 2016

The Soil Food Web



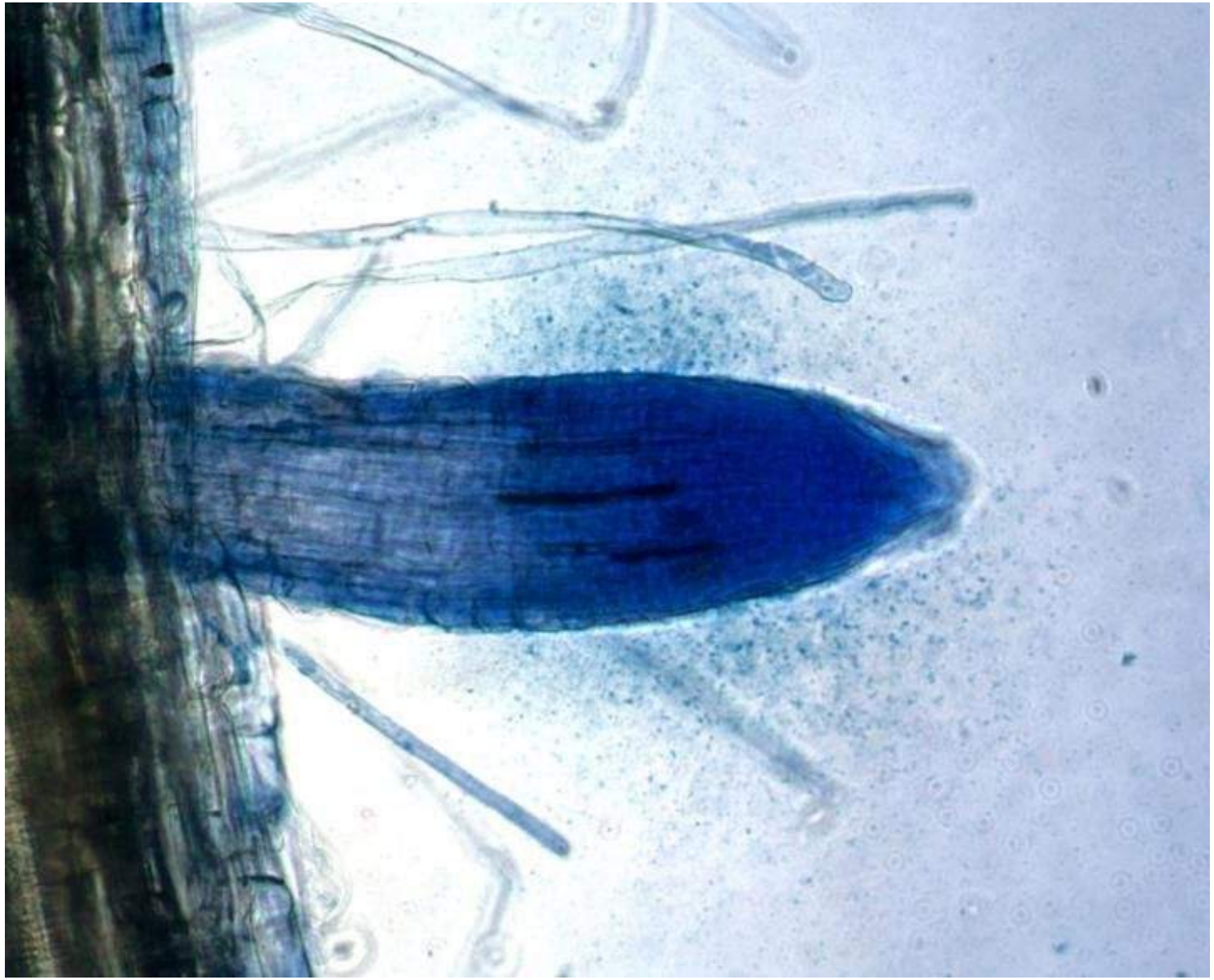
First trophic level:	Second trophic level:	Third trophic level:	Fourth trophic level:	Fifth and higher trophic levels:
Photosynthesizers	Decomposers Mutualists Pathogens, Parasites Root-feeders	Shredders Predators Grazers	Higher level predators	Higher level predators

Dr. Elaine Ingham, USDA, NRCS

Study could lead to enhanced crop growth, fewer weeds and lower fertilizer and herbicide use.

September 17, 2018

Rutgers University



Summary:

Scientists have discovered how *plants harness microbes in soil to get nutrients,* a process that could be exploited to boost crop growth, fight weeds and slash the use of polluting fertilizers and herbicides.

The **human microbiome** refers specifically to the collective genomes of resident microorganisms

*The **human microbiota** is the aggregate of microorganisms that resides on or within any of a number of human tissues and biofluids, including the skin, mammary glands, placenta, seminal fluid, uterus, ovarian follicles, lung, saliva, oral mucosa, conjunctiva, biliary and gastrointestinal tracts. They include bacteria, archaea, fungi, protists and viruses. Though micro-animals can also live on the human body, they are typically excluded from this definition.*

Sherwood, Linda; Willey, Joanne; Woolverton, Christopher (2013).
Prescott's Microbiology (9th ed.). New York: McGraw Hill. pp. 713–721.

A symbiotic relationship between the gut microbiota and different bacteria may influence an individual's immune response.

Honda, Kenya; Littman, Dan R. (7 July 2016).
"The microbiota in adaptive immune homeostasis and disease". *Nature.* ***535*** (7610): 75–84.

Understanding soil through its microbiome

First global survey of soil genomics reveals a war between fungi and bacteria

August 1, 2018

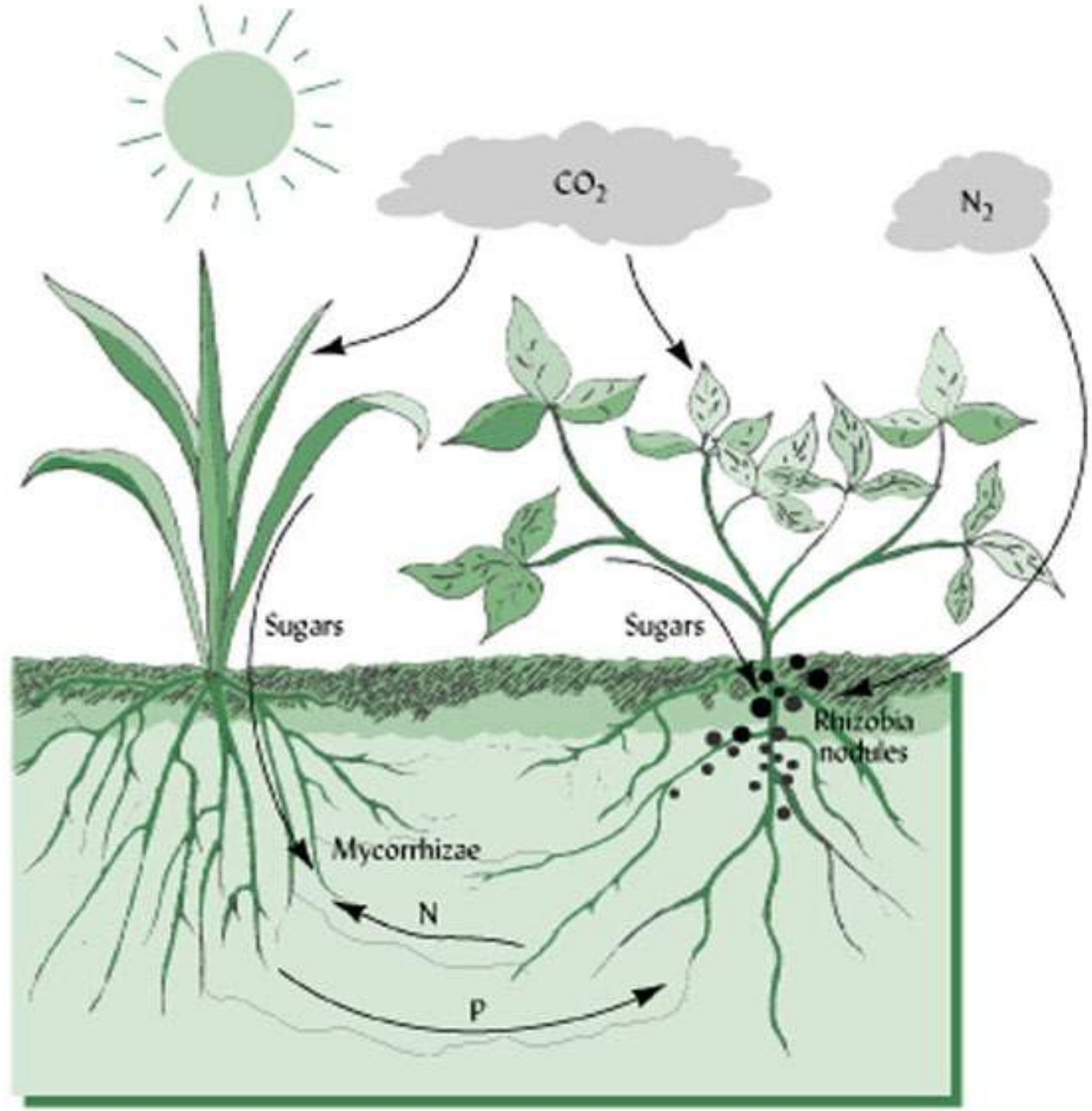
European Molecular Biology Laboratory

Summary:

Soil is full of life, essential for nutrient cycling and carbon storage. To better understand how it functions, researchers conducted the first global study of bacteria and fungi in soil. Their results show that bacteria and fungi are in constant competition for nutrients and produce an arsenal of antibiotics to gain an advantage over one another.

	Average nutritional needs for healthy plant growth. mg/kg	Median of 3 million Soil Samples. mg/kg
Iron (Fe)	30.0	40,000
Carbon (C)	30.0	20,000
Calcium (Ca)	500.0	15,000
Magnesium (Mg)	100.0	5,000
Potassium (K)	150.0	14,000
Sodium (Na)	NA	5,000
Manganese (Mn)	150.0	1,000
Zinc (Zn)	3.0	90
Molybdenum (Mo)	0.2	1.2
Nickel (Ni)	0.5	50
Copper (Cu)	1.5	30
Nitrogen (N)	25.0	2,000
Phosphorous (P)	13.0	800
Sulfur (S)	25.0	700

Minerals in Soil (Sparks 2003)

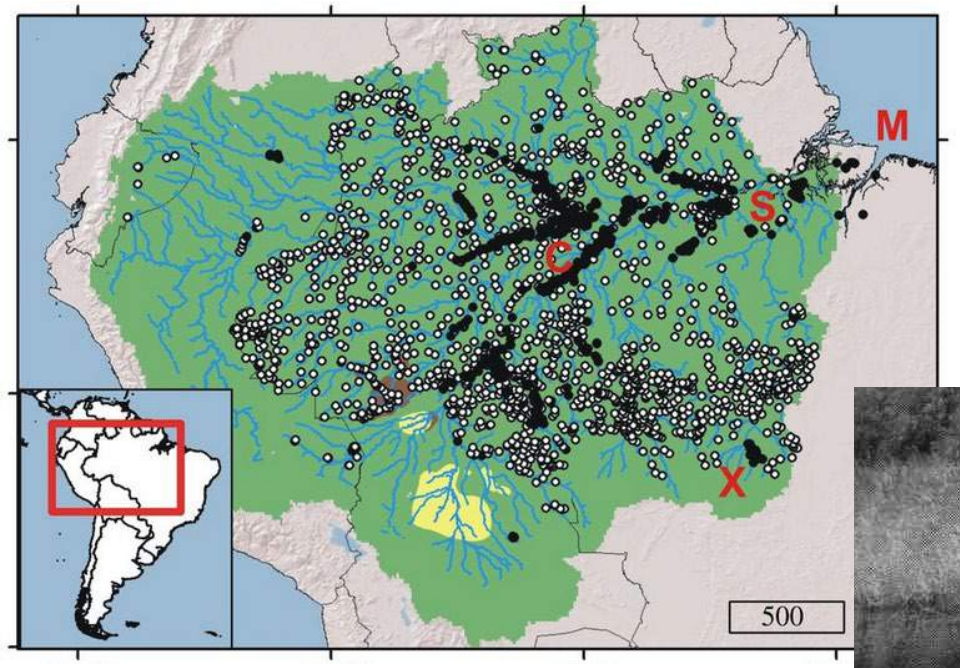


The Origins and Development of an Indigenous Agricultural Complex in Eastern North America

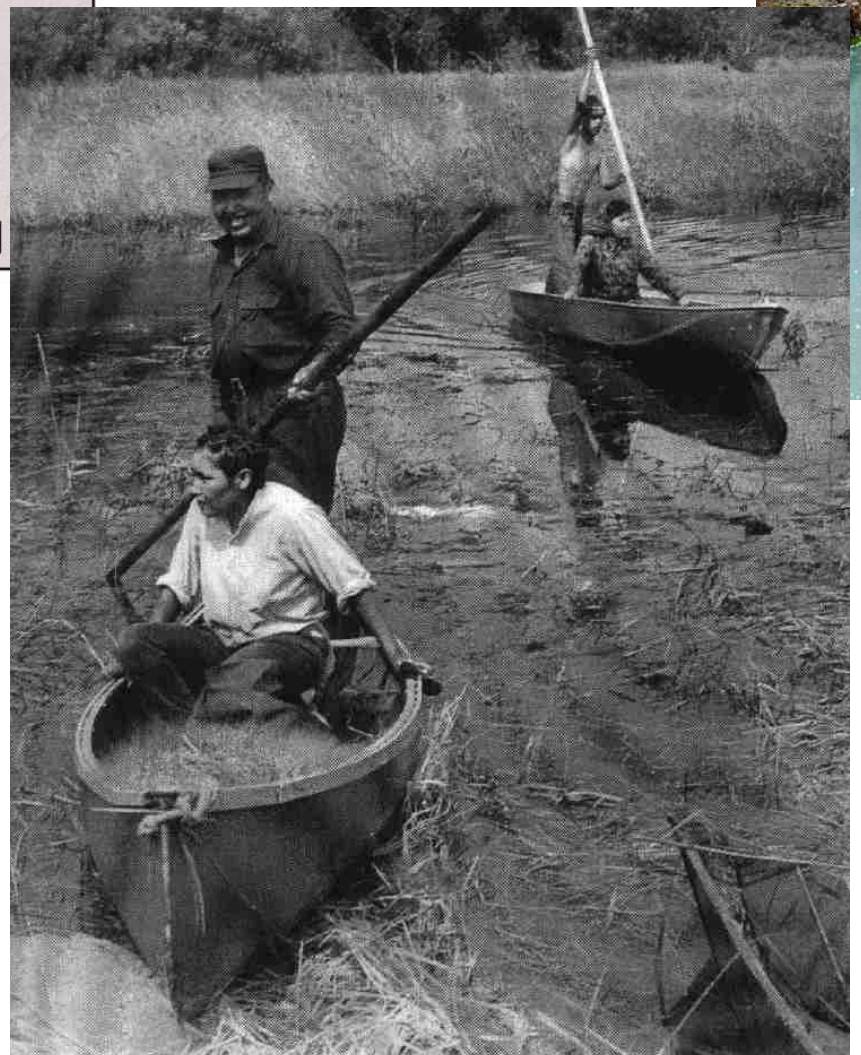
By Nathan Bensing *Sat, Feb 25, 2012* The Collegiate Journal of Anthropology

***The earliest and perhaps most important component of this eastern cultivation complex was the common squash*, species *Cucurbita pepo*. Some of the earliest examples of this plant in the eastern United States are found at the Koster site in southwestern Illinois, with the earliest example coming from about *5100 BCE*.** (Ford, 1985)

> ***The common sunflower, the only domesticate of this period still in use today*, was important, but it seems that within this early period there was little to no evidence of its use in western Illinois. This is most likely due to its importation from the Southwest.** (Keegan, 1987)
>
> > **While *maize* was likely to have been known to the people of Eastern North America, it *was not a notable source of food until the 7th to 9th centuries CE.* Even then, it initially appeared to become a simple addition to the already existing complex of crops in Eastern North America.**



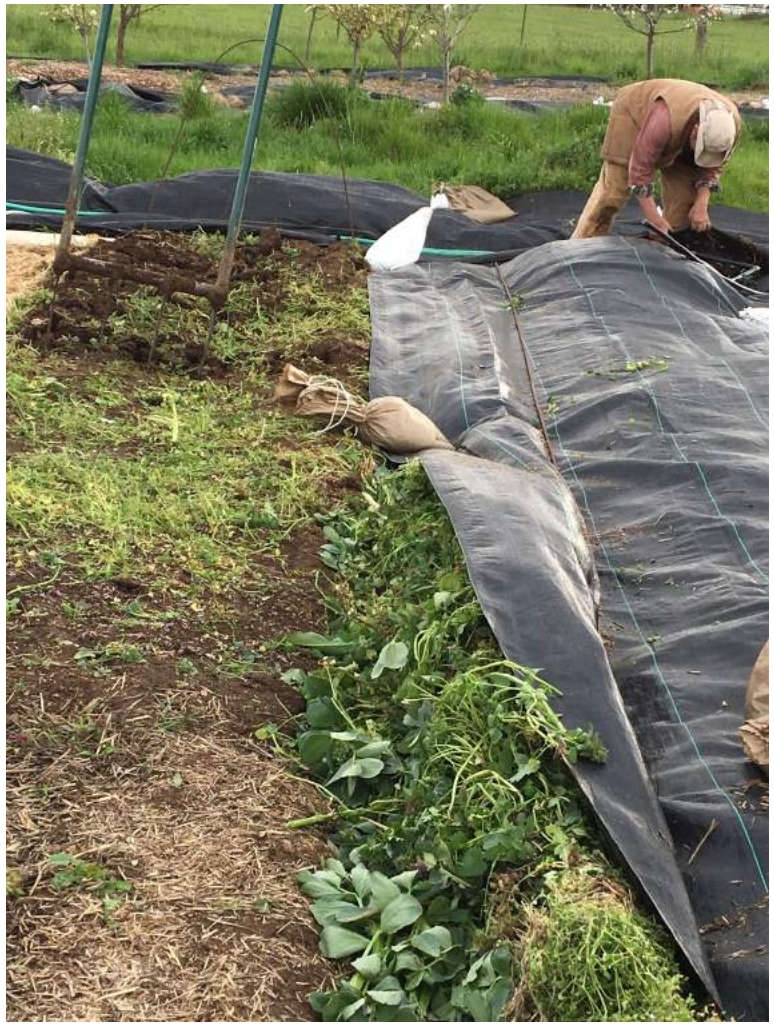
- **Terra Preta Sites**



Building a Terra Preta in-ground composting system

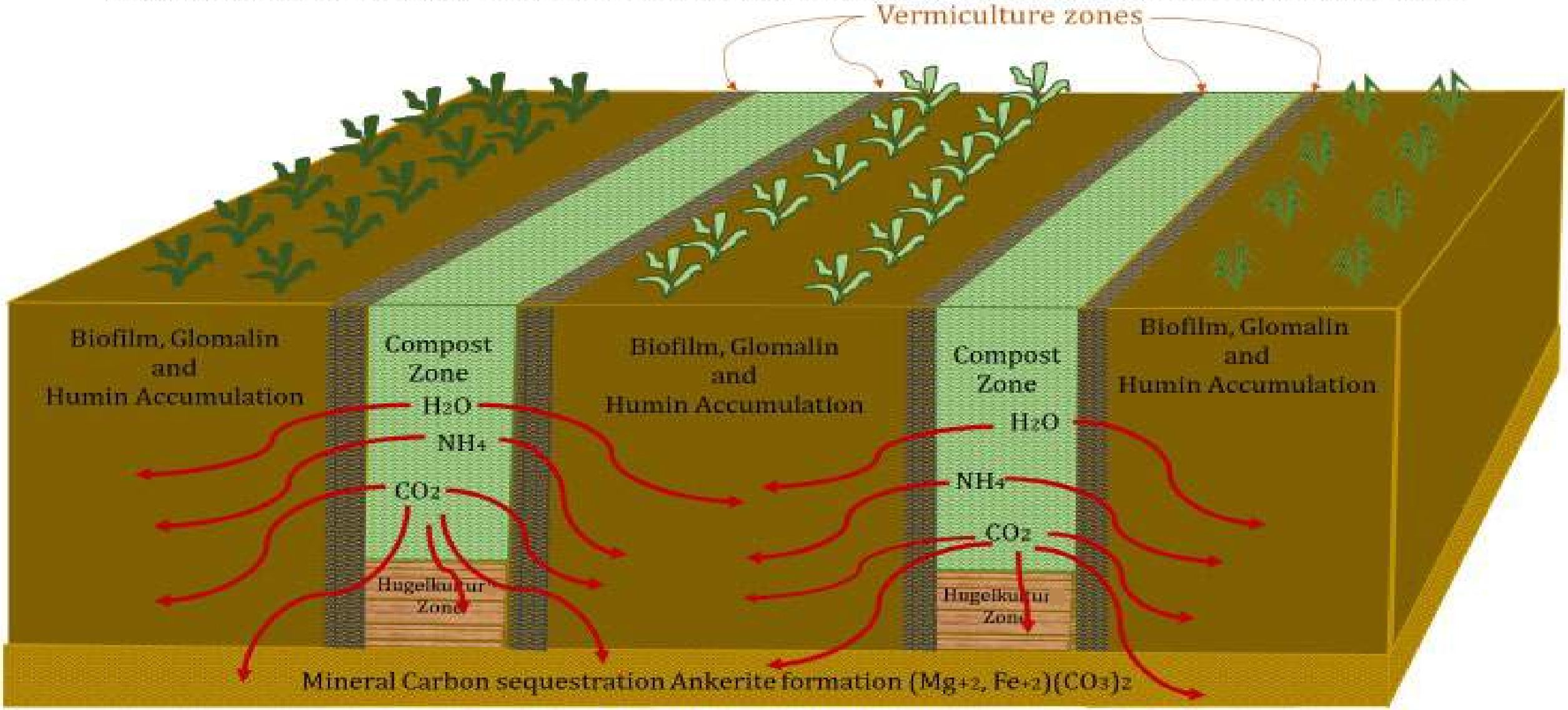
When crops are finished producing, the debris is composted in the walkways. Any summer cover crops are added as well.

Winter's nitrogen-fixing cover crops are harvested in the spring and placed in the walkways to provide nutrients to vegetable crops that grow through the summer.
Any weeds that emerge are added to the walkways well before they flower.



Integrated in-ground compost systems of Terra Preta cultivation

Earthworms inhabit the zone adjacent to the composting trenches (vermiculture zones) enriching the soil with worm castings.
The cropping beds accumulate soil organic matter which is preserved by heavy mulching and no-till soil management.
CO_2 concentrations in the Hügelkultur zones exceed 670 ppm promoting rich glomus (mycorrhizal) populations.



A Composting Walkway in Action

Thank You!