

EXPLORING THE HIDDEN WORLD OF MICROBES

A course curriculum to enhance farmer microbial literacy

COURSE PURPOSE: The primary purpose of this course is to render the invisible world of microbes visible to farmers. This course offers introductory science-based instruction exploring the diverse applications of microbes on farms.

INTENDED AUDIENCE: This curriculum is designed for farmers seeking to enhance their foundational microbial knowledge. This material can also assist extension agents, citizen scientists and other non-experts wanting to explore the hidden world of microbes.

CURRICULUM OUTLINE:

UNIT 1: *What microbes are living in my soil?*

Module 1: Key players in the soil food web

- fungi; bacteria; nematodes; protozoa

Module 2: Clarifying central definitions

- microbe; microbiome; microbiota

Module 3: Quantifying soil microbial biodiversity

- estimates of belowground biodiversity; conservation challenges

Module 4: Introduction to soil fungi

- types of fungi; fungal functions

Module 5: Introduction to soil bacteria

- types of bacteria; bacterial functions

UNIT 2: *How to microbes benefit the farm?*

Module 1: Microbes in the soil

- decomposition; nutrient cycling; soil structure

Module 1: Microbe and plant co-evolution

- holobiont concept; second genome

Module 2: The rhizosphere effect

- rhizosphere microbial density; rhizophagy cycle

Module 3: Mycorrhizal fungi

- arbuscular mycorrhizal fungi; benefits beyond nutrient acquisition

Module 4: Nitrogen fixation

- legumes and bacteria

Module 5: Disease suppressive vs. conducive soils

- the potential of indigenous microbes

UNIT 3: *How do current agricultural practices harm microbes?*

Module 1: The war on microbes

- microbiophobia; farmer *cosmos*

Module 2: Microbes and tillage

- microbes and physical disturbance; fallow fields

Module 3: Microbes and pesticides

- pesticide cocktails; resistance; selective pressure

Module 4: Microbes and fertilizers

- changing nutrient availability

Module 5: The story of microbes and glyphosate

- most used pesticide; patented antibiotic

UNIT 4: *How can we build a microbially-assisted agriculture?*

Module 1: What on-farm practices support microbial diversity?

- no-till; cover crops; perennial agriculture; polyculture; animal integration

Module 2: Does working with microbes make economic sense?

- economic services of microbes; input cost reduction

Module 3: What are methods for monitoring microbes on the farm?

- root staining; soil sieving; experimental design

Module 4: How can we build farmer education networks?

- farmer field schools; microscope clubs