

## **Beneath the Surface: Cultivating Biodiversity in Agricultural Soils**

### **Defining the Principles of Regenerative Organic Agriculture**

#### What Is Soil?

There are five key ingredients that make up soil:

- Minerals (clay, silt, and sand)
- Gas (nitrogen, oxygen, hydrogen, carbon dioxide, etc.)
- Water
- Organic material (dead or decaying carbon matter)
- Living organisms

#### What Living Organisms Exist In the Soil?

Here is a list of microbes you can find in soil, that include but are not limited to:

- Fungi
  - A lot of fungal species grow in the soil and form complex and intricate networks in and around plant roots to cycle nutrients, decompose carbon matter, and direct water flow.
- Bacteria
  - Bacteria take on the role of the decomposer in the early stages of breaking down decayed material. They take unusable forms of things like nitrogen gas and phosphorus, and they convert it into a form that is then usable by plants.
- Protozoa
  - Protozoa are similar to bacteria in that they are both single-celled organisms, but protozoa are actually more similar to plant and animal cells. In the soil, they feed on bacteria and maintain their population sizes so that bacteria are constantly processing materials into usable metabolites.
- Nematodes
  - Nematodes are microscopic worms that behave as predatory grazers in the soil. They consume smaller organisms, spread fungal spores and bacteria through the soil, and release ammonia that becomes available for use by plants.
- Insects and Other Arthropods
  - Insects and other arthropods can contribute greatly to soil health in moderate numbers. They cycle nutrients, ward off harmful pests, and facilitate the spread of fungal spores and pollen.

#### What Is Biodiversity?

Biodiversity, short for "biological diversity," is the variety of life in all its forms, from genes to species to ecosystems. Biodiversity takes shape in various environments, like remote deserts and bustling rain forests. It contributes to the natural biomes of Earth. If you look close enough, you will see it in your own farm.

## Why Bother with Biodiversity?

Having diverse species growing in the fields and soil is crucial to a successful farm because ecosystems with greater diversity:

- Have better defenses against diseases and pests
  - Living organisms in the soil are key factors in plant defenses against pests and diseases. Having multiple species in the soil that can perform the same job (e.g., converting nitrogen into a plant available form) helps guard against the loss of one or two species to environmental factors or disease. Having these beneficial microbes “set up shop” around a plant’s roots also means there’s no room for undesirable (bad microbes) to get established and cause disease in the plant!
- Provide more nutrients to the soil
  - Different plants require unique metabolites. By growing a multitude of species above ground, we’re able to support a multitude of species below ground. Each species contributes something different to the (eco)system, ensuring that it continues to function even when faced with disease or environmental pressures. A diversity of species is necessary in healthy soil as none can operate alone.
- Build resilience against natural disasters and disruptions
  - As the climate continues to change, farms are facing drought, floods, and storms that threaten food production. Having biodiversity in the soil allows the plants to build strong defenses against these issues by incorporating more microbes that store water, aerate the soil, provide fundamental minerals that can fortify cell walls, etc. This is why biodiversity builds resilience in an ecosystem.

## What Can You Do to Increase Biodiversity In Your Farm?

- Include species from different functional group into your crop mix
  - Add forbs (flowering plants), grasses, and legumes to farmland
- Increase and/or extend crop rotations
  - Plant beneficial crops together and rotate crops between seasons for longer or shorter durations
- Be intentional with the sequence of your rotation
  - For example, one year of peas → next year of oats → next year of sunflowers
- Keep crop residue on the soil
  - Helps to prevent erosion, top soil degradation, and more
- Seed directly into the previous year’s litter
  - Prevents erosion, top soil degradation, and minimizes disturbance
- Reduce tillage
  - Repetitive tillage disrupts the soil microbiome (especially the fungi) and breaks down soil structure, reducing the soil’s ability to support the plants growing in it
- Use organic fertilisers
  - Not only do they contribute nutrients to the soil, but they also add organic material that helps build soil structure

- Plant cover crop
  - A diverse cover crop provides a diverse buffet of exudates to soil microbes. They also protect crops and microbes from the elements and keep the soil moist and cool.

## Conclusion

The principles of regenerative organic agriculture provide the framework for how to repair and restore soil health, and the principle of diversity focuses greatly on promoting biodiversity above and below ground.