



Welcome to Ground Work

Microbial Growth Patterns

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How weather and conditions affect biological activity in your soil

When it comes to soil microbes, the three factors that have the biggest impact on population numbers and diversity are:

- Soil temperature
- Soil moisture
- Available food sources

Most farmers have little control over soil temperature unless they are working in a greenhouse or hoop house. Farmers with crops out in a field won't have much control over soil temps nor will they have control over soil moisture levels unless they have an irrigation system. **The one variable that all farmers have control over is the amount of food sources they make available to their soil microbes.**

It is good to understand these three factors and how they affect your resident soil microbes and as a result, your crops.

Soil Temperature

Soil temperature directly affects the rates of physiological reactions in the soil. As the soil warms in the Spring, biological activity increases; as the soil cools in the Fall and Winter, biological activity decreases. The source of this pattern is solar energy. More solar energy = warmer soils.

Factors that control soil temperatures include daily and seasonal effects, vegetation status and type, soil moisture levels, and soil depth.

In most soils, microbiological activity nearly doubles for each 18 degrees Fahrenheit rise in temperature between 32°F and 95°F. If you go any warmer than this, then there is a significant decrease in biological activity as a result of thermal breakdown of proteins and membranes. There are some bacteria that are designed to withstand very high temperatures (they are called thermophilic bacteria), but many bacteria simply perish or go dormant if the soil gets too warm.

Soil temperature likely interacts with other factors such as soil moisture to regulate biological activity.

Soil Moisture

Soil moisture levels directly affect the growth and activity of all soil organisms. Besides needing water to live (for vital cell processes), soil microbes, soil animals, and plants rely on soil water to make nutrients available and accessible.

Maximum biological activity generally occurs at soil water potentials of about 40%, conditions usually found right after a rain or deep in the soil, just above the water table. At soil moisture levels above and below this, the rate of biological activity slows considerably.

Having healthy soil with good tilth and plenty of organic matter is critical if you want to maintain diverse populations of soil microbes throughout the year. If you have good soil tilth, then you have plenty of pore space, nice soil structure and soil aggregates, as well as ample water-holding capacity and water infiltration rates.

All of these variables, if present, help keep soil moisture in balance and promote robust and diverse populations of beneficial soil microbes.

Available Food Sources

The third and final factor (the one that *is* under your control) affecting soil microbes is available food sources. For microbes, this is usually carbon.

Soil organic carbon exists in many different forms and flavors, but if you boil it down, there are 3 main categories or “carbon pools.”

- **The insoluble carbon pool** is made up of cellulose and lignin (from plant cell walls), chitin (from soil animals and fungi), and soil humus (decomposing organic matter).
- **The soluble carbon pool** comes primarily from exudates that are released by plants and some soil organisms; some soluble carbons also come from enzymatic decomposition of insoluble and biomass carbons. Soluble carbons are usually found in low concentrations (less than 1% of soil organic carbon) because they are rapidly used by soil organisms. These soluble carbons provide an immediate food source for a diverse range of soil microbes.
- **The biomass carbon pool** consists of living and recently dead soil microbes and animals. Decomposer soil microbes are responsible for the turnover of carbon in soils...all organic matter passes through this microbial pool before moving to other carbon pools. The biomass carbon pool represents a small percentage (1-2%) of the total organic carbon in the soil, but is the driving force of the soil carbon cycle.

It's impossible to control the weather, as much as we wish we could. When it gets hot and dry, it's good to understand how this affects our soils and microbes.

- Some beneficial soil microbes are very resilient and are able to wait out the tough conditions. Filamentous fungi and gram-positive soil bacteria (particularly *Streptomyces* and *Bacillus*) are the most tolerant microbes to water stress.
- Other beneficial soil microbes are less resistant to water stress and these organisms may perish during a drought.

The best way to protect against loss of microbial diversity is to apply AgriEnergy Resources biological products (**SP-1™**, **Residue™**, and **Mycos Seed Treat™**) multiple times a year.

- Spread out your applications and make sure you time them right.
- Putting out food sources such as fertilizers, humates, molasses, and fish can help newly applied microbes get established as well as feed the ones that already inhabit your soils.

Remember, diversity is key, so keep your microbes well fed and watered so they multiply and flourish!