



Soil Simplified



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An Introduction to Your Garden's Microbial Life

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I. Plants Relationship with Microbes

Until modern times, plants have relied on nutrients provided by their relationship with microbial life. This relationship can seem complex and mysterious. There are however, some key elements to microbial soil life that can enlighten curious gardeners with little more than a brief explanation:

1. Plants exude sugars from their roots.
2. Bacteria and fungi ingest these sugars.
3. Protozoa and nematodes then eat the bacteria and fungi.
4. Their excess waste is transformed into "plant available" nutrients right in the root zone.
5. The plant uses these nutrients to grow.
6. The plant is in control of when and what it eats. By using a piece of its' own energy to feed these microbes, the plant insures a future source of energy greater than what it has lost.

Understanding this cycle will help you better learn how plants relate to the soils in which they are grown. Realizing that plants evolved with this relationship can help you decide what is best for your garden.

II. Soils Relationship to Microbes

Soil is a mixture of organic matter, minerals, and a full spectrum of living creatures. It is also a microscopic landscape where life decomposes to its base ingredients and ushered into new forms.



Gardeners don't need to know complex biochemistry to know their garden, but understanding some of the processes going on in your soil can be rewarding:

1. Fresh organic material is broken down by microbes. The bacteria eat the sugars and fresh green material. The fungi eat the tougher woody material and proteins.
2. The plant material is further broken down by larger microbes, small bugs, and worms that feast on the bacteria and fungi.
3. Microbes hold moisture and nutrients in their biomass. They keep the water from evaporating and the nutrients from leaching away.
4. Bacteria produce slimes that bind particles together to form humus in your soil. This helps the soil store oxygen, creates cracks for water to flow, and provides a shelter for the multitude of creatures thriving underfoot.

These are just a few examples of microbial soil interactions that can help you better relate to your garden. Through these processes, the life in your soil maintains balance with the environment that it is a part of.

III. Working with Soil Biology

If you are adding compost, mulching, or avoiding chemical fertilizers, then you are probably already doing much to improve your soils health. By learning how these actions affect your garden, you can better trust your own reasoning and intuition to guide your relationship with soil life.

IV. Compost

Compost is organic matter that has been broken down by microbes so that its' energy is stored for further use. Applying it to your garden ads colonies of diverse organisms to the soil. It also supplies a new food



source for existing colonies. There is much variation in qualities compost can possess. For instance, the debris that comprises the compost should be fully broken down and unrecognizable. It should have a deep brown color and rich but subtle smell. If it smells strong than it is probably potent in some way. If it smells rotten, than it could add problems to your soil. Many methods of producing compost can yield different results, but remember: We evolved with these microbes, plants, and soils as well. Your senses can be the best judge of the quality of compost.

V. Compost Tea

Compost tea is a brew of oxygen rich water, high quality compost, and some foods to help microbes bloom in population. The goal of good CT is to substantially multiply the beneficial organisms. They can then be used to coat leaf surfaces, inoculate compost, and restore or improve soil health. A bio-film of CT on leaf surfaces can keep pathogens from reaching the plant as a food source. The microbes also respire CO₂ that helps fuel plant metabolism. Use of tea in compost or soil can drastically increase the biomass of healthy life that stores and converts energy.

VI. Mycorrhizae

Most plants in the Earth's soils have evolved to have a mycorrhizal relationship with Fungi. This is when a specialized species of fungi attaches to the root of a plant, and directly exchanges nutrients in the soil for foods from the plant. The fungi use enzymes and organic acids to break down minerals in the soil and draw them into the plants roots. The fungal hyphae (strands of cells that form the organism) can multiply the water-absorbing surface area of the root zone by hundreds of times. Use of mycorrhizal fungi spores can greatly increase your plants access to water and nutrients.

VII. Minerals

Many of the nutrients locked within our soils are in the form of minerals. Some are readily available to plants, while others need the



help of microbes to unlock their energy. When we harvest from our gardens, we deplete the nutrients made available from organic matter and minerals. We usually replenish organic matter in the form of compost or fertilizers. It is also good to add minerals while restoring fertility to your soil.

VIII. Mulch

Mulch can be a useful tool for dealing with a number of garden issues. It can keep moisture in the soil, prevent weeds from sprouting, and be a food source for the microbes in your garden. Mulch should be layered thick enough to accomplish these tasks but loose enough to allow for the flow of oxygen. It can take many forms and each possesses unique functions. Try different materials and decide for yourself what's best for your garden.

IX. Tilling

Tilling your soil can destroy fungal colonies, damage bacteria, and release precious nutrients back into the air. Sometimes it is necessary while rehabilitating a landscape to till the damaged soil. Compost and Compost Tea should be applied soon after to inoculate the soil and restore its' composition. Hand picking weeds, cover cropping and mulch can be useful alternatives to annual tilling. When it comes to tillage, less is more.

Everything you do to your garden affects microbial life. With little effort, you can enhance this life for the benefit of your garden, your health, and your environment.

Builder Series Supplement

Water Conservation with TransFarming and Aquaponics

Here in Texas we face myriad obstacles to growing food in a “sustainable” fashion. What does sustainable mean? Well, it has a lot to do with producing food in a manner that is not interrupted by “outside influences”. One of the major outside influences here in Texas is the weather – long seasons of heat, extended periods of cold, rapid changes between those two conditions, and no rain in between.

The entire premise of TransFarming was started on the realization the weather here in Texas can be brutal and a different approach must be taken to combat the elements in light of our modern challenges.

At the core of all this is water. Without water, nothing prospers. TransFarming is about “re-thinking” traditional gardening methods to address *regional environmental challenges* like droughts and water restrictions, while keeping in mind techniques for prosperous food production. These approaches involve growing food in ways that conserve water.



Weather wise, not much has changed from the days of our ancestors, but they used vastly different approaches to dealing with the climate than we do today. Following are a few techniques used to conserve water on a TransFarm.

WICKING BEDS

Wicking beds have proven to be a viable solution to the Texas heat and water conservation. These simple structures, based on a raised bed garden, incorporate a reservoir underneath the bed to store water. The garden is watered through an exposed pipe which then wicks water upward through the soil to the roots where water is needed the most. There is minimal evaporation.



TRADITIONAL RAISED BED GARDENS

Traditional raised bed gardening involves selecting the correct structure and materials for a specific outcome base on environmental factors such as shading, sun path, wind direction and desired crop. Additionally, soil composition will play a very large part in crop success and water conservation. A simple small hoop house may be desirable to protect from direct sun and winter cold.



AQUAPONICS

Aquaponics is the combination of aquaculture (fish farming) and hydroponics (soilless plant production). With Aquaponics, the nutrient-rich water that results from raising fish provides a source of natural fertilizer for the growing plants. As the plants consume the nutrients, they help to purify the water in which the fish live. A natural microbial process keeps both the fish and plants healthy, and helps sustain an environment where all can thrive. Both the plants and fish are harvested.



HUGELKULTURE

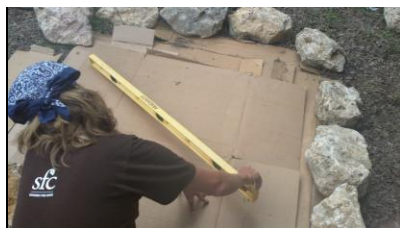
A HugelKulture is a type of raised bed garden that allows one to use organic materials that are too big to go in the compost. Over time, that is 3- 5 years, the materials in the bed decompose, and provide a slow release of nutrients for garden plants.

Because of its three-dimensionality, a HugelKulture raised bed garden combines the multiple functions of rainwater harvesting, catchment, and irrigation using no cistern, pumps, or pvc pipes. Done properly, there may be no need to water all summer!



KEYHOLE GARDENS

A keyhole garden uses the same principle as a HugelKulture in that decomposing matter is used to absorb and retain water in the soil. Large amounts of “rotting” wood and kitchen scraps are used in the soil which is stacked within layers of cardboard and paper. Kitchen scraps are also added to the bed via a foot-wide tube which nourishes the entire system. A wedge is cut in the circular bed to access the tube, which makes the garden look like a keyhole when viewed from above.



HOOP HOUSE/MONKEY HUTS

One of the major concerns with growing food (and fish) in the winter is the cold. The wind does not help much either. Greenhouses are expensive, and any constructed structures tend to be somewhat permanent. Enter the simple Monkey Hut. These structures are by their very nature flexible, and designed to withstand strong wind and rain (dust too). Built correctly, they are easily dis-assembled in the Spring, or used to support a shade cloth in the Summer.



VERMICULTURE AND CONSTRUCTING A WORM BIN

Worm Composting is an excellent way to create organic matter for gardens and Aquaponic systems. They can be added directly to gardens and Aquaponic media systems, and also used to feed fish and chickens. Worm farming includes choosing a worm and bin type, setting up the worm composting bin, maintaining the system, harvesting compost and worms, making and using worm tea, and such activities.

