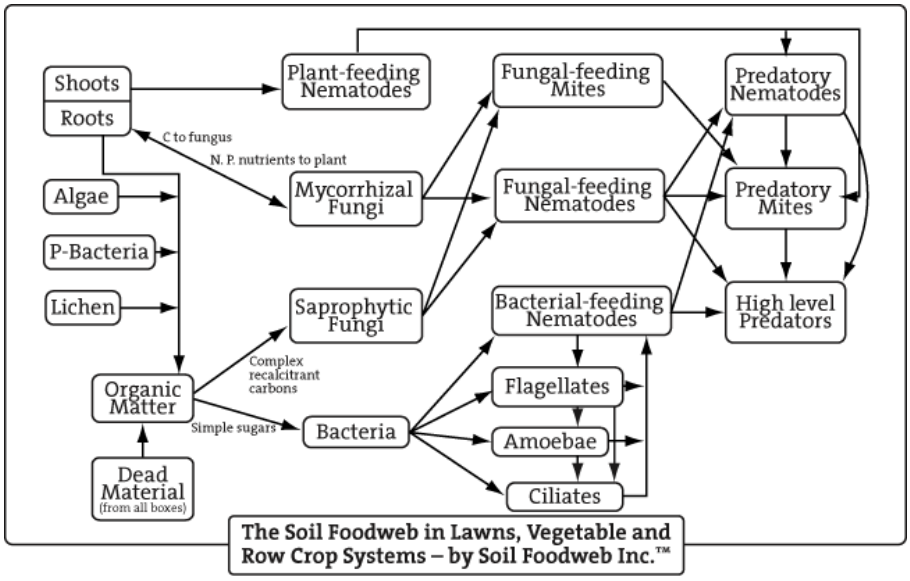
Biological Understanding of Soil Improvement ©

Sustainable Growth Texas (Agriculture) / Soils Alive (Lawn Care) specializes in the blending and custom application of liquid compost extracts, biological inoculants, and microbial foods. These methods repopulate, feed and stimulate high populations of diverse soil organisms that regulate every aspect of soil health and crop productivity: soil fertility, nutrient cycling, residue decomposition, soil structure, and disease suppression.

We use a patented machine called the Hronek Flow-Thru Compost Extractor to make **liquid compost extract** (LCE). The process is analogous to a washing machine that strips beneficial micro-organisms (bacteria, fungi, protozoa, and nematodes) out of compost and results in a dark liquid compost solution that can be sprayed on soils and crops. LCE has the biological benefits of compost, without the bulk.

The application of *biological amendments* such as liquid compost extract and microbial inoculants is a form of **"bioaugmentation"**. Billions of microbial organisms land on soil and plant surfaces through application of liquid compost. These micro-organisms colonize root and soil surfaces and initiate a series of biological mechanisms that improve soil structure and facilitate nutrient availability to plants. This supplemental biology stimulates grazing by native arthropods (mites, springtails) in the soil, which in turn serve as prey for higher level predators on a food chain, eventually feeding birds and mammals. *Life begets life*. This community of soil organisms —competing for food sources and performing biological functions — is known as a *Soil Foodweb*.



Soil foodweb organisms compete for the same carbon resources such as organic matter, animal manure, leafy debris, and each other. The predator-prey relationship of this food chain is akin to the big fish eating the little fish, and so on, ad infinitum. Protozoan grazers feed on bacteria to derive their food and energy. In the process of protozoan feeding, left-over amino acids and proteins are squirted into the soil environment and further metabolized into nitrate-nitrogen for crop uptake. This process is known as nutrient cycling. Nematodes feed on fungi and bacteria, micro-arthropods feed on nematodes, and according to E.O. Wilson the famous biologist at Harvard University, *"ants eat mites like popcorn"*. A soil foodweb is a holistic system and all of the micro- and macro-organisms perform a role. Biocides like herbicides and insecticides upset the delicate balance of this system and should be avoided.

The application of *organic amendments*, also known as *microbial food sources*, feeds and stimulates indigenous populations of soil organisms and is a form of **"biostimulation"**. Organic soil amendments are widely noted in the scientific literature for their ability to stimulate microbial communities and suppress soil-borne diseases. For example, Sustainable Growth Texas uses humic acid, fish, and kelp to feed and stimulate fungal organisms and molasses and fulvic acid to feed and stimulate bacterial organisms, as well as other organic ingredients.

Sustainable Growth Texas coined the phrase ***liquid biological amendments*** (LBA) to describe the technology of spraying fields at different times of the growing season with our **Bio-Augmentation Mix™** or **Bio-Stimulation Mix™.** The timing of LBA field application is adjusted for each crop and soil type to match biologically-driven mechanisms that occur during the growing season such as root stimulation, biomass production, and organic matter decomposition.

A robust, diverse, complex soil foodweb will suppress diseases; retain nutrients, reduce nitrate and phosphorus leaching; make nutrients available to plant roots in the right form at the right time during the growing season; detoxify or decompose harmful substances like excess salts and chemicals; improve the structure and tilth of soils; increase water holding capacity; improve root depth and root health; and help maintain aerobic conditions.

A Quick Review of the Players: Soil Foodweb Organisms

Bacteria
Bacteria are tiny, one-celled organisms which decompose organic matter, mineralize and immobilize nutrients, suppress diseases, fix nitrogen, and solubilize phosphorus. In agriculture soils a desirable range is 100 million to 1 billion bacterial organisms in one gram of dry soil.

Fungi
Fungi are microscopic cells that grow as long threads or strands called hyphae. These single-celled strands push their way between rocks, soil particles, and roots. When these strands fuse together they look like fungal roots called mycelia. Fungi decompose organic matter and crop residues, solubilize nutrients from parent rock, and physically bind soil particles into aggregates which improves soil structure. In agriculture soils a desirable range is 150 to 300 meters of beneficial fungi in one gram of dry soil.

Protozoa
Flagellates and Amoebae are single-celled animals that feed primarily on bacteria, but also eat other protozoa, nematodes, organic matter, and sometimes fungi. Ciliates are the largest of the protozoa and they feed primarily on anaerobic bacteria. Protozoa facilitate nutrient cycling by grazing on bacteria and releasing excess nitrogen into the soil environment. This process of bacterial grazing stimulates further growth of bacterial populations. In agriculture soils a desirable range is several thousand *flagellates* and *amoebae* and one hundred to several hundred *ciliates* in one gram of dry soil.

Nematodes
Nematodes are non-segmented microscopic worms. The majority of free-living soil nematodes function as beneficial organisms in the soil foodweb: bacterial-feeding, fungal-feeding, and predatory nematodes. A fourth type, plant-parasitic nematodes, are widely recognized in agriculture because they infest roots and injure crops, but when their numbers reach injurious levels it is an indication of a soil foodweb imbalance. Beneficial nematodes are the 'balancers' and play a critical role in nutrient cycling by consuming bacteria, fungi, and other nematodes. In turn, they serve as prey for higher-level predators. If fungal biomass is low certain types of nematodes will "switch" and consume plant roots, thus they also serve as biological indicators of soil health. In agricultural soils a desirable range is 10 to 30 bacterial- and fungal-feeding nematodes and a few predatory nematodes per gram of dry soil.

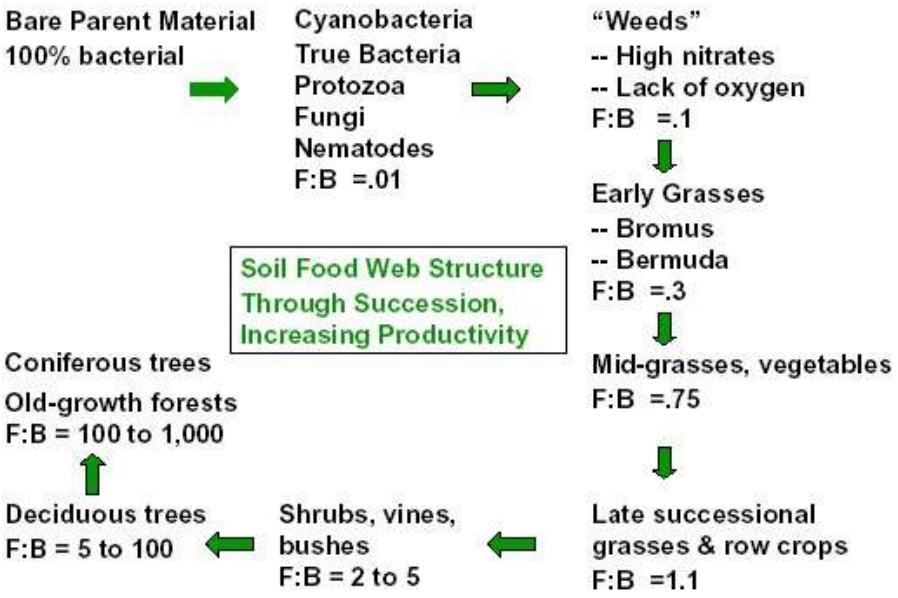
Micro-arthropods:
Mites (*acari*) and springtails (*collembola*) are the best-known tiny soil dwellers known as micro-arthropods. They range in size from microscopic to visible to the naked eye. They shred organic material, stimulate microbial activity, mix microbes with their food, mineralize plant nutrients, enhance soil aggregation, and burrow. All consume their chosen prey group: bacteria, fungi, nematodes, and other arthropods. In forest soils there may be as many as 250,000 to 500,000 mites in a square yard.

Earthworms:
Earthworms are the major decomposers of dead and decomposing organic matter. They obtain part of their nutrition by consuming protozoa, bacteria and fungi that grow on these decaying residues. Earthworms shred and bury plant residues, ingest soil, mix and aggregate soil, and stimulate microbial activity. Their burrowing activity provides channels and pores for root growth and increases water infiltration. In agricultural soils a desirable range is 5 to 30 per square foot.

Succession Chart: A Road Map to Match Biology with Desired Plant Growth

Dr. Elaine Ingham of Soil Foodweb, Inc. Laboratory (SFI) in Corvallis, Oregon, promotes the use of Fungi-to-Bacteria ratios as a key to understanding how a below-ground soil foodweb succession parallels an above-ground plant ecological succession. The following succession chart illustrates this concept. Early-successional plants (invasive weeds and annual crops) are bacterial-dominated while late-successional plants (prairies, shrubs, trees, and forests) are fungal-dominated. The numbers in the chart are based on a soil biology lab test. They are reported as Total Fungal Biomass **:** Total Bacteria Biomass (F:B) in micrograms per gram.

The soil biology test provides a practical glimpse of *which kinds* and *how many* soil critters make up the existing soil foodweb on a farm or ranch. The succession chart serves as a roadmap for custom blending an LBA, or "bio-spray", to match the soil foodweb needs of farm and ranch properties we manage. Bio-augmentation (adding biology to soils) and bio-stimulation (feeding and stimulating soil biology) practices are employed to encourage an active soil foodweb that more closely matches the crop's needs in terms of a bacterial-dominated or fungal-dominated soil ecology.



In Texas, this approach has been successful in pastures, prairies, pecan orchards, row crops, and urban lawns and landscapes. We rely on liquid compost extract, microbial foods, trace elements, and selected biological inoculants to build healthy soils and grow healthy crops.

Hronek Flow-Thru Compost extractor

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Products and Services:

- Site analysis and soil sampling
- Soil test report, written assessment, and biological program
- Custom application of liquid biological amendments
- Compost tea products
- Organic fertilizer products
- Consulting and training services

Specialized Management:

- Pasture management
- Prairie restoration
- Pecan orchards
- Vineyards
- Row crops
- Lawns and landscapes
- Roadside vegetation
- Flood control vegetation