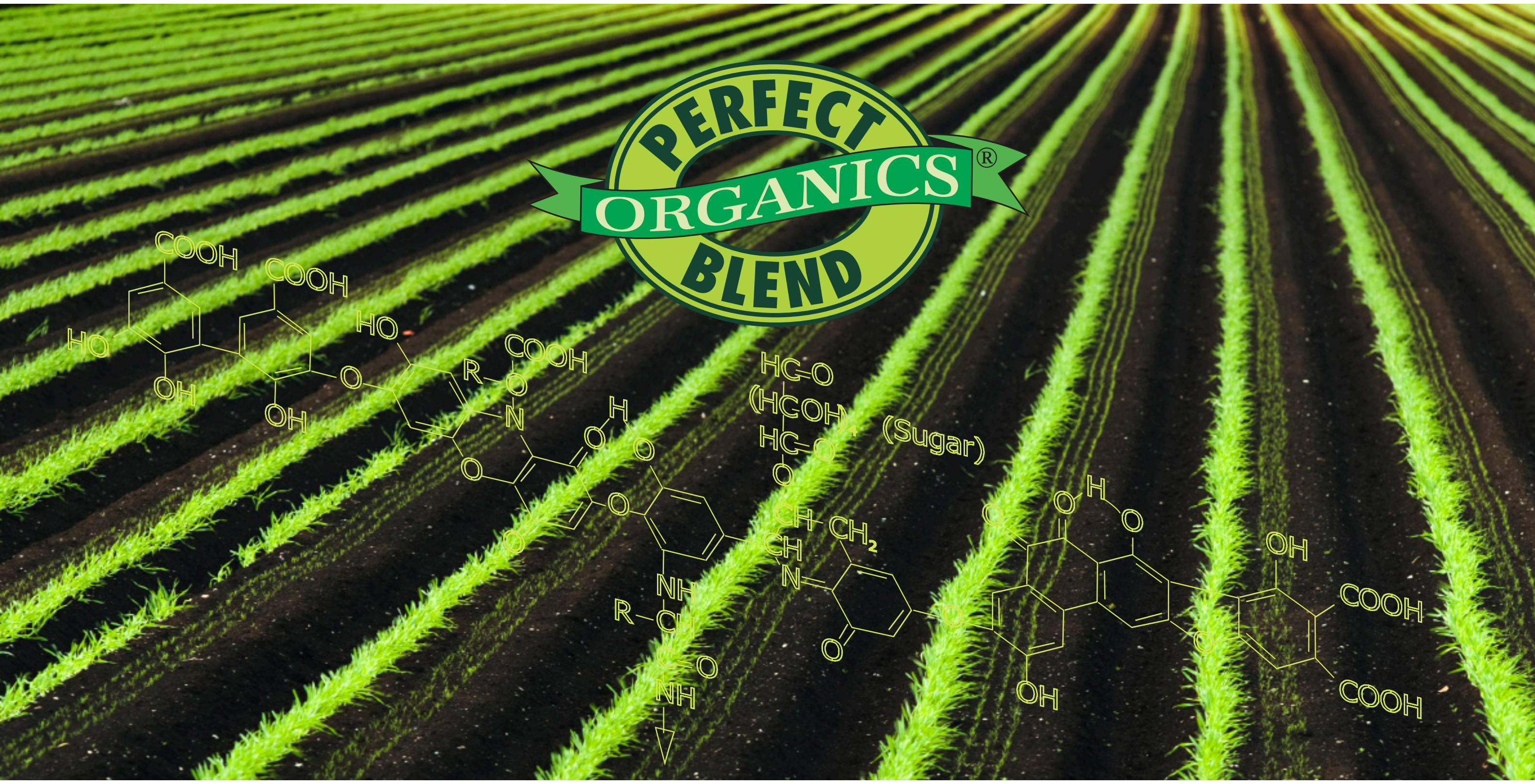
Organic Fundamentals

Technical Series



Biotic Fertilizers: High-efficiency Carbon Sequestration Fertilizers

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Perfect Blend Organics Technical Series

Carbon sequestration is the controlled storage of carbon compounds to prevent their release into the environment. In agriculture, this term is used as a technical description of building carbon-based natural fertility deposits in soils. ***In agriculture, soil carbon sequestration and natural fertility are always the same. Growers sequestering carbon in soil automatically build natural soil fertility levels.*** Both occur as the result of microorganism life cycles. They do not come simply from adding organic material to the soil. Carbon sequestration and natural soil fertility are always the result of a microbial population that has increased its numbers, and the expansion of a soil microorganism population is always the result of soil microbes consuming all or part of the organic material added to the soil. Populations of soil microbes grow quickly, and then just as quickly die. It is only in the topsoil, which is a stable shelter that is slow to heat or cool, that the total waste from the lives of soil microbes, mainly bacteria, become what soil scientists identify as soil acids. ***Only after the waste from the lives of untold numbers of soil microbes have been transformed into stable soil acids can it be said that carbon has been sequestered and natural fertility has been increased.***

Most growers don't spend a lot of time thinking about natural fertility in soil since they haven't had much experience with this natural phenomenon. The farmers who moved west across the United States went to a lot of trouble to locate and farm areas of naturally fertile soils. Today, arable areas of naturally fertile soils are mostly depleted. Only with the advent of biotic fertilizers have growers had a means of increasing natural fertility in their soils. To understand the benefits of biotic fertilizers, farmers have to learn the new science of biotic soil fertility based on research from the last two decades. Biotic science, the science of "living" fertility, reveals how to sequester carbon and enhance natural fertility in soils. This paper is a brief introduction to the wonderful new world of biotic fertilizers.

Carbon Sequestration and Natural Soil Fertility

Soil is Earth's carbon bank. Global soils have been estimated to contain about 1,500 gigatons of organic carbon. There is more carbon in the soil than in Earth's combined vegetation and the atmosphere. ***Ever wonder how nature can grow beautiful forests and immense plant-covered landscapes without NPK fertilizers ?*** The continual process of carbon sequestration is nature's fertilizer system that keeps plants green, healthy and growing. The problem commercial growers have with carbon sequestration is that natural-process sequestration is a slow process that cannot possibly keep up with the intense nutrient demands of their agriculture programs. It was not until the invention of biotic fertilizers that growers could efficiently and economically accelerate carbon sequestration at a rate that can meet the needs of commercial agriculture.

Problems with Organics

Farmers attempting to sequester carbon and increase natural fertility in their soils often learn, after trial and error, that not all organic materials are equally efficient in the transformation from an applied material into increased carbon levels in soils. Growers used to calculating soil fertility in precise measurable units often find organics to be a challenge. Organics are usually difficult to measure precisely due to variability in moisture content, microbial activity, pH, carbon nutrient content, and content of cellulose and lignin from straw or shavings. Farmers applying what they believe are 5% nitrogen products may actually be applying materials that tested at 5% but are decomposing so rapidly that 25% of nitrogen values are lost in the first 24 hours. In addition to difficulties in measuring nutrient values in organic material, the organic industry is plagued by widespread unethical practices. Some suppliers water outgoing loads with a fire hose before delivery. Alternatively, they may test and report nutrients from fresh manure but deliver remoistened products invigorated by the addition of moisture and/or a light spray of liquid urea. This old trick gives a shallow surface test of old manure not only a higher level of tested nitrogen but also the appearance of a fresh, vigorous product.

Efficiency of Transformation

Any organic matter's efficiency in transforming from a solid material into sequestered carbon and natural fertility can be measured as a food value for soil microbes. This efficiency of transformation cannot simply be measured by "nitrogen values or nitrogen units" in the organic matter. To focus solely on "N" values of organic matter is to ignore the entire complex nutrient values of organic material and carbon sequestration. The efficiency of transformation from a solid into soil acids varies with the nature of the organic material. ***Just as not all foods are equal, not all organic materials are equal.*** To soil microorganisms, organic material is food, and bacteria have food preferences just like all of Earth's organisms. Most humans are able to eat larger amounts of ice cream but they are not able to eat large amounts of hot chili peppers. This understanding, coupled with the fact that different foods have different levels of the necessary nutrients for any organism to reproduce, provides the basis for carbon sequestration and development of natural fertility in any soil.

The simple understanding that all living things on Earth have distinctive nutritional needs was the basis for the design and development of biotic fertilizers. ***A biotic fertilizer is an organic or organic-based NPK supplemented fertility program designed specifically to increase carbon sequestration and natural fertility in a soil.*** Biotic fertilizers have none of the negatives associated with raw organic nutrients. Weed seeds, insects, insect casements, fungal spores, and pathogenic and volatizing bacteria are all eliminated. Biotic fertilizers are manufactured using an understanding of carbon sequestration. Biotics are highly water soluble to avoid the bacterial and fungal-driven surface decomposition that robs many organic materials of their nutrients before they can be integrated into the soil by topsoil microbes. They are correct, focused foods for soil microbes. The pH, complete balanced nutrients, homogeneity and particle size focus on the single event of consumption by soil microbes, expansion of the population of soil microbes and deposit of the waste from their lives in the soil.

To understand biotic fertilizers, one must first understand the differences in organic nutrients. ***For example, one ton of compost sequesters less carbon than one ton of manure***. Compost loses much of its nutritional value through the composting process. If composting temperatures are correctly maintained at 145°F to 155°F for four to six weeks, the resulting material is mostly a depleted carbon material that scientists describe as low-reactivity humin. Humin is part of humus but is the least important and useful part of humus. Raw manure has nutrients that are more viable. Likewise, one ton of either compost or manure can sequester only a fraction of the carbon that can be deposited by a single ton of biotic fertilizer. Biotics fertilizers are focused, complete nutrients. All the nutrients required by soil microbes for reproduction are in a biotic fertilizer in a water–soluble, chelated form that soil microbes can immediately use. Manure or compost, of any type, contains less of these nutrients, in less usable forms, than a biotic fertilizer. Biotic fertilizers have a higher rate of conversion of their nutrients into increased populations of soil microbes than any raw or processed fertilizer on the market today.

Manure Nutrient Limitations

Growers using conventional fertility systems sometimes attempt to use “nitrogen units” in their fertility calculations for raw, composted or dehydrated organic materials. While nitrogen units work well in the calculation of chemical fertility programs, they are often unreliable in use with organic materials. Frequently, much of the nitrogen unit value of manure is lost before topsoil aerobic microbes can digest and sequester manure nutrients into soil. Topsoil bacteria are a completely different type of bacteria than the bacteria resident in raw manure. ***Most raw manure applied by growers is still alive with anaerobic heterotrophic methane-producing bacteria. These bacteria are intent on destroying the manure and can continue to work below the soil surface after they are applied.*** Most of the nitrogen nutrients are volatilized into the atmosphere as carbon dioxide, hydrogen sulfide, methane, ammonia, nitrogen gas and nitrous oxide gases. The smell of applied manure, the result of nitrogen-driven production of hydrogen sulfide, is a good indicator that much of the carbon sequestration and natural fertility value of the manure is being lost into the atmosphere and is not being deposited into the soil. As a result, “nitrogen unit” calculations of organic materials are difficult, if not impossible, to apply with any reliability. Organic materials have a wide range of efficiency in transforming their nutrients from a solid or liquid state into sequestered carbon and natural fertility.

Value of pH in Carbon Sequestration and Natural Fertility

In addition to the problems with nutrient volatilization, much of the value of manure nutrients is denied to soil carbon-sequestering topsoil microorganisms because the pH of manure is too alkaline. Raw manure pH is typically from 7.8 pH to as high as 9.2 pH. ***While a high pH level suits anaerobic methane-producing bacteria and Coprophilous (dung-loving) fungus very well, it is not a good food pH for aerobic topsoil bacteria, fungus and microbes responsible for carbon***

sequestration and natural fertility. Nature normally composts in thin layers on the surface of the soil. Soil bacteria residing in topsoil under the surface of the soil usually receive their nutrients as liquids, which results when nutrients on the surface decompose and slowly enter the soil from the surface. Because of nature's own system, carbon sequestering and natural fertility bacteria prefer foods with a more acidic pH, at or slightly below 7.0 pH. The decomposed organic foods that carbon sequestration and natural fertility bacteria normally receive from the surface of the soil are a lower pH level than the pH of raw manure. ***The higher pH levels in raw manure inhibit the ability of topsoil bacteria to efficiently convert manure nutrients into sequestered carbon and natural fertility.***

Carbon Sequestration and Natural Fertility Mechanisms

As we have discussed, simply adding carbon materials such as manure or compost to the soil does not immediately, or automatically, achieve efficient carbon sequestration. Adding organic materials is only the first step in nature's clever program of banking plant nutrients in the form of stable soil acids. Soil microbes, already present in all soils, use added organic materials and root waste left in the soil after a harvest as food to grow their populations. Remember, it is the actual growth and death of soil microorganisms that is necessary for carbon sequestration to occur. When soil microbes die, their bodies and waste are deposited in the soil as soil acids. It is this final step, the fixing of soil acids in the soil, which sequesters stable forms of carbon into soil and builds natural fertility. When this occurs, the soil acids are ready to accept moisture and nutrients from other microbes and fungi into their structures. Soil acids are, in effect, the foundation materials necessary to form topsoil and natural soil fertility. They are rich in nutritional elemental minerals in an ionic form that plants can immediately uptake and use as systemic nutrients.

Secrets of Perfect Blend Biotic Fertilizers

Feeding topsoil microbes the correct organic nutrients they prefer to rapidly expand their populations is the secret of Perfect Blend biotic fertilizers. The Perfect Blend biotic fertilizer manufacturing process eliminates undesirable decomposition factors and corrects nutritional deficiencies in CAFO waste chicken egg layer manure using high-speed kinetic, chemical and thermal action. This process alters the molecular structure of the manure to make it a more efficient water-soluble compound while increasing its nutritional value to topsoil microorganisms.

Soil Carbon Sequestration Mechanisms

Organic matter and water are two necessary food ingredients used by soil microorganisms to make carbon sequestration possible. Temperature, sunlight and clean air are also important. Soil microbes prefer, but do not require, warm temperatures to accelerate reproduction. They make do with what temperatures they have and are continually at work in every soil, climate and place on Earth. The driving force in the world of bacteria, as with every other organism in this world, is reproduction. Like every other organism, bacteria cannot reproduce without a complete balanced food source that provides their tiny, simple bodies with sufficient nutrients. While bacteria are able to survive on a wide range of organic nutrients, to reproduce they must have a fully balanced diet that contains every primary, secondary and trace mineral element in the form of amino acids and other carbon-based compounds.

> "Growers are often surprised to find that a single bacterium is a tiny bag of perfect crop fertilizer that contains every mineral necessary to grow a crop to its full genetic potential."

When microbes die, they leave the remains of their bodies and their waste in the soil in the form of soil acids. Soil acids are the most basic form of sequestered soil carbon. They provide the foundation of nature's topsoil fertility, called humus. Soil acids contain complex molecules made up of the chemical components of the soil microorganisms. These molecules contain every elemental chemical a plant requires for healthy growth.

Soil bacteria are high in protein. All organisms reproduce by protein synthesis. This is simply a term meaning that cells are growing by collecting and using enough food to enable them to grow. Due to their simple forms, bacteria are much higher in protein than most other organisms. Knowing the protein levels in bacteria allows chemists to determine how many primary, secondary and trace minerals are in their bodies. Protein has a fixed formulation with specific percentages of elemental minerals. Most growers rely on chemicals to grow their crops. Bacteria contain all these chemicals and more. ***A single bacterium is like a tiny bag of a perfect blend of chemical fertilizer.*** It contains all the chemicals necessary to grow plants to their full genetic potential, including a complete range of primary, secondary, and trace minerals. ***A bacterium contains nitrogen levels that range from 10% to 14%.*** In addition to the nitrogen, bacteria contains 3% phosphorus, 1% potash, 1% sulfur, 5% calcium, 5% magnesium, 2% iron and complete proportionate trace minerals. Leading soil scientists believe an acre of healthy soil can easily contain one ton or more of bacteria, along with one to two tons of fungi and two to three tons of other soil microorganisms. ***By using focused organic nutrients in biotic fertilizers, a farmer can grow 1,000 pounds of a bacteria population quickly and efficiently.*** If a grower is successful in doing so, he will add 100 to 140 pounds of nitrogen, 30 pounds of phosphorus, 10 pounds of potash, 10 pounds of sulfur, 50 pounds of calcium, 50 pounds of magnesium, 20 pounds of iron, and proportionate trace minerals to the soil in a field. Perhaps the most amazing thing about the ability of bacteria to quickly add valuable elemental minerals to a field is the fact that the minerals contained in the tiny bodies of bacteria and other soil microorganisms are "plant ready." They are in an ion-rich and oxygen-rich molecule that plants can immediately uptake and use in their systemic nutrient fluids.

> Growers who wish to grow high–yielding, high-nutrient-density crops to their full genetic potential must grow two crops. The first crop is a crop of soil microorganisms that will die and leave all the nutrients in the soil necessary to grow an excellent, high-yielding crop for harvest."

Soil Acids and Sequestered Soil Carbon.

The waste produced during the life span of soil microbes becomes a soil acid when the population dies. These soil acids, which include both fulvic acid and humic acid, are hydroscopic; they attract and hold water in their structures. Soil acids are permanent carbon deposits in the soil. As long as moisture is available to these acids and the soil is undisturbed, they will stay in a useful form for an unknown span of time that may well be centuries. Given the right circumstances, and thousands of years, these carbon forms will become coal or even hydrocarbons. ***Soil acids will remain in the soil in a useful form for plants until the soil is actually destroyed.*** Such destruction can occur when the soil completely dries out or is deconstructed because of poor tilth practice, lack of replenishing organic nutrients, or other physical damage.

While soil acid is often the primary carbon from in topsoil, it is soon joined by a mix of other carbon materials to form a soil acid matrix. In addition to soil acids, there are exudates from plants, complex sugars resulting from bacterial and fungal reduction of plant and root cellulose and lignin, stored nutrients from the work of mycorrhizal fungi, and compounds created by other soil microorganisms. ***This incredible mix of complex nutrients surround plant roots and enter into the roots through the trans-cellular injection provided by fulvic acids, which can penetrate the cell walls of a plant's roots with a cocktail of elemental mineral rich nutrients in ionic form that plants use immediately.***

Benefits of Soil Acids and Carbon Sequestration

During rainfall or irrigation, soil acids become gels that expand to protect themselves and the soil l when it rains. Soil becomes slick on the surface when this occurs. Most people have experienced this event when they find a slippery piece of ground after a rain in an area that is otherwise not slippery. ***The moisture-holding ability of soil acids is nature's means of protecting soil from wind and water erosion and of holding long-term moisture in soil.*** Soils that have high sub-surface moisture levels provide plants with greater drought protection, as well as greater resistance to temperature extremes such as hot, dry conditions or extreme cold.

Soil scientists now believe that crops grown in nutrient-rich soil acids are more capable of fending off insect pests and are less susceptible to fungus and disease. This has proven true with organic crops and conventional crops grown with Perfect Blend biotic fertilizers.

Perhaps the ultimate value of carbon sequestration is the long-term sustainability of arable soils. Currently farmers worldwide are losing arable topsoil carbon at the rate of about 1% a year. Globally, farmers have lost more than 50% of carbon in formally arable topsoil. After carbon has been lost from topsoil, it can no longer be considered topsoil. It is simply sand, silt or clay. Jerry Hatfield of the USDA Tilth lab in Ames, Iowa, estimates that more than 10 gigatons of soil carbon has been lost in the last 50 years. This massive loss of living organisms and their stored food supplies is without precedent in the history of the world. Illustrating such an equivalent loss in human terms would require us to consider the death of the entire global human population 20 times over. The drive for sustainability and carbon sequestration is an effort to rebuild carbon in topsoil, and restore and rebuild topsoil. By restoring topsoil, a grower ensures sustainability not only for his own lands, but also for the sustainability of the hundreds, thousands or many thousands of human beings dependent upon the food he grows for their lives and the lives of their descendents to come.

Growers should replenish carbon in their soil for their own benefit. Biotic fertilizers are the future of agriculture for the simple reason that they provide growers with solid economic benefits and their soils with vital carbon nutrients. Healthier crops with less susceptible to disease and insect attraction, higher yields, and better moisture holding capacity of the soil are all proven benefits of increased carbon sequestration in soils.

Organic Transformation Rate of Efficiency – ORTE Scores

Perfect Blend Organic Research has developed a means of scoring the *Organic Rate of Transformation Efficiency (ORTE)* according to the estimated ability of an organic material to increase carbon sequestration and natural fertility levels in soils. A chart showing ORTE scores for different products is provided at the end of this bulletin. A low ORTE score indicates an organic material is less efficient at increasing carbon sequestration efficiency. A high ORTE score indicates a high efficiency of carbon sequestration efficiency that increases natural soil fertility.

Organic materials generally fall into five OTRE score levels:

Negative to very low OTRE Scores

- Non-Carbon NPK Fertilizers (possible negative score) ~ -0.5% -1.00%

Very low OTRE Scores

- Dried leaves ~ 1% - 2%
- Straw ~ 1% - 2%
- Wood chips ~ 1% - 2%

Low OTRE Scores

- Composted green urban green waste, high humin content ~ 2% - 3%
- Composted mint straw and/or other crop residues ~ 2% - 3%
- Grade O Manure – Outdoor pen collected bovine manure ~ 1% - 4%
- Grade 1 Manure – Unturned broiler manure, 33%+ litter ~ 3% - 5%
- Grade 2 Manure – Turned broiler manure, 25%+ litter ~ 3% - 5%
- Grade 3 Manure – Turned layer manure, no litter ~ 6% - 10%
- Grade 4 Manure – poultry manure, life enclosed, no litter ~ 8% - 10%
- Grade 5 Manure – poultry manure dehydrated, 33%+ litter ~ 8% - 12%
- Grade 6 Manure – poultry manure dehydrated, no litter ~ 10% - 12%

High OTRE Scores

- Organic fertilizers – NPK model - non-homogenized ingredients ~ 20% - 30%
- Organic fertilizers – NPK model – homogenized ingredients ~ 30% - 40%

Very High OTRE Scores

- Biotic fertilizers – Full nutrient, homogenous, pH adjusted ~ 60% - 70%
- NPK+ Biotic fertilizers (full biotic formulations) ~ 60% - 88%

Any organic material will increase soil carbon and soil fertility and increase some amount of natural fertility and carbon sequestration. This chart provides guidelines for growers based on observations and trials by Perfect Blend Research and Development. Biotic fertilizers are the most efficient means of carbon sequestration because they are designed and manufactured specifically to grow soil microorganisms.

Information on Perfect Blend Biotic Fertilizers

For more information on biotic fertilizers and technical information relating to the application and advantages of biotic fertility products please contact: **info@perfect-blend.com** or call **425-456-8890**.

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