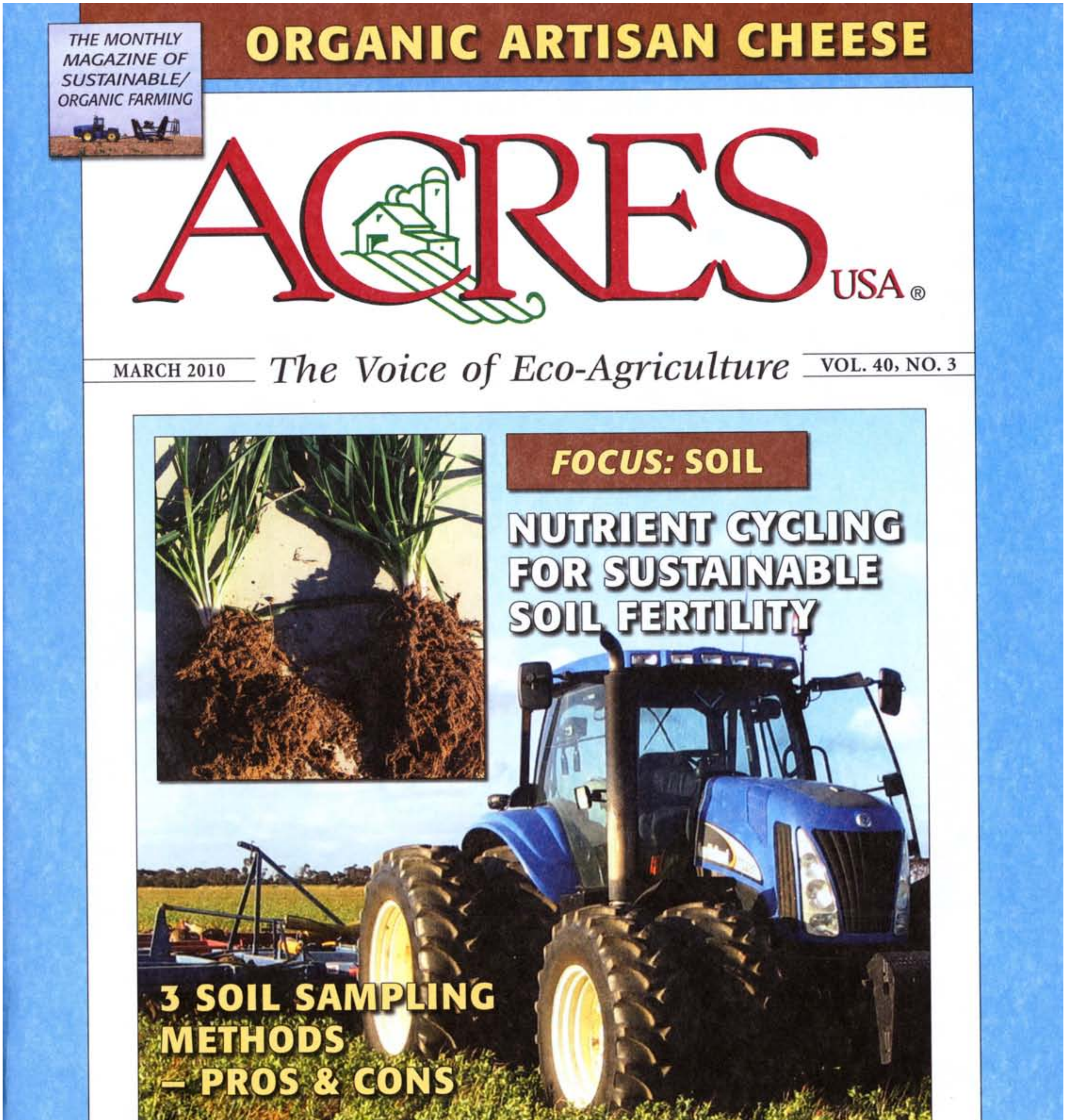


# Efficiency of Transformation

by John Marler

PERFECT ORGANICS BLEND

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Carbon sequestration is the controlled storage of carbon compounds to prevent their release into the atmosphere. 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 microbiological life cycles. They do not result 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 oil. 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 phenomenon outside of controlled conditions. 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.

## 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 all of Earth's vegetation and the atmosphere combined. 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 grower 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.

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 percent nitrogen products may actually be applying materials that tested at 5 percent but are decomposing so rapidly that 25 percent of nitrogen values are lost in the first 24 hours. In addition to difficulties in measuring nutrient values in organic material, the industry sometimes suffers from unethical practices. Some suppliers 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 what we call biotic fertilizers, a key component of 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 volatilizing bacteria are all eliminated. 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 these fertilizers, one must first understand the -differences in organic nutrients. For example, one ton of compost sequesters less carbon than one ton of manure. 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 not the most important or useful part. 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. All the nutrients required by soil microbes for reproduction are in these fertilizers in a water-soluble, chelated form that soil microbes can immediately use.

## 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, 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 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 to as high as 9.2. While a high pH level suits anaerobic methane-producing bacteria and Coprophilous (dung-loving) fungus very well, it is not a good environment 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. 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.

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.

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. The driving force in the world of bacteria, as with every other organism in this world, is reproduction. 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.

Soil bacteria are high in protein. All organisms reproduce by protein synthesis, but 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. 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. A bacterium contains nitrogen levels that range from 10 percent to 14 percent. In addition to the nitrogen, bacteria contain 3 percent phosphorus, 1 percent potash, 1 percent sulfur, 5 percent calcium 5 percent magnesium, 2 percent 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 nutrient in specially formulated biotic fertilizers, a farmer can grow 1,000 pounds of a bacteria population quickly and efficiently, thereby adding 100 to 140 pound 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.

The waste produced during the lifespan 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 deposit in the soil. As long as moisture is available to thus acids and the soil is undisturbed, they will stay in a useful form for an unknown span of time that may well be centuries.

While soil acid is often the primary carbon form 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. 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. Soils that have high subsurface moisture level provide plants with greater drought protection, as well as great 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 susceptible to fungus and disease.

Perhaps the ultimate value of carbon sequestration is the long-term sustainability of arable soil. Currently farmers worldwide are losing arable topsoil carbon at the rate of about 1 percent a year. Globally, farmers have lost more than 50 percent 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 land, but also for the sustainability of the hundreds, thousand or many thousands of human beings dependent upon the food he grows for their lives and the lives of their descendants to come.

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.**