Organic Fundamentals

Achieving Sustainable Soils

Technical Series

Perfect Blend Organics

Soil sustainability requires profitability. No matter how desirable a sustainable program might be it must be tempered by the realities of making a total commercial agriculture program work economically. Growers attempting to deal with this reality often focus on sustainability in a piecemeal manner as they do not always understand the basic rules or guidelines that are required of a sustainable soil program. In this information, we will review the guidelines on achieving sustainability and also report on a new class of sustainable soil nutrition products. In the near future these products will help growers achieve sustainability on a profitable basis and also give growers basic guidelines for the mechanics of achieving that sustainability.

Commercial Ag programs are often unable to profitably approach sustainability due to economic pressures. Time honored practices of sustainability which required land to lay fallow, cover crops along with manure or compost applications are expensive when compared to the rapid prepare-fertilize-plant-harvest cycle of most commercial practice. As a result, sustainability struggles within a marketplace dominated by the need for financial return. Growers get rarely get a premium for crops grown on sustainable soils versus crops grown conventionally. When a grower is faced with the hard choice of feeding his soil or feeding his family, the family will win as the soil is mute in its demands and family needs are the first priority.

A new concept in fertilizer manufacturing is attempting to bring about a quiet revolution in the science of sustainability. This revolution will accelerate the realization of sustainable soils by bringing the economics of sustainable level fertilization and soil amendment to a price point below that of conventional fertilizers alone. The vision driving this revolution is the concept to build nutritional products that will allow a grower to achieve a profitable yield of a high quality crop while leaving, after harvest, a soil that is improved in its ability to grow future crops. With these new products, known in the trade as CNEF – Complex Nutrition Enabling Fertilizers, growers will soon be able to build and maintain sustainable soils at a annual cost / acre of applied nutrients and amendments that is equivalent or less than today's conventional nutrient programs. CNEF products offer a glimpse of the future of growing as they are both fertilizer and soil amendment in a single product. Together, in a single application interactive form, these components engender a synergistic action of the soil that accelerates the microbial action within the soil resulting in increased nutrition for plants. Manufactured with a stable slow release organic base, CNEF can actually grow crops in sand by adding critical organic content to the soils along with primary, secondary and trace nutrients with a single application. High application rates can have startling effects. One California high rotation salad greens grower starting out with hard pan at one end of a 300 acre field and sand in the other. After 2 tons of CNEF per acre he was able to point out that after a year he can no longer differentiate between the soils at either end of his field – both are now a loam. Soils with high levels of sand and little soil organic matter can flourish and become loamier with repeated applications of the new organic fertilizers since the fertilizers act to provide nutrients and to provide long term organic soil amendments at the same time. Repeated applications actually decrease the need for the use of these products. Once a grower nears sustainability, the amounts of CNEF required drop as the soil is again alive and productive and able to sustain itself with only the replacement of extracted nutrients.

1st rule of sustainable soils

The first rule of sustainable soils is straightforward.

Complete soil minerals + humic soil acids + moisture = sustainable soils

Working with CNEF has provided us with insights that have allowed us to developed rules for sustainability which may be universally applied with or without the new fertilizers. We quickly realized that many growers do not fully understand the mechanisms involved in mineral and organic restoration. Given adequate soil moisture along with temperate soil and atmosphere temperatures almost any soil can be rendered sustainable. Sustainability requires that two simple components be added to moist soil. One of the components is the restoration of complete mineral nutritional values to the soil. The other component is the restoration of carbon forms of soil acids gels, in the form of humic and fulvic acids to the soil.
Complete secondary nutrients, including sulfur, calcium, and magnesium as well as a full complement of trace minerals. In addition, a grower must systematically build organic matter in the form of soil acids to his soil in order to put these minerals to work.

Building CNEF we learned that combined mineral components added together in a balanced blend along with a slow release organic base provides a superior means of delivering mineral values to the soil. Molecular structures containing chelated minerals in the soil acid gels are determined by the minerals available at the time of acid structure formation. The basic goal of any grower should be to build nutritionally balanced soil acid gels as these gels offer a long term, slow release source of nutrition for soil microbes and plants.

Complete mineral restoration is essential to all farmed soils that are to be sustained. Farming is essentially a form of mineral mining. Some have described it as precision strip mining, which it is, as crops systematically remove certain minerals. Mono-culture is the most destructive as it concentrates the removal of the same minerals over and over in a repetitive manner. A tomato grower who removes a crop of tomatoes from a piece of land has essentially mined that land of the minerals contained within the tomato crop. While the mineral value in the tomatoes produced by a single plant are only a fraction of an ounce, by the time the aggregate of the field is weighed the amount of minerals mined becomes substantial. Over years, and decades, the amounts add to hundred weights and then tons of minerals. Without mineral replacements, soils are slowly stripped of minerals. Without complete and full mineral restoration, plants are unable to sustain their health and will fail from mineral nutritional deficiency diseases that are the result of disproportionate mineral contents. Molds will increasingly appear on crops as systemic copper and zinc are simply no longer available from the soil to protect plants. Land is often labeled as diseased or poor simply due to the lack of a few nutrients. Without the ability to grow profitable and nutritious crops farm land is more easily abandoned or turned into pasture. Frequently, after the loss of their top soil structures weakened or destroyed soils are subject to erosion.

In a similar manner, humic substances in the form of fulvic and humic soil acids are essential to all farmed soils. Any organic matter that decomposes creates a leachate that is used by soil dwelling bacteria and fungus to create soil acids. Soil acid gels are created when the soil acids collect moisture to their structure. As much as 98% of a soil acid gel can be contained moisture.

Soil acid gels are vital to the soil as they perform multiple functions, all of which are critical to the sustainability of soils and the growth of plants. According to literature from the International Humic Substances Society and our own observations and research, some of the functions of soil acids include: 1) acting as a source of nutrition to soil microbes, 2) acting to transform soil minerals into an ionic form that can taken up by plants through chelation, 3) transfer of the minerals in the soil directly into the roots of plants through transcellular penetration, 4) formation of minerals into chemical substances, 5) de-toxifying pesticides and herbicides into the soil by rendering them into elemental forms, 6) dissolve silica to transmute vegetal silica and magnesium into a form of plant contained calcium, 7) dissolving minerals to eliminate molds and disease through higher systemic levels of copper and zinc, and 8) to hold very large amounts of water in the gel matrix. Without soil acids, the engines of the soil, micro-organisms shut down along with a wide range of critical soil operations. Nutrient building work stops and crops will decline.

Humic substances in the form of soil acids are the principal holding elements of moisture and nitrogen in the soil. That statement refutes much of the available water capacity science and Nitrogen Cycle beliefs of the last 50 years. New soil science, along with the understanding of the role of humic substances in the soil has refuted much of the earlier theory about how the soil works.

When soil acids are present in a soil they act like a sponge that has been buried in the soil which absorbs and retains moisture. These acids hold moisture in a gel-like form that does not migrate into ground water structures or is easily subject to wind, sun, or other drought conditions. Soil acids are usually only lost from soils by plant utilization or by out-of-balance carbon to nitrogen ratios that are the result of over application of nitrogen fertilizers. A failure to replace these acids results in the soil loosing its resistance to rain. Soil acids act to give soils waterproof permeability in much the same way that high-technology rainwear can repel water but still breathe. Given the moisture retention ability of soil acids much of the ability of the soil to hold water is lost when soil acids are not present. Without the carbon based soil organic matter form of soil acids, soil becomes sand and subject to the erosion of wind and rain.

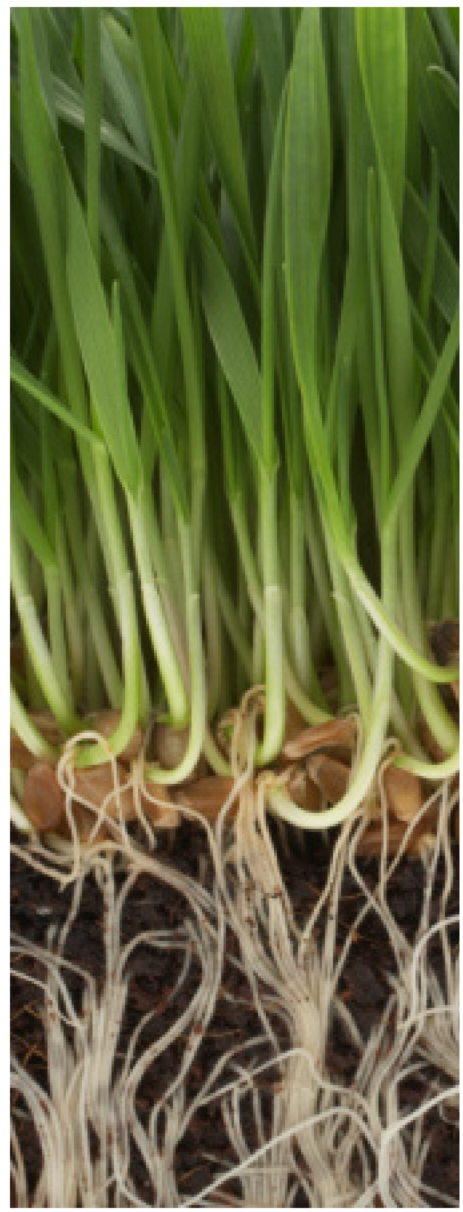
A chelating agent is required for the transfer of soil minerals from an elemental form or from an elemental form already bound to another element, into an ionic form that is usable by plants. Soil acids act as chelating agents to react with minerals to transform them from a solid elemental form that is unusable by a plant into an organic molecular structure form that is usable by plants. Soil acid gels, formed when soil acids attract and hold moisture, act as storage facilities for ionic mineral forms. Soil acids play a dual role of adopting mineral elements into a form that a plant can use and then storing those elemental forms until the plant is ready to use them. Soil acid gels are the critical transfer agent of minerals within a soil. Only soil contained, organic based, bacterially reacted and formed soil acids can perform this work.

2nd rule of sustainable soils

The second rule of sustainable soils is intriguing yet elegantly simple. In order for plants to efficiently intake minerals nutrients the minerals must be subjected to the transfer and storage mechanism of soil acids. Without soil acid there is decreased transfer of minerals into plants.

Synthetic fertilizer blends, based primarily on N-P-K formulations have no such transfer mechanism. Neither mined humic acid, reconstituted fulvic acid, or man made fulvic acid has this transfer mechanism. Only living, soil produced humic and fulvic acids that are the result of organic deterioration have the ability to efficiently affect elemental transfers within the soil. Born from natural process, soil acids are unique in molecular composition. Soil acids are specifically tailored by soil bacteria and fungus to the climate and soils in which they originate. Man, despite millions of dollars of research, is currently unable to duplicate these extremely complex carbon structures. The only way soil acids are manufactured is by the addition of organic materials to the soil and the reduction of these materials by soil micro-organisms.

Soil acids provide the transfer and storage mechanism to change the minerals into usable forms. These usable mineral forms are vital to the health and well being of plants and to sustainable agriculture.



The fresher the organic material, the greater the likelihood that the organic material will convey valued nutrients to a soil. For this reason, green cover crops plowed under are a high quality method of developing soil acids. Fresh green leaves and plants have more nutritional value than dried dead leaves. Fresh manure has more value than dried or sun baked manure.

The complexity of nutrition is another factor. Some organics simply have greater mineral values than others. A mineral rich organic material will convey greater nutritional value to the soil than a mineral poor organic mixture. Applied organics with nutritionally complex ingredients will form soil acids with complex molecular structures. Nutritionally complex soil acids are of greater value to crops than simple nutrients.

That said, growers must be knowledgeable when applying organics as the nature of the organics and the efficiency of transformation from a solid into a soil acid is an important factor to be known and understood by the grower. Some organics can be dangerous or destructive to the soil. Little has to be said as to the unpredictability and unreliability of manure as a fertilizer as many growers who have used it have suffered losses as a result. Manure with a high pH, manure with high Arsenic V contents (in the case of poultry manure) and manures with active colonies of harmful bacteria can actually damage or ruin fields. Conversely, many growers have successfully mastered the use of manure and learned the small secrets of successful applications.

Learning how to apply effectively organics is critical to a grower who is working for sustainable soil.

3rd rule of sustainable soils

The third rule is the empowering rule that will change the way a grower views soil elements.

Any organic material applied to the soil will eventually dissolve into the earth and become a form of soil acids.

The fourth rule acts to clarify the third rule. The fourth rule is actually a set of sub-rules as follows, or that which might be initiated through experience. Often the sub-rules are only established after trial and error.

4th rule of sustainable soils

The fourth rule is a little more complex and requires understanding, application and is, unfortunately, only truly understood with experience.

Organic materials do not transform from an organic material into soil acids in an equally efficient manner.

Raw or dehydrated manures are labile substances that do not always efficiently transform contained nutrients into soil acids. The labile nature of manure means that raw or moisture exposed dehydrated manure will quickly lose its nutrients into the atmosphere, ground, or surface

Raw or dehydrated manures often carry putrefying bacteria that can seriously damage soils and fail altogether to transform into soil acids. Manure incorporated into the soil will more often effectively transmit its nutrients into soil acids. However, such manure is often prone to putrefying as its pathogen content may overcome the existing soil bacteria responsible for transformation into soil acids. When this occurs, the manure can produce potentially harmful putrefactive soluble metabolites which can actually harm plant growth. Given such an event, there is little or no transformation into soil acids. Application of raw manures that putrefy can kill the aerobic organisms that form beneficial soil aggregates including soil acids. Should this occur the soil structure can collapse? Soil clays can de-flocculate. In the worst circumstances of collapse the soil may seal completely. The result is that the soil is then subject to a high degree of erosion.

Compost often does not efficiently transform contained nutrients into soil acids. Commercially composted organics are typically processed at temperatures of between 135 ° F. to 155 ° F. (57° C. - 68° C.) for four to six weeks to get rid of weed seeds, spores, and pathogens. During this time the majority of nutrients are destroyed by the heat process to turn into CO_2, methane, and ammonia which are released into the atmosphere or lost by leaching into ground or surface water. The balance of most well processed composts is essentially humin, a type of soil organic matter that is almost inert. The transformation of this material into soil acids is slow and inefficient from the viewpoint that the majority of nutrients have already been lost through processing.

Cover crops do not usually offer immediately usable soil acids. While cover crops are an excellent way of building soil acids, a grower must also be aware of the time lag caused by the dual problems of conversion and nitrogen immobilization. Conversion from a cover crop into usable soil acids is a factor of soil temperature and moisture. Higher temperatures and higher moisture accelerate the conversion. Low temperatures and dry soils slow down the process. Nitrogen immobilization may be a factor if the carbon: nitrogen ratios of the cover crop are out of balance. The availability of nitrogen from the soil acids may be temporarily blocked by soil microbes who use it for the digestion of the carbon remnants of the cover crop.

While this format does not support extension instruction, it is easy to observe that for every soil nutrient there is an accompanying rule. An example is feather meal. This organic nutrient is high in nitrogen but is sometimes slow in transformation into soil acids, especially in drier regions. Feathers from which feather meal is made, is made up largely of keratin. This is the same material that makes up hooves and fingernails. Surface applied feather meal can still be seen on the surface of soils a year after application in some circumstances. Buyers who focus solely on what they perceive to be units of N (a synthetic concept in that synthetic N units are easily measured) may find themselves short changed when attempting to buy or correlate N units from organic sources. In organic nutrition, the degree of efficiency of transformation is the most important aspect of the nutrient source.

Heading into Sustainable Agriculture

While any organic material can be transformed into soil acids, the ideal organic materials for the formation of soil acids are typically low cost processed organic fertilizers which have been rendered into stable, slow-release forms specifically for soil microbes. These fertilizers are not frequently produced at this time as they require science and an understanding of soils and microbiology that is often not found in organic fertilizer companies focused on waste. Dehydrated manure is simply manure without the water that is steamed to form a pellet that is then crushed – a process destructive of amino acids and phytochemicals important to the soil. The new CNEF fertilizers are pH balanced, homogenized, pathogen free, weed seed and spore free, homogenized, and granulated. They are carefully produced without high heat and frequently fortified with mycorrhizae and bacteria additives. They have balanced formulations that include all the nutrients necessary to achieve a plant's full genetic potential.

Growers who are looking for sustainable soils should take the time to learn about the new organic fertilizers and understand their natures, advantages and limitations. Within the next decade, facilities for manufacturing these fertilizers will gain an even greater foothold in the nutrient marketplace. Within the next few years, high speed manufacturing processes and new larger facilities for these fertilizers will lower CNEF prices to a point below that of synthetic nutrient programs.

Crops grown with the new products are nutritionally superior to those grown with synthetic nutrient programs due to the organic mineral transfer mechanism inherent in these fertilizers. Crops grown with these fertilizers are typically less susceptible to fungus due to the plant's high systemic levels of copper, zinc, and magnesium. Additionally, growers have observed higher Brix levels in their produce grown with these fertilizers. Many CNEF growers believe that their higher Brix produce is more prone to store and transport without bruising, more resistant to drought and freezing, taste better, of higher overall quality, and more prone to resist insect and fungus.

Currently, CNEF organic fertilizers are only manufactured in North America. However, they will soon be available worldwide. For more information of these new fertilizers please contact Perfect Blend Organics in Bellevue, Washington USA – CNEF@perfect-blend.com and request The Symphony of the Soil, a guide to the new Complex Nutrition Enabling Fertilizers.

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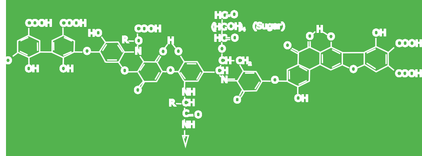

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