# 4 RULES FOR ORGANIC SOILS

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# FOUR RULES FOR SUSTAINABLE SOILS

## UNDERSTANDING ORGANIC IMPUTS

By: John B. Marler

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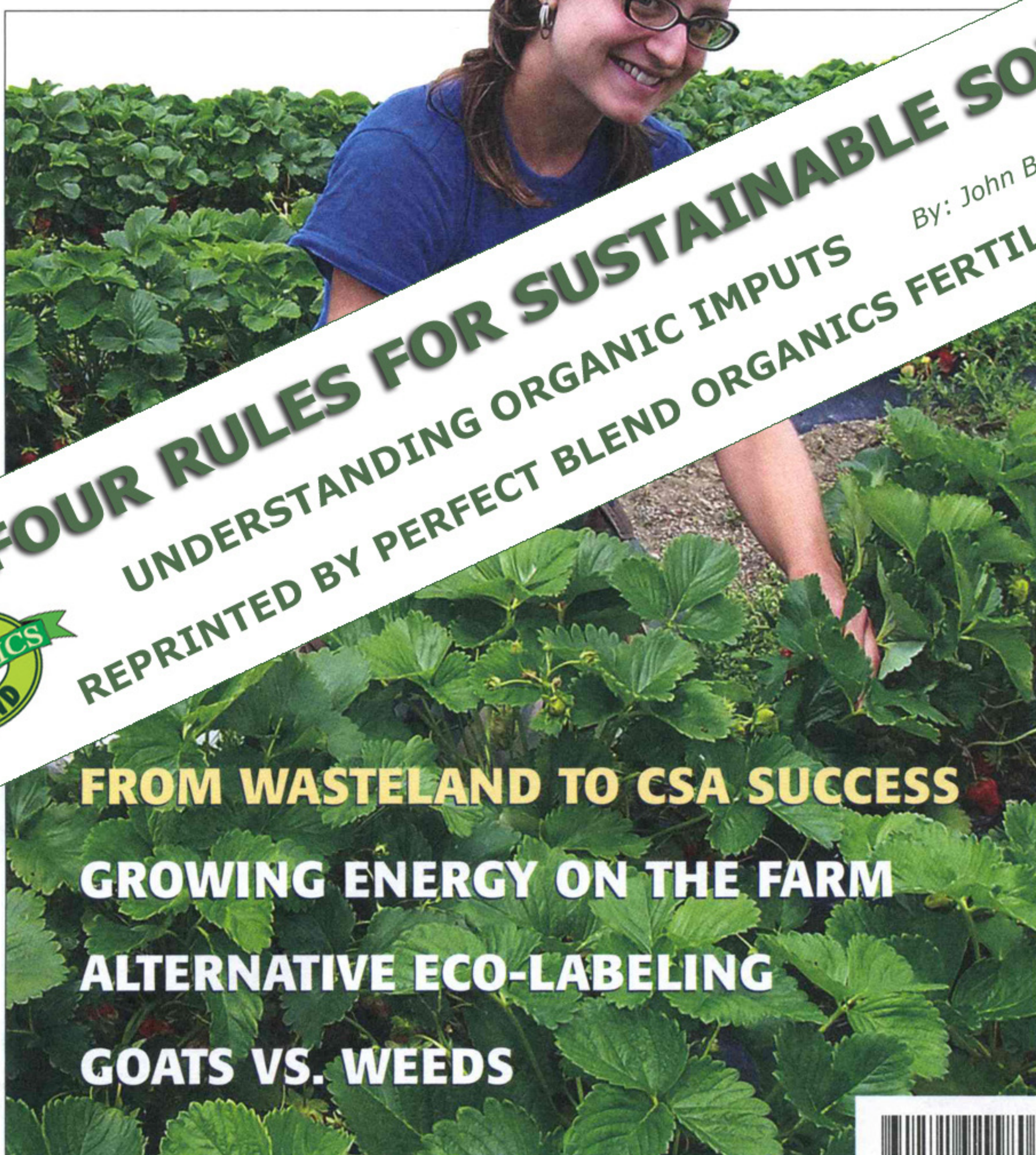

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# Four Rules for Sustainable Soils

## Understanding Organic Imputs

by John B. Marler

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 article, we will review the guidelines on achieving sustainability and also report on new developments in sustainable soil nutrition products.

Commercial agriculture programs are often unable to profitably approach sustainability due to economic pressures. Time-honored practices that require land to lay fallow and the use of cover crops along with manure or compost applications are expensive when compared to the rapid prepare-fertilize-plant- harvest cycle that has come to dominate commercial practice. Sustainability struggles within such a' marketplace, as growers rarely receive 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.

A new concept in fertilizer manufacturing is the attempt to accelerate the realization of sustainable soils. With these new products, known in the trade as CNEF — Complex Nutrition Enabling Fertilizers — growers will be able to build and maintain sustainable soils at an annual cost per acre of applied nutrients and amendments that is equivalent or less than today's conventional nutrient programs.

Together, in a single-application interactive form, fertilizer and soil amendment components engender a synergistic action of the soil that accelerates microbial action, 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 in a single application. 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.

Developing CNEF has provided insights that have allowed us to develop rules for sustainability rules 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 acid gels, in the form of humic and fulvic acids to the soil.

### *Rule 1: Complete soil minerals + humic soil acids + moisture = sustainable soils.*

The first rule of sustainable soils is straightforward. While all growers are aware of the need for nutrients in order to grow crops, many only focus on NPK, as these are primary growth nutrients. However, in order to achieve sustainable soils a grower must, in addition to the primary NPK minerals, restore 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 in order to put these minerals to work.

While developing CNEF, we learned that combined mineral components 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 sustainable farmed soils. Farming is essentially a form of mineral mining. A tomato grower who removes a crop from a piece of land has essentially mined that land of the minerals contained within that crop. While the mineral value in the tomatoes produced by a single plant is only a fraction of an ounce, by the time the aggregate of the field is weighed, the total amount of minerals mined becomes substantial. Over years and decades, the amounts add to hundredweights and then tons of minerals. Monoculture is thus the most destructive approach, as it concentrates the removal of the same minerals over and over in a repetitive manner.

Without mineral replacements, soils are slowly stripped, and plants are Un- able 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, farmland is more easily abandoned or turned into pasture. After the loss of their topsoil structures, weakened or destroyed soils are frequently 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 fungi 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:

- Acting as a source of nutrition to soil microbes;
- Acting to transform soil minerals into an ionic form that can be taken up by plants through chelation;

- Transfer of the minerals in the soil directly into the roots of plants through transcellular penetration;
- Formation of minerals into chemical substances;
- Detoxifying pesticides and herbicides in the soil by rendering them into elemental forms;
- Dissolving silica to transmute vegetal silica and magnesium into a form of plant-contained calcium;
- Dissolving minerals to eliminate molds and disease through higher systemic levels of copper and zinc;
- Holding very large amounts of water in the gel matrix.

Without soil acids, microorganisms — the engines of the soil — shut down along with a wide range of critical soil operations. Nutrient building stops and crops 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 an understanding of the role of humic substances, 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 losing 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 bf soil acids much of the ability of the soil to hold water is lost when soil acids are not present. Without the car bon based soil organic matter form of soil acids, soil becomes sand and subject to the erosion of wind and rain.

***Rule 2: In order plants to efficiently intake 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.***

The second rule of sustainable soils is intriguing yet elegantly simple. A chelating agent is required for the transfer of soil minerals from an elemental form, or 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 and transform them from a solid elemental form that is unusable by a plant into an organic molecular structure that is usable. 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 processed and formed soil acids can perform this work.

Synthetic fertilizer blends, based primarily on NPK formulations, have no such transfer mechanism, nor do mined humic acid, reconstituted fulvic acid or man made fulvic acid. Only living, soil-produced humic and fulvic acids that result from organic deterioration have the ability to efficiently affect elemental transfers within the soil. Born from natural processes, soil acids are unique in molecular composition. They are specifically tailored by soil bacteria and fungi 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 microorganisms.

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.

***Rule 3: Any organic material applied to the soil will eventually dissolve into the earth and become a form of soil acids.***

The third rule is the empowering rule that will change the way a grower views soil elements. The fresher the organic material, the greater the likelihood that the 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 greater value to crops than simple nutrients.

That being said, growers must be knowledgeable as to the nature of the organics and the efficiency of transformation from a solid into a soil acid. Improperly applied organic methods can be dangerous or destructive to the soil. Little has to be said as to the unpredictably and unreliability of manure as a fertilizer, as many growers who have used it indiscriminately have suffered losses as a result. Manure with a high pH, manure with high arsenic-V content (in the case of poultry manure) and manure 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 secrets of successful applications. Learning how to apply organics effectively is critical to the grower who is working for sustainable soils.

***Rule 4: Organic materials do not transform from an organic material into soil acids in an equally efficient manner.***

The fourth rule is a little more complex and requires understanding and application, and is only truly understood with experience. This rule acts to clarify the third rule, and is actually a set of sub-rules, as described below. Often these sub-rules are only established after trial and error.

**Manures.** Raw or dehydrated manures are unstable substances that do not always efficiently transform nutrient content 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 waters. As -a result, untreated manure usually transforms poorly into soil acids when compared to better processed materials.

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 effectively transmit its nutrients into soil acids. However, such manure is also prone to putrefaction, as its pathogen content may overcome the existing soil bacteria responsible for transformation into soil acids. When this occurs, manure can produce potentially harmful, putrefactive, soluble metabolites that 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 becomes subject to a high degree of erosion.

**Compost.** Compost does not always efficiently transform contained nutrients into soil acids, either. Commercially composted organics are typically processed at temperatures of between 135 F to 155 F (57 C to 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 and turn into GO2, 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 humic, a type of soil organic matter that is almost inert. The transformation of this material into soil acids is slow and inefficient, in that the majority of nutrients have already been lost through processing.

**Cover crops.** As for cover crops, whereas they 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 that use it for the digestion of the carbon remnants of the cover crop.

**Other materials.** While space constraints do not allow extensive instruction in this area, it is easy to observe that for every soil input 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, are made up largely of keratin, the same material that makes up hooves and fingernails. Surface-applied feather meal can still be seen on the surface a year after application in some circumstances. Growers 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.

To sum up, while any organic material can be transformed into soil acids, the ideal organic materials for this task are typically low-cost, processed organic fertilizers that have been rendered into stable, slow-release forms specifically for soil microbes. Such fertilizers are not commonly produced at this time. Growers who are looking for sustainable soils should take the time to learn about 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.

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