



FERTILITY

MOSES ORGANIC FACT SHEET

The Importance of Organic Matter to Soil Fertility and Crop Health

One of the greatest challenges producers face when beginning organic management is providing adequate fertility to meet crop needs. Synthetic fertilizers provide nutrients in an inorganic form, and are therefore immediately available for uptake by the crop. In the absence of these fertilizers, organic nutrient sources are needed to supply fertility. These sources require processing by the soil microbial community before plants can utilize them. Soils that have been under conventional management often do not support the levels of organic matter needed to supply plant nutrients, or an active microbial community that can efficiently process those nutrients and make them available to the crop. However, careful planning of fertility programs can alleviate nutrient deficiencies that may occur in the transition years, as well as help to build healthy, disease and pest resistant soils and crops.

Soil organic matter is the most fundamental source of fertility in organic agriculture and it is important for producers to understand the basics of organic matter cycling in the soil. Soil organic matter is that portion of the soil that consists of biological residues, from plant to animal to microorganism. Organic residues supply not only readily available nutrient sources but also the building blocks of humus. Humus is the product that is left over after decomposition has ended, and it is extremely important in increasing and maintaining soil fertility. It possesses an overall negative charge, which means that positively-charged nutrients are attracted to it. Humus can be thought of as a bank which holds nutrients and can release them in response to plant or microorganism needs.

Including a broad selection of crops in a rotation ensures diverse sources of organic matter, and is an important strategy for increasing the overall organic matter content of the soil. Low carbon-to-nitrogen (C:N) ratio materials such as legume residues decompose quickly because they contain relatively large amounts of nitrogen, but they contribute very little to the building of humus. High C:N ratio residues such as cornstalks, on the other hand, break down more slowly in the soil. These residues increase humus content but contribute relatively fewer readily available nutrients.

Diverse residue sources sustain a microbial community that is efficient and has more diversity. For instance, bacteria are associated with high nitrogen materials, while the abundance of fungi increases in relation to high carbon materials. It is important to note that if the C:N ratio of the soil is too high, nitrogen will be in short supply and will be used up by microorganisms before it is available to the crop. Over time, and with good soil management, the cycling of nutrients through microbial biomass will reach equilibrium. At that point nutrients will be readily available for crop needs.

High organic matter content also has a positive effect on soil physical properties. For example, soils with high organic matter content contain a greater abundance of water-stable aggregates and have a greater exchange capacity, which translates into better structure and water-holding and nutrient absorption capacities. Larger aggregates also slow organic matter degradation, producing a slowly mineralizing pool of nutrients.

Organic matter also reduces crop attractiveness to insect pests. In fact, crops growing in soils receiving diverse organic matter inputs have been shown to be less attractive to some insect pests, as a result of a more nutritionally-balanced growth medium. The effect of fertilization based on one nutrient out of balance with other essential nutrients often leads to an environment attractive to insect pests. A plant grown in mineral-balanced soil will first produce simple metabolic compounds, such as amino acids and sugars, which are then made into secondary metabolic compounds that promote (1) vegetative/reproductive growth and (2) enhanced insect and disease resistance. In environments with an excess of readily available N the plant will accumulate a large amount of simple compounds, being unable to metabolize these compounds further due to the nutrient imbalance. Not only does the absence of secondary compounds reduce pest resistance, but the simple compounds actually attract herbivorous insects.

In many cases, healthy soils can also promote the suppression of common soil-borne crop diseases. Many plant pathogens are poor competitors in the soil and therefore general suppression of these pathogens results from competition for resources by other non-pathogenic microorganisms. This type of suppression is a result of a diverse microbial community. A soil system that is nutrient deficient will often lack an active microbial community, creating inefficiencies and imbalances in the community which pathogens can exploit. Apart from general suppression, specific suppression can also occur. This usually takes the form of predation of plant pathogens by other soil microbes.

Soil fertility can also affect weed abundance. Increasing organic matter content has been found to be related to decreased weed abundance. This is due to a higher abundance of bacteria being present which degrade and consume weed seeds. Weed seed predation by invertebrates such as crickets and beetles is also important and is enhanced by increasing ground cover. The distribution of weeds in a field also has some links with varying soil properties. Weeds have the ability to adapt to and survive in a vast array of soil conditions. However, for all plant species

there are certain soil conditions that are most favorable. Therefore weeds can sometimes be useful as indicators of soil conditions and imbalances. For example, giant ragweed is associated with low or unavailable soil potassium, and velvetleaf is associated with low or unavailable calcium and phosphorus. Overall, weed occurrence is probably related to the ratio of one nutrient concentration to any number of other nutrient concentrations, or the interaction of various soil physical properties.

The benefits of healthy soils to crops are many, and management is the key to ensure that a soil is functioning correctly. Practices that can help to build healthy soils include crop rotation, organic matter additions and mineral and nutrient amendments to correct soil imbalances. The inclusion of green manures and cover crops in a rotation is an excellent way to sponsor fertility, suppress weeds and provide a break in pest cycles. Incorporating several different species of crops in a rotation, along with manures and/or compost, ensures a diversity of organic matter sources. Diversity ensures sufficient organic C and N for humus formation and produces a pool of potentially available nutrients that can become mobilized according to crop demand. This reduces leaching, waste and toxicity that can result from immediately-available inorganic fertilizer additions. Ultimately, managing for good soil fertility is extremely important because the soil environment and the surrounding air environment are in reality virtually inseparable, and the establishment of a functional and stable system in one environment can have far-reaching impacts in the other.

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-updated October 2009