PLANT NUTRITION TODAY

2018 ISSUE 2, NO. 4

# ENHANCE SOIL HEALTH WITH FERTILIZER?

**Dr. Rob Mikkelsen**
Vice President, Communications
rmikkelsen@ipni.net

We can agree that healthy soil is essential for sustainable and productive agriculture. While we have a general understanding of what soil health means, it can be difficult to define and even more difficult to agree on the best was to measure it. A definition certainly includes aspects of physical, chemical, and biological properties of soil.

Some proponents envision an undisturbed prairie or forest soil as providing the archetype of an ideal healthy soil. However, in real life, agriculture by its very nature is a disruptive human activity that we engage in to meet our existential need for farm products. Just harvesting a crop will subtly change soil properties.

We can agree that maintaining soil in its top possible condition will require careful stewardship, conservation, and greater appreciation of its unreplaceable value.

## Chemical Properties

Soil pH is probably one of the most important attributes of a healthy soil. Soil acidity is especially important for determining both the microbial population and the distribution of microbial community structure. For farmers, soil acidity presents a pernicious attack on crop yields that is generally best addressed by application of lime. Applications of ammonium and urea fertilizer, when not buffered, gradually lower soil pH. When soil pH drops below 5, microbial biomass generally decreases. However, when pH is maintained near neutral, the input of N fertilizer does not seem to have long-term negative effects on microbial biomass in annual cropping systems.

## Physical Properties

Soil compaction is damaging for health, and is often exacerbated by the traffic of heavy equipment across the field at an inappropriate time. Certainly, a soil in good physical condition allows better root growth and recovery of nutrients and water. An interesting study from long-term research showed that root access into a soil is an important part of improving P availability to crops[1]. The importance of soil microaggregates is becoming more appreciated[2]. Root channels also make an important contribution to water infiltration that improve soil properties and reduce runoff.

## Biological Properties

Many short-term studies have been conducted to measure the effect of fertilization practices on soil

**PLANT NUTRITION TODAY** is a monthly publication of compiled scientific information developed by the International Plant Nutrition Institute (IPNI). Website: http://www.ipni.net/pnt

> *"Too frequently it is parroted that any fertilizer inputs are automatically detrimental for soil health. It's just the opposite."*

biology. Most of this work shows that nitrogen (N) fertilization has little impact on microbial communities[3] apart from any acidity that may be produced during nitrification. However, long-term studies are needed to provide a full understanding.

A recent literature review concluded that long-term N fertilization of agricultural soil results in increased microbial content, most likely due to associated greater input of organic carbon (C) resulting from higher crop productivity. The measured increases in soil microbial biomass carbon (Cmic) in fertilized soils under annual crops contrasts with some observations in natural ecosystems, where N inputs may decrease Cmic[4].

Another recent report from long-term research reported that applications of organic manure (which is more diverse in nutrient content and organic content than fertilizer) resulted in strong enhancement in soil microbial biomass and diversity[5]. The use of inorganic fertilizers alone resulted in a slight increase in microbial biomass, but strongly enhanced the activity of specific soil enzymes. They concluded that a combination of manures and inorganic fertilizers may be the most beneficial for microbial health. However, the authors do not suggest where the large quantities of manure could be obtained or where the nutrients in the manure likely originated.

An unanswered question is how much biological activity is optimal for soil health. Farming practices that support soil health provide benefits but may also come at a price (such as yield penalties). For example, tillage generally has a negative impact on earthworms, but may be beneficial for improving the crop root zone, incorporating nutrients deep in the profile, and reducing the susceptibility of some nutrients to be lost through runoff.

Too frequently it is parroted that any fertilizer inputs are automatically detrimental for soil health. It's just the opposite. When properly managed, appropriate addition of fertilizer stimulates plant growth and results in greater biomass returned to the soil, a healthy plant canopy that quickly covers and protects the soil, and an extensive root system that provides a habitat for beneficial organisms.

Many of these relationships have received insufficient attention. Instead the discussion is too often dominated by polarizing debates over the merits of organic or inorganic nutrient sources.

There is no doubt that the proper use of nutrients has a great benefit on soil health and helps us to sustain agricultural production. Let's use whatever nutrient resources are available to carefully protect and enhance our valuable soil resources.

## References


1. Johnston, A.E. and C.J. Dawson. 2010. Proc. International Fert. Soc. 675:1-40.
2. Totsche, K.U. et al. 2018. J. Plant Nutr. Soil Sci. 181:104-136.
3. Yu, H. et al., 2016. PLoS ONE 11(3):e0151622. doi:10.1371/journal.pone.0151622
4. Geisseler, D. and K.M. Scow. 2014. Soil Biol. Biochem. 75:54-63.
5. Francioli, D. et al. 2016. Front. Microbiol. 7:1446. doi:10.3389/fmicb.2016.01446



IPNI International Plant Nutrition Institute

5550 Triangle Parkway, Suite 300, Peachtree Corners, GA 30092-6515 U.S.
Phone: 770-447-0335 | Fax: 770-448-0439 | www.ipni.net