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Soil Quality: More Than A Soil Test*

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BACKGROUND

It was not too many years ago that soil scientists began to dabble in soil quality issues. Today soil quality has become the focus of a lot of research in soil science. Many questions still remain concerning soil quality including the most basic question, *"what is soil quality?"* The USDA–NRCS Soil Quality Institute describes soil quality as *"the capacity of soil to function."* Today, a great deal of effort is being directed toward assessing, maintaining, and improving soil quality when making decisions about crop type, inputs, and management options.

Soil Quality Assessment

Mike Hubbs, Agronomist on the NRCS Soil Quality Institute Staff, advises farmers to consider their soil's physical, chemical and biological characteristics, some of which are affected by management practices. An assessment of organic matter content, degree of compaction and infiltration rate are dynamic soil properties and will respond to manipulations near the soil surface. Texture, mineralogy and depth to bedrock, are relatively fixed.

For an overall assessment of soil quality at a particular location, one site can be monitored overtime to determine long-term impacts of management changes. The goal is to better understand soil properties and which management practices will improve soil function.

Biological Characteristics

Respiration—The rate of respiration, which can be determined by measuring carbon dioxide production in the soil, provides some indication of biological activity. High amount of respiration does not always indicate good soil quality, however. When oxygen is added to the plow depth, as in conventional tillage systems, biological activity increases temporarily as microorganisms rapidly decompose organic material. Also, biological activity subsides during dry periods and quickly become active again with a rainfall event.

Earthworms—Earthworm activity in the soil improves water movement, breaks down and distributes residues, improves nutrient availability and enhances soil structure and stability. Under favorable moisture conditions the presence of earthworms usually indicates a healthy system. A conventional tillage system usually reduces earthworm activity in the soil. An interesting fact is that each initial tillage pass destroys about 25 percent of earthworm population.

Physical Characteristics

Structural Stability—Aggregate stability measures soil vulnerability to destructive forces, such as wind and water. Like respiration, soil stability is correlated with organic matter levels. Because of its weak structure, overly tilled soil will lose integrity, fall apart quickly, and crust more easily when exposed to rainfall. Soil with more organic matter and surface residue, however, will remain more stable and will not crust. "The key for improving soil structure is to produce plenty of roots and residue and leave it intact," says Hubbs.

Infiltration rate—Infiltration rate, the rate at which water moves into the soil, correlates somewhat with organic matter levels, earthworm numbers and soil stability. Good infiltration reduces erosion and helps keep vital topsoil and organic matter in place. In addition, water that infiltrates into soil is less likely to run off fields and carry soil, nutrients and chemicals to nearby water resources.

Chemical Characteristics

Electrical conductivity (EC) —Soil electrical conductivity (EC) assessments measure the soluble salts in soil and can be correlated with soil properties that affect crop productivity. Excess salts, which may occur naturally or as a result of management, inhibit plant growth and disturb the soil-water balance. Any process that changes the soil-water balance may affect the movement and accumulation of salts in the soil.

pH—Soil pH, the acidity or alkalinity of soil, affects plant nutrient availability, microorganism activity, and mineral solubility. Managing soil pH according to crop needs will stimulate plant growth. "Where pH is a concern, the important factors to consider are nitrogen fertilization, temperature, and rainfall", says Hubbs.

Nitrate—Nitrate is the inorganic form of nitrogen most available to plants. Nitrate levels in soil can be determined by measuring the biological breakdown of organic matter into nutrients. High nitrate levels at the end of the growing season, though, indicate potential nitrate loss through leaching and denitrification.

Understanding soil quality is the first step to making management decisions that maximize soil productivity. Conservation practices, including conservation tillage, buffers, pest management (IPM) and nutrient management, can help increase organic matter and infiltration rates, support earthworm populations and maintain ideal soil chemical conditions.

More information on soil quality is available on the NRCS Soil Quality Institute web page at *http://soils.usda.gov/sqi/index.html*.

***** Published by Dr. Jim Bauder, Montana State University, Agronomy Technical Note 302, May 25, 2001.