Soil Health

Soil quality or soil health is a concept that farmers and gardeners are starting to learn more about. Soil quality/soil health is define by Natural Resource Conservation Service (NRCS, soils.usda.gov) as "The capacity of a soil…to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health."

What does a healthy soil smell and look like compared to an unhealthy soil? Farmers often call their soil "dirt" but soil is more than dirt! Dirt is the sand, silt and clay you wash off your clothes. Soil contains those elements plus soil organic matter but it is also alive with various microbes and small animals. You can actually smell the difference. Take a scoop of soil from a fence row and compare it to a shovel of soil from a typical field. Fence row soil typically has an earthy smell and will be teaming with microbes and small critters while a bare field generally will have fewer microbes and smell stale. The fence row soil should crumble and be high in soil organic matter while bare field soil may have a "massive" soil structure, meaning the sand silt and clay in the soil is cemented together. Bare soil tends to be hard and compacted. Why might that be?

Healthy soils have several things in common. Healthy soils have live plants growing year round to absorb energy from the sun and to increase soil organic matter. A typical plant will spend as much as 25 to 40% of its total carbohydrate reserves feeding the microbes in the soil. This "active" organic matter; the sugars, polysaccharides, microbes, root exudates; enhances the soil and improves soil structure (soil crumbles). Each individual plant uses hormones to attract specific microbes to the root hairs and then feeds the microbes sugars and carbohydrates it exudes into the soil. Plant roots, especially hair roots, have 1,000 to 2,000 times more microbes than bare soil without roots (Foster, 1988). Microbes process more than 90% of the nutrients and energy in a typical soil (Nannipier et al 2003). Keeping the microbes active and well fed is critical to having a healthy soil.

Sick or unhealthy soils also have several things in common. Sick soils tend to be bare soils that are compacted and have high bulk density, poor water infiltration, and poor water holding capacity. Unhealthy soils often have lower soil organic matter and soil nutrient imbalances. When a farmer or gardener tills the soil in the fall, at first the microbes flourish as nutrients are released, but then as their food supply decreases (no roots, no food), the microbes start to die off and nutrients are released. During the late winter and early spring, as the snow melts and heavy spring rains occur, many of these valuable soil nutrients like nitrogen and phosphorus either runoff the soil surface or are leached into the subsurface drains and tile into our surface water.

One way to prevent this from happening is to plant cover crops. The cover crop roots and microbes work together to recycle soluble soil nutrients. Healthy soils tend to decrease soluble nutrient losses to surface water. Cover crops improve your bottom line by more efficiently utilizing the existing soil nutrients, so less commercial fertilizer may be needed. Planting cover crops either before or after the main grain crop is harvested very closely mimics the natural

nutrient cycles that exist in Mother Nature. Soil is meant to be covered at all times with a live crop to prevent soil erosion and prevent soil nutrient losses.

So what cover crops should we be planting? Late in the season, cereal rye is one of the best grass cover crops to grow because it tolerates cold weather and germinates at 32 degrees Fahrenheit. Cereal rye can be sown about any month of the year, but for best results, drill it about 0.5 to 1.0 inch deep at .5 to 1.0 bushel per acre (5.6 pounds for 1/10 acre or .5 pounds on 1/100 acre). Cereal rye costs about $15 to $20 per bushel or about $0.35-$0.40 per pound of seed. Cereal rye is extremely fast growing and will even grow under the snow. Cereal rye is easy to kill with Roundup (glyphosate) or it can be killed by rolling it when the stems are elongated (3-4 feet tall) in the spring (Cover Crops Field Guide, 2012).

Other cover crop options include the brassicas like rape, kale, or turnips; cool season crops that grow well in the fall. These plants can tolerate temperatures as low as zero degrees Fahrenheit and still remain green. For rape and kale, plant 3.5 to 4.0 pounds of seed per acre and 1.5 to 2.0 pounds per acre for turnips. Oil seed radish is another brassica than can be fall planted but generally should be planted before October 10-15$^{th}$ each year, depending on the weather. Most small seeded brassicas should be planted 0.25 to 0.5 inches deep for best growth. Good seed to soil contact (drilling) enhances plant growth but broadcasting early in the fall with a good rain will also work. Most cover crops require a minimum of 60 days of growth to survive the winter and most brassicas mature in 90 days (Cover Crops Field Guide, 2012). See our website at putnam.osu.edu for new articles on soil health, cover crops, guidelines for manure application, and other topics.