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James J. Hoorman

Hoorman Soil Health Services

Website: HoormanSoilHealth.com

Email: HoormanSoilHealthServices@gmail.com

Cell: 419-421-7255

What is Soil Health?

Soil Health is a term that everyone seems to be confused about or have their own opinion. Soil health is about three things: soil organic matter (SOM), soil microbes and organisms, and plants. Good soil and soil health are dependent upon the interaction of these three things. Active short-term organic matter are the root exudates, root carbohydrates (sugars) and microbial bi-products which produces good soil structure and is missing from most of our tilled soils. Soil microbes process nutrients to make them plant available and produce humus which is the long-term SOM. Plants and live roots supply the carbon, nitrogen and energy from sunlight to feed the microbes and to produce SOM. The end result is a rich fully functioning soil producing healthy dense food to feed livestock, humans and wildlife.

What is the difference between good soil health and degraded soil health? I saw a dramatic difference at my father's house. My father's lawn gradually grew into the neighbor's field. This year, the farmer planted corn right through the grass that had grown there 20 years. Corn in the grass was 8-10 feet tall, dark green, with huge leaves and ears while the corn 3 feet over in the tilled soil was half as tall, with smaller paler leaves, and smaller ears.

To understand what good soil looks like, dig a hole in undisturbed soil. Try digging in a fence line, the edge of a woods, a cemetery, or a long-term pasture. Use a tile probe then a shovel. Virgin or undisturbed soil is easy to probe (like hot butter), the soil should crumble in your hands and has a great "earthy" smell from active healthy microbes. Move to a conventional tilled agricultural field and try to do the same thing. Generally, the soil probe will hit degraded soil with hard pans and tight soils that are not fully functioning. The difference in the soil can be attributed to difference in SOM, microbes, plant intensity and farm management (tillage and plant intensity).

Most of us have forgotten what good soil looks like and how it feels and smell. The early settlers said that Midwestern soils were dark and black as midnight. These soils were rich, fell apart in your fingers, and produced great crops without much fertilizer with around 5-8% SOM. Most of our soils have paled and turned hard due to the loss of 50% to 80% our SOM, with an average 1.5-4% SOM remaining.

Plant root turnover is the source of most SOM (80-85%). A soil with 1% SOM by volume takes up 5% of the soil, creating a sponge and pore space for water, gasses, and soil organisms. You can see this by looking at the elevation difference between tilled fields and the fence row. The fence row will be 6-9" higher, spongier, and may hold 3-4.5 inches more water than compacted, dense, tilled soil, due to the difference in SOM.

The microbial population also differs in healthy soils. Healthy soils have 10X more diversity in microbial species and total microbial populations. Tilled soils tend to be dominated by gram positive bacteria and mostly ciliate protozoa which tolerate poor soil structure, low SOM, tight water logged soils lacking oxygen, and tend to be pathogens. Healthy soils have a diversity of gram positive and negative (oxygen loving) organisms which promote efficient nutrient cycling for good plant growth. Healthy soils also have higher numbers of mycorrhizae fungi, beneficial nematodes, diverse protozoa, actinomycetes and other soil organisms (earthworms, centipedes, etc.) which promote root growth and reduce soil diseases and insect pressure. You can smell, feel, and see the difference between good and bad soil.

Keeping soils covered with live plants protects and enhances our soil. One of the best ways to increase SOM is to grow more plants more often. In a typical corn-soybean rotation, crops are only grown 4-5 months, leaving the soil bare 58-67% of the time. Planting a cover crop after wheat or corn silage is a great opportunity to add SOM and to improve soil health. Double crop soybeans results in less SOM accumulation, acid soils, and more disease. Planting a diversity of cover crops (grasses, legumes, clovers, brassicas, and pollinators) promotes a wide diversity of roots (fibrous, tap, shallow, deep) that support diversified soil microbial species and higher soil organism populations. Healthy soils produce high density crops, with less inputs, and create a safer environment for the air we breathe and the water we drink.