The USDA’s Natural Resources Conservation Service defines soil health as the “continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.” Soil health is complex and dynamic, which means that a healthy soil can look different in different regions and cropping systems. A number of different soil health indicators can be useful for tracking how the soil responds to management, and measuring soil health in the field and in the laboratory.

**Indicator types**

**Chemical Indicators**

**pH**
Soil pH impacts availability of key nutrients, which means that an optimal pH (between 6 and 7 for corn, soybeans, and wheat) is critical for crop growth.

**Primary Macronutrients**
N, P, K, are all essential macronutrients that are vital to plant growth. Crops need sufficient quantities of these nutrients in order to grow and thrive.

**Secondary and Micronutrients**
Nutrients such as Ca, Mg, and S and micronutrients such as Mg, Fe, Mn, and Zn are also critical for crop growth, but in smaller quantities. Typically, soils provide plants with enough of these nutrients, but consider regional recommendations for sufficient levels of these nutrients when reviewing soil test results.

**Physical Indicators**

**Soil Texture**
Inherent soil properties such as soil texture cannot be changed through management practices. Soil texture impacts what management practices might be a good fit for an operation, and also mediates responses of other soil health indicators to changes in management.

**Available Water Capacity**
Available water capacity depends on innate soil texture but can be impacted by the amount of soil organic matter and soil aggregation, both of which can increase water holding capacity.

**Aggregate Stability**
Soil aggregates are held together tightly via root exudates, soil fungi, and inherent soil properties. They can be improved upon by creating environments for “biological glues” to be produced by plants and microbes by reducing tillage that physically breaks soil aggregates.

**Bulk Density**
The proportion of dry solid material in a cubic volume indicates the amount of pore space in a soil. Soils with a high bulk density have less pore space which leaves less room for air and water critical for root growth and nutrient cycling. This can also be an indicator of how compacted the soil is.
Inherent soil properties such as soil texture cannot be changed through management practices.

**Biological Indicators**

**Soil Organic Matter**
Organic matter influences water holding capacity and contains nutrients that can be broken down by bacteria or fungi to make them available for growing plants. The ability to increase soil organic matter through management varies with climate and soil type and texture. However, decreasing soil disturbance by reducing tillage and keeping living roots in the soil (e.g. by using cover crops) may contribute to building soil organic matter.

**Soil Protein**
The nitrogen contained in soil organic matter is primarily found in soil proteins. Soil protein indices such as the Autoclaved Citrate Extractable (ACE) protein index indicate how much nitrogen can potentially be mineralized by the soil microbial community and made available to plants.

**Active Carbon**
This measures the portion of soil organic matter that is readily broken down by microbes as food. Active carbon is essentially a measure of the food stock available for microbes, which promotes nutrient availability and cycling.

**Respiration**
This measures the amount of CO2 produced by microbes, which is an indicator of soil microbial activity.

**Soil health indicators in the field**

- **Water Infiltration**
- **Smell**
- **Erodibility**
- **Root Health and Rooting Depth**
- **Slump Test or Slake Test**
- **Soil Micro and Megafauna**

The fastest way to degrade your soil is by losing it. There is no one size fits all method to soil health. Work to develop strategies that work on your farm. Visit soilhealthpartnership.org to learn more about soil health indicators.