USDA NRCS

On-Site Soil Quality Indicators

OVERVIEW

Soil functions to intake and store water, cycle nutrients, provide support/habitat for plants and soil organisms, and filter and/or buffer chemicals and/or pollutants in the soil. Soil quality is the capacity of a particular soil to perform the functions required for its intended use. Three interdependent components... biological, chemical, and physical... comprise soil quality. Several indicators of soil quality have been identified within each of these three components. Practical field tools and approaches are used to measure these indicators to assess soil quality. Indicator data and field observations help make better decisions to sustain and improve the soil resource for future generations.

BIOLOGICAL INDICATORS

Soil biota mediate nutrient cycling, increase soil stability, and degrade contaminants. The soil food web is a complex system consisting of earthworms, fungi, bacteria, mites, ants, beetles, and numerous other organisms. Measurements of organic matter, earthworm populations, soil respiration, decomposition rates, crop yields, and even the smell of the soil are used as biological indicators.

An earthy smell indicates a healthy soil and is associated with Actinomycete bacteria that grow as hyphae like fungi.

Presence and abundance of soil life is a positive sign of soil improvement.

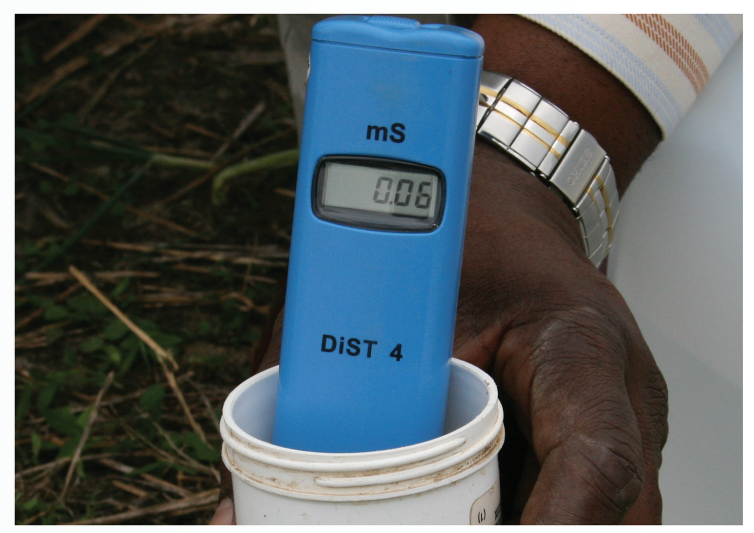
Soil respiration indicates soil's ability to support soil life and is measured by the amount of carbon dioxide given off.

Crop diversity (above and below ground) helps feed and increases diversity of soil biota.

Darker soil color usually indicates more organic matter and better nutrient cycling.

CHEMICAL INDICATORS

The chemical component of the soil affects the availability of plant nutrients, soil and plant relationships, soil's buffering capacity, water quality, and mobility of soil nutrients and contaminants. Cation exchange capacity, soil pH, electrical conductivity, and nitrate-nitrogen are among the chemical indicators that help determine the capacity of the soil to store and release nutrients, and can also be indicators of potential soil, plant, and ground water contamination.



A pocket electrical conductivity meter is a quick method to measure salts in the soil solution.

Soil salinity influences biological, chemical, and physical properties and processes in soils.

Soil pH can be measured with a pocket pH meter and used as an indicator of potential nutrient deficiencies.

Nutrient deficiencies are revealed as leaf discoloration or burn (phosphorus deficient corn).

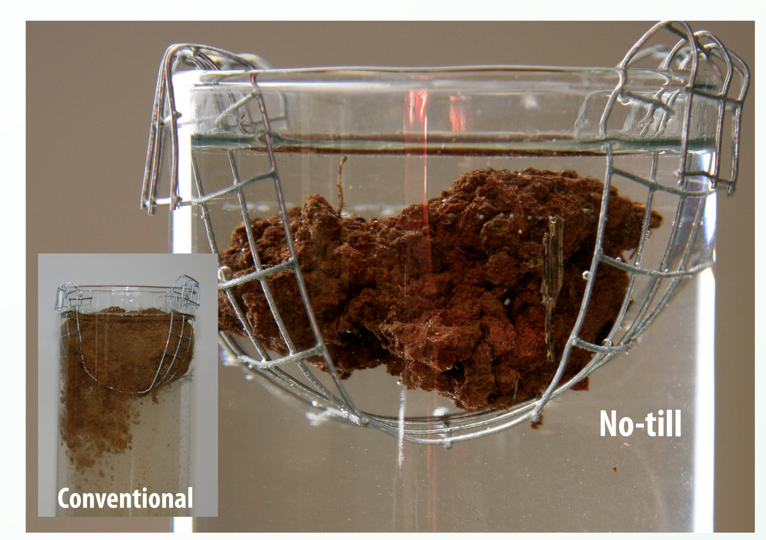
A nitrate test strip can be used to determine nitrate-nitrogen levels in the soil.

PHYSICAL INDICATORS

Physical characteristics of the soil refer to the type and arrangement of soil particles and pores. Physical indicators, such as texture, infiltration rate, bulk density, soil compaction, aggregate stability, and soil crusting help determine how well water and roots are able to move through the soil and how stable the soil resource is to the effects of climate. Topsoil thickness, soil color, subsoil exposure, sediment fans, and soil structure are visual examples of physical indicators.

Granular soil structure (right) indicates a stronger aggregate stability than massive structure (left).

Higher bulk densities can indicate less pore space, less oxygen and increased resistance to root penetration.



The Slake Test demonstrates a soil's ability to retain its structure and allow water to infiltrate into it.

Water infiltration is measured using a ring infiltrometer; if soil is severely compacted, sit back and wait.

Wind and water erosion are symptoms of poor soil function and remove valuable topsoil and degrade soil quality.

SUMMARY

Improved soil quality helps reduce runoff and soil erosion, improve nutrient efficiencies, and ensures that the soil resource is sustained for future use. Soil quality information can be used in different ways: (1) as benchmarks to compare with future soil quality measurements; (2) to determine the present condition of the soil resource as compared to its inherent potential; and (3) to determine which management practices should be applied to enhance the soil resource.