Soil Quality Indicators Explained

Biological Parameters

Organic Matter

This is the total amount of organic matter in your soil. In general the greater the amount of organic matter in your soil, the more productive and healthy it is. However, not all organic matter is equally useful or functional biologically or physically. Very high organic matter levels (above 20 %) can cause the soil to become hydrophobic (repel water) if it becomes very dry. Very high organic matter can also cause the soil to hold too much water and not drain properly in some cases. The ideal range for total organic matter is somewhere between 5 – 10 %. Soil under turf or sod will naturally accumulate and maintain organic matter within that range.

Particulate Organic Matter (POM)

POM is a physical size fraction of total organic matter, smaller than 2 mm and larger than 0.05 mm (50 microns). This is relatively fresh organic matter in the initial stages of breakdown. This physical size fraction is usually the most useful to beneficial soil microbes as a food source. POM should be regularly replenished by tilling in cover crops, old sod, animal manure, leaves, and compost. POM can still vary in quality.

Active Carbon

Active carbon is the fraction of organic matter that is directly useable by microbes. It is measured using the Carbon Burst Solvita test. Dry soil is rewet and sealed in a jar at room temperature with a CO_2-sensitive Solvita paddle. Rewetting dry soil creates a burst of microbial respiration in the first 24 hours. This test, in effect, has the microbes themselves tell us how much organic matter is useable as a food source. It is a very good test for organic matter quality. This measurement can also be used to calculate microbial biomass, a gauge of the biological health of your soil. A robust population of beneficial microbes is essential in cycling nutrients in a plant-available form and for competing with and suppressing disease causing (pathogenic) organisms.

Potential Mineralizable Nitrogen (PMN)

Nitrogen is one of the most important nutrients that beneficial microbes make available to plants. The PMN test isolates those microbes that transform nitrogen from the organic form to plant available ammonium and nitrate (mineral) forms. The soil is incubated for 1 week at 40 C, after which the increase in available nitrogen is measured. This is only a gauge of your soil's potential to release nitrogen in a plant available form. It does not take into account the many ways nitrogen can be lost from your soil during the growing season. This is also a measurement of organic matter quality in terms of nitrogen content and carbon/nitrogen balance, both of which affect nitrogen release characteristics of your soil.

Physical Parameters

Water Stable Aggregates (WSA)

Sand, silt, and clay particles clump together in the soil to form small clods or crumbs called aggregates. Aggregates are extremely important in determining the workability (called tilth) of your soil and its tendency to compact and/or crust over after a rainfall. The ability of aggregates to hold together in the presence of water or after rewetting is a key physical factor in soil quality assessment. Dry soil aggregates are isolated on a small sieve, rewet, and gently washed in a water bath. Those remaining on the sieve after this treatment are called Water Stable Aggregates. Aggregates are held together by a variety of plant root and microbial byproducts that act like glue. A robust microbial population, fed by good quality organic matter additions, is very important in forming and maintaining aggregate stability, resistance to crusting, and soil workability. Cover crops such as cereal grains and grasses, with fibrous root systems, also promote aggregate stability.

Plant Available Water (PAW)

Plants obtain most of their water from the soil. The soil's ability to hold water is especially critical during drought periods. Soils with higher silt and clay content (silt loams, loams, and sandy loams) have a higher natural water holding capacity than soils with high sand content (loamy sands and sands). Soil texture is measured and classified on the report (page 2). Water holding capacity is expressed as percent of the dry soil weight. It is the amount of water plants can access from your soil after it has been saturated and drained. PAW is approximately 1/4 the total amount of water your soil can hold when completely saturated in a closed container. Plants are no longer able to obtain sufficient water from the soil once the moisture content drops below "permanent wilting point", the lower limit of plant available water in soil. Ideal or target PAW levels generally run between 10 – 15 % of dry soil weight, depending on soil texture. PAW can be improved primarily through organic matter additions.

Soil Hardness

Topsoil and Subsoil Hardness are measures of soil compaction as it exists in the field. As such, it must be measured on site. This is typically done using a soil penetrometer, which can be purchased or sometimes borrowed from a county Extension office or Soil & Water Conservation District office. Penetrometers measure the pressure of resistance to root penetration into the soil. The roots of most crop plants can penetrate up to about 300 pounds per square inch (psi) pressure equivalence. The depth to this penetration pressure is the Potential Rooting Depth (PRD). This indicates the limited depth of soil that plant roots can use to access nutrients and water. Tillage and heavy equipment often create a compacted layer, called a tillage pan or traffic pan, that cannot be penetrated by plant roots and which greatly restricts water movement. This pan layer is often only 1 – 2 inches thick and can be broken using a mechanical "ripper" or by growing certain cover crops known for greater root penetration pressure. These include sweet clovers, canola, and tillage radish. A small diameter metal rod or dowel (1/4 inch or smaller) can also be used to measure approximate depth to the 300 psi penetration limit.