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High Energy Forages and Soil Building Cover Crops

Soil Health Indicators

Before investing in seed, get to know your soil. **Soil health and quality is estimated by measuring or observing several different properties or processes, none of which can be used in isolation as a reliable index of soil quality.**

Soil productivity, usually measured in terms of crop yield, is influenced by the cumulative effects of many soil health indicators.

Visual indicators include exposure of the subsoil, change in soil color, gullies, ponding, runoff, plant response, blowing soil and deposition. Physical indicators involve the arrangement of the soil particles and pores; we can understand these factors by observing topsoil depth, bulk density, porosity, aggregrate stability, texture, crusting and compaction. Physical indicators primarily affect root growth, seedling emergence, water infiltration and movement within the soil profile.

Chemical indicators include soil pH, salinity, organic matter, phosphorous concentrations, cation-exchange-capacity (CEC), nutrient cycling and concentrations of elements that are needed for optimum plant growth.

Biological indicators of soil health include the effects of the micro and macro-organisms, their activity and/or their byproducts. Observing earthworms has been suggested as a simple means to evaluate soil biology. Respiration rate can also be used to detect microbial activity, specifically microbial decomposition of organic matter in the soil. The mix of living organisms in the soil, such as beetles, springtails, mites, worms, spiders, ants, nematodes, protozoans, fungi, bacteria and others, form the soil biological food web that enhances nutrient cycling. These organisms contribute to the formation and stability of the organic matter portion of the soil. Many are also critical to supplying nutrients to the living plants, as their population is greatly concentrated in the rhizosphere (or growing root zone of the living plants).

Several important physical soil indicators include:

- **Aggregate stability** – the ability of soil aggregates to resist disruption when outside forces (usually associated with water) are applied. Spaces between aggregates provide pore space for retention and exchange of air and water.
- **Infiltration** – Water movement in the soil as a result of soil texture, crusts, compaction, aggregation and structure, water content, frozen surfaces, organic matter, and pores. Both infiltration and aggregate stability help indicate the capacity of the soil to intake water and resist runoff and erosion.
- **Bulk Density –** The ratio of dry soil mass to bulk soil volume (including pore spaces). This can be measured and expressed in grams per cubic centimeter, and is largely a function of relative pore space and organic matter content. Bulk density influences water infiltration and plant root health, and reflects the degree of soil compaction.
- **pH –** Negative logarithmic scale that measures the "Potential of Hydrogen" concentrations in aqueous solutions. Soil pH influences the solubility, and therefore the availability, of several plant nutrients. It also affects the activity of microorganisms responsible for breaking down organic matter, as well as chemical

transformations in the soil. The type and population densities of soil microorganisms change with pH. A pH of 6.6 to 7.3 is favorable for microbial activities that contribute to the availability of nitrogen, sulfur, and phosphorus in soils.

- **Soil Crusts –** Created by the breakdown of soil structural units by flowing water or raindrops, or through freeze-thaw action, crusts reduce water infiltration and increase runoff, restrict seedling emergence, reduce surface water evaporation, and increase wind erosion in sandy soils.
- **Organic Matter –** Soil organic matter is the fraction of the soil composed of anything that once lived, including plant and animal remains in various stages of decomposition, cells and tissues of soil organisms, and substances from plant roots and soil microbes. Organic matter gives soil a sponge-like quality that allows it to soak up about twelve times its weight in moisture, which helps prevent nutrients from leaching out and makes your system less "leaky." Soil food web organisms derive their energy from organic matter inputs.
- **Available Water Capacity –** The amount of water that a soil can store that is available for use by plants, affected by rock fragments, organic matter, bulk density, osmotic pressure, soil texture, and rooting depth, and improved by incorporating organic matter into the soil surface. Available water near the surface is especially important at the seedling and transplant stage when the roots are very shallow and not yet fully developed.
- **Soil Biodiversity –** The mix of living organisms in the soil that comprise the "soil food web," such as insects, worms, and microorganisms, whose interaction and biological activity influence many soil processes. These organisms influence the entry and storage of water into the soil, resistance to erosion, nutrient cycling, and residue decomposition. A wide variety of organisms provides checks and balances to the soil food web through population control, mobility, and survival from season to season.