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Soil Health

Assessing and Maintaining Your Soil's Health

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Soil health is a broad concept that goes beyond simply measuring nutrient levels. It also involves evaluating the physical and biological aspects of the soil to understand the key factors that influence its overall condition, long-term productivity, and sustainability (Karlen et al., 1997). These factors all play a role in how well crops perform and how resilient the soil remains over time.

By monitoring soil health each year, you can observe the effects of any changes made in the field, such as adjustments to tillage practices. This can help in determining how effective your management strategies are. Maintaining good soil health can also be a good risk management strategy as it can hold more moisture under drought conditions and help reduce fertilizer inputs.

This article identifies some basic ways to monitor soil health in the field and also provides methods to enhance it.

Field Indicators

Qualitative measurements can be made without lab tests (USDA-NRCS, 2014) and are considered field-based soil health indicators. It's best to make observations from multiple areas of a field and at the same time of year under similar conditions. Below are some indicators that can be used to assess and compare soil health.

Soil aggregate strength: This can be assessed using a slake test. Place a soil aggregate (the natural clumps or clods of soil) in water to see if it holds together or disintegrates. Soil that breaks apart easily is more susceptible to erosion and poor infiltration.

Soil ponding and erosion: After heavy rainfall, look for surface signs such as ponding, which can indicate compaction issues, or areas where runoff and erosion have occurred.

Soil crusting: Soil can form a hard crust at the surface that may hinder seedlings from emerging, especially when conditions are dry. These crusts are usually caused by tillage and the breakup of soil aggregates.

Nutrient deficiency: Nutrient deficiencies appear differently for each nutrient. For example, yellowing on older leaves can indicate a nitrogen deficiency, dead tissue on the tips or margins of older leaves can indicate a potassium deficiency, and interveinal necrosis (dead leaf tissue between leaf veins) on older leaves indicates a magnesium deficiency (Marschner, 2003) (Fig. 1).

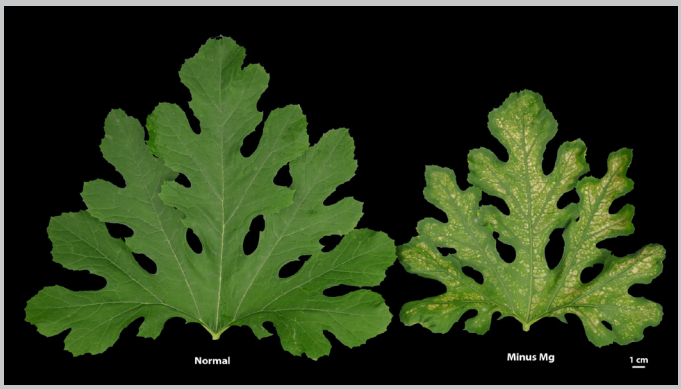

Fig. 1. Interveinal necrosis on a squash leaf (right) that has not received adequate magnesium. Image by Dr. Dharma Pitchay.

Soil tilth and surface hardness: A penetrometer can can measure this and readings above 300 psi mean that root growth may be restricted. Simpler tools, like a spade or probe, can also provide useful comparisons. Too much traffic or tillage can cause compaction or a plow layer, reducing infiltration and limiting roots.

Soil biology: There are more microorganisms in a teaspoon of healthy soil than there are people on Earth. Earthworms are visible indicators of healthy soil; they decompose organic matter (OM), release nutrients, and improve soil porosity. They are best assessed in mid-spring or mid-fall when soils are moist. Finding around 10 worms per square foot of topsoil (~top 6 inch layer) suggests a biologically active soil.

Plant roots: Examining plant and root systems provides further clues. Healthy roots are well-branched and hold soil aggregates together (Fig. 2). Short, dead, or decaying roots may indicate compaction or disease.

Fig. 2. Healthy lateral roots creating soil aggregates (left) and lateral roots (right). Image by Dr. Abbey Wick.

How to Improve Soil Health

Once soil constraints are identified, improvement can be achieved through a combination of short- and long-term practices. The five main approaches are (Sahu et al., 2024; Singh et al., 2021):

- **Reducing tillage**
- **Avoiding compaction**
- **Growing cover crops**
- **Improving crop rotations**
- **Balanced application of organic and inorganic amendments**

Think of soil as a bank account. When you make a "withdrawal," such as tilling in wet conditions, it's important to balance it with a "deposit," such as planting a cover crop or adding compost.

Soil health management practices for row crop farmers

1. No-till, strip-till, or zone tillage reduces OM loss, erosion, and degradation of soil structure as compared with conventional tillage.

2. Controlled-traffic farming limits compaction but may require equipment modifications and GPS guidance.

3. Cover crops can reduce erosion and suppress weeds. Legume cover crops also contribute nitrogen, while tillage radish can alleviate compaction.

4. Crop rotations help break pest/disease cycles while enhancing nutrient availability and OM levels.

5. Fresh OM such as manure or cover crops quickly stimulate biological activity, while stable materials like compost or residues build long-term soil structure and fertility. Supplemental inorganic fertilizers can be used to prevent any plant nutrition deficits.

Soil health management practices for animal producers

1. Perennial forage crops reduce tillage and erosion while improving soil health properties.

2. Silage harvests remove plant residue, so manure can be used to replenish OM. Manure can be applied under dry conditions and injected or gently incorporated with aerators to minimize disturbance.

3. Pasture aeration reduces compaction and produces holes that can capture manure if spread after aeration.

4. Rotational grazing techniques allowing for adequate rest/recovery periods and proper stock density, will improve soil health benefits and forage productivity.

5. Over-application of manure can lead to nutrient loss, so regular soil testing is essential.

Summary

Soil health plays a vital role in crop productivity and sustainability, allowing farmers to be more resilient. Regular assessments provide an understanding of soil health status and its potential for improvement. This can be an effective risk management strategy to help reduce or prevent losses and decrease inputs.

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