

Simple Soil Tests for Onsite Evaluation of Soil Health in Orchards

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The Importance of Soil Health

Soil health or quality is the ability of a soil to function as a suitable environment for root growth and to maintain water and environmental quality. Optimal soil health allows for water retention and infiltration, filtering of contaminants, buffering of pH, efficient recycling of nutrients, and maintaining a stable porous structure even under erosive pressures from water and wind. Healthy soil provides habitat for a diversity of soil life, and these diverse life forms can prevent soil borne diseases and help maintain soil properties over a long period of time.

The goal of simple on-site soil health tests is to enable a grower or landowner to track the effects of soil management practices on soil health. This can be achieved by comparing two different management approaches such as a tilled plot to an area covered in perennial vegetation in the same orchard, or testing the same orchard year after year to monitor long-term change in soil health. Keeping track of the physical and biological properties of soil as a complement to traditional measurements of soil fertility can be helpful to overall farm management decisions and may even save the grower money in the long-term through improved soil health. An example of an important soil physical property is aggregate stability, which is the ability of primary soil particles to remain attached under disruptive forces. Aggregate stability tests are specifically useful in addressing a soil's potential for erosion (Kemper and Koch, 1966; Kemper and Rosenau, 1986). Soil organisms are important biological indicators of soil health as they are rapidly responsive to shifts in management practices (Pankhurst et al., 1997). Soil organisms affect the rate of nutrient decomposition, and can inform to prevent over application of nutrients in efficient systems (Guillard et al., 2015).



Healthy Soils:

- Filter contaminants
- Retain more water
- Resist erosion
- Provide habitats for beneficial organisms
- Aid in prevention of soil borne diseases
- Save money and resources



Best Soil Testing Practices

For best results, choose soil test sites that represent the main soil textural type present in the orchard or field. It is important to test within the same soil textural type as texture can have a greater effect on soil health than management practices. Soils rich in clay form aggregates much easier than soils rich in sand, and also tend to have greater biological activity as the primary particles are of a size that store water and carbon more easily than sandy soils (Franzleubers et al. 1996, Mulder et al. 2011). Sandy soils may show little to no structure at all, as larger primary particles are not as cohesive as smaller primary particles.

If possible choose a neighboring site on the same soil type that has a history of long-term management in perennial vegetation as a comparison. Repeat tests at the same time every year, and preferably at least 2 days after a rainfall or irrigation event to ensure similar soil moisture conditions.

Supporting soil health promotes long-term plant and tree health. These tests will help you detect early signs of soil degradation so that remedial actions can be taken in order to help avoid or reduce costs associated with soil erosion and compaction, increased irrigation and nutrient inputs. Reductions in pest management needs, and plant diseases may also be noticed as soil health improves over the long-term. The following tests include physical and biological parameters.

Chemical evaluations of the soil, including N,P,K and pH are best completed by laboratories as simple chemical test kits available on the market are prone to inaccuracies. The following simple soil tests have been tested for their ability to discriminate between soils of different known soil health. They all ranked high when compared to similar lab based tests and were evaluated for ease of use by growers in the field.

Taking Soil Samples

- Choose sites with a representative soil type for the area
- Choose sites—same soil type—under differing management practices for comparison
- Remove organic material from the surface of the soil before taking the soil sample
- Take a shovel full 7-9" deep



Physical Soil Tests – Test # 1: Soil Slaking

1. Fill a large sieve to the rim with un-sieved soil.
2. Remove any rocks and large pieces of organic material.
3. Soak sieve with soil in a bucket of water for 5 minutes.
4. Raise the sieve out of the water to let drain, and then slowly raise and lower the sieve 5 times into the water.
5. Take note of the surface texture of the soil.
6. Rate the soil from 1 to 10 (see Table 1) based on how much of the surface soil texture appears to have remained the same after the repeated soaking, with 1 being the lowest health indicator and 10 being the highest.
7. Take a picture,

Location	Observations	Soil Rating from 1-10	Least desired 1	Mid-level 5	Most preferred 10
			<10% surface aggregates visible	50% surface aggregates visible	100% surface aggregates visible

List location of test, general visual features of soil before and after the test under the observations column, and checkmark the number that best fits the test, from 1-10 with 1 being less than 10% surface aggregates visible after repeated soaking of the soil, and 10 being 100% surface aggregates visible after repeated soaking of the soil.

Rating the Soil Slake Test

Weaker soil structure typically shows less varied surface texture, displays qualities such as smoothness, shininess and glossiness. **Strong soil structure** typically shows a variety of shapes and sizes of soil aggregates (clumps of soil).

Example Pictures

1. Least desired



Loam soil from a peach orchard under tillage for 30 years

5. Mid-level



Sandy loam from a peach orchard under conventional NPK and herbicide

10. Most preferred



Loam soil from a peach orchard under long-term undisturbed grass cover

Test #2: Hose Test

1. Take the sieve filled with soil and bring it to a running water source, preferably a hose.
2. Turn the hose on just above medium flow, but not the highest flow setting. It may be helpful to record the number of turns it took to reach the desired flow rate.
3. Hold the sieve about two feet from the sieve and spray down the soil in the sieve using circular motions, maintaining an equal distribution of water flow over all surface points of the soil in the sieve.
4. Record 1) the amount of time until all soil is washed away, or 2) the percentage of soil left in the sieve after 1 minute of hosing.
5. Record what is observed.

The greater the percentage of soil remaining after hosing the stronger your soil aggregates.

List location of test, general visual features of soil before and after the test under the observations column, and checkmark the number that best fits the test from 1-10, with 1 being less than 10% of soil volume remaining after spraying of the soil and 10 being 100% of soil volume remaining after spraying of the soil.

Biological Soil Tests

Test #3: Soil Organism Biodiversity Test

- At your selected soil test site, dig a 1’x1’x1’ cube of soil and place into a bucket.
- Examine soil out of the bucket one handful at a time. Count and record the number of different kinds of soil organisms (examples include, earthworm, centipede, ant, spider, ladybug, etc.) you find before returning the soil to the hole.
- Record the total number of organisms found once all of the soil from the bucket has been examined.

*Note-According to the NRCS if you have more than 10 earthworms in this amount of soil, it is also good indicator.

Location	Observations	Soil Rating 1-6	Least Desirable 1	Mid-Level 3	Most Preferred 6
			<1 visible soil organism	3 different soil organisms	>6 different soil organisms

Biologically Rich Soils...

- Need fewer inputs, due to more efficient breakdown of organic residues and greater nutrient cycling
- Increase stable physical soil structure, as residues from organisms help bind soil particles together in aggregates, creating more pores for aeration, water passage and root access.



Summary

Less than optimal soil quality can promote erosion, poor water holding capacity and infiltration, and will likely need more inputs for optimal productivity. Soil quality tests can help land managers compare the effects of land management practices and gauge over a period of time whether soil health is being maintained, improved or depleted. Timely recognition of soil health problems can be recognized and corrected before soil health worsens to the point that significant negative impacts on crops occur.

Practices that are helpful for maintaining and improving soil quality or health are moderate additions of organic matter through mulch, compost or manure; reducing the frequency or extent of tillage; and incorporating cover crops and/or more perennials into a system. Cover crops can be planted after the main crops have been harvested as a fall/winter cover crop, and they can also be planted as buffer strips, companion plants or understory plants. Maintaining or improving soil health will improve the bottom line for growers in the long term by improving yields and reducing the need for inputs such as water and fertilizers.

Related Fact Sheets

Preparing Garden Soil:

https://extension.usu.edu/files/publications/factsheet/HG_H_01.pdf

Soil Testing Guide for Home Gardens:

https://extension.usu.edu/files/publications/factsheet/HG_H_05.pdf

Understanding Your Soil Test Report:

http://extension.usu.edu/files/publications/publication/AG_Soils_2008-01pr.pdf

Preparing and Improving Garden Soil:

https://extension.usu.edu/files/publications/factsheet/pub__8066784.pdf

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