UMass Soil Health Test Kit and Guide

This kit includes directions, general guidance, and physical materials to complete soil health assessments.

This kit does not include some simple consumables that you might need, specifically: water, cups, pens, sharpies, and sample collection bags. Check to make sure you have these items before your site visit.

> How to Use the UMass Soil Health Test Kit and Guide
>
> This resource was created to simplify soil health and make soil health more accessible for both educators and stakeholders.
>
> This kit includes items needed for popular methods of soil health assessment. This resource is not exhaustive; the emphasis is on simple, free, chemical and physical assessments. Additional information is provided about fee-for-service laboratory tests where appropriate.
>
> Guidelines are provided to help with method selection. For example, some methods are very effective for general education about soil health principles, while other methods can be used to support farm visits or collect data for on-farm trials.

This kit is designed to be a "grab-and-go" resource. Some users may find value in reviewing the complete guide for a refresher, as a decision support tool, or to build a workshop. Other users may find the most value in simply reviewing methods and borrowing the physical items.

This kit and guide are meant to be universally applicable, from vegetable farmers to community gardeners, from pasture managers to turf managers. Adapt considerations and interpretations as needed.

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Data Interpretation: Context Collection

<u>Interpret all data in context</u>

- Why do you and/or the land manager care about soil health at this location?

- What current conditions should you expect based on inherent soil properties and historical management?

- What changes to management and changes to soil conditions are reasonable to expect in the future?

1. Goals:

A method should always be conducted with a use in mind. If there is no use for the data, there is no reason to perform the method. “Use” is subjective. To determine the use, identify the goal.

Examples of Goals:

- Satisfy curiosity.
- Educate about soil health.
- Conduct a general assessment for informational and decision-making purposes.
- Identify risks and room for improvement.
- Diagnose a problem.
- Demonstrate the effectiveness of soil health management practices on different fields or farms.
- Quantify changes to soil over time or in response to a practice.
- Conduct research.

METHOD:

- Interview with land manager.
- Walk the land during a single visit.
- Visit the land several times throughout the season or over multiple growing seasons.
- Consider grant and stipend funds related to soil health that support farm improvement.
- Review county, state, federal, and global sustainability initiatives.

Caveat: Goals are subjective and dynamic. Data collected for curiosity or as a routine assessment in one season could be used to help diagnose a problem next season. Consider data collection with this in mind.

2. Management history:

Includes type, frequency, and depth of soil disturbance, frequency and volume of organic matter inputs (compost, mulch, manure, uncollected grass clippings), soil cover (mulch, cover crops, high tunnel over bare soil), fertilizer, soil fumigation, and irrigation.

METHOD:

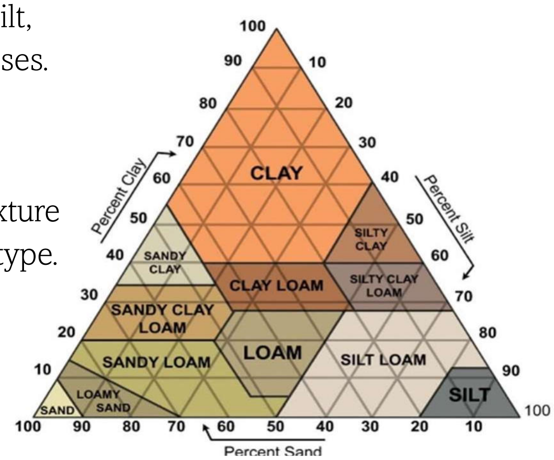
- Interview with land manager

Caveat: Management history is often approximated information. Focus on big-picture details.

3. Soil texture/Soil type:

Soil texture is defined by the proportion of sand, silt, and clay in the soil. There are twelve texture classes. Example: clay, sandy clay, sandy loam.

Soil type refers to a highly detailed, taxonomic classification of soils. It is more complex than texture but texture is a substantial factor in defining soil type.



The soil texture pyramid.

METHOD:

- Guide to texture by feel
- Mason jar texture test
- Laboratory texture test
- Web Soil Survey of soil type

Caveat: Texture by feel is free and immediate, but takes practice. A jar test takes time and has some margin for error, but is free and easy. A laboratory test costs money and is not always needed, but provides high accuracy and precision. A soil texture assessment could differ from the web soil survey soil type description due to historical management, but the Web Soil Survey is standardized, easy, free, and fast.

4. Site Characterization:

Data collected for soil health analyses are snapshots. These snapshots are affected by season, weather, and natural variation in sample collection. On a given day, soil health measurements may not reflect the typical soil condition. For instance, plant growth may be stunted in some areas due to compaction. But, if the soil is uncharacteristically wet on the day the field is sampled, compaction will be underestimated by the penetrometer.

Site-scale observations can provide a reality check for unexpected measurements.

Examples of site characteristics worth noting:

- Plant growth
- Plant stress during wet or dry weather
- Soil-borne disease
- Erosion
- Soil crusting
- Water ponding

Remember to note any spatial variation in the area. Comparisons to nearby areas can be relevant. For example, does one field or garden bed look bad but a neighboring area looks good?

Some soil health characteristics are only clearly visible under certain conditions (e.g. wind erosion, ponding) or are most easily observed through their effect on plants.

METHOD:

- Interview with land manager.
- Walk the land during a single visit.
- Visit the land several times throughout the season or over multiple growing seasons.

Caveat: Site-scale characteristics are generally the result of interactions among many factors. For example, ponding may occur simply because a spot in the field is slightly low-lying, but this ponding could be made worse because of compaction. Care must be taken in associating site characteristics with soil health tests.

Soil Health
Testing Methods

<u>Method Use Key</u>

 Demonstration/Educational

 Quick Check

 Routine Check

 In-Depth Assessment

Aggregate Stability - Physical

Background

Pick up a handful of soil and observe the naturally occurring little balls that have formed; these are soil aggregates, soil particles bound together. Aggregates can be microscopic or more than an inch in diameter. Aggregates are held together by chemical bonds between negatively charged particles (clay, silt, organic matter) and positively charged elements (calcium, magnesium, potassium, sodium). Aggregates are also held together by sticky substances made by soil microbes, and by the physical reinforcement of plant roots and fungal networks.

Aggregate stability tests measure how well these balls of soil particles hold together when they are disturbed.

Disturbance can mean tillage, the impact of rainfall, or the rewetting of a dry aggregate. Aggregate breakdown is associated with soil compaction, reduced water infiltration, increased erosion, and increased surface runoff. Decreased aggregate stability is associated with decreased microbial activity due to habitat loss.

Aggregate stability is heavily impacted by soil texture. For example, sandy soil would be expected to have less aggregate stability than clay soil because sand does not have a charge and does not form chemical bonds with other soil particles.

Slake   Slump   Aggregate Stability Test Kit

SLAKE TEST

Items: Tap water, mason jar, wire basket.

Prep time: 48-hour aggregate airdry.
Test time: 5 minutes.

Method: Find an aggregate on the soil surface about 1 inch in diameter. Allow the aggregate to air dry for 48 hours in a warm, dry location. Do not place in an oven, this can affect the result. When aggregate is dry, place a wire basket in a mason jar. SLOWLY and GENTLY place the air-dried aggregate in the basket.

Observe how much of the aggregate breaks down and falls through the basket within 5 minutes. Can perform on just one sample or compare different soil types or different management practices. Demonstrations typically use 1 aggregate per field or management type.

Collect 5 – 10 aggregates per field, up to five acres
Record and rank aggregate breakdown according to the following chart (Table 1).

Table 1. Ranking scale for the slake test. Modified from the scale for the Aggregate Stability Test Kit.

Rank	Criteria
0	The soil immediately disintegrates and falls through the mesh.
1	50% or more of the soil falls through the mesh within the first five seconds.
2	50% or more of the soil falls through the mesh within 5 – 30 seconds.
3	50% or more of the soil falls through the mesh within 30 seconds to 5 minutes.
4	10 – 25% of soil remains in the basket at 5-minute mark.
5	25-75% remains in the basket at 5-minute mark.
6	75 – 100% remains in the basket at 5-minute mark.

Interpretation: Imagine dry soil in summer receiving rainfall. Water rushes inside the aggregates, displacing and trapping air. Internal pressure to build up. This can cause an unstable aggregate to fracture and break down. Some soils will not have any aggregates large enough for this test. The lack of large aggregates could indicate a history of soil disturbance or a sandy soil. Some aggregates will break down almost immediately. This indicates poor aggregate stability. If large aggregates are formed but don't hold together, the soil is likely low in soil organic matter. The more that the aggregate holds together, the better.

Caveat: If the aggregate holds together until the end of the test, break it open. If it is dry inside, this is a bad sign. The aggregate held together, but water was not able to enter the aggregate. This soil will have issues with compaction, water infiltration, and water retention.

SLUMP TEST

Items: Tap water, mason jar, dish strainer, splat board.

Prep time: none
Test time: 1-2 minutes

Method: Take a handful of surface soil. Crumble so any large aggregates are ½ cm diameter. Place in a dish strainer. Place the strainer in a jar of water to wet the soil for one minute. Flip strainer over onto the splat sheet.

Observe how well the soil holds the form of the strainer, and how much the base spreads out.

Interpretation: If the soil looks like pudding and spreads out, it has poor aggregate stability. If the aggregates hold together and form a structure that looks closer to a lava cake, it has good aggregate stability.

AGGREGATE STABILITY TEST KIT

<u>Items:</u> Distilled water, aggregate stability test kit box, stopwatch, mist bottle for dry soils.

<u>Prep time</u>: 1.5 hours total. 30 minutes to collect samples and 1 hour to airdry after samples are collected.

<u>Test time</u>: 10 – 20 minutes.

<u>Method</u>:

1. Randomly collect 9 aggregate samples from the soil surface and 9 aggregate samples from the depth of typical/historical disturbance. Ideally from up to 2 acres, maximum up to 5 acres. Aggregates should be 6 – 8 mm in size (Half the width of the average pinkie fingernail; 0.6 – 0.8 cm. There are 2.5 cm in an inch.)

2. Place samples in each sieve in the first box. Allow to air dry for one hour. Best to complete this test in the field. Jostling during transportation back to the office will break aggregates.

3. Once dry, fill the second, empty box with distilled water to a depth of 2 cm.

4. Before placing samples in water, note that each sample must be observed at 5 seconds, 30 seconds, and 5 minutes using the assessment chart (Table 2). At the 5-minute mark, sieves must be dipped in and out of water five times.

To hit these time points, gently place 9 sieves with their aggregates in the cells filled with water 30 seconds apart. By the time you complete the 9th sample, it will be almost time to begin the 5 minute read on the first sample. Use values 0 – 3 on Table 2 for readings in the first 5 minutes.

5. Once the 5 minute read is collected using values 0 – 3, move each sieve up and down five times, removing it fully from the water each time. It should take 1 second to remove the sieve, and 1 second to replace the sieve, for a total of 2 seconds per up and down cycle. Be consistent. If you followed the timing, you have 30 seconds per sample to complete this step. This step is completed on all samples with greater than 10% of the original aggregate remaining.

Record the final result using values 3 – 6 on Table 2.

Table 2. Soil stability ranking table. Original table source is Herrick et al., 2001.	
Rank	Description
0	Soil too unstable to sample*
1	50% of the sample breaks down within 5 sec
2	50% of the sample breaks down in 5 -30 sec.
3	50% of the sample breaks down in 30 sec – 5 min. OR < 10% of the sample remains after 5 dipping cycles
4	10 – 25% of the sample remains after dipping cycles
5	25 – 75% Of the sample remains after dipping cycles
6	75 – 100% of the sample remains after dipping cycles.

* No aggregates large enough or that hold together even if misted with water.

Interpretation: The data from the first five minutes is nearly identical to a slake test. The difference is aggregate size and volume of samples. These small aggregates are critical for soil function, and are easier to find in soils with lower clay content and increased disturbance compared to the large aggregates used in a jar slake test. This data indicates how a dry soil will initially respond to re-wetting.

The data taken after the dipping cycle represents increased force acting on the aggregate, similar to water infiltrating and draining or water running across the surface. The aggregates are wet when this step begins, and this indicates how aggregates hold up throughout a precipitation or irrigation event.

In general, a higher rank means better aggregate stability! This test is best used to look for improvements over time after a significant management practice change is made. This test can also be interesting to compare the two fields with the same management practice on different soil types, or to compare two fields with different management practices on the same soil type.

To improve the quality and interpretation of this test, consider reviewing the Herrick paper. It is easy to read and understand.

Soil Compaction - Physical

Background

Compaction is measured in PSI, pressure per square inch. The PSI indicates structure and pore space. Fluffy, chocolate cake soil is less compact. Pudding cup soil is more compact.

Compaction is affected by soil texture and management. Clay soils are likely to be more compact than sandy soils. Small clay particles clog up soil pores, increasing compaction.

Tillage is a temporary fix for compaction. Tillage creates a fluffy structure at first, but that structure will collapse within the growing season. Tillage breaks up the components that maintain fluffy, well-structured soils: roots, channels created by roots, channels created by soil fauna, fungal hyphae, and biological glues released by fungi and bacteria.

Foot and vehicle traffic will also compact soils from the surface pressure. This includes farm equipment, vehicles, human walking paths, fields used for athletic activities, and grazing animals on pasture. Soils are more susceptible to compaction from this surface pressure when they are wet. A single, significant compaction event – such as using a wet field as a parking lot – could result in long-lasting compaction evident over 20 years or more.

Soil compaction is also connected to aggregate stability. Increased aggregate stability is associated with decreased compaction.

As PSI increases, compaction increases. As compaction increases:

1. Root growth decreases. Root exploration comes to a halt at or above 300 PSI. Once 300 PSI is reached, root growth will be limited to existing cracks or pores in the soil.
2. Water infiltration decreases. Water enters the soil slowly and drains slowly. The soil is more susceptible to ponding, runoff, erosion, drought, and waterlogging.
3. Soil aeration decreases, compromising roots and soil creatures who require oxygen for respiration.
4. Habitat decreases. Bacteria, fungi, earthworms, and insects struggle to live, and contribute less to soil structure, carbon storage, and nutrient availability for plants.

Wire Flag

Penetrometer

WIRE FLAG

Items: One wire flag

Prep time: None

Test time: 1 second

Method: Hold the flag at the top and push the wire into the ground until it bends. If the wire goes in easily to a depth of 12 inches, the soil is not considered to be compact. If the flag does not go in 12 inches, measure the length of the wire that does enter the ground before bending. This tells you where the compaction begins.

Interpretation: This test is short and sweet. Do you have compaction, yes or no. You can also ask: what depth does the compaction start? Compaction that begins 6 inches deep is not as bad as compaction that begins 2 inches deep. This gives you an immediate understanding of the conditions that plants are experiencing as they try to root. This also gives you an immediate understanding of how easy it might be for water to enter the soil. Where compaction starts, drainage slows down.

PENETROMETER

Items: Penetrometer, analog or digital

Prep time: None

Test time: 1 minute per sample

Method:
Push the penetrometer into the soil, using consistent pressure. Record the depth at which pressure above 300 PSI begins.

Record values at 3-inch intervals. The penetrometers have tick marks every 3 inches. Analog versus digital is subjective. Digital records the value as you go. Take 10 – 20 readings per field, up to 5 acres. Use the small tip for hard or rocky soils.

Interpretation: Compaction is ranked as good (0 – 200 PSI) elevated (200 – 300 PSI) or bad (over 300 PSI). Use these readings for detailed quantification of compaction relative to depth.

Caveat: Don't overemphasize the precise number from the digital penetrometer. Soil moisture and your personal downforce on the penetrometer will affect the precise number. To track changes over time, the digital penetrometer is better if values are assessed with the understanding that they can have a significant, but poorly defined, margin of error.

Water Infiltration - Physical

Background

Water infiltration is simply the rate at which water enters the soil, typically measured as inches per hour. If water cannot quickly and easily enter the soil, bad things happen:

- Water runs across the soil surface, eroding the soil and carrying nutrients with the water; this steals topsoil, results in less nutrients for plants, and contributes to environmental pollution.
- Less water is stored in the soil to support plant growth, so more frequent irrigation is required.
- It is easier for drought conditions to develop, and harder to reverse drought.
- Ponding is more likely to occur in low-lying areas, producing difficult wet spots that stunt plants and encourage disease.

Water Infiltration Ring

WATER INFILTRATION RING

Items: Infiltration ring, mallet, wood block, tap water, graduated cylinder, plastic wrap, stopwatch.

Prep time: 5 minutes

Test time: 1 hour

Method: Remove any large debris from the soil surface. If measuring a grass system, leave the grass. The grass and thatch will affect the infiltration rate.

Place the wood block over the infiltration ring. Hit the block with the mallet to drive the ring into the ground without bending it. Uniformly drive the ring into the ground until it is three inches deep. Gently press soil around the inside of the ring to eliminate any gabs that formed.

Drape plastic wrap over the ring, covering the soil. Using the graduated cylinder, add 444 ml of water to the ring on top of the plastic wrap. This is equivalent to adding 1 inch of water. When ready, pull the plastic wrap away letting all the water enter the ring and come into contact with the soil. Start the timer. Record how long it takes for the water to fully enter the soil.

This test is time consuming, and there can be a lot of variation. 1 test gives a nice estimate.

To increase the quality of the test, repeat it several times throughout the field.

Interpretation: Consider rain events in New England. Is the soil able to handle a summer rainstorm, a fall Nor'easter? Consider our hilly landscape. Is a pasture, cropland, golf course, or garden on a hillside extra-susceptible to runoff due to poor infiltration rates?

Measuring water infiltration is a great way to identify risks and set priorities. Poor water infiltration is associated with compacted soils, poor aggregate stability, and low soil organic matter. This information can help prioritize which fields are most in need of soil-health minded management.

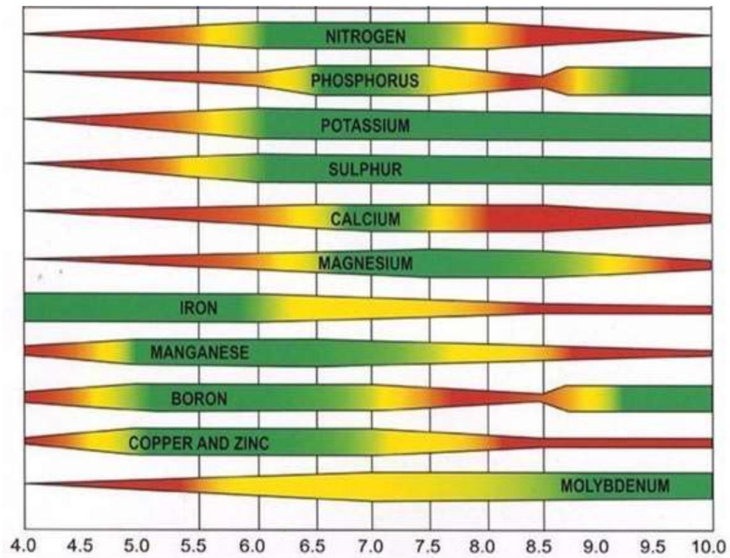
Soil type will affect infiltration rate. Sand has the largest infiltration rate potential (nearly an inch per hour) and clay has the smallest infiltration rate potential, less than $1/5^{th}$ of an inch per hour. Loamy soils are in the middle, around ½ in per hour.

Caveat: Soils that are bone dry will initially have a lower infiltration rate, but the rate will improve after some water has time to work its way in. Soils that are very wet will be too saturated to accept more water, also resulting in a low infiltration rate. Consider the question you are asking. Do you want to know how a field will accept water when it is bone dry? Do you want to know if a soil is so saturated it can't accept any more water? Do you want to get an assessment of "normal" infiltration? If you want a "normal" assessment, pre-wet the area if it is excessively dry before beginning the test.

pH – Chemical

Background

Soil pH impacts plant available nutrients. For example, when we measure calcium with a laboratory test, there is far more calcium in the soil than what we measure; the laboratory test measures calcium in a form that plants can easily access.



Each plant nutrient has an optimum pH. Some plants are said to be "acid-loving", meaning they like a low pH. In fact, these plants, like blueberries and rhododendrons, like iron, which is more available at low pH.

A quick soil pH test can help identify fertility problems. But, a good pH does not mean that a soil definitely has enough nutrients. For example, a soil may have a pH of 6.5 where phosphorus and potassium are very available to plants, but the soil could still be deficient in phosphorus and potassium simply because these nutrients have not been added to the soil.

However, a low pH result is a quick indication that there is a problem to be solved. In New England, soils are naturally acidic due to rainfall and the original materials that our soils are made out of. To increase the pH, we add lime.

How much lime? You need a proper soil test for that.

Why? Some soils are more stubborn than others. Stubborn soils have more "exchangeable acidity", and it takes more lime to raise the pH of a stubborn soil. This is why two people could have a pH of 5.5 but get different lime recommendations after a laboratory soil test. Measuring exchangeable acidity requires chemicals found only in a laboratory setting.

To better understand lime and pH, review the factsheets linked at the end of this document, reach out to the UMass Soil Health Educator, or reach out to the UMass Soil and Plant Nutrient Testing Laboratory.

pH Soil Slurry & Test Strip pH Test

SOIL SLURRY & TEST STRIP pH TEST

Items: distilled water, cup, pH test strip, soil probe, bucket, ½ measuring cup.

Prep time: 25 – 45 minutes total. 10 – 30 minutes to collect a soil sample, depending on field size, plus 15 minutes for the soil slurry to sit before testing.

Test time: 5 seconds.

Method: Soil pH can be conducted on a field up to 20 acres. Randomly collect approximately 20 soil samples using a soil probe, mixing them together in a bucket as you go. Sample distinct sub areas separately. For example, uphill versus downhill, a garden bed versus a lawn area.

Mix the 20 samples together very well in the bucket. Using the ½ measuring cup to scoop up some well-mixed soil and place it in a cup. Fill the ½ measuring cup with water and add it to the soil to create a 1:1 ratio. Mix well. A stick, pen, pencil, or finger are all acceptable mixing tools. Allow the mixture to sit for 15 minutes.

After 15 minutes, the soil particles will settle to the bottom of the cup. Dip a soil pH strip into the liquid and determine the pH using the color chart on the pH strip box.

Interpretation: A pH of 6.5 - 7 is considered ideal for most crops (excluding iron-lovers, like blueberries and azaleas). A pH of 6 indicates that lime will be needed, but pH is probably not a major, limiting factor. A pH below 6 indicates that pH is a significant limiting factor for plant growth. The lower, the more problematic.

Soil with a pH below 6 is in need of lime, and a soil test is recommended to provide specific guidelines.

Caveat: Could you apply lime without a lab test and recommendation? Sure. In some case,s it might even be a good idea to get a jump start. But there is nuance, and too much lime creates new problems. Ask the UMass soil health educator or the UMass testing laboratory for help if you think applying lime before/without getting a soil test might make sense (i.e. pH is very low).

For iron-loving plants, a pH of 4.5 is ideal. Lowering pH is an easier approach than raising pH. You don't need to know reserve acidity, and if you take a good soil sample, you could skip the lab test. If pH needs to be lowered, follow the sulfur application recommendations found here:

https://ag.umass.edu/sites/ag.umass.edu/files/fact-sheets/pdf/spttl_3_adjusting_soil_ph_0.pdf

Soil Critters - Biology

Background

Soil biology affects many processes in the soil ecosystem including nutrient dynamics, disease, and soil structure. Bacteria and fungi are responsible for decomposition of organic residues, transforming organic and mineral nutrients into plant-available forms and promoting soil aggregation through the release of various organic glues, among their many other activities. On the other hand, microbes can also release greenhouse gases into the air, cause plant disease, and compete with plants for resources. Additionally, diverse microbial ecosystems are difficult to directly observe. While there are research-focused lab tests which can usefully distinguish between management induced soil health differences *in the same soil*, there are not yet standard biological benchmarks for a healthy soil.

Instead, soil biological health can be qualitatively assessed by looking for visual indications of a robust soil ecosystem. Often, this means looking for evidence of larger animals which feed on microbes rather than the microbes themselves.

Caveat: Soil life is highly sensitive to environmental conditions. It's very important to understand soil biological observations as a snapshot of the soil. Additionally, soil life must be thought of in the context of a soil's function. For instance, the same earthworms in a forest soil may cause excessive decomposition of surface residues while they could serve an important role in tilled fields by creating macropores for water movement and root growth.

EARTHWORM SAMPLING AND IDENTIFICATION

Items: Shovel, magnifying glass, earthworm identification book, tap water, mustard powder.

Prep time: 10 minutes

Test time: 10 minutes

Method: Dig a one square foot hole 12 inches down. Collect the soil from the hole on a tarp. Mix 2 tablespoons of mustard powder into one half gallon of tap water. Pour water and mustard into the bottom of the hole. Count and identify the worms from the removed soil as well as any that came into the hole after mustard application.

Interpretation: Finding more than 10 worms likely means that there is a fairly health soil ecosystem. While in many cases a high worm population is indicative of a healthy soil, almost all earthworms in New England are introduced species that are not necessary for biological soil health. In fact, some can even be very disruptive in forest ecosystems. If you don't find many worms but the soil and larger ecosystem otherwise looks good, it's not anything to worry about.

Jumping worms (*Amynthas* spp. and *Metaphire* spp.) are of particular note currently because they are relatively new to the area and their long-term impact on New England ecosystems is unknown. They can be identified by the fact that the clitellum (the band or belt close to the head) wraps entirely around the worm's body rather than looking like a saddle on other Massachusetts worms. Jumping worms are also very wiggly and have bristles that can be seen with a magnifying glass. Detailed identification of earthworm species can be useful since different species have different soil habitats and activities.

FUNGAL OBSERVATION

Items: Shovel, magnifying glass.

Prep time: Less than one minute to collect a shovel of soil.

Test time: 5 minutes to carefully examine soil

Method: After collecting a shovel of soil, carefully break apart aggregates looking for fungal hyphae. Many soil fungi live most of their lives as networks of thread-like hyphae which often look like very fine white roots. Look near the roots of plants as many mycorrhizal soil fungi form partnerships with plants.

Interpretation: Like most soil biology, fungal hyphae are sensitive to environmental conditions and may be more or less visible depending on the time of year or soil moisture. It's not uncommon for there to be little visible fungal growth in the spring and late fall even in a healthy New England soil.

NODULATION OBSERVATION

Items: Shovel, magnifying glass, legumes.

Prep time: Less than one minute to dig up a legume.

Method: Gently remove soil from the roots of the legume. Look for pink lumps attached to the roots.

This method requires that legumes are present. The legumes could be a crop such as beans or clover, a cover crop such as field peas, or a weed such as white clover or alsike clover (note, oxalis species are commonly confused as legumes, but they are in the wood sorrel family and are not legumes).

Interpretation: The nodules are the creation of legume plants and rhizobia bacteria. Together these organisms turn nitrogen in the air into a plant-available nutrient. They are generally not found below about 50°F or when large amounts of nitrogen fertilizer or manure are applied. This test would be most useful for assessing different sections of a field where different plant growth was observed.

BIOPORE OBSERVATION

Items: Shovel, magnifying glass.

Prep time: Less than one minute to collect a shovel of soil.

Test time: 5 minutes

Method: Examine the soil surface for biopores. Looking under leaves and residue. Carefully dig up a shovel of soil and look at the soil profile for biopores. The biopores are generally one to several millimeters across and will look like small tubes going through the soil.

Interpretation: Biopores are a useful indicator of biological activity because they remain visible for some time after an animal has made them. This means that biopores are more consistent over the course of a day.

INSECT OBSERVATION

Items: Shovel, magnifying glass.

Prep time: Less than one minute to collect a shovel of soil.

Test time: 5 minutes

Method: Directly observe the soil surface looking under leaves and residue. Dig up the top few inches of soil and gently break it apart looking for invertebrates. Notable animals may be collected for further identification.

Interpretation: A warm and healthy soil will have some invertebrates in it. Finding different types of insects or spiders is a better sign that the ecosystem is functioning well than finding lots of one kind of animal. Consider that some invertebrates can cause severe damage to plants, so even though cutworms and slugs may be indicators of a robust soil ecosystem, they may still be unwelcome.

Additional Resources

Soil Test Items

Soil Probes – for collecting samples for a routine fertility test.

Spade – for conducting samples for laboratory soil health tests.

References

USDA NRCS In Field Soil Health Assessment Guide, 2019

https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=44419.wba

USDA NRCS Soil Quality Test Kit Guide, 2001

https://www.nrcs.usda.gov/sites/default/files/2022-10/Soil%20Quality%20Test%20Kit%20Guide.pdf

Guide to Texture by Feel

https://www.nrcs.usda.gov/sites/default/files/2022-11/texture-by-feel.pdf

Mason Jar Soil Texture Test

https://extension.unl.edu/statewide/lincolnmcpherson/Soil%20Texture%20Analysis%20%E2%80%9CThe%20Jar%20Test%E2%80%9D.pdf

USDA Web Soil Survey

https://websoilsurvey.nrcs.usda.gov/app/

UMass Soil and Plant Nutrient Laboratory Sample Test Forms

https://ag.umass.edu/services/soil-plant-nutrient-testing-laboratory/ordering-information-forms

Field soil aggregate stability kit for soil quality and rangeland health evaluations. Herrick et al., 2001.

https://www.ars.usda.gov/ARSUserFiles/30501000/SoilAggStabKit.pdf

UMass pH Factsheet and Directions to Lower pH

https://ag.umass.edu/sites/ag.umass.edu/files/fact-sheets/pdf/spttl_3_adjusting_soil_ph_0.pdf

Crop codes for soil tests:

https://ag.umass.edu/sites/ag.umass.edu/files/fact-sheets/pdf/spttl_10_master_crop_code_list_1.pdf

Forms

The following sleeves contain forms. Please help yourself.

Forms include:

Site visit data sheet

Aggregate Stability Test Kit data sheet

Soil Compaction (penetrometer) data sheet

Laboratory Sample: Routine Soil Test form

Laboratory Sample: Soil Texture