

# Soil Sampling Guidelines

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# Overview

**The Regenerative Organic Certified™ (ROC™) Soil Health and Land Management Pillar requires soil testing, both lab tests and field tests, every three years.** This document provides guidance on the requirements for those tests. Although soil testing is required, **certification decisions will not be based on soil testing improvements or results.**

The ROA's intention with soil testing is to provide valuable qualitative and quantitative information on the physical, chemical, and biological properties of soil that influence and are influenced by agricultural practices. Lab tests of soil samples provide quantitative measures of important health metrics, such as soil organic carbon & texture. Soil testing also enables tracking soil carbon content to potentially measure carbon sequestration over time.

**During your first ROC certification cycle, your operation must conduct soil health lab tests for five indicators (page 4) and provide the results to your auditor during the initial audit.** After initial certification, these tests should be performed every three years. These Soil Sampling Guidelines also provide a list of recommended indicators (page 4) to test each year—these are not required.

**Field soil health testing (i.e. performed in the field without using a lab) is also required for all operations every three years.** Operations may choose six of 10 recommended field tests (page 9). An overview of recommended in-field testing indicators is included in this document. For additional guidance, please refer to the resources provided at the end of this document (starting on page 10) and at [RegenOrganic.org/resources](https://regenorganic.org/resources), a local agriculture research or support agency, and/or your accredited soil health testing lab.

**Please record the GPS coordinates of your sampling locations at the time of sampling.** You will be asked to submit these at the time of audit by your auditor and record them on your in-field soil test worksheet. Most smartphones allow you to drop a pin and see coordinates.

Soil science is a rapidly evolving field. As our understanding of the relationship between regenerative organic management practices, soil health and soil carbon changes, the ROC Soil Sampling Guidelines and ROC Framework will be updated as needed to incorporate new insights, methods, proxies and technologies for measuring and interpreting soil health.

## Process for ROC Soil Sampling

1. Find an accredited lab and ensure they are capable of performing all required ROC soil tests
2. Determine sampling locations and follow the ROC sampling protocol (page 11)
3. Submit samples to the lab, record results, and identify areas for improvement
4. Conduct field tests to measure progress
5. Repeat and record the soil health lab and field tests every three years

# Lab Tests

Soil lab tests help your operation understand the physical, chemical, and biological composition and characteristics of your soil. Having your soil professionally tested helps you identify deficiencies, troubleshoot problem areas, and optimize soil amendments based on your land's specific needs. In addition, regular soil tests can demonstrate progress and the effectiveness of regenerative organic practices over time.

## Required & Recommended Tests

The ROC requires five lab tests to be conducted at initial certification and four tests every three years thereafter. Other lab tests are recommended to improve the overall picture of your soil health but are not required.

<b>Required indicators (first year)</b>	<b>Required indicators (every three years)</b>	<b>Recommended (every three years, must pick one)</b>	<b>Recommended (every three years)</b>
pH / Electrical Conductivity (for semi-arid environments)	pH / Electrical Conductivity (for semi-arid environments)	<i>Aggregate Stability</i>	<i>Extractable P</i>
Soil Organic Carbon (Soil Organic Matter is acceptable if SOC is not available, accompanied by letter from lab)	Soil Organic Carbon (Soil Organic Matter is acceptable if SOC is not available, accompanied by letter from lab)	<i>Total Soil Nitrogen</i>	<i>Extractable K</i>
Bulk Density	Bulk Density	<i>Total Microbial Biomass</i>	<i>Cation Exchange Capacity</i>
Soil Texture		<i>Extractable Micronutrients</i>	
		<i>Active Carbon - PoxC</i>	
		<i>Water Holding Capacity</i>	

A full list with descriptions of the required and recommended indicators is provided in Appendix B. For more detail on the indicators and interpretation of results, contact your lab or consult the resources provided at the end of this document.

## Testing Availability

Some soil testing labs may not offer or be capable of performing all the required tests. If this is the case, you may need to contact multiple labs in your region to complete testing for all of the required indicators.

In cases where a certain indicator(s) is unavailable at testing facilities within a reasonable distance, you must provide proof to the auditor in the form of a letter from the accredited lab(s) in your region that a test is not available.

## Soil Organic Carbon

There are two analysis methodologies to test for soil organic carbon: 1) Automated Dry Combustion (Automated DC) and 2) Loss on Ignition (LOI) methods.

ROC requires that the Automated DC method be used where available. This testing method provides the most accurate and consistent results for soil organic carbon. You may need to contact your testing provider directly to ask if they can perform the Automated DC test.

In cases where the Automated DC method is unavailable at testing facilities within a reasonable distance, you must provide proof in the form of a letter from the accredited lab(s) in your region. If Automated DC is unavailable, the LOI method may be used.

During your ROC audit you must provide evidence of the testing method (DC or LOI) used by your lab.

## Using an Accredited Lab

The lab tests for the required soil health indicators should be performed by an accredited laboratory such as a university, state agricultural agency, or private organization with soil analysis expertise. The testing organization should comply with one or more of the following:

- Adhere to the guidelines in the ISO 18400 series of standards (Soil Quality Sampling)
- Participate in the North American Proficiency Testing Program (NAPT) or an international equivalent
- Follow the protocols outlined by a reputable organization with soil testing expertise, such as:
  - Cornell University's Comprehensive Assessment of Soil Health (CASH) - <https://soilhealth.cals.cornell.edu/>
  - Soil Science Society of America – Methods for Soil Analysis - <https://acsess.onlinelibrary.wiley.com/hub/books/methods-soils>
  - The FAO Global Soil Laboratory Assessment - <http://www.fao.org/3/ca7091en/CA7091EN.pdf>

## Where to Sample

Soil sampling should occur on the same fields or areas for each sampling cycle (every three years).<sup>\*</sup> For operations larger than one hectare, choose three sampling locations: one representative plot, your best plot, and your worst plot. For operations less than one hectare, sample from two locations: your best and worst plots. Guidance for how to best determine these plots is provided below. A field or parcel where sampling consistently takes place is referred to in this document as a “**sampling location**”.

*\* Note: For shareholders, co-ops, and grower groups where the ROC Group Sampling Methodology is applied, soil sampling must be conducted at the same farms for each three-year sampling cycle. Soil sampling should be conducted at farms that provide a representative sample of soil health for the grower group and region(s), based on soil types and morphology, crops and growing practices, geography, and other relevant land characteristics.*

How to determine sampling plots:

Representative plot	Best plot	Worst Plot
Representative of your operation’s standard activities and is informed by the variation in landscape and soil type	Representative of your operation’s best soil. Qualities include but are not limited to: water infiltrates well, yields are high, low pest/weed/disease pressure, good tilth, and good germination	Representative of your operation’s worst soil. Qualities include but are not limited to: water ponds or runs off, poor yields, high pest/weed/disease pressure, hard to work up, and seeds germinate slowly

## Number of Sampling Locations

The number of sampling locations required to meet the ROC criteria depends on the size of your business operation(s) within your ROC certification scope. At least two soil samples must be taken from each distinct operation. For larger operations, an additional soil sampling location is required.

Distinct operations are those that use different management practices and/or are non-integrated. Operations are considered non-integrated if they are physically separated and managed independently. Non-integrated operations may include those that produce different crops or livestock, such as perennial versus annual crops or separated crop and

livestock production. For additional guidance on determining the number of distinct operations on your farm, contact your certification body or the ROA.

Integrated operations include those that utilize crop and animal rotations through all areas of the farm. Where operations are integrated, this should be documented and can be considered a single operation.

The table below provides examples for the required soil sampling locations based on operation type and size. For additional guidance on determining the number of samples needed for your farm, contact your Certification Body or the ROA.

Description		Operation Type	Parcel Size (ha)	Sampling Locations Required	Total Sampling Locations
Farm A	2-ha farm with 2 non-integrated operations: perennial fruits and annual vegetables	Perennial fruits	0.5	2	4
		Vegetables	1.5	2	
Farm B	20-ha farm with fully-integrated rotational grazing and annual crops	Integrated	20	3	3
Farm C	50-ha farm with no-till and conventional-till parcels	No-till	10	3	6
		Conventional tillage	40	3	
Farm D	150-ha farm with rotationally grazed chickens and cattle, and separately managed rotated annual crops	Integrated livestock	120	3	6
		Integrated crops	30	3	

## How to Sample

Sampling should be conducted in the same way year-to-year to ensure consistent results. Sampling Protocols A and B in Appendix A (page 11) provide step-by-step instructions for taking samples in-field at each sampling location. You may follow the ROC-provided protocols or refer to your sampling lab and the resources provided at the end of this document for accepted sampling methods.

## Sampling Time

Soil sampling should occur at a time of year most reflective of typical conditions on your operation. Sampling should not be conducted at a sub-optimal time solely for the purpose of meeting ROC requirements. Appropriate soil sampling times will depend on your operation, location, and growing season. Sampling should not occur shortly after disturbance or amendments to the soil, such as primary/secondary tillage or applications of manure,

compost, and fertilizer. Sampling should be conducted at roughly the same time of year and dates and coordinates should be documented in your testing records.

### **Sampling Coordinates**

Please record the GPS coordinates of your sampling locations at the time of sampling. You will be asked to submit these at the time of audit by your auditor and record them on your in-field soil test worksheet. Most smartphones allow you to drop a pin and see coordinates.

### **General Sampling Process**

For most soil tests, you will take a sample according to the following general process, which is outlined in more detail in Protocol A:

- 1) Select a sampling location;
- 2) Identify **five** randomly located spots within the sampling location ("Subsample Locations");
- 3) Dig to a consistent depth (15cm/6in) and collect soil at each subsample location ("Subsamples");
- 4) Mix the subsamples together to create **one** composite sample for that sampling location.

Please note that the **Bulk Density** and **Available Water Capacity** tests require a different sampling method as outlined in Protocol B.

### **Submitting to the Lab**

For specific guidance on submitting your sample(s), contact your testing lab. General recommendations are provided here.

- 1) All samples should be stored and shipped in individual sealed plastic bags, preferably with a secondary container (e.g. double-bagged).
- 2) Label each sample clearly with the name of your farm, date, time, and location the sample was taken.
- 3) If possible, wear gloves when handling samples.
- 4) As much as possible, keep samples out of direct heat and sunlight. Refrigerate or otherwise keep samples cool before transporting to the lab.
- 5) Mail samples to the lab as soon as possible after collection and use rapid delivery where available.



## What to Do with Your Results

Documentation of completed testing and all results must be documented in your Regenerative Organic System Plan and provided to your auditor for certification and re-certification.

The results of your soil test can provide valuable information on your land's health as well as monitor the effectiveness of any management practices you have in place to improve certain aspects of your soil. For detailed guidance on interpreting the results of your soil tests, consult your testing lab, local agricultural agency, or the resources listed at the end of this document. If your tests identify deficiencies or areas to improve, these resources can also help you understand what soil amendments or management practices are needed to improve soil health and crop performance.

## In-Field Tests

Field tests are more qualitative than lab tests and can be performed right on your farm without special equipment. In-field tests can provide valuable insights into your operation's soil health and help inform adaptive management decisions.

This section provides some basic guidance on recommended field tests and how to interpret your field test results. For more information, we recommend contacting a local resource such as an agricultural research institution or extension office.

Producers are required to choose six of the following 10 field indicators. See "Summary of Recommended Field Tests" in Appendix B (page 16) for a summary of recommended field test details, how to assess them, and what the results mean for your soil. The ROA has also developed a video series explaining how to easily conduct these field tests and how they can inform management decisions—you can find these videos at [RegenOrganic.org/Resources](https://RegenOrganic.org/Resources).

### **Please record the GPS coordinates of your sampling locations at the time of sampling.**

You will be asked to submit these at the time of audit by your auditor and record them on your in-field soil test worksheet. Most smartphones allow you to drop a pin and see coordinates.

## Field Indicators

- |                            |                          |
|----------------------------|--------------------------|
| 1. Compaction              | 6. Plant health          |
| 2. Crusting                | 7. Root growth           |
| 3. Abundance of macro-life | 8. Structure/aggregation |
| 4. Ground cover            | 9. Soil color            |
| 5. Infiltration            | 10. Soil smell/taste     |

# Resources

Your certification body, soil testing lab, grower's group/co-op, or local research or extension agency are good resources to contact for questions related to the ROC soil testing requirements and completing the required lab tests. Additionally, the following resources may provide additional guidance and information related to soil sampling and interpreting results of your lab tests.

## **Cornell University**

- Comprehensive Assessment of Soil Health - The Cornell Framework (<http://soilhealth.cals.cornell.edu/training-manual>)
- College of Agriculture & Life Sciences and Testing Laboratory (<https://soilhealth.cals.cornell.edu>)

**European Soil Data Centre (ESDC)** - <https://esdac.jrc.ec.europa.eu>

## **ISO**

- Soil quality- vocabulary (<https://www.iso.org/standard/59259.html?browse=tc>)

**ISRIC: World Soil Information** - <https://www.isric.org/explore/library>

**The Rodale Institute** - <https://rodaleinstitute.org/why-organic/organic-farming-practices/soil-health/>

**U.S. Natural Resources Conservation Service (NRCS)** - <https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>

# Appendix A: Soil Sampling Protocols

The following sampling protocols are intended to serve as a general overview and reference point for collecting soil samples in accordance with the requirements of Regenerative Organic Certified. Please defer to your specific lab's soil sampling protocol, if available.

## Sampling Protocol A: General Sampling

Follow this protocol for all ROC soil tests other than bulk density and available water capacity (to test bulk density and available water capacity, use Sampling Protocol B). This soil sampling procedure references page 27 from <http://www.css.cornell.edu/extension/soil-health/manual.pdf>.

### Applicable Soil Tests

- Active Carbon
- Aggregate Stability
- Carbon Stock
- Extractable micronutrients
- Extractable P, K
- Geometric Mean Diameter
- Mean Weight Diameter
- Nitrogen stock
- pH
- Potentially mineralizable N
- Respiration
- Soil organic carbon
- Soil organic matter
- Soil protein
- Soil texture
- Total soil nitrogen
- Total soil carbon
- Water content

### Materials/Supplies

- 1 bucket for each sampling location
- 1 bucket to hold supplies
- Marker or pen
- Straight shovel (sharpshooter or drain spade style)
- Cooler for sample storage and transfer
- Ice packs (optional); only needed for very hot days
- Gloves
- Sealable 4-liter (1-gallon) plastic bags, such as zip-top; double-bagging recommended

### Definitions

**Sampling Location:** The field or parcel of your farm where sampling is conducted. Sampling locations should be representative of the general activities of your operation and should be recorded using GPS coordinates. The sampling locations you use for soil lab tests must be consistent year to year. The number of Sampling Locations you need is determined by your farm size and number of distinct operations.

**Sub-Sample:** Within each field or parcel, you will collect five “sub-samples” that represent the sampling location. These are randomly spaced throughout the field and will be combined to form one composite sample.

**Sample:** The combined mixture of the sub-samples. This is your final “sample” that you will send to the lab for soil chemical analyses. One sample is submitted per sampling location (i.e. field).

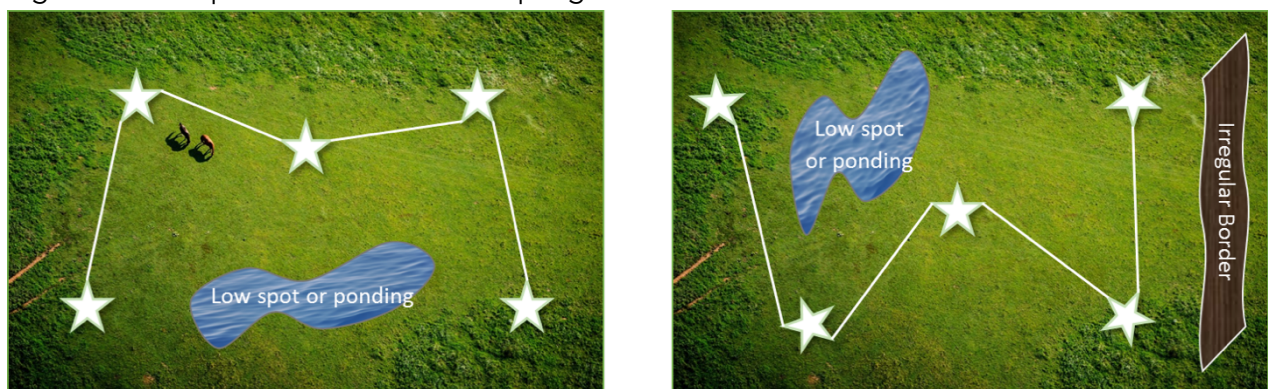
### **Selecting Sampling Locations**

Samples should be taken in the same locations (i.e. field or distinct parcel) consistently to track changes in soil health over time. Refer to page five for the required number of sampling locations for your farm.

For all sampling locations, be sure to do the following:

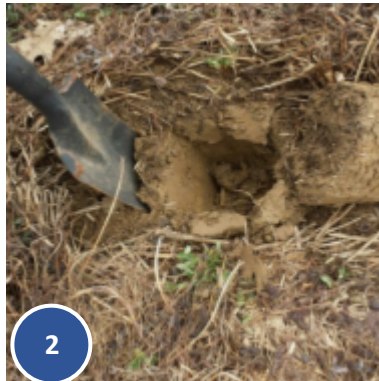
- 1) **Record Sampling Location(s):** Take the GPS coordinates (latitude, longitude) at the border points of your field or parcel (four to five points). GPS coordinates can be taken using a cell phone or an online tool such as Google Maps. You will provide the coordinates to your Soil Health auditor along with the soil test results. The same sampling locations should be used for all sampling in subsequent years.
- 2) **Determine Sub-Sample Locations:** For generally uniform fields (e.g., even crop performance, etc.), select five locations that are representative of the field or plot. Follow an M- or W-shaped pattern or select random locations spread throughout the field. Avoid borders or irregular areas. (See Figure A)

Figure A. Examples: General field sampling



## **Taking Your Samples**

- 1) Remove any debris on the soil surface. Use the drain spade to dig a hole 15 cm (6") deep.
- 2) From the side of the hole, use the drain spade to take a vertical, rectangular slice of soil 15 cm (6") deep and about 5 cm (2") thick.
- 3) Remove any extra soil to ensure that the sample is the same width at the top and bottom of the slice.
- 4) Place your sample in a clean bucket.
- 5) Identify another sub-sample site (within the same relative sample location). Place your second sample in the same bucket as the first sample and mix thoroughly. Repeat for all five sub-samples.
- 6) Place about 1-liter (4 cups) of your combined sample in a 4-liter (1-gallon) plastic bag, seal and label with the date and sampling location.
- 7) Double bag your soil sample. You can either place the single sample within another plastic bag or place multiple sample bags in a secondary, larger plastic bag.
- 8) Repeat steps 1-7 for each of your chosen sampling locations.



*Images courtesy of the Cornell University Soil Sampling Protocol and adapted for use by the Regenerative Organic Alliance*

## Sampling Protocol B: Bulk Density & Available Water Capacity

Follow this protocol for the Bulk Density and Available Water Capacity lab tests. This soil sampling procedure references [https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_050957.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050957.pdf).

### **Applicable Soil Tests**

- Bulk Density
- Available Water Capacity

### **Materials**

\*If you have a bulk density hand sampler or can borrow one from your testing lab, you may use that. If not, use the following materials to collect bulk density samples:

- Metal pipe/ring, approximately 10 cm (4") in length, 5 cm (2") diameter
- Hammer or hand sledge
- Wood block
- Garden trowel
- Flat bladed knife
- Sealable plastic bag (e.g. zip top)

### **Definitions**

**Sampling Location:** The field or parcel of your farm where sampling is conducted. Sampling locations should be representative of the general activities of your operation and should be recorded using GPS coordinates. The sampling locations you use for soil lab tests will be consistent year to year. The number of sampling locations you need is determined by your farm size and number of distinct operations.

**Sample:** Each bulk density core that you take represents one sample that is sent to the lab for chemical analyses. Three bulk density samples are submitted for each sampling location (i.e. field).

### **Selecting Sampling Locations**

Samples should be taken in the same locations (i.e. field or distinct parcel) consistently to track changes in soil health over time.

For all sampling locations, be sure to do the following:

- 1) **Record Sampling Locations:** Take the GPS coordinates (latitude, longitude) at the border points of your field or parcel (four to five points). GPS coordinates can be taken using a cell phone or an online tool such as Google Maps. You will provide the coordinates to your Soil Health auditor along with the soil test results. The same sampling locations should be used for all soil lab testing in subsequent years.
- 2) **Determine Sub-Sample Locations:** For generally uniform fields (e.g., even crop performance, etc.), select three locations spread throughout the field that are representative of the field or plot. Avoid borders or irregular areas.

### **Taking Your Samples**

- 1) Remove any vegetation, rocks, or debris from the soil surface. Place the metal pipe/ring on the flat field surface.
- 2) Place the wood block on top of the metal pipe/ring.



- 3) Using the hammer, drive the pipe fully into the ground, to a depth of approximately 10 cm.
- 4) Using the garden trowel, dig around the pipe.
- 5) With the trowel underneath the pipe, carefully lift it out to prevent loss of soil.
- 6) Remove excess soil with the flat-bladed knife, ensuring the sample is flat and even with the edges of the pipe.
- 7) Using the flat-bladed knife, push the sample into a plastic sealable bag. Alternatively, you can leave the sample in the pipe and request the lab to send it back.
- 8) Seal and label the bag with the date and location.
- 9) Repeat steps 1-8 for your other sub-samples.



Sampling materials: trowel, metal pipe, wood block, and plastic bag



*Photos courtesy of the Rodale Institute*

# Appendix B: Test Descriptions

## Description of Required Lab Indicators

Soil Health Indicator	Required or Recommended	Units	Measures	Interpreting Results
<b>ACTIVE CARBON - POXC</b>	<i>Recommended</i>	ppm	The proportion of organic matter that is highly labile and readily available to microbes.	Largely responsible for fueling microbial activity; improves with additions of “fresh” organic material (manure, leguminous cover crop residues, continual plant input through roots). Like soil respiration, active carbon can be a quick-to-respond soil health indicator.
<b>AGGREGATE STABILITY</b>	<i>Recommended</i>	%	An indicator of soil structure and resistance to intense “wetting” episodes like heavy rain and irrigation.	An indicator of soil structure, higher aggregation indicates optimum air and water movement through soils; aggregation generally improves with no-till and the addition of organic matter; can be directly reduced by physical disturbance.
<b>WATER HOLDING CAPACITY</b>	<i>Recommended</i>	g H <sub>2</sub> O/g soil	The amount of plant available water in the soil.	Largely determined by soil texture (clay content); Generally, increases with the addition of organic matter in both the short and long-term; important to gauge a soil's resistance and resilience to drought conditions.
<b>BULK DENSITY</b>	<b>Required</b>	g/cm <sup>3</sup>	A measure of soil compaction.	Both an indicator of soil structure (heavily compacted soils have higher bulk densities) and also necessary to measure carbon stocks over time. Generally, bulk density improves in the mid-term (~2-3 years) with the addition of organic matter and adoption of regenerative practices.
<b>EXTRACTABLE P</b>	<i>Recommended</i>	ppm	An indicator of how much P is available to plants.	More is generally better, however too much can cause environmental damages such as eutrophication.
<b>EXTRACTABLE K</b>	<i>Recommended</i>	ppm	An indicator of how much K is available to plants.	More is generally better and can be adjusted using specific amendments and organic fertilizers.
<b>PH</b>	<b>Required</b>	log-scale	A measure of soil acidity.	Soil acidity can impact nutrient availability (at low pH values, certain nutrients can become unavailable to plants). Specific crops can require specific pH ranges, and the pH of a soil can be adjusted through the use of amendments (e.g. lime additions for very acid soils, or sulfur additions for basic soils).
<b>RESPIRATION</b>	<i>Recommended</i>	mg CO <sub>2</sub> /kg soil	A measure of how active the microbial community is within a given soil.	Generally, more respiration means more biological activity, and thus indicates nutrient flows and availability (as microbes decompose organic matter to make



				nutrients available to plants). Generally, improves with the addition of organic materials and is one of the indicators most sensitive and fastest to respond to changes in management.
<b>SOIL ORGANIC CARBON (SOC)</b>	<b>Required</b>	g C/g soil	The amount of organic carbon within a gram of soil.	Necessary to accurately measure carbon stocks over time. Significant (and meaningful) changes in carbon stocks are very difficult to detect over short time scales (<5 years). <b>SOC makes up about 58% of soil organic matter.</b>
<b>SOIL ORGANIC MATTER</b>	<b>Required</b>	%	A measure of all material that was or is living in the soil.	Confers a host of beneficial biological (food source for microbes), physical (improves soil structure, holds onto water, improves aeration), and chemical (binds nutrients) properties. In the short-term (1-3 years), soil organic matter levels can increase with the addition of compost, manure, and crop residues, but to sustain and build levels over time, continued regenerative practices are necessary.
<b>SOIL TEXTURE</b>	<b>Required</b>	% sand, % silt, % clay	The percent sand, silt, and clay in the soil.	An important mediator variable to determine a soil's potential for accumulating organic matter; an inherent soil characteristic, soil texture generally does not change in response to management.
<b>TOTAL SOIL NITROGEN</b>	<b>Required</b>	g N/g soil	The concentration of total nitrogen present in the soil.	Different forms of nitrogen can be converted to plant-available nitrate. More is generally better for plant growth, though excess amounts can cause environmental damage through runoff leaching or greenhouse gas emissions.
<b>CATION EXCHANGE CAPACITY (CEC)</b>	<i>Recommended</i>	meq/100 g or cmol(+)/kg	The total capacity of a soil to hold exchangeable cations.	CEC is an inherent soil characteristic that is predominantly controlled by clay content; adding organic matter can increase CEC; Sandy soils rely heavily on the high CEC of organic matter for the retention of nutrients.
<b>TOTAL MICROBIAL BIOMASS</b>	<i>Recommended</i>	mg/kg soil	A measure of the mass of the living component of soil organic matter.	The microbial biomass decomposes plant and animal residues and soil organic matter to release carbon dioxide and plant available nutrients; Soil clay content, pH, and the availability of organic carbon all influence the size of the microbial biomass.
<b>EXTRACTABLE MICRONUTRIENTS</b>	<i>Recommended</i>	ppm	Essential nutrients (including Cl, Fe, Mn, Zn, Cu, Bo, Mo) taken up by plants in relatively small amounts.	Micronutrients play an important role in crop production; crop yield or quality will decline if any of the micronutrients are deficient; toxicities can also occur if concentrations are too high.

## Summary of Field Tests

INDICATOR	MEASURES	UNITS	RATING	INTERPRETING RESULTS
<b>COMPACTION</b>	How easily penetrable the soil surface is	Measured using a wire probe	<b>POOR:</b> Wire probe will not penetrate <b>FAIR:</b> Wire probe penetrates with difficulty to less than 20 cm (8 in) <b>GOOD:</b> Wire probe penetrates to 20 cm (8 in) or more very easily	A heavily compacted soil can restrict root growth and limit air and water movement in soil. This is a simple field measure of surface and sub-surface hardness.
<b>CRUSTING</b>	A measure of the soil's surface crust	Measured by visual observation	<b>POOR:</b> Surface seals after rain <b>FAIR:</b> Some surface sealing, minimal restriction of seedling emergence <b>GOOD:</b> Open, porous soil; seedlings emerge without any restriction	Surface crusting can indicate poor water and air movement in soils and is generally associated with high levels of tillage and poor structure. This is a qualitative assessment of aggregate stability.
<b>DIVERSITY OF MACRO-LIFE</b>	The number of different soil animals present	Number of unique soil animals per shovel full	<b>POOR:</b> <2 kinds of soil animals <b>FAIR:</b> 2-5 kinds of soil animals <b>GOOD:</b> >5 kinds of soil animals	A higher diversity of soil animals indicates a healthier, more robust soil food web, which fuels nutrient availability.
<b>GROUND COVER</b>	Percentage of ground covered by plants, plant residues, or mulch	% cover per unit	<b>POOR:</b> <35% ground cover <b>FAIR:</b> 35-50% ground cover <b>GOOD:</b> >50% ground cover	A higher percentage of ground cover protects soil from erosion, provides soil animals with a food source, and improves soil structure. Observations should be conducted for each distinct field within the operation.
<b>PONDING</b>	How easily water enters the soil	Visual assessment of surface ponding	<b>POOR:</b> Water ponds on the soil surface <b>FAIR:</b> Some ponding on the surface <b>GOOD:</b> No ponding	A field ponding test can provide an indication of how easily water moves through the soil; less surface ponding means water can easily infiltrate and provide water for plants. This field measurement is related to available water capacity and aggregate stability lab tests.
<b>PLANT HEALTH</b>	Visual measure of crop leaf color, height, and uniformity	Visual assessment	<b>POOR:</b> Yellow, stunted growth; variable stand height; spotty germination <b>FAIR:</b> Variation in color, height, and germination <b>GOOD:</b> Dark green, even growth and germination	Identifying zones of uneven or stunted crop growth can help a farmer locate problematic areas on a farm that may require specific attention and management interventions.
<b>ROOT GROWTH</b>	Visual measure of fine root growth in the surface soil (0-5 cm)	Visual assessment	<b>POOR:</b> Restricted roots, few fine roots <b>FAIR:</b> Somewhat restricted roots; some fine roots <b>GOOD:</b> Healthy, uninhibited roots, lots of fine roots	Inspecting fine root growth provides an idea of how well the plants are able to put out roots and can indicate whether or not there are restrictions to root growth either physically (poor soil structure) or chemically (nutrient deficiencies).

<b>STRUCTURE/ AGGREGATION</b>	How easily a soil crumbles, the amount of soil bound up in aggregates	Measured by touch, feel, and observation of the soil	<b>POOR:</b> Hard soil, lots of clods; difficult to break apart	A soil that crumbles easily promotes air and water movement and indicates robust biological activity (as microbes generate soil aggregates). This qualitative assessment is related to aggregate stability and should be assessed for each distinct field within an operation.
<b>SOIL COLOR</b>	Description of soil color	Measured by observation of the soil	<b>Please indicate the color as best you can (ranging from black to orange/beige)</b>	Darker soils are generally richer in carbon. Soil color can also indicate the clay content informing of the nutrients available.
<b>SOIL SMELL</b>	Description of soil smell	Measured through smelling the soil	<b>Please describe the smell/notes as best you can (i.e. minerally, earthy, sewage, etc.)</b>	Soil smell can help indicate what minerals or substances are prevalent helping to inform the nutrient load.

# FAQ

## **Why lab testing?**

One of the goals of Regenerative Organic Certified (ROC) is to build soil organic matter (SOM) overtime and to increase soil carbon sequestration, drawing carbon out of the atmosphere and into the ground. In order to achieve this goal, we need to measure soil carbon as it changes over time.

Soil health as we define it is dependent on myriad biotic and abiotic factors such as nutrient availability, water holding capacity, micro-organism presence and biodiversity and much more. That is why we require a number of tests. In order to gain the best understanding of soil health we need to measure and record. A number of different indicators. The results from these soil tests when incorporated with other influences such as geographic location and crop type can help give farmers, ranchers, researchers, and the ROA an overview of soil health and how it can be improved through regenerative organic practices.

## **Why in-field testing?**

Through requiring in-field testing every year for ROC participants, we hope to encourage farmers to monitor their land and soil health on a more consistent basis and for these observations to inform better management decisions. All of the required soil tests can be done with equipment found on farm or at home. We encourage producers to perform these tests more often, but we only require they submit their results on a yearly basis. Instructional videos on how to best perform these in-field soil tests can be found at [RegenOrganic.org/Resources](https://RegenOrganic.org/Resources).

## **Why 15cm?**

Much of the feedback we received from our pilot participants was that the required soil testing for ROC was cost and equipment prohibitive. In order to honor this feedback, we discussed the depth of soil tests with our Soil Health Advisory Council (SHAC) - comprised of soil scientists and industry experts. This group decided that although studies are showing variation in soil carbon storage between 30 - 100cm, studying carbon at these depths is the job of academia and is both cost and equipment prohibitive for farmers and ranchers participating in ROC. With this decision to take lab samples from 15cm depth, we intend to connect ROC participating farms who express interest with academic institutions around the world that are doing this important soil carbon research. We also intend to explore developing other soil carbon programs as the ROA evolves and grows.