IN FIELD SOIL TESTING

Guidance & Support Document

PUR PROJET | ROA Regenerative Organic Alliance

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This document was created by PUR Project with the support of the Regenerative Organic Alliance and Tradin™ Organic and builds upon the in-field testing criteria described in the Regenerative Organic Certified™ (ROC™) framework.

The purpose of this document is to support farmers to conduct in-field soil tests and understand the results. For each test outcome, a grade of poor, fair, or good will be assigned which can highlight areas of concern and warrant further, more robust testing with the support of a lab. **Certification decisions are not contingent on in-field soil test results.**

This document is split into three sections:

> **Introduction** - Provides background information on the purpose of these tests, a description of each indicator, and how they are linked to management practices.
> **Materials & supplies** - A list of the materials you will need to conduct the tests (includes photos).
> **Soil tests, advice, & interpretation** - This section is broken down by soil test and provides a description of how to conduct each test, a video link, advice for conducting the tests, understanding the results, and how to score each test results.

Start by reading the introduction and background information for each test. Next, review the materials and supplies and ensure you have everything required prior to going to the field to conduct the tests.

Then, we suggest that you review the test protocols to familiarize yourself with how to conduct each test.

Next, read through the soil test tips and interpretation to get an inside look at how to complete the tests, photos showing some of the steps, and photos and info on how to interpret each result. This section also provides guidance on how to interpret results into poor, fair, and good categories.

We highly recommend printing this document and having it on-hand while in the field to use as a reference guide.

II. Introduction

< Watch Introduction

ROC requires that producers sample from three areas. The first is an area that is identified as performing well – this is referred to as your best plot. The second is an area that is identified as underperforming – this is referred to as your worst plot. Lastly, is an area that is identified as representative of your entire operations – this is referred to as your representative plot.

Soil properties within a targeted area can vary, so it is important to ensure that your in-field tests help depict an accurate representation of your soil health. In order to facilitate this, it can be helpful to take multiple samples – not only for the lab tests, but also for your annual in-field soil tests. From these multiple samples/tests you can aggregate your understanding to determine an overall score or rating.

This guide aims to explain how to perform simple in-field soil health tests on your land - whether it's a backyard garden or a 1000-acre ranch. This guide is meant to help all growers, but it was specifically written to help those applying for ROC. ROC requires that in-field tests be conducted every year, but certification decisions are NOT contingent on those test results. The intention of requiring these tests is to help people connect with their land and make better adaptive management decisions based on various indicators of soil health.

If you aren't familiar with ROC and want to learn more, check out the ROA website at RegenOrganic.org.

Feel free to read through the entire guide or skip around to the tests that are most important to you and your land.

In-field soil tests are simple, cost-effective means to understand soil health, identify problem areas in the field that may affect yield or be prone to degradation, and better understand the impact of management practices on soil. Below, you will find a description of ten indicators and how to measure each by following soil test protocols. ROC producters are required to submit soil samples every three years. Producers are encouraged to submit soil samples to a lab for more detailed analysis to help inform management decisions.

Some of the below tests will require you to choose a specific spot in the field to conduct the test while others are more observational where the entire field or surrounding area is taken into account. For the tests that require a specific spot, producers are encouraged to choose representative areas of the field to conduct the test; producers choose areas of low and/or high productivity to compare results between the areas or identify soil health issues that warrant further testing.

Test	Description	Management Practice Link
COMPACTION	Compaction is the compression of soil particles into a smaller volume, which reduces the size of pore space available for air and water. Results from a compaction test will tell you how easy it is for roots to grow in your soil and whether or not air and water can penetrate the soil profile.	Soil compaction can result from repeated or poorly timed use of heavy machinery, hoof traffic from livestock, or tillage at a constant depth.
CRUSTING	Crusting is a thin layer of hard, dense, and tough material that sits on the soil surface. A crusting test assesses the extent to which surface crusts occur on your land and can inform you about the potential for seedling emergence and water infiltration.	Surface crusts develop when soil is left bare, or when a soil is overworked through tilling.
DIVERSITY OF MACRO-LIFE	The numbers and kinds of organisms that can be found in and around your soil tells you something about the ability of the system to support biodiversity and complex food webs. This biodiversity is critical, as it helps to drive carbon, nutrient, and water cycling.	Maintaining plant cover throughout season, adding fresh organic materials, reducing tillage, and increasing crop rotation diversity all support life in the soil.
GROUND COVER	Having your ground covered protects the soil from eroding, it helps to minimize water loss due to evaporation, and ensures sufficient food is supplied to soil organisms and ultimately back to your plants.	Cover cropping, mulching, or any other practices that is used to cover bare soil will increase ground cover.

Test	Description	Management Practice Link
PONDING	Ponding, or standing water on the surface of your land, happens because of poor water infiltration. Poor infiltration, in turn, can result from inherent soil properties like soil texture or the presence of a hardpan layer.	Management practices that affect surface crusting, soil structure, and aggregate stability can lead to ponding.
AGGREGATE STABILITY	Soil aggregates are groups of soil particles bound together by roots, fungi, and the glue-like substances that these organisms produce. They are important for keeping organic matter in the soil, maintaining good water infiltration, and providing habitat for plant roots and soil organisms. Aggregate stability refers to how well these groups of soil particles stay together in the face of things like tillage, wind, and rain.	Incorporating fresh organic materials, mulching, composting, using shallow rooted cover crops, and reducing tillage can improve aggregate stability.
SOIL SMELL	The smell of your soil can tell you if it needs some work. A sour or rotten scent indicates that a soil has been waterlogged, allowing different kinds of bacteria - those that love low oxygen conditions - to thrive.	Cover cropping, compost, and organic material additions can support life in the soil and add organic matter.
SOIL COLOR	The color of soil can be an indicator of how much organic matter is present. Typically, more soil organic matter leads to a darker brown or black color. The color of your soil can also tell you whether it has been waterlogged for extended periods of time. When this occurs, your soil will become gray and may or may not have red or brown spots throughout (mottling).	Management practices that add organic materials (compost, residues, manure, mulch) and build soil carbon leading to a darker soil color.
ROOT GROWTH	Aside from their role in water and nutrient uptake for plants, roots also help to feed the soil food web and build soil organic matter, which in turn can help improve soil fertility, water retention, and ultimately things like crop resilience to drought.	Root growth can be impeded by compaction issues related to management practices (see above) and nutrient deficiencies in soil.
PLANT HEALTH	The symptoms of a healthy or unhealthy plant may depend on the cropping system you're working with. A general assessment of plant health can be done by looking at crop leaf color, signs of wilting, height, and uniformity.	Plant health can be affected by any number of factors - from pests and diseases to things like water stress and nutrient deficiency.

III. Materials & Supplies

Before going to the field, collect the following materials and supplies you will need to complete the soil tests:

One medium size (500 mL) clear glass jar or other transparent container (glass is best).

A notebook and pen to record results

A 30 cm (12 inch) ruler

A spade or shovel for digging 30cm deep soil pits

A small handheld trowel or small shovel

A thin metal wire approx. 5 - 10 mm in diameter (like a wire coat hanger) or plastic stick for penetrating the soil

A tape measure or a 12-foot piece of rope marked off every 1 foot

Water for tests (about 2 liters)

For instructional videos demonstrating each soil testing technique, please visit the Regenerative Organic Alliance YouTube channel.

IV. Soil Tips & Interpretation

1. SOIL COMPACTION < Watch Tutorial

For this test, you'll be pushing a stick, wire flag, or thin metal bar (a "probe") into the ground to feel for areas that are hard to push through. You shouldn't have to push extremely hard, and you should only use one hand on the probe. As you're pushing the probe into the soil, when all of a sudden it gets harder to push, **don't keep forcing it down**. Instead, stop there and measure how deep you were able to go.

Step 1	Step 2	Step 3
Push the probe in until it is difficult to push further and place your hand at the base of the probe where it meets the soil.	Pull the probe out of the soil being sure to keep your hand in the same place as step 1.	Use a ruler or measuring tape to record the depth you were able to push the probe into the soil.

Interpret the results as follows:

GOOD	If you can push the probe deeper than 20 cm or 8 inches score the test as good.
FAIR	If you can push the probe in but not further than 20 cm or 8 inches until starting to feel it getting harder to push in.
POOR	If you can't get the probe into the soil at all or it's extremely difficult to.

2. SOIL CRUSTING

< Watch Tutorial

This test is best done after a rain, so we suggest doing in the afternoon after a rain, or early in the morning after an evening rain.

This is a visual test, so you don't need any equipment to do it. For visual tests, it is important to walk around an area of several meters rather than trying to see everything from one place. Ideally, you'll want to conduct this test shortly after a rain - but if that's not possible no need to worry. You're going to be walking around looking for signs of crusting – basically areas where the soil is hard on top, where soil remains intact when you pick it up, and where plants might not be growing well. Check out the photos below which show examples of surface crusting.

Interpret the results as follows:

GOOD	You either can't see areas where there's surface crusting or there's a very small amount covering less than 5% of the parcel.
FAIR	You can see some areas, but not many, where there's some surface crusting and there's evidence of it on at least 5% of the parcel.
POOR	There's lots of surface crusting in the parcel and it's easy to spot in multiple areas.

3. DIVERSITY OF MACRO-LIFE < Watch Tutorial

For this test you're looking for different macro-life (insects). It's not so important to be able to identify individual insects since for this test you're just going to count how many different ones you can find. So, if you see 1,000 ants you'd only mark down that you've seen 1 kind of insect. If you see one ant and one beetle, you'd mark down 2 and so on.

Start by selecting an area where you'll dig a small hole, but before you dig, walk close by (2 steps in all directions) to your digging location and see if you can spot any macro-life on the surface of the soil. Mark down how many different kinds you see.

Next, you'll dig a hole and count how many different insects you can find in one shovel full of soil. If you are able to place the soil on a tarp or sheet or other solid surface as you take a scoopfull it makes it easier to spot different macro-life.

Interpret the results as follows:

GOOD	You found more than 5 different insects and/or insects.
FAIR	You found between 2 - 5 different insects and/or insects.
POOR	You found less than 2 different insects and/or insects.

4. GROUND COVER < Watch Tutorial

For this test, you'll walk along a transect, line, or tape measure and at every 1 foot interval record if the soil is covered or not. Do this over a 10 foot line so you have 10 measurements (e.g. 10 points of either covered / not covered) which you then calculate the percentage cover from. You can pull out a tape measure and secure both ends or you can use a piece of rope with tape or marks every 1 foot and lay that across the soil.

Interpret the results as follows:

For this test, your results aren't ranked as poor/ fair/good, instead you're going to calculate the percent cover (% cover) as follows:

Number of points recorded as covered / total points along transect x 100

Example: 7 points recorded as covered, 10 points measured
% cover: 7/10 = 0.7
%cover: 0.7 x 100 = 70%

GOOD	Above 50%
FAIR	35-50%
POOR	Less than 35%

5. PONDING

< Watch Tutorial

This test is best done after a rain, so we suggest doing in the afternoon after a rain, or early in the morning after an evening rain.

This is another test that is visual and doesn't require any equipment or tools. Ideally, you'll want to do this test shortly after it has rained because you'll be looking for areas where water collects and "ponds" or remains on the surface. If you can't do this one after a rainfall event, but you have lots of water available, you can pour some water on a few different areas of the field and see if it soaks into the soil or hangs around on top. Note that these areas should not be natural streams or areas where water is present for the entire year or season.

Check out a few examples below:

POOR
Widespread ponding

FAIR
One or two puddles

GOOD
No ponding

Interpret the results as follows:

GOOD	No standing water in the field 24 hours after it rains.
FAIR	Standing water in a few places but not widespread across the field 24 hours after it rains.
POOR	Lots of standing water in many places across the field 24 hours after it rains.

6. AGGREGATE STABILITY < Watch Tutorial

You'll need a clear glass jar, a stopwatch (cell phone will do if it has a timer) and some water for this test. Fill a jar with some water, about halfway full and pick up a soil clump (aggregate) from the surface of the soil and drop it in the water. Wait five minutes and then record your observation based on the results interpretation below. Soil aggregates come in a variety of sizes so you may find differences depending on where you are. An aggregate about the size of a fingernail was used for this test and shown in the pictures below.

Find a soil aggregate

Drop in jar with water for five minutes

Clear water and intact aggregate (good)

Cloudy and broken down (poor)

Interpret the results as follows:

GOOD	After 5 mins, water is clear or fairly clear and more than 80% of the aggregate remains intact.
FAIR	After 5 mins, water is somewhat cloudy and less than 80% of the aggregate remains intact.
POOR	After 5 mins, water is very cloudy, and the aggregate has mostly broken a part.

7. SOIL SMELL < Watch Tutorial

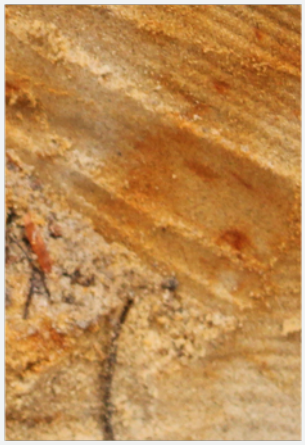
You just need a shovel for this test (and your nose!). It may sound a bit odd, but you can tell quite a bit about a soil by the way it smells. Dig a fresh soil pit and stick your head in or grab a big handful of soil and give it a smell. It should smell fresh and earthy if it's healthy. If it smells sour or rotten then you might have a water problem where soil is waterlogged or full of water for long periods and no oxygen can get in.

Interpret the results as follows:

GOOD	Pleasant, sweet, earthy smell.
FAIR	No strong smell, not bad but also not earthy and fresh smelling.
POOR	Sour, rotten, or just an overall bad smell.

8. SOIL COLOR < Watch Tutorial

Pull some soil out of a hole you've dug or dig a new hole and grab a handful of soil. Wet it slightly and look at the color. First check if your soil has a gray color and/or if you can find red dots or reddish-brown dots/spots (called mottling). This usually occurs when your soil is waterlogged for long periods of time but if that's not the case then you shouldn't see these spots. They also should be pretty obvious (see below for an example). Otherwise, you're looking for dark brown and rich colors or even a black soil color. Check below for some examples.



< Red spots (motting)

Light Brown/Tan

Brown

Dark Brown

Black

Interpret the results as follows:

For this test, just record whether your soil is dark brown, medium brown, or light brown and whether you've noticed any gray features. It can be helpful to compare productive areas to poor performing areas of the parcel to get a sense of how color can change between the areas.

9. ROOT GROWTH < Watch Tutorial

Another visual test. For this test you'll be digging a hole and looking at crop roots - the way they grow, their depth, branching, and pattern. If it is sunny out, it is helpful to have the sun at your back and shining on the side of the hole dug in front of you so you can see without any shadows getting in the way. Check out the photos below for some examples of things you'll be looking for when you're looking at the roots.

Abundant root, well branched

Roots lacking

Deep root growth, unrestricted

Shallow root growth, restricted, example of compacted layer restricting deep root growth

Interpret the results as follows:

GOOD	Roots are abundant, branched, and unrestricted.
FAIR	Roots are somewhat restricted and there are some fine roots.
POOR	Roots are lacking (not many of them), seem restricted and not well branched.

10. PLANT HEALTH < Watch Tutorial

Start this test by walking around the field and looking for areas where plants look less healthy than other areas of the parcel– for example, plants are not growing as well, are smaller, ground cover plants don't grow as well, plants are different shades of green or a different color.

Next, get up close to any plants that you've identified as not being as healthy compared to other plants in the field. Look for signs like specific discoloration, stunted growth, etc.

Plant health can be related to other non-soil factors like water deficiencies or differences in light. But they can also be directly related to soil like nutrient deficiency which can present as discoloration (purple or yellow leaves for example). It's important to note that nutrient deficiencies can vary in appearance depending on the crop and they may only be part of a larger problem affecting plant health.

Interpret the results as follows:

GOOD	Plants are dark green with good even growth.
FAIR	Plant growth is adequate but variable and plants are a light or medium green color.
POOR	Plants are discolored, have stunted growth, and variable height.

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