IN FIELD SOIL TESTING

Guidance & Support Document

2020
PUR PROJET

Contents

I. HOW TO USE THIS DOCUMENT

This document was created by PUR Projet, building upon scripts written by Regenerative Organic Alliance and the ROC in-field testing criteria.

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.

This document is split into four sections:

1. Introduction: Provides background information on the purpose of these tests, a description of each indicator, and how they are linked to management practices.
2. Materials and supplies: A list of the materials you will need to conduct the tests (includes photos).
3. 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.
4. Test result sheet: You can use this sheet to record your test results in the field.

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 off and having it on hand while in the field to use as a reference guide.

II. INTRODUCTION

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. 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; alternatively, producers may choose areas of low and/or high productivity to compare results between the areas or identify soil health issues that warrant further testing.

Test / Indicator	Description	Link to Management Practices
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 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.
Ponding	Ponding, or standing water on the surface of your land, happens because of poor	Management that affect surface crusting,

	water infiltration. Poor infiltration, in turn, can result from inherent soil properties like soil texture or the presence of a hardpan layer.	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 of shallow rooted cover crops, and reducing tillage can improve aggregate stability.
Soil Smell	The smell of your soil can also 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 Colour	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 colour.
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 (video link):

1. One medium size (500 mL) clear glass jar or other see through container (glass is best)	
2. A notebook and pen to record results	
3. A 30 cm (12 inch) ruler	
4. A spade or shovel for digging 30cm deep soil pits	
5. A small handheld trowel or small shovel	

6. A thin metal wire (like a wire coat hanger) or plastic stick (approximately 3mm in diameter) for poking the soil	 or
7. A tape measure or a 12 foot piece of rope marked off every 1 foot	
8. Water for tests (about 2L)	

IV. SOIL TEST TIPS & INTERPRETATION

1. Soil Compaction – **Video Link**

For this test, you'll be pushing a stick, wire flag, 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: 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.	Step 2: Pull the probe out of the soil being sure to keep your hand in the same place as step one.	Step 3: 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:

Results Interpretation

Poor: You can't get the probe into the soil at all or it's extremely difficult to

Fair: 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

Good: If you can push the probe deeper than 20 cm or 8 inches score the test as good

2. **Soil Crusting – Video Link**

Tip

This video 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 actually 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 to 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.

Results Interpretation – See video

Poor: There's lots of surface crusting in the parcel and it's easy to spot in multiple areas

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

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

3. Diversity of Macro-life- See Video

For this test you're looking for bugs. It's not so important to be able to identify individual bugs 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 bug. 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 insects and bugs 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 bugs you can find in one shovel full of soil. I find if you are able to place the soil on a tarp or sheet or other solid surface as you take a scoop full it makes it easier to spot bugs.

Results Interpretation

Poor: You found less than 2 insects/bugs total

Fair: You found between 2 – 5 insects/bugs total

Good: You found more than 5 insects/bugs total

4. Ground Cover – See Video

For this test, you'll walk along a transect/line/pulled out tape measure and at every 1 foot interval record if the soil is covered or not. Do this over at least a 10 foot line so you have 10 measurements (e.g. 10 points of either covered / not covered) which you then calculate 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.

Results Interpretation

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 – See Video

Tip

This video 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 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 could 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

Results Interpretation

Poor: Lots of standing water in many places across 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.

Good: No standing water in the field 24 hours after it rains.

6. Aggregate Stability – See Video

You'll need a clear glass jar, a stop watch (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 and wait five minutes before making your observation. Soil aggregates come in a variety of sizes so you may find differences depending on where you are. I used an aggregate about the size of my finger nail for this test.

Find a soil aggregate	Drop it in a jar with water and wait 5 mins	Clear water and intact aggregate (good)	Cloudy and broken down (poor)

Results Interpretation

Poor: After 5 mins, water is cloudy and less than 80% of the aggregate remains intact

Good: After 5 mins, water is clear or fairly clear and more than 80% of the aggregate remains intact

7. Soil Smell – See Video

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.

Results Interpretation

Poor: Sour, rotten or just an overall bad smell

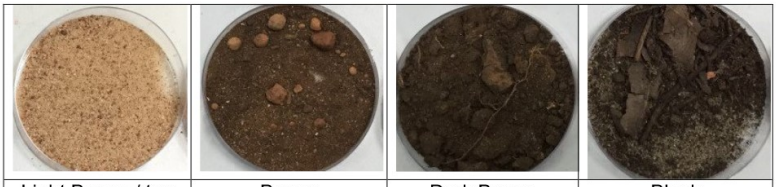
Fair: No strong smell, not bad but also not earthy and fresh smelling

Good: Pleasant, sweet, earthy smell

8. Soil Colour – See Video

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 colour. First check if your soil has a grey colour 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 colours or even a black soil colour. Check below for some examples.

Grey soil with red spots (mottling)



Light Brown / tan	Brown	Dark Brown	Black

Results Interpretation

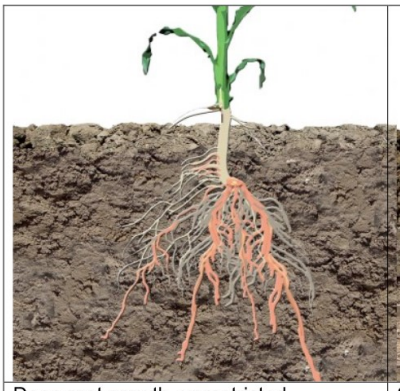
For this test, just record whether your soil is dark brown, medium brown, or light brown and whether you've noticed any gray features. It can be helpful to compare productive areas to poor performing areas of the parcel to get a sense of how colour can change between the areas.

9. Root Growth – See Video

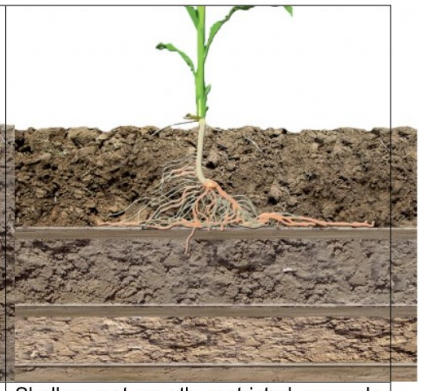
Another visual test. For this test you'll be digging a hole and looking at crop roots - the way they grow, their depth, branching, and pattern. If it's sunny, I find it helpful to have the sun at my back and shining on the side of the hole I dug in front of me so you can see without shadows getting in 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 roots, well branches

Roots lacking



Deep root growth, unrestricted



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

Results Interpretation

Poor: Roots are lacking (not many of them), seem restricted and not well branched

Good: Roots are abundant, branched, and unrestricted

10. Plant Health – See Video

This is a general test to look at overall plant health but make sure to get up close to look for signs of plant issues too. 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 colour.

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 discolouration, 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). Its' 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.

Results Interpretation

Poor: Plants are discolored, have stunted growth, and variable height

Fair: Plant growth is adequate but variable and plants are a light or medium green color

Good: Plants are dark green with good even growth

V. TEST RESULTS SHEET

Test	Results Key	Location		Date	Results		
		Latitude	Longitude		1 (representative field)	2 (best field)	3 (worst field)
Compaction	**POOR**: wire probe will not penetrate **FAIR**: wire probe penetrates with difficulty to less than 20 cm (8 in) **GOOD**: wire probe penetrates to 20cm or more very easily						
Crusting	**POOR**: surface seals after rain **FAIR**: some surface sealing **GOOD**: open, porous soil						
Diversity of Macro-Life	**POOR**: less than two (2) kinds of soil animals **FAIR**: 2-5 kinds of soil animals **GOOD**: > 5 kinds of soil animals						
Ground Cover	**POOR**: < 35% ground cover **FAIR**: 35 - 50% ground cover **GOOD**: > 50% ground cover						
Ponding	**POOR**: water ponds on the soil surface **FAIR**: some ponding on the soil surface **GOOD**: no ponding						
Plant Health	**POOR**: yellow, stunted growth, variable height **FAIR**: variation in color and height **GOOD**: dark green, even growth						
Root Growth	**POOR**: restricted roots, few fine roots **FAIR**: somewhat restricted roots; some fine roots **GOOD**: healthy, uninhibited roots, lots of fine roots						
Structure / Aggregation	**POOR**: hard soil, lots of clods; difficult to break **FAIR**: soil crumbles with pressure; few clods **GOOD**: soil crumbles easily; no clods						
Soil Color	Please describe the color as best you can						