Soil Health Benchmark Study

EFAO's pilot Soil Health Benchmark Study is citizen-science research that provides farmers with a rigorous assessment of the health of their soils and educational resources to set a course for continued improvement.

EFAO IS RESPONSIBLE FOR

1. **Training, protocol, and kit**
2. **Analysis of active carbon and soil organic matter**
   - 9 of each; 3 fields x 3 replicates
3. **Soil Health Benchmark Report**

PARTICIPATING FARMERS ARE RESPONSIBLE FOR

1. In-field measurements

- Using rings that you provide yourself, you will measure **water infiltration,** which estimates soil structure

2. Soil sampling

- You will use the pre-paid box to mail your soil to A&L Laboratories, where they will analyze for **soil organic matter** (SOM), which estimates the amount of carbon stored in soil; and **active carbon** (POXC), which estimates the carbon that is available for microbes (i.e. labile carbon) and is related to soil microbial activity and biomass. Active carbon is measured via permanganate oxidation (POX) and also known as reactive carbon.

3. Completing online survey

- Modelled after the Farmland Health Check-Up

WORKFLOW FOR FARMER

- Prep and choose a day
- Sample soil
- Measure water infiltration
- Mail soil samples
- Complete the online survey

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Instructions for Soil Sampling & Water Infiltration Measurements

It's important for farmers participating in this study to follow consistent soil sampling procedures so that we can compare data. ***Please follow the instructions closely, and don't hesitate to contact us if you have any questions!***

STEP 1. GATHER YOUR SUPPLIES

Plot marking supplies

- GPS / GPS app
- Camera
- Stakes to mark plots (*optional)*

Soil sampling supplies

- Spade/straight shovel, or soil corer. *Note: the straight shape helps to ensure you collect an even amount of soil along the 15 cm profile of your sample. If you must use a pointed-tip shovel, take extra care to take an even profile of soil.*
- Ruler or tape measure
- 5-gallon bucket
- Permanent marker
- Cooler and ice packs or other way to keep samples out of direct sunlight and near room temperature
- Measuring cup
- ***Provided by EFAO****:* 9 freezer storage bags, 1 for each sampling plot
- ***Provided by EFAO****:* Submission form & Shipping box

Water infiltration supplies

- 6-inch diameter ring, ~ 6" high (plastic or metal)
- Plastic (plastic wrap or clean plastic bag)
- Bottle to measure 500mL (e.g. 500mL plastic bottle or something with mL marks)
- Clean water, 1L per sampling plot
    - e.g. 9L for 9 sampling plots, if you are taking 1 measurement per area - ***mandatory***
    - e.g. 27L for 9 sampling plots, if you are taking 3 measurements per area - ***optional***
- Stopwatch or timer
- Block of wood
- Sledge hammer

STEP 2. CHOOSE A DAY

- **This protocol will probably take 1 day**
- Sometime between mid-October and early November, when you can also deliver samples to the post office on the day of sampling or the next.
- Collect samples from all fields/sampling plots on the **same day.**
- If necessary, soil collection and water infiltration measurements can be separated by a day, but be sure your sampling locations are well marked.
- Avoid taking samples at times when the soil is too dry or saturated and muddy.
- A good rule of thumb is if the soil is workable and able to be tilled, it's a good time for soil sampling.

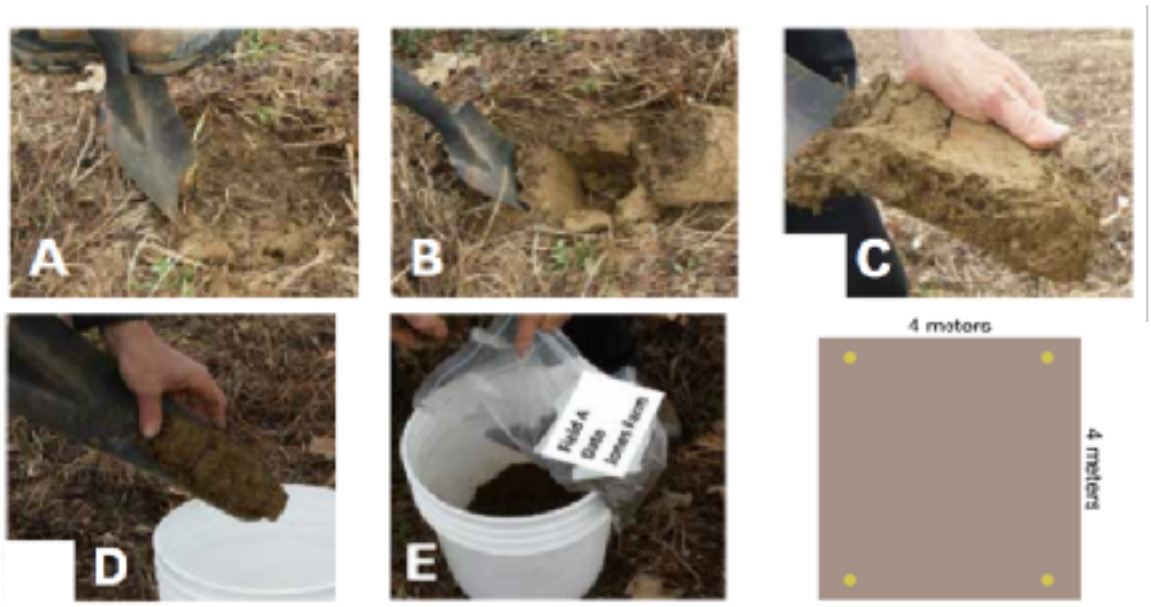
For vegetable farms: If a cover crop will be planted in a field you're sampling, take the sample *after* the cover crop has been planted - and after any field prep operations.

For row- and forage-crop farms: Take your samples after you've harvested grain or silage, or after your last cutting of hay. If you will plant a cover crop or forage crop, take the sample *after* the cover crop has been planted - and after any field prep operations.

STEP 3. LOCATE AND MARK YOUR 9 PLOTS (3 PLOTS X 3 FIELDS)

A. Walk each field and choose **3 representative sampling plots** that are each **4 meters x 4 meters**. Avoid field borders and any irregular areas or "trouble spots," such as a low spot or rock outcropping.
B. Use a GPS and record the coordinates of your plot. Depending on your GPS accuracy, you may just record the centre of you plot. You may also want to mark your plots on a paper map. You can also mark the transect with permanent stakes or markers, depending on the situation.
C. Take a photo of each sampling plot.
D. In total, you will have 9 sampling plots, 3 sampling plots for each of your 3 fields.

STEP 4. TAKE SOIL SAMPLES FROM EACH PLOT (4 SUB-SAMPLES x 3 PLOTS x 3 FIELDS)



You can watch this video, https://www.youtube.com/watch?v=5DSi0N6yZHY&feature=youtu.be, between 2:00 - 3:40 min. Ignore details that are mentioned on the video that may conflict with EFAO's protocol.

You will take **4 sub-samples** (yellow dots) from **each sampling plot.**

A. For each sub-sample, remove surface debris around the sampling location**.**
B. **If using a shovel or spade**, dig a small hole about 20cm (8”) deep and 20-25cm (8-10”) wide. **If using a soil corer**, take 3-5 x 15 cm deep cores per corner and proceed to F.
C. From the side of the hole, position the spade or shovel at a 90 degree angle to the ground and take a vertical, rectangular slice of soil **15cm** (6”) deep and about 5cm (2”) thick.
D. Ensure that the sample is the same width at the top and bottom of the slice by removing any extra soil hanging past the sides of the spade or shovel. You want to end up with a rectangular, **15cm** (6”) deep x **5cm** (2”) thick slice of soil and the same width of the shovel or spade. For accurate test results, it is important to collect the same amount of soil through the 15cm sample profile so that your sample is not biased with more soil from the surface compared to the subsurface. *If you need to use a pointed-tip shovel, getting an even profile will be a bit trickier.*
E. Slide the slice of soil into your bucket.

F. Repeat steps A through F for each sub-sample within the 4m x 4m area (yellow dots). Add soil from each sub-sample to the same bucket but ***do not mix samples from different field / sampling plot in the same bucket.***
G. After all 4 sub-samples are in the bucket, mix them together and break-up the soil by hand; remove any debris and stones. Place 2 cups in the pre-labeled bag. On page 7, **record the field ID that corresponds to each bag.**
H. Keep your soil samples away from direct sunlight, and near room temperature - a cooler with ice packs works well. While you don't need to refrigerate them, please don't let them get hot. They should be shipped within 1-2 days from when you collected them in the field (the sooner the better).

*****CALL OR TEXT SARAH IF YOU HAVE QUESTIONS!*****

If you want other analyses on these samples (e.g. nutrients/micronutrients), you can use the "left over" soil from each plot. Bag it up separately and mail it separately to the lab of your choice.

STEP 5. TAKE WATER INFILTRATION MEASUREMENTS (1 OR 3 MEASUREMENTS PER PLOT)

- Please take at least 1 measurement per sampling plot (e.g. 1 corner). If you have the time and motivation, you can take 3 measurements per sampling plot (e.g. 3 corners).

You can watch this video, https://www.youtube.com/watch?v=yo1NEI2G3wU, between 1:20 - 2:10 min. Note that if your soil is not saturated, EFAO's protocol has you saturate the soil by pouring water without recording infiltration rate.

A. Pick a spot near the 4 x 4 m plot that you soil sampled that has not been trampled (e.g. near a corner). Clear the sampling location of surface residue, etc. If the site is covered with vegetation, trim it as close to the soil surface as possible.
B. **Drive ring into the soil.** Clear the sampling location of surface residue, etc. If the site is covered with vegetation, trim it as close to the soil surface as possible. Using a hand sledge and block of wood, drive the 6-inch diameter ring, beveled edge down, to a depth of three inches.
C. **Firm soil.** With the 6-inch diameter ring in place, use your finger to gently firm the soil surface only around the inside edges of the ring to prevent extra seepage. Minimize disturbance to the rest of the soil surface inside the ring.
D. **Line ring with plastic.** Line the soil surface inside the ring with a sheet of plastic wrap to completely cover the soil and ring. This procedure prevents disturbance to the soil surface when adding water.
E. **Add water and remove the plastic**. Add 500mL water onto the plastic and then remove the plastic by gently pulling it out, leaving the water in the ring.

F. **Let the water wet the soil.** Without timing, let the water infiltrate the soil. This wets the soil and prepares it for your infiltration test.

   If soil moisture is at or near field capacity, the second test is not necessary - skip steps E and F and go directly to G.

G. **Add water (again).** Add (another) 500mL water onto the plastic wrap and **get your timer ready.**
H. **Remove the plastic and start recording**. Remove the plastic and **start the timer** *as soon as the plastic is removed*. Record the amount of time it takes for the water to infiltrate the soil. **Stop timing** when the surface is just glistening. If the soil surface is uneven inside the ring, count the time until half of the surface is exposed and just glistening.
I. **Record the time**. Record the time on the data sheet (page 8).

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STEP 6. PACK YOUR SAMPLES AND MAIL THEM TO THE LABORATORY

A. Bag each sample in a zippered storage bag. Record which plots correspond to which bags (#1-9).
B. Place your samples in the prepaid Canada Post box provided by EFAO.
C. Complete the A&L Laboratories submission form by writing in "**Date Sampled**" on the form for each of your nine samples. The rest of the form has been pre-filled by EFAO.
D. Place the **submission form and your soil bags** in the shipping box.
E. Take the box to your nearest Canada Post office.
F. The box we provided you with already includes a shipping label. If you lose the box and need to send the samples out, here is the address:

A&L Canada Laboratories, 2136 Jetstream Rd, London, ON N5V 3P5

STEP 7. CALL OR EMAIL IN YOUR DATA

- Call or email Sarah, sarah@efao.ca or (226) 582-0626, to let give her your water infiltration data and let her know you have mailed soil samples.

STEP 8. COMPLETE THE MANAGEMENT RECORDS SURVEY

- Sarah will email out survey link in October

Field and Plot Record Sheet

Your name: _____

Date	Bag/Plot	Field Name	Sampling plot
Example (see explanation below)	6	P2	3
	1		1
	2		2
	3		3
	4		1
	5		2
	6		3
	7		1
	8		2
	9		3

It really doesn't matter which sample goes into which bag. Just record what is going where!

Example in table:
You are sampling soil from 3 fields, which you call P1, P2, and S4 and you set-up 3 sampling plots (1,2, 3) in each of those fields. Place soil from P2, area 3 in bag 6.

Water Infiltration Data Collection Sheet

Your name: _____

Date	Plot	Field Name	Sampling plot	Infiltration rate in sec.
	1		1	
	2		2	
	3		3	
	4		1	
	5		2	
	6		3	
	7		1	
	8		2	
	9		3	

If you opt to take additional water infiltration samples at each sampling plot, record the data below: