Citizen Science Soil Sampling Protocol

This is a protocol that is designed to support the citizen scientist in all of us. These soil tests will provide essential information about the short and long-term effects of management decisions on soil health.

We are predominately approaching this work to understand how much carbon is currently in our soils (through baseline samples) and over time, through continued sampling, we will determine the effect of our land-management on the total stock of soil carbon. This understanding can help us, as a community, determine if and how we are building soil carbon.

These efforts will support us in continuing to develop our understanding of a soil-based life cycle assessment of our regionally grown goods.

FIBERSHED

Local Fiber, Local Dye, Local Labor

This protocol summarizes:

- Land area to sample
- Time of sampling
- Sampling depth
- Sampling tools
- Sampling process
- Sample identification
- Bulk Density testing

The importance of soil carbon

Soil organic carbon is the primary component of soil organic matter (SOM) and provides the basis for soil fertility. It helps retain and release nutrients for plant growth, promotes soil structure, biological and physical health, and increases the buffering capacity and resilience of soils against adverse climatic events. Soil organic carbon is part of the natural carbon cycle, with the world's soils holding roughly twice as much carbon as is found in the atmosphere and vegetation.

It is well known that atmospheric CO_2 levels are increasing and therefore, in addition to lowering emissions, it is imperative that we also explore means of sequestering atmosphere carbon over extended periods of time. Through photosynthesis, atmospheric CO_2 is manufactured into organic material that is eventually returned to the soil through plant or animal decomposition and recycling. The goal is to increase the quantity of carbon that remains in the soil following these processes, with the understanding that soil carbon increases the health and productivity of our systems and reduces the concentration of atmospheric greenhouse gases—it's a win-win!

Sampling tools:

- Stainless steel soil sampling auger (not galvanized or brass equipment)
- (20) Stakes (for marking corners and intervals of grid)
- 30-meter (100-ft) tape measure
- String to lay out grid
- (35) 1-quart sealable plastic storage bags to store soil samples
- Permanent marking pen to label bags
- (2) 3-inch diameter sampling tubes
- 8-inch long wood block
- 3-lb sledge hammer
- Flat-bladed knife
- Garden trowel
- Yardstick

Choosing the location to sample from

It is up to each producer to determine the size of the land area they would like to monitor. This land area should be one that there is interest in understanding more about, specifically how the land-management is affecting soil carbon stocks. It is important, when deciding where to sample, that all of the samples come from the same uniform soil, as determined by soil survey reports (http://www.nrcs.usda.gov/wps/portal/nrcs/soilsurvey/soils/survey/state/) and field observations, as well as uniform management history and yields as determined by the land manager.

If possible, also locate a land area to test from that could be used as a control plot. This area should have similar (as uniform as possible) soil characteristics to the other land area, but should be absent of the management practice(s) on your production field. This will help us compare and contrast the effects of your management decisions on soil carbon stocks. Consider this soil as a 'naturally managed' comparison to your soil.

It is important to avoid areas like feedlots, compost piles, fences, roads, depressions, areas with high salinity or consistently high moisture content, or with other factors that may influence soil properties. Additionally, if sampling from a row-cropping or orchard system, take consideration of what area(s) are of most interest to understand (I.E. row versus inter-row areas).

Uniform soil characteristics:

- Texture
- Color
- Slope (and degree of erosion)
- Drainage

Uniform management characteristics:

- Crop history
- Fertility history
- Grazing history
- Crop yields and/or forage production

Choosing the sampling time

Take initial baseline samples, for a given land area, before changes in management practices occur. Sampling fields near the same time of year for each subsequent sampling event will help ensure the most accurate estimates of soil carbon gains over time. It is highly advised, though not mandatory, that sampling events not occur immediately after heavy rainfall or irrigation events. Some fields, depending on soil type, will require rainfall or irrigation events to occur before sampling events in order to soften the soil enough for inserting the auger. It is still advised to wait at least 2 days afterwards to allow for water drainage from the soil. To obtain the most accurate estimates of total soil carbon, sampling should occur before heavy applications of organic amendments (manure, compost, etc.).

Determining sampling depth

Laboratory tests are often calibrated to specific soil depths. It is important to accurately separate core samples into discrete depths, in order to avoid producing inaccurate results. The top 15 cm of soil generally have the most root activity and are most effected by management practices, such as tillage and fertilizer application. These surface samples (0 to 15 cm) are the most important for testing total carbon content, among other sampling metrics. However, it is also important to collect other samples, from 15 to 30 cm and 30 to 45 cm, in order to complete the story of what interactions are occurring in these soils.

Soil sampling process

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Once you have identified a uniform soil, with similar management history, and chosen the land area to test:

1.

Lay out a 24-square-foot grid with 6-foot intervals, using 16 stakes to mark the outside of the grid. Use string, tied to opposing stakes, to create the grid.

Note the approximate location of the grid corners for use in future sampling events. It is important that subsequent sampling events (taken every few years) are done within the same grid area as this baseline sampling event. Using a permanent land marker, such as a T-post at the corner of the grid or colorful ribbon tied to an adjacent fence post, will help mark this area for future use.

2.

Randomly select 3 of the 16 intervals to sample from:

Use **https://www.random.org/integers/** to randomly select intervals.

3.

Expose the bare mineral soil by removing live vegetation, litter, duff or crop residue.

It is important not to disturb the soil surface. If the site is covered with vegetation, trim it as close to the soil surface as possible.

4.

Using the soil auger, collect one subsample for each depth (0-15cm; 15-30cm; 30-45cm), from each of the randomly selected 3 intervals. There should be a total of 9 samples from this land area.

5.

Place the sample (each depth at each interval) into individual zip lock bags and seal the samples, attempting to disturb the samples as minimally as possible.

Make sure to clearly identify each sample, using a permanent marker (see below for details)

There should be a total of 9 samples in 9 individual zip lock bags.

6.

If possible, repeat process for control field (which is not under chosen management practices)

Only 1 sample is needed, for a total of 3 subsamples (0-15cm, 15-30cm, 30-45cm)

Sample identification:

Properly identifying and organizing samples should be done with care. On each zip lock bag, clearly indicate:

1. Sample number (1-9)

2. Interval number (1-16)

3. Depth of the sample (0-15cm, 15-30cm, 30-45cm)

Be sure to fill-out the Soil Sampling Information Sheet with relevant information through-out the sampling process.

Measuring bulk density*

Bulk density is a measurement of the weight of a soil within a given volume. This measurement allows us to better understand soil compaction and the relative distribution of pore spaces in the soil. In general, the greater the density, the less pore space in which water and air can travel through.

To get the most representational value for bulk density, two separate measurements should be taken. This process should occur within the same grid layout used for the sampling protocol.

** This methodology was identified and chosen based on soil quality testing publications produced through the USDA and NRCS*

For each bulk density measurement:

1.

Randomly select 1 of the 16 intervals to test from:

Use **https://www.random.org/integers/** to randomly select intervals.

2.

Choose an area with even soil surface and expose the bare mineral soil by removing live vegetation, litter, duff or crop residue.

It is important not to disturb the soil surface. If the site is covered with vegetation, trim it as close to the soil surface as possible.

3.

Place the 3-inch diameter tube on the ground and lay the wood block on top of it. Using the rubber mallet, evenly drive the ring into the soil to a depth of 3 inches (to the marked line on the outside of the ring).

It is important that the depth of the ring be as exact as possible. Attempt to insure that the ring is evenly driven into the soil to the marked line on the outside of the ring.

This should also be checked by using a ruler to measure, in 4 different areas around the edge of the ring, the distance from the soil to the top of the ring.

Record the average distance measurement in the Soil Sampling Information Sheet.

4.

Dig around the edge of the ring with a hand trowel and carefully lift the tube, preventing any soil from escaping the bottom

5.

With a flat-edge knife, remove excess soil from the bottom of the tube, so that the sample is flat with the edge of the ring

6.

Using the knife, push the sample out of the tube into a sealable plastic storage bag. Take care that entire sample is placed into the bag. Seal and label the bag with the following information:

- Sample number (BD 1, BD 2, etc.)
- Average height of ring above soil surface