Soil Health Sample Intake and Processing

Background / References:

The Cornell Soil Health Laboratory receives soil samples for analysis year-round. Rapid shipping and inclusion of blue ice packs with the sample during the hottest months protects the sample from damage due to high temperatures. Once a Soil Health sample arrives in the lab, it should either be processed immediately or stored at 4° C (40° F) until the earliest opportunity. Soil samples need to be friable before they are ready for processing i.e. the sample should readily crumble or break into smaller fragments without smearing as it passes through the sieve. The received sample is broken into sub-samples for all the Soil Health laboratory tests. **NOTE:** Refer to the 2016 Cornell Soil Health Manual for appropriate sampling techniques. See Figure 1 below for a picture overview of the received sample flow through the laboratory.

Objective:

Upon receipt of the Soil Health sample, data from the Submission Form should be recorded into the Cornell Soil Health Lab Sample Sign-In Sheet (Table 1). Initial crumbling, mixing, sieving and partitioning of the sample is performed before oven drying. If the sample arrives too wet to process, it can be spread out on a large pan and allowed to dry enough to be friable. After this initial processing, sub-samples are routed through the laboratory according to the requirements of the particular analysis (Figure 1). The Standard Cornell Soil Health Assessment package 2020 provides for determination of: Rapid Soil Texture, Wet Aggregate Stability, predicted Available Water Capacity, Active Carbon, predicted Soil (ACE) Protein, Soil Respiration, and Standard Nutrient extraction and analysis.

NOTE: ***For quarantined soils, see labeled procedures in italics at the bottom of each section.***

Materials and Equipment:

Analytical Balance
8mm sieve
2mm sieve
Wire brush
Indelible marker
Tared aluminum cans (2 sets)
Falcon tubes with 42ml of 3% Hexametaphosphate (soap) solution
Weigh boat
Fan
Plastic pan
Funnel/Acetate sheet
Scintillation vial
Plastic cups and lids
Plastic bags
Plastic bin
Ethyl Alcohol, 70%
Bleach
Autoclave Bags

Sterilization solutions approved for use with Quarantined soil:
Bleach-10% Bleach solution within a labeled spray bottle must be left on contaminated equipment for ½ hour before rinsing.
Ethyl Alcohol 70% within a labeled spray bottle must be left on contaminated equipment for 30 minutes before rinsing.

Additional Quarantine Protocols:

1. ***In the event of spilling quarantine soil, the soil should be swept up using a hand broom and dustpan and disposed of in an autoclave bag. The hand broom and dustpan as well as any surfaces contaminated with Q soil should be heavily sprayed down with 70% ethanol. The alcohol should be left on surfaces for 30 minutes.***
2. ***In the event of spilling bleach water, the water should be mopped or sponged up and bleached again with a 10% bleach solution for 30 minutes. The mop head or sponge should be disposed of in a autoclave bag and autoclaved. The surface contaminated should be sprayed down with 70% alcohol. After 30 minutes the bleach water can be disposed of down the drain.***

Procedure:

I. Sample Sign-in and Storage:

1. Before processing the sample, assign a sample ID to the sample according to test type (regular or a la carte). Record this ID on the sample bag and on the master data sheet (Table 1 below). Maintain sample at 4°C (40°F) until it is ready to be processed.
   Quarantine soil permit holder must sign in samples according to permit specifications. All other following quarantine procedures may be done by properly trained laboratory technician. Autoclave all packing materials that the quarantined samples arrived in. Assign a sample ID with "Q" to the sample. Record this ID on the sample bag and on the quarantined master data sheet (Table 1 below).

Table 1. Cornell Soil Health Lab Sample Sign-In Sheet

Cornell Soil Health Sample Sign-In Sheet 2020

Once sample is signed in (ex. t1), write that # on the sample bag.

Sample Number	Date Sampled	Date Received	Sample ID	Agent Contact	State	Moisture Correction Factor: moisture can ID	wet wt. with can	dry wt. with can	Add-on Analyses: Available Water Capacity	ACE Soil Protein	Hot Water Soluble Boron	Soluble Salts
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2. Even if the sample is friable, it will need to air dry to a constant weight for several days. Spread the soil out into a deep plastic pan and place in front of a fan. As much surface area should be exposed to the air as possible to maximize drying rate – occasionally turn soils by hand to facilitate drying. The soil should crumble apart by hand and not smear when sent through the sieve. DO NOT BEGIN PROCESSING SAMPLES UNTIL THEY ARE FRIABLE.
   Use secondary container labelled with quarantine sign for quarantine samples. Sterilize all quarantine laboratory equipment that comes into contact with quarantined soil with an approved disinfectant.

II. Initial Sieving of Samples (large 8mm sieve):

1. Once the sample is air dry, pass entire sample through the 8mm sieve. Discard any material that does not pass through the sieve. Use the wire brush to remove all soil from the sieve and ensure that it is clean for the next sample. Thoroughly mix the soil to ensure that the sample is homogenized, using separate containers if necessary, to mix properly. Re-assemble the entire sample into one unit before continuing.
   Use quarantined sieves and quarantined wire brushes for all sieving. Discard any soil or stones that will not pass through 8mm sieve into autoclave bags and autoclave. Do all laboratory procedures inside a plastic tub and disinfect with an approved quarantine disinfection solution before rinsing.

2. Roughly 2 cups of 8mm sieved soil is needed for below listed analyses, distributed accordingly:
   a. 1 cup for Wet Aggregate Stability.
   b. 75-100 grams (3/4 cup) for Soil Respiration test and Soil Protein Assay.

3. After distributing 8mm sieved soil, pass the remaining portion of soil thru 2mm sieve.
   Do all laboratory procedures inside a plastic tub and sterilize any laboratory equipment that comes in contact with quarantined soil. Put remaining soil into boxes clearly labeled as containing quarantined samples and archive at 40° F.

III. Secondary sieving of samples (small 2mm sieve)

1. Pass air dry soil through the 2mm sieve. Put the remaining portion of soil back into the bag and archive at 40° F. Roughly 2 cups of 2mm sieved soil are needed for below analyses, distributed accordingly:

   A. Moisture Correction Factor (MCF- used to convert air dried soil weight to oven dried soil weight (105C) basis):
   1. Weigh one teaspoon (about 5g) of 2mm sieved soil into a pre-tared aluminum can. Record can ID and total wet weight on the sample sign-in sheet (Table 1 above).
   2. Place can in oven at 105°C, stirring soil in evening before leaving. Dry to constant weight (about 1 day). (Determine complete dryness by weighing sample, recording weight, date/time weighed and then reweighing two hours later. If the sample has not lost any weight it is then completely dry and ready for further processing).
   3. Record dry wt. of soil with aluminum can on the sample sign-in sheet. The moisture loss in this "thimble" of soil is used to correct the lab analyses to oven dry soil weight.

IV. Texture, Available Water Capacity (AWC), Nutrient Analysis, Active Carbon

1. Place ~14g soil (+/- 0.10g) into Falcon centrifuge tube that contains 42 ml of Sodium Hexametaphosphate solution. See Rapid Soil Texture procedure –CSH 02 for textural analysis specifics. Record exact weight on the Texture data sheet.
2. Collect about 60g of soil (4 tablespoons) into a labeled plastic bag for Available Water Capacity determination. See Available Water Capacity procedure – CSH 04 for specific laboratory protocols for this analysis.
3. Put 3/4 cup soil into cardboard box (with the sample ID recorded on it) for standard nutrient analysis-CSH 16.
4. Pour the soil into a 20 ml scintillation vial labeled with the sample ID. Cap and store in a dry place until ready for Active Carbon-CSH 13 analysis. See Active Carbon procedure – CSH 05 for this protocol.
5. Fill a second 20ml scintillation vial labeled with the sample ID for Loss on Ignition/Total Carbon-CSH

Sterilize all quarantine laboratory equipment that encounters quarantined soil with disinfection solution. Discard any soil that does not pass-through sieve into an autoclave bag and autoclave as soon as possible. Discard cardboard boxes and any remaining soil after testing soil for nutrient analysis into autoclave bags and autoclave as soon as possible.

V. Sieving sample for Wet Aggregate Stability

1. Place 1 cup of 8mm sieved soil on stack of 2mm and 0.25mm sieves with a catch pan.
2. Soil is placed atop the sieve stack that is shaken for 15 seconds on a Tyler Coarse Sieve Shaker.
3. Soil in the catch pan and on top of the 2mm sieve can be discarded. Note: If there is not enough soil in the 0.25 sieve, grind soil that did not pass through the 2mm sieve by hand and repeat steps 2 through 4.
4. Gently shake (by hand) soil in 0.25 sieve to remove any fine dust.
5. The 0.25-2.0mm aggregates will be lying on top of the 0.25mm sieve – save this fraction in a cup for the Wet Aggregate Stability test. Note that this test requires 20-30g of this material for each sample.
6. See Wet Aggregate Stability procedure – CSH 03 for the protocol for this test.
7. Store Wet Aggregate Stability soil in labeled, deep-dish plastic trays that hold 15 individual cups.
8. Order in the tray and sample ID should correspond to data sheet for Wet Aggregate Stability.

Discard any soil that does not pass through 2mm sieve into autoclave bag. Autoclave materials in bag as soon as possible. Sterilize any laboratory equipment that encounters quarantined soil with an approved disinfectant solution and let sit for required time before rinsing. Label all sub-samples with a "Q".

Calculations and Data Entry:

After all data from each sample is added to the sign-in sheet and other data sheets, transcribe into the appropriate EXCEL spreadsheet for a later generation of the Cornell Soil Health Report. See other Standard Operating Procedures (CSH 02- 07) for specific calculations to convert raw data to useful reported indicator parameters.

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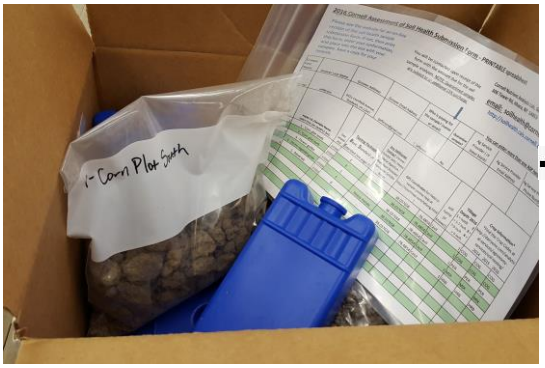
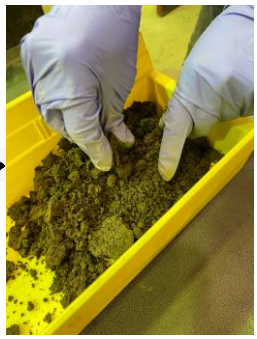
Figure 1. Soil sample intake and processing overview in the Cornell Soil Health Lab 2022



Soil Health Sample (6 cups)



Break up to ~8mm by hand

Air dry sample

Sieve through 8mm sieve

Sieve through 2mm sieve

Wet Aggregate Stability

Respiration/ACE Protein

Nutrient Analysis

Rapid Soil Texture

Active Carbon

Total Carbon, Total Nitrogen

Moisture Correction Factor