THE UNIVERSITY OF VERMONT EXTENSION

State of Soil Health in Vermont

Field Soil Sampling Protocols

April 2021

Summary

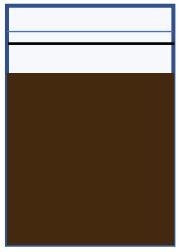
There are three basic soil samples, plus management information, being collected on fields as part of this study. Biological analyses and carbon fractionation analysis are also being conducted on a sub-set of the soil samples. Samples for biological analyses are time and temperature sensitive and need special handling.

Sampling is ideally conducted in the spring, before the soil is disturbed, tilled or amended. In this study, we are measuring at the field scale, to the boundaries of management changes, and this will differ by farm.

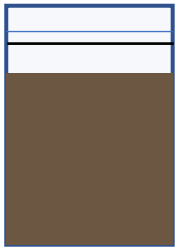
From each field, the following samples and information should be collected

1. **A composite soil sample to 15 cm depth**
    a. 4 -6 cups of this sample will be submitted for CASH analysis (Cornell Comprehensive Assessment of Soil Health)
    b. 1 cup of this sample will be saved for biological analyses & nitrate analyses at UVM
    c. ½ cup of this sample will be used for carbon fraction analysis by our Dartmouth collaborators
2. **A composite soil sample to 30 cm depth**
    a. 1 cup of this sample will be submitted to UVM NWCS lab.
        i. ¼ cup of this will be used to analyze organic matter content
        ii. The remainder will be banked
3. **Three intact 30 cm soil cores for bulk density analysis**
    a. These three cores will be submitted to the UVM NWCS lab or UVM AETL for bulk density analysis
4. **Field management information**
    a. A field management survey can be completed in paper or on a computer by the farmer, or the researcher/advisor in consultation with the farmer

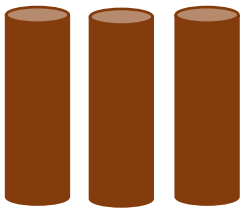
For each field, you'll need 2 large Ziploc bags, 3 small plastic bags, 3 sample cores, a Cornell soil health test form and a way to record the management information (print or digital). We suggest planning 45 minutes per field for collecting samples, not including chatting with farmers.



15 cm sample



30 cm sample



Soil cores for bulk density

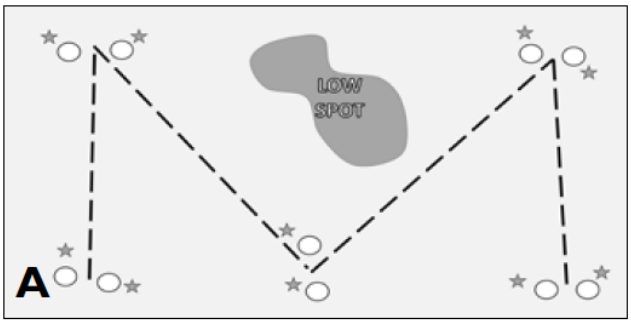
Cornell CASH form

Management information

Part 1 in field. **Composite soil sample to 15 cm depth (6 inches)**

Methods for obtaining a soil sample from this top layer of soil follows the protocols from the Cornell Comprehensive Assessment of Soil Health. Figures and language below are from the Cornell manual.

- Identify a minimum of ten locations for soil sampling across the field that are representative of the field. Avoid irregularities, like a low depression or a rock. Cornell recommends finding 5 locations that fall along an M-shaped path across the field, and taking a pair of samples 15 feet apart from each other at each location.



- At each sampling location:
    a. Remove surface debris
    b. Use a shovel to dig a small hole about 8” deep
    c. From the side of the hole, take a vertical, rectangular slice of soil 6” deep and 2” thick. The top and bottom of the slice should be the same thickness. Use your ruler.
    d. Place in a clean bucket.
- Repeat at each location

- Mix samples thoroughly in the bucket and transfer ~ 6 cups of soil into a one gallon size sealed bag.

- Label with:
    - Field ID
    - Date
    - Depth of sample (15 cm)
    - Your initials

- Transport this sample in a cooler with ice packs if possible, away from heat and sunlight.

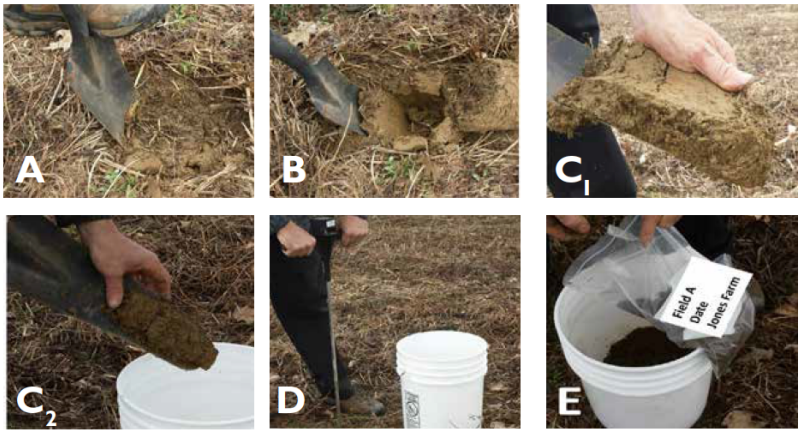


FIGURE 2.08 A - E. The steps of taking a soil health sample. The microorganisms in the soil are sensitive to heat. Keep samples out of direct sunlight and keep as cool as possible during sampling and storage. Store samples in a refrigerator or cold room after returning from the field and ship to Cornell as soon as possible.

Part 2 in field. **Composite soil sample to 30cm depth (12 inches)**
Use the same methods followed above for the 15 cm depth sample, with the following modifications:

- Use the same locations that you used for the 15 cm sample
- Deepen each hole to 15 inches deep
- Take a slice of soil from the side of each hole that is 30 cm (12 inches) deep by 2" thick
- Place these samples in a separate, clean bucket
- Mix the together, *thoroughly.*
- Place 1 cup of this soil in a sealed plastic bag and label it with the field ID, date of sample, your initials and depth of sample.
- (If you have a 12" soil auger, you may use that instead of the shovel)

Part 3 in field. **Intact soil cores to 30 cm depth (12 inches) for bulk density measurement**
Bulk density is a measure of mass per volume. Taking this sample accurately is all about getting an undisturbed soil core without loosing any soil in the process, and without causing compaction in the sample from over-hammering. If the soil is too wet, smearing/sealing can occur on the sides, and we want to avoid this.

Find 3 locations within the field that are representative of the field. These can be some of the same locations that you took the other soil samples from, but should not be taken from a spot where you were kneeling. Avoid compacted or disturbed soils for these cores.

At each location:

- Insert the plastic liner into the metal coring cup
    - If you are using an AMS slide hammer, insert the 1" plastic sleeve afterwards, so that it will be on top of the 12" plastic sleeve within the cup.
- Remove debris from the undisturbed soil surface.
- Using a slide hammer or mallet, depending on which equipment you have, hammer the core straight down, vertically, into the soil until the 12" plastic sleeve is just below surface of the soil.
- Take care not to overdrive the sampler. (Do not hammer the top of the core cup below the soil surface)
- Remove the equipment from the soil as gently as possible. (If you take this sample in a location near one of holes used for the other soil samples, it may be easier to remove, by tilting it sideways into the hole.)
- Carefully remove the plastic liner from the metal core cup.
- Use a knife or sheer edge to cut the soil core cleanly at each end of the 12" liner. If you knock soil loose from the sampled core, you'll need to retake the sample. The AMS samplers have an extra 1" spacer so that you can cut an undisturbed core sample cleanly.
- Place caps on both ends.
- Label the sample with the field ID, Date, type of bulk density equipment and # 1, 2, or 3 for each field. *****Marking down the type of bulk density equipment you used is essential to getting an accurate calculation****!* We use the volume of the core in the calculation and this is different for the Giddings and AMS equipment.

Part 4. **Forms**

- Fill out the Cornell Soil Test form for the Standard Package: http://www.css.cornell.edu/extension/soil-health/form.pdf or http://www.css.cornell.edu/extension/soil-health/form.xlsx
- Fill out our Management Information Survey for this field as much as you can, and ask the farmers for the information you don't know. Use either a printed copy or enter it online here: https://qualtrics.uvm.edu/jfe/form/SV_3OTtLjVOC5WjqrI

Part 5. **Splitting the samples up for lab analyses**

After you've obtained samples from the field, please split them up for the appropriate lab destination and label them.

The 15 cm sample should be split like this:

- Homogenize the sample in the bag with your hands. If it doesn't look consistent, keep mixing. The goal is to mix thoroughly so that it is a true composite.
- Measure approximately ½ cup and place it in a clean quart-sized Ziploc bag. Label this as *For: C fractions/Dartmouth.*
- Measure approximately 1 cup and place it in a clean quart-sized Ziploc bag. Label this as *For: Biological/UVM*
- Make sure these are labelled with the Farm & Field ID, depth of sample, date, and your initials.
- These are temperature and time sensitive. Place these two smaller 15 cm depth samples in a cooler and transfer to a fridge as soon as possible. If they are going to be used for Ecoplate analysis, that should be done ASAP, and they need to get to Jeffords same day, or next.
- The remaining soil can stay in the large Ziploc and will be shipped to Cornell. Label this as *For: CASH*

The 30 cm sample should be split like this:

- Homogenize the sample in the bag thoroughly.
- Measure approximately ¼ cup into a clean Ziploc bag. Label this as *For: LOI/UVM*
- The remaining soil can stay in the large bag and will be banked for potential future analyses. Label this as *For: Bank*
- Make sure both of these bags are labelled with the Farm & Field ID, depth of sample, date, and your initials.

The bulk density samples are not time sensitive, but the plastic cores will likely need to be used again soon. In this case, transferring the bulk density cores to other containers while they wait to be processed is fine, but take care not to loose any soil mass during the transfer. Jar scrapers are in the sampling kit just for this purpose! A plastic bag is fine. Write the sample details on the label of the new bag and also ***write the volume of the core on there or the equipment you used (Giddings or AMS)***. This last part of very important for calculating the bulk density.

Part 6. **Notes on Handling & Shipping**

The 15 cm sample **for UVM Biological** is time and temperature sensitive. Please keep it on ice and get that to Hilary at the Jeffords Hall Lab ASAP, so that it can be run within 24 hours.

CASH samples should be shipped to the Cornell lab. Cornell recommends treating the samples as follows:

- Always keep soil samples out of direct sunlight and away from heat, preferably in a cooler.
- Soil Health Assessment samples need to be stored in a refrigerator or cold room after returning from field.
- Make sure to send a completed Soil Health Submission form,
- Use rapid shipping method, **double Ziplock bag your soil sample** and ship sample with blue ice packs during warm weather periods.
- Use Small Flat Rate box or send up to four, 4-cup samples, using USPS Priority Mail Medium Flat Rate box. Ship to Cornell as soon as possible:

  Cornell Soil Health Lab
  G01 Bradfield Hall
  306 Tower Road
  Cornell University
  Ithaca, NY 14853-1901
  (607) 227-6055

Dartmouth carbon fraction samples should be treated as follows:

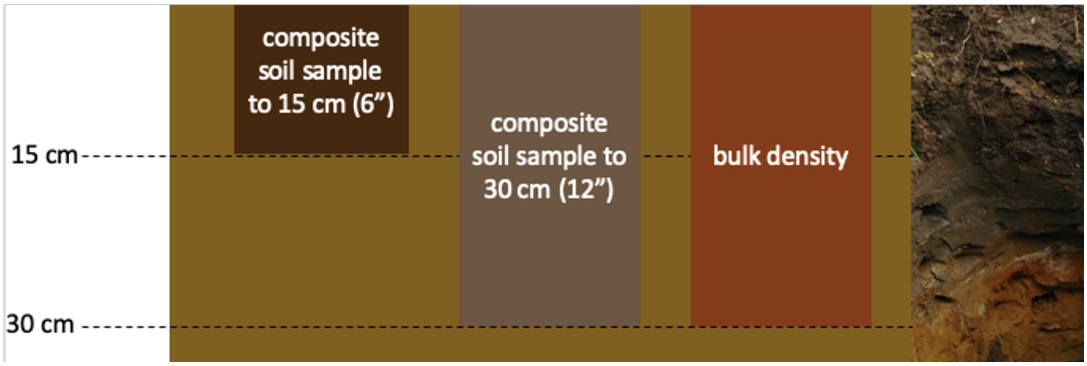
- Store in a fridge until you can ship it to Dartmouth. If you cannot ship for >2 weeks, store in a freezer.
- Mail to Dartmouth Soil Carbon Lab:

  Caitlin Pries
  78 College St
  Hanover, NH, US, 03755

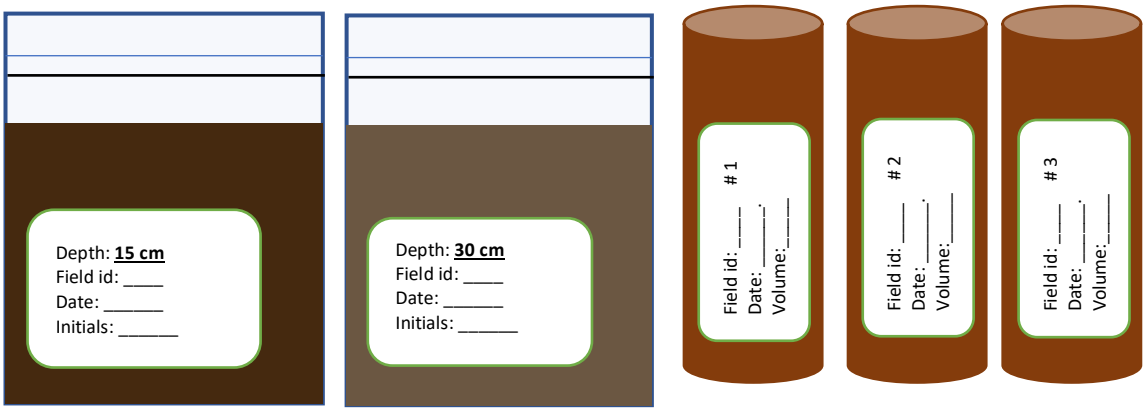
- If unable to mail, store in a freezer and contact Erin Lane (below) to arrange a pickup. If near UVM, you can bring the samples to their soils lab in Jeffords.

  Dartmouth Contacts:
  Erin Lane: erin.d.lane.gr@dartmouth.edu; 603-393-0372
  Caitlin Hicks Pries: mailto:Caitlin.Hicks.Pries@dartmouth.edu

Field samples that should be collected:

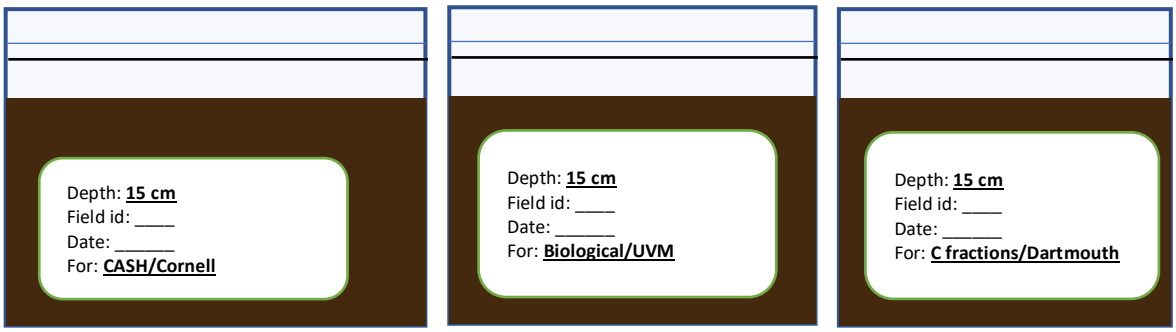


This is what you should leave the field with:

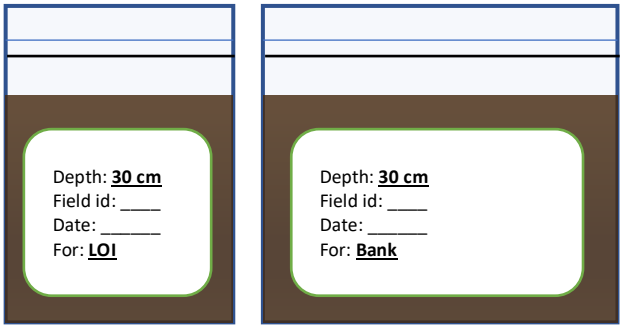


Soil samples should be split for lab analyses in this way:

The 15 cm sample gets split like this*:



The 30 cm sample gets split like this:



* Transport the 15 cm samples in a cooler if possible, and get them to a lab as soon as you can. Biological sample should go in a freezer ASAP.