Soil properties analysis

Back ground

Soil is a complex, living, changing and dynamic component of the agroecosystem. It is subject to alteration, and can be either degraded or wisely managed. A thorough understanding of the ecology of the soil ecosystem is a key part of designing and managing agroecosystems in which the long-term fertility and productive capacity of the soil is maintained, or even improved. This understanding begins with knowledge of how soil is formed in a given ecological region, and includes integration of all the components that contribute to the structure and function of the entire soil ecosystem (Gliessman 1998: 99-110).

A great many biological, chemical and physical factors determine soil quality. By measuring some of these components and determining how they respond to management in an agricultural context, a foundation for assessing the health of the soil can be established. Ultimately, indicators of sustainability can be grounded in the assessment of soil conditions and how they change as a result of the choices a farmer makes in managing the agroecosystem. For a complete introduction to the nature and properties of soils, consult a soils textbook (e.g., Brady and Weil 1996).

Synopsis

The soils from the different sample points at Cove Creek are characterized by measuring a number of soil properties. On the basis of these data, the soils are compared, and differences in properties are linked to differences in management history.

Objectives

- Gain experience with a range of methodologies for measuring soil properties and assessing soil quality.
- Become familiar with different soil types and varying soil properties.
- Observe the relationship between soil conditions, terrain conditions, and past management practices.
- Use the analysis of soil conditions to assess the impact of varying management strategies on soil quality, and hence, sustainability.

General note on soil sampling

The properties of soil ecosystems vary both spatially and temporally, even on a small scale. Sampling must therefore be carefully planned and take into account the local variability that might be encountered. Each soil property entails a different kind of sampling for its measurement. The procedures that follow describe the sampling steps only generally, and how to take each sample. The following general principles apply to all the sampling carried out in this investigation:

- Define the horizontal boundaries of the soil to be sampled.

- Take samples from depths with the greatest agricultural significance (this should be the 1-15 cm upper stratum unless otherwise noted).
- Use a standard sample design that insures the samples are representative of the system. Depending on the system and the factor being measured, sampling can be random, selective (based on judgement), or stratified random (divided into subsites in which samples are taken randomly).
- Take an adequate number of samples to account for local variability.
- Use proper soil collection, handling and sampling equipment and techniques.

A. Measuring pH and soil moisture in the field

Soil acidity or pH is a measure of the hydrogen ion (H+) activity in the soil solution, in this case water, and is specifically defined as the -log 10 of the hydrogen ion concentration. Soil pH will rise or fall depending on the i pact of a range of factors, including farming practices. If as a result of these impacts pH falls below or rises above certain optimum levels for biological and chemical activity (Gliessman 1998: 106-107), the soil will become much less productive.

We will be using the Kelway HB-2 acidity and moisture tester for in-field measurement of these two parameters. The instrument measures pH and moisture content (% relative saturation). The pH and moisture readings use a tiny flow of current through two metal plates located on each side of the unit's housing. Since the current is so small, these metal plates *must be kept clean* at all times. Therefore, one should not touch the metals plates with one's fingers. Fingerprints are greasy and will reduce the flow of current.

Procedure for soil moisture

1. Choose a sample design: Put a 30-m measuring tape on an axis perpendicular to the slope of your sample point, with the 15 meter mark in the center of your plot. Starting at the 1 meter mark, and at distances of 4 meters (i.e., at the 1, 5, 9, 13, 17, 21, 25 and 29 meter marks), measure the soil moisture.
2. Before using the Kelway probe, the tester's plates must be totally free of contamination (wipe off remaining soil particles after each use) and chemically clean. The metals plates must be rubbed clean before use with the Kelway Conditioning film provided; place the dull side of the Conditioner Film around the plates, squeeze lightly and rotate a few times. This rubs the plates clean. Then wipe the plates with a clean rag or paper towel. Be sure not to touch the plates with your fingers.
3. Remove grass, leaves, pebbles and other debris in the spot to be tested, and soften the soil. Break up pieces if it is hardened. Now gently insert the tester vertically into the soil to a depth which will cover the tester's metal plates fully (8 cm or 3.25 inches). Press the soil **tightly** around the tester so that the metal plates are in *close contact* with the soil.
4. Press the button on the side of the tester and hold it for 2-3 minutes to read the moisture content on the *lower* scale. This time period is necessary for the meter to stabilize. The reading you obtain is percent relative saturation, and is NOT the percent moisture by weight.

Each type of soil has its own field capacity (meaning its own ability to hold water) after it has been irrigated or rained on and then drained for 24 hours. This could be termed relative saturation.

5. After use, wipe the plates clean with a paper towel to remove all dirt particles. Remember to use the Conditioner Film before the next reading.

Procedure for pH

1-3 Steps 1-3 for this measurement are identical to steps 1-3 for soil moisture. Both measurements can therefore be taken at the same time if there is sufficient moisture in the soil (relative saturation moisture obtained from the reading above should be at least 35% to do a pH reading). If relative soil moisture is lower than the minimum, loosen soil in a second spot, preferably slightly downhill from the first, add about 1 cup of distilled water (or water from one of the creeks on the farm, which is assumed to have about the same pH as the surrounding soil; tap water introduces its own pH and generally requires several hours of stabilizing before you can make readings) to the soil and let it sink in for 3-5 minutes. Then proceed with your pH reading.

4. Read the pH on the *upper* scale. Generally, the tester indicator needle makes a swing to the right and then drops to the correct pH reading, where it stabilizes in 2-3 minutes. Your proper reading should be made at the time of stabilizing. A little practice will help you get the correct readings easily.
5. See step 5 above.

Write-up:

- Describe the soil moisture and pH range across your plot. Explain why there may or may not be a difference between the different points you measured (think about soils, aspects, vegetation, land use history, ...).
- Knowing just the soil water status and pH, discuss the suitability of your particular plot for agriculture. What crops could be grown here? Why?

B. Measuring soil temperature

The temperature of the soil is an important but often overlooked variable, affecting root growth, water and nutrient uptake, root metabolism, microbial activity, decomposition of organic matter, soil chemistry, and soil moisture levels. Each type of crop plant responds differently to soil temperature, depending on its range of tolerance of soil temperatures and its temperature optimum. In agroecosystems, the goal is to maintain soil temperatures as close to the crop's optimum as possible, and to keep variations in soil temperature within a crop's range of tolerance. Each combination of crop and environment, however, requires a different approach. In some situations, such as growing strawberries during winter in coastal central California (Gliessman 1998: 67; Gliessman et al., 1996), the farmer must take steps to keep the soil temperature warmer than what it would normally be. In other situations, such as growing temperate-climate vegetables in the tropics, the farmer must design and manage the system to keep the soil cool. In temperate climates, the farmer may be in the position of having to raise soil temperatures during one season and cool them during another.

In modifying soil temperature, the farmer can take advantage of both soil coverings and the microclimate-modifying abilities of crop and non-crop plants themselves (Gliessman 1998: 66). Plant leaves shade the soil, blocking absorption of solar energy and lowering the soil temperature. At night, vegetative cover has the opposite effect, helping to block convective loss of heat to the atmosphere. Soil covering (i.e., mulches) have a more complex relationship to soil temperature. Because they are in contact with the soil, it makes a difference whether they absorb, reflect, or trap solar energy. Lighter-color mulches will reflect more solar energy that strikes them and therefore keep the soil cooler. Darker-colored mulches will absorb more solar energy as heat and transmit it to the soil below. Clear plastic (and, to some extent, materials such as floating row covers) will trap solar radiation, also raising soil temperature. At night, most mulches will reduce heat loss.

In practice, the farmer must be aware that techniques for modifying soil temperature will usually affect soil moisture as well. Mulches of all kinds, as well as increased vegetative cover, will tend to conserve soil moisture; exposing more of the soil to the sun (e.g., by pruning perennials) will dry out the soil as well as raise temperature. The farmer can make inferences about soil temperature, but unlike air temperature, soil temperature isn't experienced by just walking out into the field. To understand this important variable and how it is affected by agroecosystem structure and design, we must go out and measure it.

Procedure

Choose a time in the middle of a sunny day for measuring soil temperatures, if possible. The measurements in the different sample points should be done simultaneously so that we can compare the differences between points.

1. Choose a sample design: Put a 30-m measuring tape on an axis perpendicular to the slope of your sample point, with the 15 meter mark in the center of your plot. Starting at the 1 meter mark, and at distances of 2 meters (i.e., at the 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27 and 29 meter marks), measure the temperature.
2. At each of the locations determined in step 1, use a temperature probe to measure the temperature at the soil surface, 5 cm below the surface and 15 cm below the surface. In mulched systems, the soil surface is defined as the surface of the soil proper, not the surface of the mulch or soil covering/litter layer. Thus, the mulch, covering or litter must be carefully removed or pushed aside (beware of poison ivy vines!) to measure the temperature. Follow these guidelines for measuring soil temperature:
   - To take surface readings, make sure the probe is in full contact with the soil, but not buried. A good way of ensuring this is to hold the probe nearly horizontal, with the tip touching the soil.
   - To measure below the surface, mark the correct depth of insertion on the probe with a piece of tape or a permanent marker.
   - Be careful not to damage the probe when measuring below the surface. If you encounter resistance, stop and try again a few centimeters away (if there's rock underneath, skip that

location and mark in the data sheet).
  - Always be sure to wait long enough for the thermometer to reach equilibrium (a steady temperature reading). Practice using the thermometer before taking actual readings to get a feeling for how long this takes.
3. Record the data on the soil temperature dat sheet; calculate the mean and standard deviation for each soil depth (this can be done automatically in a spreadsheet [Excel or QuattroPro] on your computer, or using a pocket calculator).

Write-up

- Graph and describe how the soil temperatures of the different points along the two axes differ, and how the temperatures at the different depths at each sample point differ.
- Discuss how observed differences in soil temperatures may relate to differences in the makeup, location or vegetative structure of the sample points.
- Discuss how you could use the observed temperature differences at various depths/locations for growing crops at your sample plot. Could you extrapolate the observed soil temperature to the entire Cove Creek farm? Why or why not?

C. Measuring bulk density and soil moisture

Bulk density (BD) of a soil is defined as the ratio of the mass (M) of oven-dried soil to its bulk volume (BV), which includes the volume of the soil particles and the voids (pore spaces) between the particles. BD is a dynamic soil property, altered by cultivation, compression by animals and machinery, weather, and loss of organic matter. It generally increases with depth in the soil profile and normally varies from 1.0 to 1.7 g cm^{-3}. The higher the number, the more compacted the soil and the more difficult it is for roots to penetrate. The most useful and simple method for measuring bulk density is to cut out a cylindrical core of soil of known volume and find the mass of the dried soil.

Water is of crucial importance to agriculture. In many locations, precipitation is limited, and the input of moisture it provides must either be carefully stored in the soil and conserved or supplemented through irrigation. But water that can be used for irrigation –either from surface supplies or from the ground– is also limited in supply, and agriculture must compete with industry, cities and water-dependent natural ecosystems for its share. Moreover, irrigation itself carries with it a number of potential problems, including salinization of the soil. For all these reasons, sustainability depends on careful water management in agroecosystems. Agroecosystems are sustainable in terms of water usage if they use water efficiently, minimize losses of soil through evaporation, and are adapted to the regional climate and water supply. Knowledge of soil moisture content ad how it changes is a key basis for the design and management of such systems.

Equipment needed

- Cylindrical core sampler, 2-inch diameter
- 3 5-cm tall cores, 5 15-cm tall cores
- Knife or spatula
- Top loading balance
- Oven to dry the core samples at 105^0 C

Procedure

1. Choose a sampling design: In a N-S, E-W orientation, take three core sample at 5 meters distance from the center of your sample point. Note on the data sheet from which point your sample is taken (N, S, E, or W; note that as you only take samples at three of these points, one wind direction will not be represented).
2. Weigh and label each core if not done previously (each core has a letter-number stamped in it; record this code on your data sheet).
3. Determine the volume in cubic centimeters of each core ($\pi . r^2$ x height of core, where r is the *internal* radius of the core.

NOTE

If you have a core that is not completely filled (for example, because you hit rock), you have to adjust the core volumes in your calculations. To do this, measure how much of the core is NOT filled with soil (=Q), and plug this number in one of the following formulas:

For 15 cm cores: *Actual volume of the core in cm^3 = (15.24 - Q) x 18.086398*

For 5 cm cores: *Actual volume of the core in cm^3 = (5.08 - Q) x 18.086398*

4. Collect core samples at three sites of the top 30 cm soil layer. Take five samples using the 15-cm cores and one using the three 5-cm cores. At the point from which you collect the three 5-cm cores from the top 15 cm of the soil, also collect a 15-cm core from the 15-30 cm layer. At each sampling location, press the sampler into the soil until the top of the head is slightly below the level of the soil. Pull the head back and screw open to remove the core(s). Put a **red** cap on the top of the core, and a **blue** one at the bottom (be gentle to avoid soil falling out of the cores). You may need to cut the bottom of the core to remove excess soil; cut flush with the rim of the core; you should use a knife to separate the 5-cm cores; as there are roots in the soil, pulling them apart may result in soil falling out of the cores.

NOTE

Cores should be obtained at or near field capacity to avoid soil shattering or compaction during sampling. If the soil is compacted or dry, carefully apply 1-2 gallons of water on the sample points and allow it to drain for an hour or so.

5. In the lab, remove the caps and replace the bottom cap with some aluminum foil to prevent soil from falling out. Weigh the cores with their soil.
6. Put the core with the foil in the drying oven at 105^0 C for 24 hours.
7. After 24 hours of drying, remove the cores from the drying oven and put some Saran wrap on the top to keep out atmospheric moisture. *Caution: Cores will be very hot; wear protective gloves while handling.*
8. Use the attached data collection sheet to record the mass of each empty core (*a*), the mass of each core with the moist soil (*b*), and the mass of each core with its dry soil (*c*).
9. Calculate the BD and soil moisture content of the soil:

$$BD\,(g\,cm^{-3}) = \frac{\text{weight of oven–dry soil in grams}\,[(c)-(a)]}{\text{volume of core in cm}^3}$$

The volume of the core, calculated in step #3 above, should be the same for each sample (i.e., all 2-inch cores and all 6-inch cores have the same volume).

$$\text{soil moisture}\,(\text{weight}\,\%) = \frac{\text{weight of soil moisture in grams}\,[(b)-(c)]}{\text{weight of dry soil}\,[(b)-(a)]} \times 100\%$$

As the weight of 1 gram of water is equal to 1 cm^3, you can also calculate the percent of water by volume.

$$\text{soil moisture}\,(\text{volume}\,\%) = \frac{\text{volume of soil moisture in cm}^3}{\text{volume of core in cm}^3} \times 100\%$$

You can use the weight% and volume% water to calculate bulk density as a check on whether you did things right, as

$$\text{volume\% water} = \text{weight\% water} \times BD$$

The volume percent of water is handy to correlate the amount of water in the soil with the amount of precipitation (or irrigation) and the water needs of the crops. These numbers are often given in millimeters (mm) or inches. One volume percent water equals 1 mm water per 10 cm layer of soil. So, a quarter inch of rainfall (about 6.4 mm) would increase soil water by about 6.4 volume% in the top 10 cm layer of soil (discounting any evaporation, run-off or drainage to deeper layers).

When soil is saturated (see next exercise), all air in the soil is displaced by water. Thus, the volume of water is an indication of the total porosity of the soil (i.e., the volume of pores). You can also calculate the percent of the core taken up by pores in the soil from the ratio of bulk density to particle density (PD). Soil particles have a more or less fixed density of 2.65 g cm^{-3}. Soil porosity can be calculated as follows:

$$\%\ \text{soil porosity} = \left[1 - \left(BD / PD\right)\right] \times 100\%$$

Using the % soil porosity and the volume% water, you can then get an idea of how much of the pore space is actually filled with water (that is, the % water filled pore space or WFPS) using the following formula:

$$\% \, WFPS = \frac{volume\% \, water}{\% \, soil \, porosity} \times 100\%$$

Write-up

- Describe and discuss the difference in soil moisture content (if any) between the in-field measurement and the measurement taken in the lab.
- Graph and describe how soil moisture varies over the range of soil depths sampled.
- Describe how the bulk density of soil at different depths may affect soil moisture holding capacity.

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D. Measuring total soil water holding capacity

Procedure

1. Use one of the 15-cm cores collected in Measurement C. in this procedure. Carefully remove the caps so that soil does not fall out of the core, and put a double layer of a square of cheese cloth on the bottom of the core with a rubber band (you may do this before removing the top cap).
2. Weigh the core with the cheese cloth.
3. Set the core in a pan of water until it is almost immersed; leave it in the pan to soak up water for 24 hours until it is completely saturated. Add extra water to the pan if needed.
4. Remove the core from the pan, and let excess water drain until it stops dripping.
5. Weigh the core with soil at saturation point (a).
6. Put the core on a grate so that water can drain out of it easily; cover the top of the core with some saran wrap to prevent evaporation. Let it drain for 24-48 hours.
7. Weigh the core with soil at field capacity after 24 (b) and after 48 hours (c).
8. Carefully remove the cheesecloth and replace with a square of aluminum foil; put core in the drying oven for 24 hours at 105^0 C. Weigh the wet piece of cheese cloth you used on your core; its weight needs to be subtracted from the total weight of the core+soil to get the actual weight of the water in the soil.
9. Remove the core from the oven (*careful: hot!! - use gloves*), cover top with Saran wrap to prevent it sucking moisture from the atmosphere, and weigh the dry core (d).
10. Calculate the amount of water in the soil at saturation and field capacity after 24 and 48 hours by subtracting the weight of the core+ dry soil from the weight of the core+saturated/field capacity soil, respectively:

    weight $water_{saturation}$ = (a) - (d)
    weight $water_{24\ hours}$ = (b) - (d)
    weight $water_{48\ hours}$ = (c) - (d)

dry soil= (d) - weight of the core

Then calculate the amount of water in relation to the dry soil [i.e., (weight of core+dry soil) - (weight of the core)] in both g water/g dry soil, and as a weight% and volume% water (see formulas under exercise C). Remember, since 1 g water equals 1 cm^3, the weight of water in your cores at different times is equal to the volume (in cm^3) of water. So, to get the volume% of water, divide the volume of water by the volume of the core used (for example, if using the 15 cm cores, the volume would be 275.6367 cm^3). Note the adjustment to make to the core volume when it is not completely filled (see Exercise C.).

E. Measuring organic matter content

Organic matter plays many important roles in te soil ecosystem, all of which are of importance to sustainable agriculture (Gliessman 1999: 109-110). Soil organic matter (SOM) is one of the best indicators of soil quality, especially when a baseline number can be obtained for the soil being studied before it was put into agriculture, and when soil can be observed over a period of time. Measuring soil organic matter content with high precision and accuracy requires sophisticated equipment and involved techniques. In the simpler procedure outlined below, dried soil samples are heated at high temperature, resulting in the oxidation (to carbon dioxide) of most of the carbon present. The reduction in mass that results from this heating provides a rough measurement of organic matter content. It should be noted that various non-organic substances, such as pure carbon (charcoal), carbonate minerals, and water of hydration, can also be lost during the heating process, contributing some measurement error (see Weil 1998 for more information on this procedure).

Equipment needed

- Convective drying oven
- Aluminum pans
- Mason jars (for storing dried soil)
- Muffle furnace (capable of heating to 600^0 C)
- Analytical balance
- 2.0-mm soil sieve
- Porcelain crucibles
- Tongs or forceps

Procedure

1. Choose a sample design: Put a 30-m measuring tape on a NW-SE axes, with the 15 meter mark in the center of your plot. Starting at the 1 meter mark, take a soil sample using the 1-inch soil core to the depth marked on the core (approx. 15 cm or 6 inches). Remove the soil from the core and put into a bucket. Repeat every 3 meters (so, one core sample is taken at the 1, 4, 7, 10, 13, 16, 19, 22, 25 and 28 meter marks). Do the same for the NE-SW axis. Put the soil of all core samples taken into the bucket, mix well and put a composite sample of about 1 pound (estimate!) in a zip-lock bag. Put a paper with the location (Cove Creek farm), date taken and plot number in the bag, and also write this information on the outside of the bag using a permanent marker.
2. Construct a data table in your notebook in which to record the SOM content of the samples.
3. Measure the organic carbon content of the samples using the weight loss on ignition method.
   a. Air-dry the samples and screen each one through a 2-mm soil sieve.
   b. Place each sample in a 100-ml beaker and dry it at 105^0 C in a drying oven for 24 hours to remove moisture.
   c. Immediately upon removing each beaker from the drying oven, number and weigh your crucibles, and weigh out a 10.00 gram sample (*f*) and place sample into a labeled porcelain crucible (Prompt weighing of samples is important because the soil will begin to absorb moisture from the atmosphere when it is removed from the oven).
   d. Heat the samples at 600^0 C for 2 hours. This process is referred to as "ignition."
   e. Remove the crucible from the oven using forceps or thongs, and measure as precisely as possible the mass of each sample [(g) = total mass - weight of the crucible].
   f. Find the difference between the mass of each sample before the ignition heating and the mass after this heating. This difference is approximately equal to the organic matter content of the sample [i.e., (*h*) = (*f*) - (*g*)].
   g. Express the organic matter content of each sample as a percentage of the mass of the sample before it was subjected to the ignition heating:

$$SOM\,(\%) = \frac{(h)}{(f)} \times 100\%$$

F. Measuring soil texture

Texture is one of the most stable attributes of the soil (Gliessman 1998: 103-104); Brady and Weil 1996), being modified only slightly by farming practices that mix the different layers, such as cultivation. Textural classes indicate how easily a soil can be worked. Soils high in sand are easier to cultivate and are termed light, whereas soils that are difficult to cultivate and high in clay are called heavy. Soil texture also has an impact on water and nutrient retention and availability, with clayey soils being more retentive and sandy soil being more porous and leached.

Soil texture refers to the percentage by weight of sand (particles between 0.05 to 2.0 mm), silt (0.002 to 0.05 mm), and clay (<0.002 mm) in a soil sample. It is based on that part of a field-dried soil sample that passes through a 2-mm sieve (if coarse material greater than 2 mm in diameter makes up more than 15% of a field sample, then the soil can be classified as gravelly or stony). The type of soil particle (sand, silt or clay) that makes up the highest percentage of the sample is used to describe the soil texture class. When no one of the three fractions is dominant, the textural class is loam (refer to Gliessman 1998: 104, Figure 8.2 for the various textural classes used in soil science).

Of the many methods available for determining soil texture, there are three relatively simple methods students can use. One of these, a qualitative field method based on the feel of the soil material when kneaded and rubbed between the fingers, is described below. The other is a quantitative method using special soil sieves with meshes of different grades; a pre-weighed sample of dried soil is put on top of a column of these sieves and shaken for 30 minutes. The soil collected in each progressively smaller mesh sieve is carefully collected and weighed, and distributions of the various size soil particles can calculated as a percent of the total weight of the sample. We will be using both these methods. A third method is also quantitative and uses special hydrometers that measures the density of a suspended soil solution over time as the soil particles settle. Tables have been developed that allow for direct conversion of the hydrometer readings into size class percentages. If soil hydrometers and glass cylinders are available, this method is a fairly accurate method for determining soil texture classes. If you prefer to use this method, consult a soils textbook for details.

Procedure for qualitative 'feel' method

1. Use the same sample design described above for SOM (if doing both analyses, you therefore have to collect only one composite sample).
2. Perform the following test on the composite sample (see also the enclosed diagram on "Soil texture by feel"):
    a. Place about 25 grams of soil in the palm of your hand. Add water drops while kneading the soil to break aggregates. Stop adding water when the soil is moldable.
    b. Shape the soil into a ball by squeezing. If it does not form a ball, it is predominantly sand. If it forms a ball, go to the next step.
    c. Hold the ball of soil between thumb and forefingers, pushing and squeezing upward to form the ball into a ribbon. If the soil does not form a ribbon, it is loamy sand, silt loam, or coarse silt loam (the hydrometer or sieve method may be needed for more specificity).

If the soil forms a ribbon, go on to the next step.

d. If the soil forms a ribbon 2.5 cm (1 inch) long before breaking, wet and rub the ribbon with the forefingers. If the soil feels gritty, it is sandy loam; if it is very smooth with no grit at all, it is silt. If it feels smooth with only a little bit of grittiness, it is silt loam, and if neither grittiness or smoothness predominates, then it is loam.
e. If the soil forms a ribbon 2.5 - 5.0 cm (1-2 inches) before breaking, wet and rub it as in step (d). If the soils feels gritty, it is sandy clay loam. If there is not grit and it feels smooth, it is silty clay loam. If neither grittiness nor smoothness predominates, the soil is a clay loam.
f. If the soil forms a ribbon longer than 5 cm before breaking, wet and rub it as in step (d). The soil is sandy clay if it feels gritty, silty clay if it feels smooth, and clay if neither predominantly smooth nor gritty.

3. Record the textural class of each sample, along with the characteristics that indicate that textural class in your lab notebook.
4. Considering the range of textural classes encountered in the soil samples and the predominant class, develop a description of the overall soil texture of each sample point in Cove Creek, and record these descriptions separately in your notebook.

Procedure for the sieve method

1. Use the same sample design described above for SOM (if doing both analyses, you therefore have to collect only one composite sample).
2. Air dry about 150 grams of soil.
3. Grind or pound the soil to break up larger aggregates.
4. Weigh out a sample of 100.00 grams of the dry, ground soil and put in the top of the sieve arrangement. Shake (by hand or by machine) for 15-20 minutes.
5. Carefully collect all soil particles from each sieve separately and weigh as precisely as possible; record the data on the enclosed data sheet.
   NOTE: The weight of the individual samples collected from each sieve should total to the amount put in the top.
6. Calculate the percentage distribution of various fractions in the soil.

Write-up

- Describe the soil at your sample point as exhaustively as possible based on the various tests and measurements carried out. Also include information about characteristics such as geologic origin, color, and management history.
- Explain the suitability of the soil for agriculture, and how specific properties of the soil may (should) be improved with inputs or cropping/management practices.