



Soil Texture

What is soil texture?

Soil texture refers to a mixture of variously sized mineral particles (Fig. 1), which determine a soil's textural class. The *textural class* is defined by the relative amounts of sand (0.05 to 2 mm particle size), silt (0.002 to 0.05 mm), and clay (less than 0.002 mm) as seen in the textural triangle below (Fig. 2). Particles that are larger than 2 mm are called coarse fragments (pebbles, cobbles, stones, and boulders), and are not considered in the textural class, although they may help define a soil type. Organic matter (OM) is also not considered in the determination of soil texture, although it is very important for soil functioning. A soil's textural class—such as a clay, clay loam, loam, sandy loam, or sand—is perhaps its most fundamental inherent characteristic. It affects many of the important physical, biological, and chemical processes in a soil, but is not easily altered by management, and changes little over time. Thus, while texture is not a soil health indicator per se, it informs the interpretation of most soil health indicators.

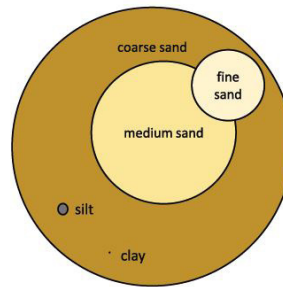


FIGURE 1. Relative size of soil particles.

Relating texture to soil function

Texture affects many important soil processes due to the total amount of pore space and how varied pore space is within aggregates. Soils with higher clay contents (finer soils) generally have higher ability to retain nutrients (more [cation exchange capacity](#), or CEC) and can accumulate, or sequester, more organic matter. The size distribution of the particles strongly influences the size of the pore spaces between the particles, the formation and stabilization of soil aggregates, and the spaces between these aggregates. Aggregates

and inter-aggregate spaces are as important as the sizes of the particles themselves, because the relative quantities of variously sized pores—large, medium, small, and very small—govern the important processes of water and air movement. These in turn affect processes like water infiltration, permeability, water storage, aeration, nutrient leaching, and denitrification. In addition, soil organisms and plant roots live and function in the pores. When the soil loses porosity (generally due to management), roots cannot grow as well, and many organisms have more difficulty surviving. Most pores in a clay are small (generally less than 0.002 mm), whereas most pores in a sand are large (but generally still smaller than 2 mm).

On the one extreme of the texture and aggregation spectrum, we see that beach sands have large particles (in relative terms) and very poor aggregation due to a lack of organic matter or clay to help bind the sand grains. A good loam or clay soil, on the other hand, has smaller particles, but they tend to be aggregated into crumbs that have larger pores between them and small pores within. Although soil texture doesn't generally change over time, the total amount of pore space and the relative amount of variously sized pores are strongly affected by management practices.

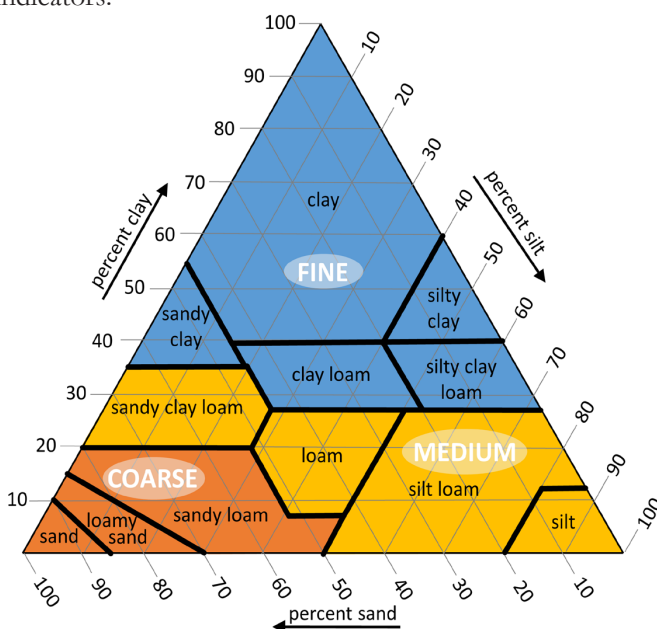


FIGURE 2. Textural triangle used in determining soil textural class.

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Using texture in developing scoring functions

Soil texture contributes to inherent soil quality, and is virtually unchangeable through soil management. However, most interpretations of soil health indicator scores are dependent on interactions with soil texture. Therefore texture is not given a soil health score. For example, given the same management, coarse textured soils generally have lower organic matter (OM) levels than fine-textured soils because they lack the ability to stabilize OM. Measured OM contents, along with other indicators, are scored relative to an appropriate distribution for soils of a particular textural grouping, to account for this type of difference.

In the soil health assessment scoring process, we distinguish between **coarse**-textured (sand, loamy sand, sandy loam), **medium**-textured (loam, silt loam, silt, sandy clay loam) and **fine**-textured (clay loam, silty clay loam, sandy clay, silty clay, and clay) soils (See textural triangle on the previous page).

Basic protocol

- Air dry and sieve soil sample past 2mm.
- Approximately 14g (+/- 0.1g) of sieved soil is added to a 50ml centrifuge tube containing 42ml of a dispersant solution (3% sodium hexametaphosphate, a detergent).
- Shake vigorously on reciprocating shaker for 2 hours to fully disperse soil into suspension.
- Wash entire contents of centrifuge tube onto a sieve assembly (Fig. 3a). Sieve assembly consists of 0.053mm sieve on top of a funnel above a 1L beaker. Rinse all material through the sieve. Sand captured on top of the sieve is washed into a tared metal can and set aside (3b).
- Silt and clay particles collected in the 1L beaker are re-suspended by stirring and allowed to settle for 2 hours (3c). The clay in suspension is then decanted. The settled silt is washed into a second tared can. Both tared cans (one containing the sand fraction and the other the silt fraction) are dried at 105° C to constant weight before recording dry weight.
- Calculate percent sand, silt clay from:
 - Sand (%) = dry wt sand (g)/dry wt soil (g) added to centrifuge tube.
 - Silt (%) = dry wt silt (g)/dry wt soil (g) added to centrifuge tube.
 - Clay (%) = 100% - Sand (%) - Silt (%).



FIGURE 3 a - c. Steps to determine soil textural class.

NOTE: This is a rapid, but reliable and robust method to categorize sample soil particle size distribution. Once silt, sand and clay fractions are known, a sample is categorized as fine, medium or coarse, and the textural triangle is used to determine textural class (previous page).

For a more comprehensive overview of soil health concepts including a guide on conducting in-field qualitative and quantitative soil health assessments, please download the Cornell Soil Health Manual.

Acknowledgment

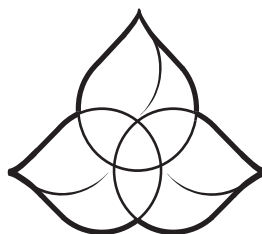
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