

Soil Organic Matter

Total soil organic matter (OM) consists of both living and dead material, including well decomposed, more stabilized materials. OM analysis is a measure of carbon containing material that is, or is derived from, living organisms, including plants and other soil dwelling organisms.

How organic matter relates to soil function

Soil organic matter (OM) is where soil carbon is stored, and is directly derived from biomass of microbial communities in the soil (bacterial, fungal, and protozoan), as well as from plant roots and detritus, and biomass-containing amendments like manure, green manures, mulches, composts, and crop residues (Fig. 1).

OM in its various forms greatly impacts the physical, biological and chemical properties of the soil. OM acts as a long-term carbon sink, and as a slow-release pool for nutrients. It contributes to ion exchange capacity (nutrient storage), nutrient cycling, soil aggregation, and water holding capacity, and it provides nutrients and energy to the plant and soil microbial communities. Soils with high organic matter tend to require lower farm inputs, and to be more resilient to drought and extreme rainfall events.

As organic matter increases, soil tilth improves as soils become less compact and have more space for air passage and water storage. Good tilth also means that the soil is porous so root development is not restricted as they more easily move through the soil to access oxygen, water and nutrients.

Managing constraints and maintaining optimal organic matter content

Intensive tillage and lack of carbon inputs decrease organic matter content and overall soil health over time. Likewise, increasing organic matter in the soil takes dedication, patience and time to rebuild. It is unlikely that a single incorporation of a green manure will noticeably increase the percent organic matter. Adding more stable organic matter such as compost, or possibly biochar, can improve water infiltration and retention in the short term.

Percent organic matter is determined by loss on ignition, based on the change in mass after a soil is exposed to high temperature in a furnace. At these temperatures, carbonaceous materials are burned off (oxidized to CO₂), while other materials remain.

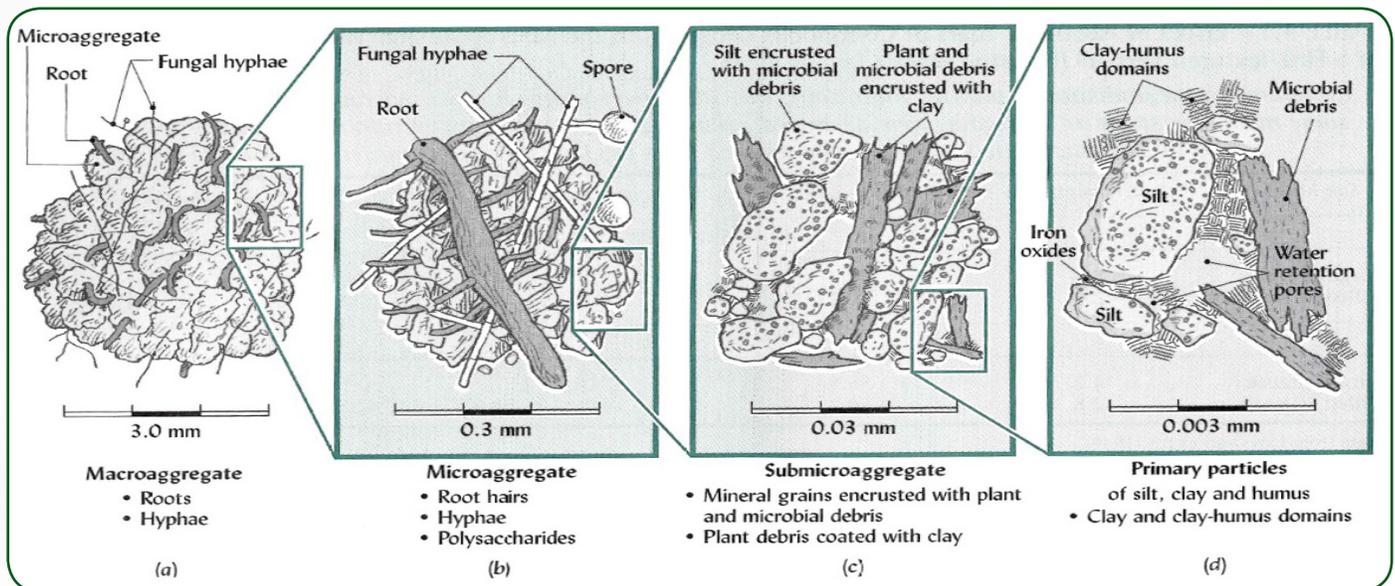


FIGURE 1. Each step (a–d) demonstrates the bonding agents and aggregation of soil as size decreases. An active microbial population will build and stabilize soil through production and interaction with adhesive by products. Adapted from *The Nature and Properties of Soils*, 12th ed., Brady and Weil (1999) Fig. 4.26 from p 150.

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Retention and accumulation of OM in the long term is improved by reducing tillage intensity and frequency (as much as is feasible within the constraints of the production system) and repeated use of diverse organic matter additions from various sources (amendments, residues, and the active growth of crops, forages, or cover crops, particularly their roots). These all stimulate both microbial community growth and the stabilization (sequestration) of carbon in aggregates.



Growing Aroostook cereal rye cover crop. Photo: Troy Bishopp

The appropriate selection of organic matter input will depend on the management goal(s) and other microbial activity and food source related constraints identified.

Basic protocol

- A sample is dried at 105°C to remove all water.
- The sample is weighed (Fig. 2)
- The sample is then ashed (for weight loss on ignition) for two hours at 500°C, and the percent of mass lost is calculated after weighing again.
- The % loss on ignition (LOI) is converted to % OM using the following equation:

$$\% OM = (\% LOI * 0.7) - 0.23$$

FIGURE 2. Soil mass is determined prior to being exposed to high temperature. Soil is weighed after being ashed to calculate the percentage of mass lost.



Scoring function

Figure 3 below depicts Organic Matter scoring functions and upper value limits for coarse, medium, and fine textured soils.

The red, orange, yellow, light green and dark green shading reflects the color coding used for the ratings on the soil health report summary page.

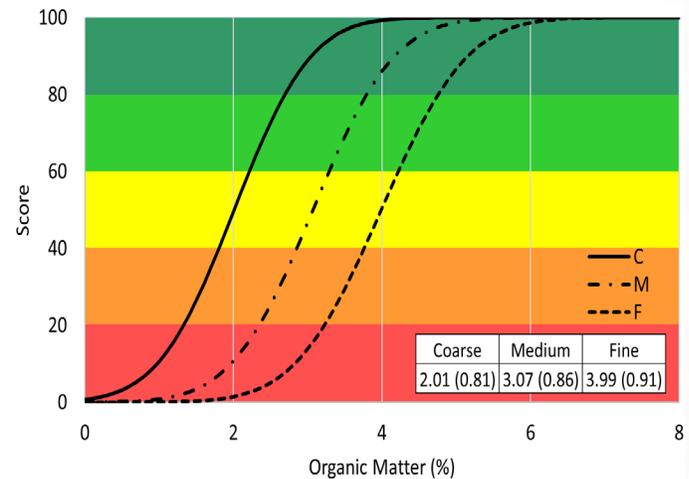


FIGURE 3. Soil Organic Matter (OM) scoring functions and upper value limits for Coarse (C), Medium (M) and Fine (F) textural classes. Mean and standard deviation (in parenthesis) for each class are provided. In this case more is better. Soils with higher OM scores generally require lower inputs of nutrients and are more resilient to drought and extreme rainfall.

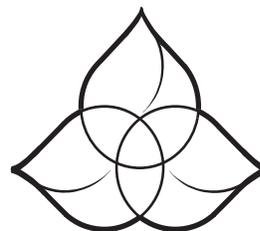
For a more comprehensive overview of soil health concepts including a guide on conducting in-field qualitative and quantitative soil health assessments, please download the Cornell Soil Health Manual at bit.ly/SoilHealthTrainingManual.

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