

Active Carbon

Active carbon is an indicator of the small portion of soil organic matter that can serve as a readily available food and energy source for the soil microbial community, thus helping to maintain a healthy soil food web.

How active carbon relates to soil function

Active carbon is highly correlated with and similar to particulate organic matter (POM), which is determined with a more complex and labor-intensive wet-sieving and/or chemical extraction procedure. Due to its role in providing available food and energy sources for the soil microbial community, active carbon is positively correlated with percent organic matter, aggregate stability, and with measures of biological activity (such as respiration) and microbial biomass.

Research has shown that active carbon is a good “leading indicator” of soil health response to changes in crop and soil management, usually responding to management much sooner (often years sooner) than total organic matter percent. This is likely because when a large population of soil microbes is fed plentifully over an extended period of time, well decomposed

organic matter builds up. Thus, monitoring the changes in active carbon can be particularly useful to farmers who are changing practices with the goal of building up soil organic matter.

Managing constraints and maintaining optimal soil biological activity

Reducing tillage and increasing organic matter additions from various sources will increase active carbon, and will feed, expand, and balance the microbial community, thus increasing total organic matter over the long term. Various sources include amendments, residues, and active and diverse forage, crop, or cover crop growth, with living roots providing labile carbon to soil microbes for as much of the year as possible (Fig. 1).

To begin the process of measuring active carbon, soil is mixed with a potassium permanganate solution, which starts off deep purple in color. The permanganate oxidizes the active carbon and loses some of its color. The more active carbon found in the soil, the more the purple color declines. This color change is measured with a spectrophotometer or colorimeter.



FIGURE 1 a - b. (a) Reducing tillage and (b) using cover crops with living roots provide the residues and labile carbon necessary to increase soil OM and promote soil microbial diversity and activity. Photo credit: (a) Jeff Vanuga, USDA-NRCS; (b) Dorn Cox, Greenstart.

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Basic protocol

- Soil is air dried and sieved to 2 mm.
- A 2.5 g sample of air-dried soil is placed in a 50 ml centrifuge tube filled with 20 ml of a 0.02 M potassium permanganate (KMnO_4) solution, which is deep purple in color (Fig. 2a).
- The soil and KMnO_4 are shaken for exactly 2 minutes to oxidize the active carbon in the sample. The purple color becomes lighter as a result of this oxidation reaction.
- The sample tube is then allowed to settle for 8 minutes, pipetted into another tube, and diluted with distilled water.
- Absorbance is measured at 550 nm (2b).
- The absorbance of a standard dilution series of the KMnO_4 is also measured to create a calibration curve for interpreting the sample absorbance data.
- A simple formula is used to convert sample absorbance value to active C in units of mg carbon per kg of soil.

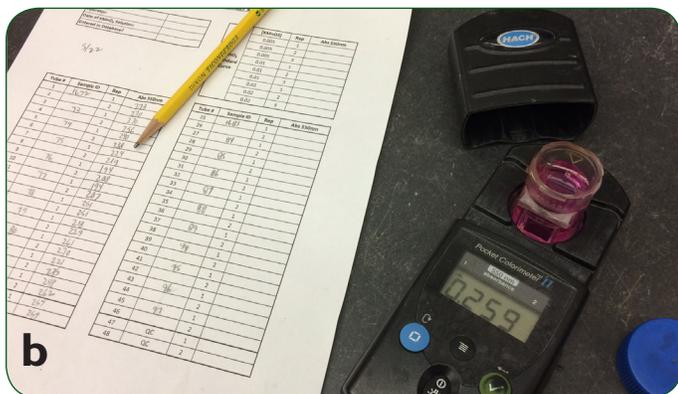


FIGURE 2 a - b. (a) Extracts before and after dilution. The samples on the left are after they have been weighed, shaken, and settled. The samples on the right show the dilution as they are prepared to be (b) measured for absorbance at 550 nm.

Scoring function

Figure 3 below depicts active carbon 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.

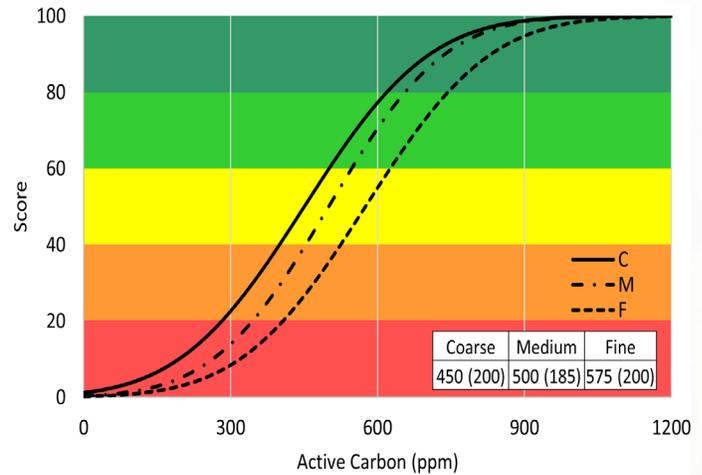


FIGURE 3. Active Carbon scoring functions and upper value limits for Coarse (C), Medium (M) and Fine (F) textural classes. Mean and standard deviation (in parenthesis) for each class are provided. In this case more is better: Higher active carbon scores indicate a trend toward more organic matter building up in the soil through biological activity.

Cornell Soil Health Laboratory Active Carbon [Standard Operating Procedures](#) (CSH 04) can be found under the [‘Resources’](#) tab on our website.

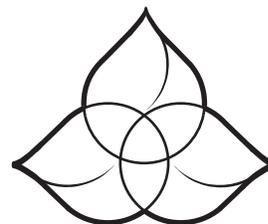
For a more comprehensive overview of soil health concepts including a guide on conducting in-field qualitative and quantitative soil health assessments, please download the Cornell Soil Health Manual at bit.ly/SoilHealthTrainingManual.

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