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This article is part of a series to promote better understanding of our agricultural soil resources along with practices that can influence soil health.

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Understanding Organic Soil Carbon

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Soil organic carbon (SOC) is one of the important soil health indicators as higher levels generally mean healthier soils that are more biologically active, able to breakdown organic nutrients or pollutants and retain more nutrients (including water).

SOC and soil organic matter (SOM) are generally used interchangeably – SOM is just over 50% carbon but includes other important nutrients like nitrogen, sulphur and phosphorus that are products of the various life forms from which SOM is comprised. A factor of about 2 (range from 1.7 to 2.2) is used to convert SOC to SOM.

Darwin Anderson describes SOM as the product of life in and on the soil, supporting plants, microorganisms and animals. It is a storehouse of gradually released nutrients, improving soil structure, increasing water storage and reducing soil erosion risks. [1]

SOM is also recognized as a critical and relatively stable pool in the global carbon cycle, estimated to be as much as twice the size of the plant and atmospheric pool. Fortunately, most of the farming practices that contribute to increased production and soil health will also serve to maintain or increase soil carbon storage.

SOC begins with the products of photosynthesis, entering the soil through the decomposition of plant and animal residues, root exudates, microorganisms and soil biota. To better understand SOC we often refer to various fractions of the total pool based on relative ease of decomposition. While it is a relatively low percentage of the total soil carbon pool, the more active light-fraction serves as the energy source for microflora that drive biological processes including nutrient cycling from organic matter – referred to as mineralization. There are a multitude of other microorganisms, many of which work symbiotically with plants species, supplying vital functions like nitrogen fixation, nutrient uptake or protection from pathogens in exchange for plant carbon.

Humus accumulates in our soil over a very long time period, representing a large percentage and most stable part of the SOC pool, helping to maintain soil aggregates and improve soil aeration. Humus is also important for soil nutrient and water holding capacity – increasing the cation exchange capacity (CEC). It also adsorbs and mediates the decomposition of otherwise harmful pollutants or pesticides that might otherwise affect crops or pollute groundwater. One of the important SOC constituents that contributes to soil health is glomalin, an organic glue like substance produced by soil mycorrhizae fungi. Glomalin content increases with reduced tillage and frequency of crops that associate more readily with mycorrhizae (for example pea versus canola). It binds soil mineral particles into micro-aggregates,

[1] Darwin Anderson, Organic Matter in Prairie Soils. 2008. Volume 1. Prairie Soils and Crop Journal. http://prairiesoilsandcrops.ca/articles/volume-1-4-print.pdf

contributing to important soil qualities like tilth, aeration and resistance to compaction or crusting. Another important by-product of good soil biology is higher levels of organic acids like oxalic acid – released during organic matter decomposition and contributing to improved soil phosphorus availability.

Healthy soils are those with stable or increasing SOC levels and a relatively higher proportion of the carbon pool in the more active-fraction. Reducing soil disturbance and good grazing management are examples of practices that improve soil biology and help build SOC. Good rotations that optimize biomass production from a variety of crop types are key cropping system practices. Adding manure is helpful, especially compost that has carbon in a more stabilized form. Organic materials and rotations with a higher frequency of cereals and/or inclusion of grazing rather than forage removal will favour SOC buildup.

In summary, SOC originates from but also contributes to life in the soil. It is not only a critical part of the global carbon pool but also the energy source driving soil biology and quite literally the glue that binds soil aggregates, supporting good soil structure. Farmers can improve SOC through practices that reduce soil disturbance, maintain soil cover, increase biomass production and include perennial crops and/or grazing on farmlands.