For Immediate Release
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Can Soil Organic Matter Increase at an Annual Rate of 1%?
By Wilma Trujillo

Soil health is a key driver of agricultural productivity and environmental resilience. In the early 1990's, soil health was defined as "the capacity of soil to function as a vital living system, within ecosystem and land-use boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health". Selected physical, chemical, and biological properties of soil are used to measure the system or the soil's ability to perform system functions.

Soil organic matter has long been suggested as the single most important indicator of soil health. Agricultural practices can impact both the amount and the composition of soil organic carbon and consequently also, the soil's physical, biological and chemical conditions that define soil health.

The ability of agricultural fields to accumulate carbon depends on several factors including climate, soil type, type of crop or vegetation cover, and management practices. Using farming practices that reduce disturbance of the soil, combined with practices that bring additional carbon to the soil, will allow for carbon accumulation over time. Such practices include implementation of conservation tillage, retaining crop residues, intensification of cropping system by including cover crops and reducing or eliminating fallow periods, adding organic nutrient sources such as manure and compost and including perennial crops in crop rotations.

Farmers have a vested interest in retaining and increasing soil organic carbon for individual fields. When considering changing management practices, farmers should have appropriate expectations and realistic goals on soil organic carbon increases. Rapid increases in soil organic carbon cannot be expected. There is no doubt that an increase from 2% to 3% sounds small, but it represents a hefty fifty percent increase in organic matter.

Can soil organic matter increase at an annual rate of 1%? Let's do some basic math to estimate how much organic matter is needed to increase soil organic matter from 2% to 3% or 1%. Typically, the weight of soil in an acre furrow slide (6.7") is 2,000,000 lb. So 2% and 3% of 2,000,000 lb are 40,000 lb and 60,000 lb, respectively. Increasing soil organic matter 1% requires an additional 20,000 lb soil organic matter or 11,600 lb of carbon as soil organic matter is roughly 58% of carbon.

Can a productive crop system increase soil organic matter at an annual rate of 1% (20,000 lb)? Let's look at a productive no-till wheat crop in rotation with a cover crop mixture. The source of soil organic matter is plant material resulting from the process of photosynthesis. If wheat yield is 80 bushels per acre or 4,224 lb of dry grain per acre and the harvest index is 0.4, there is 6,335 lb of wheat stubble left in the field. Assuming that wheat root mass is about 25% of the total above-ground biomass produced (2640 lb), the total amount of residue produced (stubble plus roots) is 8,975 lb per acre. Now, we need to account for the residue from the cover crop mixture. If the cover crop produces 4,000 lb of above-ground dry matter and 800 lb of root mass per acre, the total wheat plus cover crop residue (roots and above-ground) is 13,775 lb per acre. Typically, carbon content in crop residue is 40%. Thus, there is 5,510 lb of carbon per acre produced by the wheat-cover crop system. This is a lot less than the amount of carbon needed to increase soil organic carbon in 1%. Let's convert this carbon into soil organic carbon. Assuming that 20% of plant residue is converted to soil organic carbon, only 1,102 lb of the carbon (1,900 lb of organic matter) would end up as a soil organic carbon. This is 0.06% of 2,000,000 lb of soil.

The above calculations show that it is not possible to increase soil organic matter at an annual rate of 1%. A crop production system must produce at least 250,000 lbs of plant residue (stover and root mass) to increase soil organic matter 1%. A productive no-till wheat-cover crop system could be expected to increase soil organic matter at an annual rate of about 0.1%.

Since significant changes in soil organic matter take time, it is better to track changes in soil structure and water infiltration, or improvement on crop nutrient status. These changes may appear within two to three years of switching to new practices that bring additional carbon inputs to the soil.

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