

Soil Organic Matter

Organic matter is the key to soil health and contributes to soil productivity in many ways.

A single manure application of cover crop will not increase the percent organic matter significantly. It takes time and patience to improve the soil organic matter level.

Introduction:

Soil organic matter (SOM) is the fraction of the soil consisting of plant and animal residues in various stages of decomposition. Organic matter contains organic carbon and nitrogen. Carbon is a source of energy and nitrogen is a source of protein for microorganisms in the soil. Some of the microorganisms are pathogens which cause plant disease but in a healthy soil the vast majorities of these organisms are beneficial and help prevent any one type of organism such as a plant pathogen from being dominant.

SOM consists of three distinct parts.

Living organic matter (about 15%) consists mainly of decomposers:

<u>Microbial Group</u>	<u>Population per gram of soil</u>
Bacteria	300,000 – 200,000,000
Actinomycetes	100,000 – 100,000,000
Fungi	20,000 - 1,000,000
Protozoa	10,000 - 100,000
Algae	100 - 50,000

Other living SOM include nematodes, insects, earthworms, plant roots and small animals.

Dead organic matter (about 15%) serve as food for living organisms and include dead microbes, old plant roots, crop residues and bodies of larger insects and animals.

Very dead organic matter (about 70%) are well decomposed, dark colored organic substances also called humus. Humus continues to decompose, but at a very slow rate.

Why is SOM important?

Organic matter in soil is the key to soil health. SOM improves many physical, chemical, and biological characteristics of the soil, including water holding capacity, cation exchange capacity, pH buffering capacity, and chelating of micronutrients. Furthermore, well decomposed SOM improves soil structure by increasing aggregation, enhances biological activities in the soil, slowly releases nutrients, and suppresses some diseases. A loss of SOM can lead to soil erosion, loss of fertility, compaction, and general land degradation.

What factors influence the amount of SOM?

The average SOM in most Massachusetts soils ranges between 1-5 % where a minimum of 4% SOM is desirable. The maintenance and enhancement of soil organic matter is crucial to the soil health and sustainability of farming systems. The accumulation of SOM within soil is a balance between the return or addition of plant and animal residues and their subsequent loss due to the decay of these residues by microorganisms and mismanagement of soil. In general, any factor that affects soil microbial activity also affects SOM breakdown.

Temperature-Soil temperature has a marked influence on microbial activity. The optimum soil temperatures for bacterial activity are in the 70 to 100° F range, but some activity may occur in as low as 40° F, although at greatly reduced rates.

Oxygen-Soil microbes require oxygen and water for their respiration and when soil is compacted or saturated with water, respiration slows down which in turn reduces decomposition of SOM.

Soil pH-Under acid conditions, bacterial activity which is responsible for most of the decomposition of organic matter is greatly reduced. Soil fungi responsible for breakdown of SOM are generally less affected by low pH.

Best Management Practices to increase SOM:

Soil organic matter level depends on both uncontrollable factors i.e. weather conditions, and controllable factors i.e. soil management. Managing SOM is a balancing act of additions; crop residues, manure, and compost and losses; decomposition plus erosion.

Addition of organic materials including animal manure, compost, cover crops (green manure), and some off-farm materials such as municipal leaves and food residuals will increase SOM. Agricultural practices also have a significant effect on improving SOM level:

- Cover crops: Increase SOM directly when residues are returned to the soil, protects soil against erosion, helps to retain and cycles nutrients.
- Crop rotations: Perennial forages (hay-type crops) develop extensive root system which when die add new organic matter to the soil. They also reduce the rate of decomposition of SOM because soil is not continually being disturbed.
- Tillage practices: Conventional plowing and disking breaks down natural soil aggregates that allow wind and water erosion. They also expose the soil to direct sunlight which increases the SOM decomposition.
- Increasing the percent organic matter in the soil takes time and patience. It is unlikely that a single incorporation of manure or cover crop will noticeably increase the percentage of organic matter. Repeated application of an organic amendment in combination with reduced tillage will improve the organic matter level.

Resources:

Soil Organic Matter. Maryland Cooperative Extension, Fact sheet # 783.

Cornell Soil Health Assessment Training Manual. Cornell University, College of Agricultural and Life Sciences.

For more information visit www.umass.edu/cdl
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