USDA United States Department of Agriculture
Natural Resources Conservation Service

SOIL

Organic Matter Depletion

Organic Matter Depletion

Management-induced depletion of any or all pools of soil organic matter resulting in limited soil function and processes that support plant productivity, biological activity, and water and nutrient cycling.

What is it?

For the purpose of conservation planning, the general term soil organic matter (SOM) is used to encompass all pools of organic matter in the soil. Soil organic matter is not a single substance but consists of a complex mixture of substances with each playing an important role for soil function. The term soil organic matter encompasses all organic components of a soil: 1) living biomass (intact plant and animal residues and microorganisms), 2) plant litter residues, 3) dissolved organic molecules (root and fungal exudates and bacterial mucilages), and 4) humus. The living components play an extremely important role in restoring function and building SOM pools. These pools of organic matter are in various stages of decomposition and variable states of stability.

Why is it important?

SOM is critical for the stabilization of soil structure, retention and release of plant nutrients, and maintenance of water holding capacity, thus making it a key indicator not only for agricultural productivity, but also environmental resilience. Because organic matter improves soil structure and enhances water and nutrient holding capacity, managing for soil carbon can enhance soil productivity and environmental quality, and it can reduce the severity and costs of natural phenomena, such as drought, flood, and disease. In addition, increasing soil organic matter levels can reduce atmospheric CO_2 levels that contribute to climate change, and improved soil quality/soil health reduces dust, allergens, and pathogens in the air. Ground and surface water quality improve because better structure, infiltration, and biological activity make soil a more effective filter. SOM can be manipulated by land management practices, some of which result in losses of organic components in soil. When organic matter is depleted, the soil's agricultural productivity and environmental resilience decrease.

What can be done about it?

Use a Soil Health Management System (SHMS) that follows the core Soil Health Management Principles. The core principles are: 1) minimize disturbance, 2) maximize soil cover, 3) maximize biodiversity, and 4) maximize presence of living roots. Minimizing physical, chemical, and biological disturbance reduces rapid oxidation and rapid microbial decomposition of organic matter. Maximizing soil cover reduces the impact of raindrops, wind, sunlight, and temperature on the labile pools of SOM located near the surface. Keeping the soil covered allows for improved soil habitat for important organisms involved in the production of organic materials. Maximizing living roots provides a readily available carbon food source needed by organisms that produce the biotic glues important for building protected pools of organic matter. Increasing biodiversity provides a diverse population of plants capable of producing diverse belowground roots with variable carbon composition and exudates that feed many types of micro and macrofauna. The most practical way to enhance soil health, and as a result air and water quality, and water quantity, is to promote better management of soil organic matter or carbon. A well planned and managed system combining several of the practices below will yield the highest outcome.

Organic Matter Depletion at a Glance

(continued)

Organic Matter Depletion (continued)

Organic Matter Depletion at a Glance

Problems / Indicators—Soil cover, crusting, residue breakdown, soil color, water stable aggregates, soil structure, plant roots, biological diversity, and biopores	
Typical Causes	**Examples of Typical Solutions**
• Soil disturbance (physical, chemical, and/or biological) • Fallow (extended periods without living roots and crop canopy) • Low crop biomass (surface and roots) • Burning, harvesting, or otherwise removing crop and other plant residue • Simplified crop rotations	• Cover crops (high residue) • Diverse crop rotations with high residue crops • No-till/strip-till cropping systems • Nutrient management (reduce over application of nitrogen) • Prescribed grazing • Maintain evenly spread crop residues on the surface • Well managed animal manure and compost applications • Irrigation water management • Drainage water management • Mulching • Reduced tillage • Restoring plant communities and maintaining ecologically appropriate levels of litter and large woody debris