Factors Affecting the Availability of Soil Organic Matter

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ABSTRACT

Environmental, biological, and managerial factors interact in an elaborate manner to affect the availability of soil organic matter (SOM). SOM decomposition rates are directly impacted by climatic factors like temperature, precipitation, and humidity; in general, warmer and wetter climates speed up the breakdown of organic materials. The structure and texture of the soil are also important since finer-textured soils, like clay, can physically hide organic particles from SOM, preventing it from degrading too quickly. Microbial communities and interactions between plant roots are examples of biological activity that influences the stabilization and cycling of organic matter in soils. Crop rotation, tillage, and the application of synthetic or organic inputs are examples of land management techniques that can either increase or decrease SOM levels. Conservation tillage, cover cropping, and the application of organic amendments (for example, compost or manure) all contribute to increased SOM content by reducing erosion and increasing organic matter inputs. On the other hand, SOM depletion may result from overgrazing, deforestation, and intensive farming methods. Maintaining SOM levels, enhancing soil health, and guaranteeing long-term sustainability in natural and agricultural ecosystems all depend on an understanding of these elements.

INTRODUCTION

Soil organic matter (SOM) is the lifeblood that sustains healthy soils, delivering necessary nutrients, enhancing soil structure, and promoting plant growth. Composed of decomposed plant and animal matter, SOM is often referred to as the "soil's nutrient bank" because it enriches the soil with vital nutrients like carbon and nitrogen. However, its availability is dynamic and influenced by a number of events that have the potential to either increase or decrease it over time.

Understanding what causes SOM availability is critical for anyone working in agriculture, gardening, or land management. The amount of organic matter in soil is influenced by a number of factors, including farming practices, biological activity, soil type, and climate. While some management techniques, such as excessive chemical use or overtilling, can deplete soils of their organic matter, warmer temperatures, for example, accelerate the breakdown of organic compounds. However, SOM levels can be raised by implementing sustainable techniques including cover crops, reduced tillage, and the addition of organic fertilizers.

The presence of organic matter content in the soil which enhances the following factors.

- Nutrient supply
- Soil structure improvement
- Water retention
- Carbon sequestration
- Erosion control
- Biological control
- Pollutant filtering

FACTORS AFFECTING THE AVAILABILITY OF SOIL ORGANIC MATTER

Climate

The availability of organic matter in soil is mostly influenced by climatic factors, particularly temperature and rainfall. The kind and amount of vegetation in an area, as well as the amount of organic materials that are naturally added to the soil, the rate at which these materials decompose, and the synthesis of humus, are all influenced by temperature, particularly its diurnal fluctuations. More microbial activity is stimulated by higher temperatures than by plant development. Despite having a higher organic matter content, soil in cooler regions decomposes organic matter more slowly. As long as the temperature stays below a certain point, an increase in rainfall can lead to more vegetation growth and, in turn, a bigger buildup of organic waste. Low temperature and high rainfall are conducive to accumulation of organic matter. It has been found that the organic matter content of the soils of different world climate belts is more or less constant within narrow limits for each textural class of soils. Ladd and Amato (1985) reported that, despite differences in plant material and climate patterns, the decomposition of leguminous materials in southern Australian sites followed the same pattern as that of ryegrass for sites in Nigeria and the United Kingdom (Jenkinson and Ayanaba, 1977), although the time scales were different.

Natural Vegetation

The natural flora that grows on the soil's surface adds to the soil's organic matter. Sub-humid and semi-arid environments are typically dominated by grasslands, while humid regions are dominated by trees.

Grassland-developed soils have more total organic matter than forest-developed soils. Compared to forest land, grasslands appear to promote a lower rate of decomposition and, thus, a greater organic level. Additionally, root turnover contributes significantly to the soil's humus content, which is crucial for sequestering carbon. The majority of organic matter in forests is introduced as surface litter. However, in grassland ecosystems, up to two-thirds of organic matter is added through the decay of roots (Quideau, 2002).

Texture and Drainage

In general, organic matter is higher in clay and silt-rich soils than in coarse-textured soils. In fine-textured soils, the rate of oxidation may be a little slower than in sandy soils, and the rate at which organic wastes are restored to the soil is often higher. Fine-textured (clayey) soils have two to four times the amount of organic matter compared to coarse-textured (sandy) soils under comparable climatic circumstances (Prasad and Power, 1997). Due to their high moisture content and very poor aeration, poorly drained soils typically contain significantly more organic matter than well-drained soils. Other soil characteristics that promote the buildup of organic matter include crumb structure and erosion resistance. Optimal microbial activity occurs at near "field capacity", which is equivalent to 60-percent water-filled pore space (Linn and Doran, 1984).

Table 01. Organic matter content of Indian soils (per cent by weight)

Soil types	Organic carbon		Organic matter	
	Range	Average	Range	Average
Black soil	0.41-2.50	0.80	0.70-4.31	1.39
Red soil	0.14-2.39	0.66	1.39-4.12	1.14
Laterite soil	0.13-3.07	1.08	0.23-6.29	1.88
Alluvial soil	0.18-1.84	0.55	0.28-3.18	0.95

Cropping and Tillage

Compared to grassland soils, agricultural soils deteriorate more quickly over time. In contrast to cultivated regions, where a large portion of the plant material is removed for human or animal consumption, in nature (under grassland soils), all of the organic matter created by the vegetation is returned to the soil, hence the decline is not surprising. Tillage techniques break up the organic leftovers and raise them to the point where they come into direct touch with soil organisms, speeding up the decomposition process.

Rotations, Residues and Plant Nutrients

The amount of soil organic matter increased as a result of rotation clovers, corn and oats as comparison with continuous corn. Applying phosphorus, lime, and manure helps to maintain significantly higher quantities of organic matter. This high level of organic matter is explained by the higher return of organic matter from the additional manure and crop residues. Organic stuff is generally shielded from wasteful oxidation by lime.

Amount of Organic Matter in Soil

Soils differ greatly in the amount of organic matter they contain. There have been reports of surface soils containing anywhere from traces to 10% organic matter. Because organic matter is rapidly oxidised at higher temperatures, tropical soils have less of it. As soil depth increases, the amount of organic matter often decreases. Compared to virgin soils, cultivated soils have less organic matter. Cultivation decreases organic matter and increases oxidation. Organic matter in soils is also lost as a result of wind and water erosion. Table 01 lists the ranges of organic matter found in India's main soil types.

CONCLUSION

In conclusion, a complex interaction between natural and man-made factors affects the availability of soil organic matter (SOM). Climate, soil type, vegetation, and microbial activity are important natural elements that influence the production, breakdown, and stabilization of organic matter in soil. SOM levels can be improved or deteriorated by human activities such crop rotation, tillage, land usage, and the use of chemical or organic inputs. In order to preserve soil health, support ecosystem productivity, and reduce the effects of climate change by sequestering carbon, sustainable soil management techniques that encourage the preservation of organic matter such as decreased tillage, cover crops, and organic amendments are crucial. Thus, it is essential to comprehend and control these elements in order to preserve resilient and fruitful soils that can promote environmental and agricultural sustainability.

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