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SOIL ORGANIC CARBON AND ITS MANAGEMENT

Mahendra Choudhary[1*], Darshan K S[2], and M B Reddy[2]

[1]Department of Agronomy, G B Pant University of Agriculture and Technology, Pantnagar Uttarakhand 263145

[3]Agronomy Section, National Dairy Research Institute, Karnal Haryana 132001

Corresponding author: mcrchoudhary99@gmail.com

ABSTRACT

The soil organic carbon is the chief component of soil essential for high soil productivity and agricultural sustainability. Adding soil organic matter improves the soil's biotic life by providing energy to the soil microbes. Shifting land use patterns from forest to cultivation, over-irrigation, uncontrolled grazing, tillage, burning of crop residues, etc., resulted in accelerated soil organic carbon reduction. Adopting appropriate measures such as cultivating perennial pasture, cereal crops, green manuring, applying manures, and minimum tillage may help improve soil organic carbon.

INTRODUCTION

The soil organic carbon is the most vital component of soil that is composed of the debris of plant parts, decaying animal bodies and microbes and a mixture of other heterogeneous organic substances along with closely associated inorganic constituents. The soil organic carbon governs soil fertility and productivity by supporting various chemical reactions and biotic life. Photosynthesis, respiration and decomposition are the critical processes in an ecosystem which govern the amount of soil organic carbon. For example, if photosynthesis is slower in the plants, this may affect the plants' root biomass in the plants, and finally, less soil organic carbon will be available after decaying the plant roots in the soil.

MAJOR FUNCTIONS OF SOIL ORGANIC CARBON

- It facilitates the decomposition of organic matter to humus
- It helps in the retention of macro and micronutrients
- It binds the soil particles and forms the soil structure
- It shields plant's roots against diseases and parasites
- It improves the nutrient availability of macro and micro nutrients for plant uptake
- It releases growth hormones for plant growth and development
- It improves the water-holding capacity of the soil

REASONS FOR REDUCTION IN SOIL ORGANIC CARBON

The following are the major reasons for the reduction in soil organic carbon:

- Shifting in land use patterns from forest to cultivation.
- Over irrigation
- Uncontrolled grazing
- Tillage
- Burning of crop residues
- Growing crop plants with a high stem-to-root ratio
- Climate change

SOURCES OF SOIL ORGANIC CARBON

The source of soil organic matter may be grouped into two based on its origin:

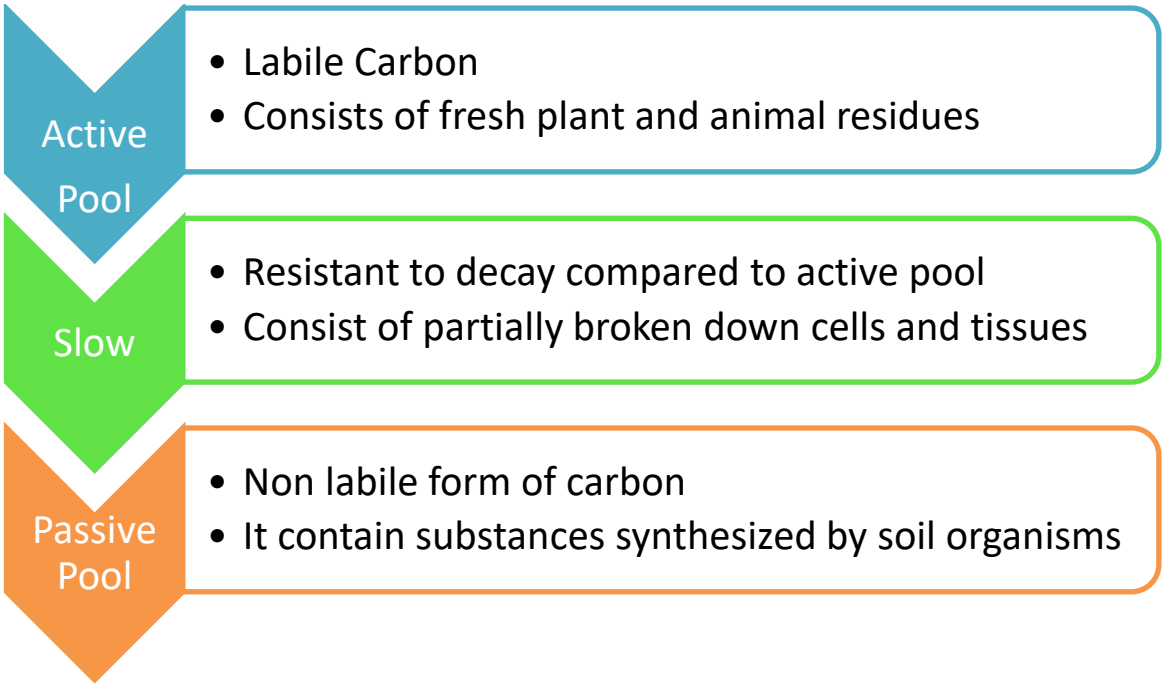
a) Plant origin sources include root biomass, root exudates, leaf litter, green manuring, and leftover crop residues.
b) Animal origin sources include residues or remain of animals and microorganisms, domestic wastes, animal feed and excreta and animal dung/manure.

Both these sources of soil organic carbon are subjected to various activities governed by earthworms, soil microbes, and soil enzymes for decomposition and forming humus.

VARIOUS POOLS OF SOIL ORGANIC CARBON

The soil organic carbon is grouped into three pools which are as follows:

- ACTIVE POOL (LABILE CARBON): This pool consists of the fresh plant and animal residues that break down quickly. This contributes to the enhancement of biological activities in the soil.
- SLOW: This is an intermediary pool of soil organic carbon that lies between active and passive soil organic carbon pools. It is mainly composed of detritus material and decomposes gradually but takes longer than the active pool for decomposition.
- PASSIVE (HUMUS or NON-LABILE CARBON): It is a dark-coloured complex mixture that is transformed from organic substances and contains substances synthesized from soil organisms. It is not biologically active.



MEASURES TO IMPROVE SOIL ORGANIC CARBON LEVELS

Soil organic carbon is very critical for agricultural productivity and sustainability. Therefore, the adoption of the following measures may improve the soil organic carbon levels in the soil:

CULTIVATION OF PERENNIAL PASTURE: Cultivating grass-dominated perennial pasture cultivation may improve the soil's organic carbon. In pasture cultivation, perennial grasses act as a good source of leafy matter, adding organic matter to the ground on decomposition.

CULTIVATION OF CEREAL CROPS: Cereal crops possess high biomass and, after harvesting, leaves significant amounts of organic matter in the form of crop residues, stubbles and root biomass at the time of crop harvest, which on decomposition adds substantially soil organic carbon.

GREEN MANURING: Addition of soil organic matter if pre-requisite to Add organic carbon. Cultivation of green manuring crops like sesbania, sun hemp etc., can improve soil fertility through biological nitrogen fixation. When the standing green manure crop in the field is plough into the soil, it adds to soil organic matter, which on decomposition and adds soil organic carbon.

APPLICATION OF MANURING: The addition of bulky organic manures carries a substantial amount of soil organic matter, but this organic matter needs to be added in a high amount to bring significant changes in the soil organic carbon.

ADOPTION OF MINIMUM TILLAGE: The heavy tillage operations break down the stable soil aggregates and expose the humus material for faster decomposition resulting in the evaporation of soil organic carbon.

Hence, adopting minimum tillage may help maintain the soil cover and prevent the overexposure or oxidation of the humus material in the soil, thus preventing the loss of soil organic carbon.

CONCLUSION

Soil organic carbon is an important component of soil, essential for high soil productivity and agricultural sustainability. Adding soil organic carbon improves the soil's biotic life by providing energy to the soil microbes. It also secrets hormones which help in the growth and development of plants. Shifting land use patterns from forest to cultivation, over-irrigation, uncontrolled grazing, tillage, and burning of crop residues, and climate change resulted in accelerated soil organic carbon reduction. Adopting appropriate measures, including cultivation of perennial pasture, cultivation of cereal crops, green manuring, application of manures, and adoption of minimum tillage, may help improve soil organic carbon.

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