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Soil Organic Carbon (SOC): A Tool of Soil Fertility and Productivity

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Soil organic carbon (SOC) content is considered the key indicator of soil health and the essence of life on earth heavily depends on it. The capacity of a soil to support ecosystem functions along with sustain environmental quality and biological productivity while promoting plant and animal health has been defined as soil health. Therefore, the domain of soil health comprises of human, animal, ecosystem and health aspects. Though under soil organic content, fresh and undecomposed plant materials do not make their contribution however it is a major product of decomposed soil organic matter (SOM) and it got build up slowly after the decomposition of plants and animals as well as micro-organisms. Since long time, farmers and scientists remained well aware of the importance of soil organic carbon (SOC) in respect of soil health and the sustainable agriculture development therefore, soil organic carbon plays a key role in many soil functions. Soil organic carbon content not only stabilizes soil structure and improves aggregation that linked to reduce the soil erosion, improves water absorption capacity but also influenced on the less retention of pesticides and other inorganic pollutants by being virtue of their enhanced mobilization and degradation. Activities, such as increasing nutrients cycling and storage, buffers crop production against water shortages etc. followed to maintain soil fertility and the activities enhanced the soil porosity and aeration, water holding capacity and hydraulic conductivity of soil which on turn provides a habitat and food source for soil organisms that ultimately improve soil biodiversity and health. Hence, the SOC stock exhibits the long-term balance between additions of organic carbon (OC) from different sources and its losses through different pathways.

Though, SOC input rates are primarily determined by the root biomass of a plant however certain parts of it also deposited from plant shoots in form of litter. Soil organic carbon content can be enhanced by many ways that includes the addition of organic sources such as legumes, pulses, tree leaves, in-situ green manuring and mulches, these reduces carbon losses from the soil. Soil organic carbon (SOC) inputs increase soil fertility, carbon sequestration, crop yield and decreased GHGs emission from the soil. Adoption of suitable crop rotations/crop diversification and crop intensification tactics are also known to increase carbon sources via the addition of more amount of leaves, stems and roots per unit land area. To mitigate the role of climate change, soil organic carbon content revealed to play its role as a carbon sink source therefore, in recent past years, a grave interest in this direction has emerged out that ultimately gave an opportunity to include the carbon trading schemes. However, there is a lack of scientifically data-based set on soil carbon stock in various soil operates under different management practices. In addition to this, there is also an immense need to educate and inform the farmers about the importance of soil organic carbon in production system, so that they can make better sense and offend confusion claims appearing in the media. Factor affecting soil organic carbon levels are:

- ***Climate:*** temperature, rainfall, humidity and evaporation.
- ***Soil factors:*** texture, structure, pH, electrical conductibility, bulk density, particle density, colour and porosity.
- ***Vegetation*** (plants, grasses, trees, higher plant roots).
- ***Time.***

SOC levels in soil are a fruit of interactions of several ecosystem processes, of which photosynthesis, respiration, and decomposition are the key operations. Temperature is directly linked to increase plant production which on turn also linked to increase carbon supply to the soil. Apart from increased plant production, increases in temperature along with good amount of precipitation can also enhance the microbial decomposition of SOC that brought out a decrease in SOC stocks worldwide. Higher soil organic matter levels cause greater soil nitrogen retention, greater microbial biodiversity and also promote the presence and growth of arbuscular mycorrhizal fungi that colonise the roots of crops and facilitate the movement of plant nutrients from the soil into plants, thus, help in improving in plant growth and yields. This in turn leads to improve a wide range of ecosystem services. Therefore, with a soil carbon credit system, carbon becomes a valued commodity for growers to beef up the additional income. One soil carbon credit represents 1 metric ton of carbon dioxide or an equivalent greenhouse gas emission that has been reduced, avoided, or removed from the atmosphere. Soil carbon strata play a vital role in reducing GHGs emission from the rice field when using a well decomposed farm yard manure (10 t/ha) and nitrogen inhibitors (Table 1).

Nutrient	***Low***	***Medium***	***High***
Soil Organic Carbon	< 0.5 %	0.5 - 0.75%	> 0.75%

Table 1: Organic carbon status in soil.

Figure 1: General appearance of high soil organic carbon profile of soil.

Use of green manure (dhaincha) in long term experiments (25years) conducted at ICAR-IIFSR, Modipuram (Uttar Pradesh), under rice- wheat cropping system in Upper Gangetic Plains of India was observed to increase soil organic carbon (SOC) and organic matter (OM) contents by 0.76% and 1.31% respectively in comparison to initial values of 0.69% and 1.19% when nutrient supplies (NPK) in crops were made by using 50% of RDF in form of chemical fertilizers and 50% via green manuring (dhaincha, *Sesbania aculeate*). Another long-term experiment conducted at Rajendra nagar (Telangana) in India for 25 years from 1988-2013 under rice- rice cropping system yielded an enhanced productivity of 8.23% (9.23t/ha/year) as compare to the initial productivity (7.93t/ha/year) when the application of 50% RDF(NPK) was done by fertilizers and 50% NPK through green manuring (*Gliricidia*). Change in Labile carbon (mg/g) which is an important fraction of organic carbon was occurred due to the use of green manure crop (*dhaincha*) in rice-wheat system, concluded based on a long term study conducted at Punjab (India) on farmers' field. The labile carbon was found highest i.e., 1.29 mg/g with the use of recommended doses of fertilizers fractionated as 50% NPK (Fertilizers) + 50 % GM (*dhaincha*) followed by 75% RDF through NPK fertilizers+25%NPK through GM (1.24mg/g). Since as compared to other counties, Indian soils becoming very poor in organic carbon and organic matter contents therefore, Government of India also emphasizing the farmers to increase the area under green mannuring, cover crops etc. owing to be of their great potential to add organic carbon in soil. Besides, presently country is facing great challenges to achieve targeted food grain production viz., 333 million tonnes by 2050 that too by reducing global warming potential with less carbon credit. Hence, it may be infers that soil organic matter transformations can play a pivotal role in the availability of ample plant nutrients from soil to plant. This is essential for the good crop yields and maintaining soil fertility since

organic matter transformations is an integral part of carbon cycle, nitrogen and water that may impact in ways to maintain sustainable agriculture development and survival of human population in India (140 crores).

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