Vol. 3 Issue-3, November 2022 (e-ISSN: 2582-8223)

Organic Carbon: Estimation, Function, and Sequestration of Atmospheric Carbon into Soil Carbon Pool

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ARTICLE ID: 49

Introduction

Soil Organic Carbon (SOC) is the quantifiable parameter of organic matter present in soil. The amount of organic matter in soil is strongly correlated with the levels of soil organic carbon (SOC), which is frequently used to evaluate organic matter in soils. Soil Organic Matter (SOM) is a heterogeneous mixture of fresh plant remains and humus, a material that has undergone extensive decomposition by the action of microorganisms and is now resistant to further decomposition.SOM primarily consists of carbon, hydrogen, and oxygen, with trace amounts of nitrogen, phosphorus, Sulphur, potassium, calcium, and magnesium found in organic wastes. It is separated into "alive" and "dead" components and can consist of relatively recent inputs, like stubble, to heavily decomposed elements that may be thousands of years old. The percentage of "life" below-ground SOM, which includes roots, animals, and microorganisms, is about 10%.The interactions of a number of ecosystem activities, including photosynthesis, respiration, and decomposition, lead to SOC levels. The fixation of atmospheric CO2 into plant biomass is known as photosynthesis. SOC input rates are primarily influenced by a plant's root biomass, though they also take into account litter left over from plant shoots. Plant roots' growth and demise affect soil carbon both directly and indirectly, as does the passage of carbon-rich chemicals from roots to soil microorganisms.SOC enhances soil's natural ability to withstand anthropogenic stressors and extreme climatic occurrences including droughts, intense rainstorms, heat waves, and floods. One approach to improve soil ecosystem services is the control of soil organic carbon (SOC) through improved management practices.

Materials & Methods

Site of Study

The Kapurthala district of Punjab, located in the Northern Rohilkh and Agro-Ecological Zone of Northern Plains covers 134ha of Net Sown land area for agricultural use. It comes under Trans-Gangetic Plains of Region (VI) of 15 Agro-Climatic Zones of India. Kapurthala experiences annual rainfall of 527.1mm owing 399.7mm to SW Monsoon that usually onsets in the 1st week of July and usually ceases around 2nd Week of September. However almost total irrigation of the cultivated lands is done through borewells. Groundwater availability to use ratio stands at over exploited state in the region i.e., utilization >100%. Rice (Rabi) and Wheat (Kharif) crops are primarily grown in this region. We conducted survey at 8 different sites of Kapurthala region for SOC. The stations were selected for analysis, based on diverse types of crops grown and agricultural operations it had undergone. A comparative study of variation is SOC was done with respect to crop practices. Refer to table 1 for geographical locations of sites of sampling.

Table 1: Sites of study.

Sites	Site No.	Latitude	Longitude
Guava orchard	01	31°14'22.59384"	75°41'57.27192"
Green manure field	02	31°14'29.6826"	75°41'44.79576"
Green gram field	03	31°14'31.35228"	75°41'49.68096"
Maize field	04	31°14'33.6552"	75°41'47.86584"
Tilled soil field after wheat cultivation	05	31°14'32.89992"	75°41'48.14592"
Rice seed bed	06	31°14'43.08036"	75°42'3.9744"
Papaya orchard	07	31°14'40.56864"	75°42'2.56608"
Polytunnel.	08	31°14'40.81344"	75°42'4.70196"

Sampling & Estimation

Care was taken while collecting the samples from these locations. A total of 32 samples from 8 sites i.e., 4 samples for each station was taken for analysis. Standard procedures for soil sampling were followed during the sampling. Soil depth was also taken into consideration based on crops grown at the site of sampling. Plantations and orchard crops were sampled at 30, 60, 60 & 90cm respectively whereas Crop fields such as rice field were sampled at 15-20 cm, respectively. This study did not use the top 0.01 m of soil, which frequently contains debris and recently fallen litter. Also, areas with clay and stagnant water

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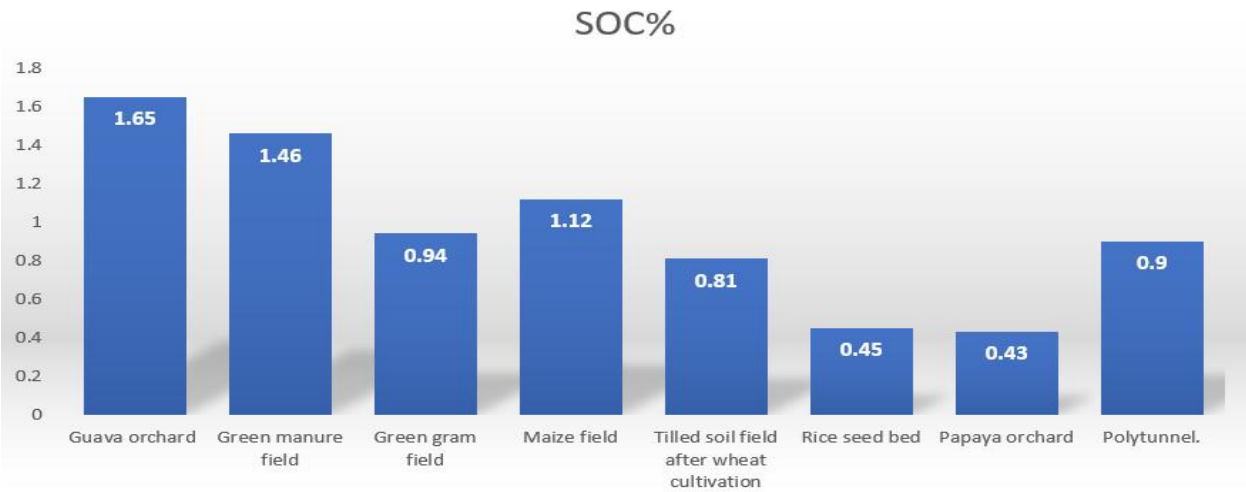
were excluded while sampling. The Estimation for Soil Organic Carbon (SOC) was done by WALKLEY-BLACK method.

In this process dichromate ion from Potassium Dichromate oxidizes the carbon. Remaining dichromate ion is then back titrated with ferrous ions. Fig 1 represents the variation in SOC from site to site.



Percentage variation in SOC (Mean Value of 4 samples each)

Results & Discussion

It is widely acknowledged that Soil Organic carbon content is a significant determinant of soil health. The physical characteristics of soil are enhanced by soil carbon. By aiding in the formation of aggregates, it improves the cation-exchange capacity (CEC) and water-holding capacity of sandy soil and adds to the structural stability of clay soils.SOM, which contains a significant amount of carbon, contains a significant amount of nutrients, cations, and trace elements that are crucial for plant growth. It is essential to the organic acids that make minerals available to plants and prevents nutrient depletion. Additionally, it protects soil from abrupt pH changes.

Conclusion

As we know, clean energy and the reduction of atmospheric carbon are necessary for climate change mitigation. Due to the advantages for agriculture, increasing carbon sinks and lowering emissions can be accomplished via increasing soil Organic carbon. Hence Carbon sequestration, a new-gen practice must be practiced ensuring sustainability of agro-environmental ecosystem. Along with those conventional practices such as keeping the land covered with perennial pastures, using organic fertilizers, growing of cereal crops that leave behind organic residue and minimum tillage etc. should be practiced keeping the SOC% optimum. The conventional methods of charging SOC have almost little to no effect and is almost nullified by the agricultural operations itself. Natural carbon sequesters such as forests & ocean work at a rate that is outperformed by the daily carbon emissions. Therefore, promoting Carbon Sequestration technologies is the need of the hour. Major countries are funding large scale carbon sequestering projects to tackle the situation. With increased anthropological emissions, research in this field is utmost needed for survival of the ecosystem, that we live in.

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