

Effect of soil organic matter on physical properties of soil

¹Y.Rajit Kumar, ²Dr. Shilpa Kaushal, ³Gagandeep Kaur and ⁴Deepika Gulati

^{1,3,4} MSc Scholar (Agronomy), UIAS, Chandigarh University, Gharuan, Mohali (Punjab)

²Assistant Professor, UIAS, Chandigarh University, Gharuan, Mohali (Punjab)

*Corresponding Email: - rajitkum6@gmail.com

ARTICLE ID: 007

Abstract

Organic matter is the lifeblood of fertile, productive soil, without it agriculture production is not sustainable. Soil organic matter plays a vital role in determining the physical properties of soils. We reviewed the information on the relationships of soil organic matter with soil structural stability, consistency, compaction, water holding capacity of soil and other physical properties of soil which are vital for agriculture production. Our review indicates that studies specifically assessing relationships between organic matter content and physical properties of soil. These studies indicates soil organic matter improves soil physical properties by providing organic binding agents , increasing water holding capacity of soils, provides better aeration , lowering soil bulk density, and improving the elasticity and resilience of the whole soil. The numerous benefits of soil organic matter on physical attributes suggest that crop residues should be returned to the soil to maintain or increase SOM concentration. Management practices including no –till with residue return, continuous cropping systems, cover crops, and grass –based rotations should be promoted to further increase SOM concentration and thus improve soil physical properties.

Keywords- Organic Matter, Organic matter decomposition, Physical properties, Soil organic carbon Soil.

Highlights

Soil Organic matter (SOM) and specifically soil organic carbon (SOC) are known to play important roles in the maintenance as well as as improvement of many soil properties. While agriculture is the area most concerned with key functions and critical levels of soil organic matter. The physical properties of the soils are very important for agricultural production and

for the sustainable use of soil. Agricultural wastes can be used as a source of organic matter and nutrients for soils and can influence physical properties of soils.

Introduction

Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of decomposition. Most of our productive agriculture soils have between 3-6% organic matter. Soil organic matter contributes to soil productivity in many different ways. Soil organic matter is made up of different components that can be grouped into three major types :-

- ✚ Plant residues and living microbial biomass.
- ✚ Active soil organic matter also referred to as detritus.
- ✚ Stable soil organic matter, often referred to as humus.

The first two types of organic matter contribute to soil fertility because the breakdown of these fractions results in the release of plant nutrients such as nitrogen, phosphorus, potassium etc. The humus fraction has less influence on soil fertility because it is the final product of decomposition (Hence the term stable organic matter).

Physical Properties of soil :-

1. Soil texture
2. Soil structure
3. Soil density
4. Soil temperature
5. Soil aeration
6. Soil porosity
7. Soil colour
8. Soil compaction

Effect Of Soil Organic Matter On Soil Structure,Texture And Aggregate Stability

Soil structural stability refers to the resistance of soil to structural rearrangement of pores and particles when exposed to different stresses. Chaney and Swift (1984) investigated aggregate stability of 26 soils from agricultural area and found a linear correlation between aggregate

stability and organic matter. Organic matter improves soil structure, allowing the free passage of air and water, both equally necessary to the growth of plants, its like a sponge holding onto water and nutrients. Tisdall and Oades (1982) proposed that the fresh or active part of SOM was largely responsible for stabilization of aggregates. The addition of organic matter to the soil usually increases the water holding capacity of soil. This is because the addition of organic matter increases the number of microspores and macrospores in the soil either by gluing soil particles together or by creating favourable living conditions for soil organisms. Oades and Waters (1991) introduced the concept of aggregate hierarchy. The concept of aggregate hierarchy suggests that organic matter controls aggregate stability, and degradation of large aggregates creates smaller, more stable aggregates.

Effect of Soil Organic Matter on Soil colour and Soil Temperature

Soil colour is often used as the highest categorical level in many soil classification systems. A good linear correlation exists between soil colour and SOM content. Dark coloured soils with a higher amount of organic matter hold comparatively larger amounts of water, which require a greater amount of energy for heating. The thermal property of soil is largely influenced by a combination of water content, soil texture and soil colour. Generally good soil conditions are associated with dark brown colours near the soil surface, which is associated with relatively high organic matter levels, good soil aggregation and high nutrition levels (Peeverill *et al.* 1999). The effect of usually dark brown or black SOM on soil colour is important not only for soil classification purposes, but also for ensuring good thermal properties, which in turn contribute to soil warming and promote biological processes (Baldock and Nelson, 1999), Konen *et al.* (2003) and Schulze *et al.* (1993) confirm that a consistent relationship exists between SOM content and Soil colour. Thus the influence of organic matter on thermal properties of soils may not only be affected by its colour but by the other soil organic properties as well. Organic matter increases the water holding capacity of the soil. It also contributes to the dark colour of the soil. These two soil properties increase its absorption of heat, thereby increasing the soil temperature.

Effect of Soil Organic Matter On Bulk Density Of Soil

Any practice that improves soil structure decreases bulk density. A system that uses cover crops, crop residues and reduced tillage results in increased soil organic matter, less disturbance and reduced bulk density. Bulk density is dependent on soil organic matter, soil texture, density of soil mineral (sand, silt, and clay) and their packing arrangement. Bulk density decreased 0.07 grams per cubic centimeter with a one percentage unit increase in organic matter (Shaykewich and Zwarich, 1968).

Effect of SOM On Soil Porosity And Soil Aeration

Soil porosity is the volume of soil not occupied by solids and can be filled with air or water. Soil porosity is strongly linked to soil organic matter concentration. Increased organic matter contributes indirectly to soil porosity (via increased soil faunal activity). Increased levels of organic matter and associated soil fauna; lead to greater pore space with the immediate result that water infiltrates more readily and can be held in the soil.

Humus is vitally important for soil it improves soil aeration. The organic component of soil, formed by the decomposition of leaves and other plant material by soil microorganisms. It improves soil aeration, as it is fibrous and porous. This improves the soil environment for many microbes and plant roots, which require aeration.

Effect of SOM On Soil Compaction

Soil compaction is the process of increasing the density of soil by packing the soil particles closer together causing a reduction in the volume of air. Soil compaction can be a serious form of soil degradation. Compaction of soil is the compression of soil particles into a smaller volume, which reduces the size of pore space available for air and water. Increase in the soil organic matter may reduce compactibility by increasing resistance to deformation and by increasing elasticity (Rebound effects :Soane 1990). High organic carbon contents can even reduce the compactibility of soil at high moisture levels in clay and silty clay soils (Smith et al. 1997).

Effect of Organic matter On Water Holding Capacity of Soil

The addition of organic matter to the soil usually increases the water holding capacity of the soil. (Hudson, 1994) showed that for each 1- percent increase in soil organic matter, the

available water holding capacity in the soil increased by 3.7 percent. When a soil is at field capacity, organic matter has a higher water holding capacity than a smaller volume of mineral soil. While the water held by organic matter at the permanent wilting point is also higher overall, an increase in organic matter increases a soil's ability to store water available for plant use.

Management of Soil Organic Matter

Soil organic matter (SOM) is the foundation for productive soils. It promotes healthy crops, supplies resources for microbes and other soil organisms, and regulates the supply of water, air and nutrients to plants. Ways to increase soil organic matter :-

- Grow perennial pasture, a period under perennial grass dominant pasture is an effective way of increasing organic matter in farm soils .
- Growing green manure crops to enrich the nutrient status of soils.
- Spreading manure and use of organic fertilizers
- Use of concentrate organic matter, retain all organic additions, whether roots, stubble or manure, close to the surface.
- Management steps like tilling and using cover crops that boost soil health can increase the organic matter content of the soil.

Conclusion

Soil organic matter is the foundation for productive soils. Organic matter is the lifeblood of fertile, productive soil, without it agriculture production is not sustainable. It is evident that there is a perfect linear correlation between SOM and physical properties of soil. The physical properties of the soil are very important for agricultural production and the sustainable use of soil. The amount and rate of water, oxygen, and nutrient absorption by plants depends upon the physical properties of the soil. Considering the physical properties, organic matter amendments can increase water holding capacity, soil porosity, water infiltration, and percolation while decreasing soil crusting and bulk density. Agricultural wastes can be used as a source of organic matter and nutrients for soils and influence the physical properties of soils. This addition can be a good strategy to maintain or even increase the levels of organic matter in the soil to improve physical properties of soils. So we need to

maintain optimum levels of organic matter content in soil for promoting better physical properties of soil, which is a key for agriculture production.

References

- Amezketta , E. (1999). Soil aggregate stability : a review . Journal of sustainable agriculture 14, 83-151 .
- Carter , M.R., Angers , D.A, And Kunelius , H.T. (1994) Soil structural form and stability , and organic matter under cool season perennial grasses . Soil science society of America journal 58, 1194-1199.
- Brady , N.C. (1990). The nature and properties of soil . (Macmillan publishing company : New York)
- Baldock, J.A. And Nelson , P.N. (1999). Soil organic matter . In ‘ Handbook of soil science
- Ekwe , E. I . (1990) . Organic matter effects on soil strength properties . Soil and tillage research 16, 289-297 .
- Franzluebbers , A.J. (2002). Soil organic matter stratification ratio as an indicator of soil quality . Soil and Tillage Research 66, 95-106.
- Harris, R.F., Allen, O.N., Chesters, G., And Allen, O.N. (1996) Dynamics of soil aggregation . Advances in Agronomy 18 , 107-169.
- Lal, R. (1993). Physical properties and moisture retention characteristics of some Nigereian soils . Geoderma 21, 209-223.
- Lal, R. (2000) Physical management of soils of the tropics : priorities for the 21 st century . Soil science 165 , 191-207.
- Oades, J.M. (1984). Soil organic matter and waterstable aggregates in soils . Plant and soil 76, 319-337.
- Sharratt, B.S. And Flerchinger , G.N , (1995). Straw color for altering bsoil – temperature and heat flux in the sub –arctic . Agronomy journal 87, 814-819.