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Soil structure and their management in farming system: A review

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Abstract
Soil structure applies an important effect on edaphic circumstances and the atmosphere. It is normally expressed as the degree of structural stability in soil. Soil structure stability or soil aggregation fallouts from the rearrangement, flocculation and cementation of soil particles. It is facilitated by soil organic carbon (SOC), biota, ionic bridging, clay and carbonates. The complex interactions of these aggregates can be synergistic or disrupting to aggregation. The clay-sized soil particles are commonly associated with soil aggregation by redisposition and flocculation, though swelling clay can upset aggregates. The organic matter creates from plants, animals and microorganisms, and their exudates. It improves soil aggregation from side to side the attachment of primary soil particles. The helpfulness of SOC in forming stable soil aggregates is associated to its rottenness rate, which in turn is inclined through its physical, chemical and microbial population act since defense. The inorganic carbon escalations soil structure in arid and semi-arid surroundings and the development of secondary carbonates is subjective through the occurrence of SOC and Ca^{2+} and Mg^{2+}. The soil biota discharge carbon dioxide and kind SOC which proliferation suspension of primary carbonates whereas cations growth precipitation of secondary carbonates. The cations such as Si^{4+}, Fe^{3+}, Al^{3+} and Ca^{2+} motivate the precipitation of compounds that act as attachment agents for primary particles of sand, silt and clay. The roots and hyphae being involves a particles together while manipulating them and releasing organic compounds that embrace particles together, a progression with a positive effect on C sequestration in soil. Soil structure is significantly modified over management performs and ecological changes. Perceives in proliferation productivity and decline soil disruption improve aggregation and structural development in soil.

Keywords: Soil structure, aggregation, soil management, tillage, and vegetation

1. Introduction

Soil structure refers to the size, shape and arrangement of solids and voids, continuity of pores and voids and their capacity to retain and transmit fluids and organic and inorganic substances, and ability to sup-port vigorous root growth and development. The promising soil structure and high aggregate stability are important to improving soil fertility, increasing agronomic productivity, enhancing porosity and decreasing erodibility. Soil structure is a key factor in the functioning of soil, its ability to support plant and animal life, and moderate environmental quality with particular emphasis on soil carbon sequestration and water quality. Soil structure, texture, organic and inorganic binding agents regulate the stability of soil aggregates. The SOC acts as a binding agent and as a nucleus in the formation of aggregates. The SOC residence time and decomposition rate are key factors influencing its effectiveness in increasing aggregation. Soil aggregation and soil organic carbon (SOC) are supposed to be most dynamic properties that are extremely sensitive to agriculture and management practices. There exists a close relationship between soil aggregation and SOC accumulation. Soil quality is also improved the soil aggregation, carbon sequestration and sustainable soil health (Kumar *et al*., 2017c) [25].

Aggregate stability is used as an indicator of soil structure. The size and stability of aggregates are determined by the quantity and quality of humic compounds and by the degree of their interaction with soil particles. The soil aggregation consequences in the rearrangement of soil particles, flocculation and cementation. It can be short-term storage in macro-aggregates

(>250 µm diameter) and long-term storage in micro-aggregates (<250 µm diameter) including the widely accepted stability of C stored in the smallest size class, the silt and clay size fraction (<53 µm). The losses in SOC are concomitant with the degradation of soil structure. The breakdown of aggregates produced by cultivation is responsible for the loss of SOC. Therefore, aggregate fractionation of soils is another useful approach for the interpretation of SOC dynamics as affected by farming systems.

Soil aggregation is arbitrated by soil organic carbon (SOC), biota, ionic bridging, clay and carbonates. Crystalline and amorphous metal oxides and hydroxides are important aggregates in soils. Metal ions form bridges between mineral and organo-mineral particles. Clay also acts as an aggregates, binding particles together and influencing SOC decomposition and turnover. Long-term stability of aggregates is often related to the presence of recalcitrant carbon compounds and metal ions. Formation of secondary carbonates in arid and semi-arid regions is also linked to aggregate dynamics. The decline in soil structure is increasingly seen as a form of soil degradation and is often related to land use and soil/crop management practices (Chan *et al*., 2003) [5]. Soil structure influences soil water movement and retention, erosion, crusting, nutrient recycling, root penetration and crop yield. Externalities such as runoff, surface- and ground-water pollution and CO_2 emissions are influenced by soil structure. Reduction in tillage and fertilization can reduce CO_2 emissions by reducing cultivation and production inputs both of which are dependent on fossil fuels. Species biodiversity is affected by management practices; generally high-input agricultural practices decrease biodiversity while the low-input practices enhance biodiversity. With increases in population and urbanization, it is important to identify methods to enhance food production while maintaining environmental quality.

2. Mechanism of soil aggregation

There are several mechanisms of aggregation. Aggregates are formed in stages, with different bonding mechanisms dominating at each stage (Tisdall and Oades, 1982) [42]. Hierarchical theory of aggregation proposes that microaggregates join together to form macroaggregates and the bonds within microaggregates are stronger than the bonds between macroaggregates. Microaggregates (< 250 Am) are formed from organic molecules (OM) attached to clay (Cl) and polyvalent cations (P) to form compound particles (Cl – P – OM), which are joined with other particles (Cl –P – OM) to form macroaggregates $[(Cl - P - OM)_x]_y$. Alternatively, macroaggregates can form around particulate organic matter (POM). As POM is decomposed and microbial exudates are released, the macroaggregate becomes more stable, the C:N ratio decreases, and microaggregates form inside. The internally formed microaggregates contain more recalcitrant SOC pool. As the more labile SOC pool is utilized and microbial activity decreases, the supply of exudates decreases and the macroaggregate loses stability, eventually disrupts and releases more stable microaggregates proposed that roots and hyphae enmesh and release organic compounds that act as glue to hold particles together. Particles can be rearranged during enmeshment, while wet – dry cycles help to stabilize the aggregates. Bacterial microaggregates form as bacterial colonies and their exudates form a polysaccharide capsule around which clay particles are aligned and pulled in by drying and shrinkage. The clay shell forms a protective coating for the bacterial colony inhibiting decomposition of the SOC inside. Concentric theory of aggregation suggests that external layers are concentrically built upon the external surface of the aggregate, with younger C in outer layers of aggregates than in aggregate interiors. The precipitation of hydroxides, phosphates and carbonates enhances aggregation. Cations such as Si^{4+}, Fe^{3+}, Al^{3+} and Ca^{2+} stimulate the precipitation of compounds that act as bonding agents for primary particles. Cations also form bridges between clay and SOM particles resulting in aggregation. Dissolved organic compounds (DOC) can complex with Fe^{3+} and Al^{3+} at low pH forming mobile, organo-metallic compounds that can be precipitated elsewhere in the soil. The complexation decreases microbial access to SOC and mineralization.

It is possible that aggregates form through a combination of these processes (Fig. 1).

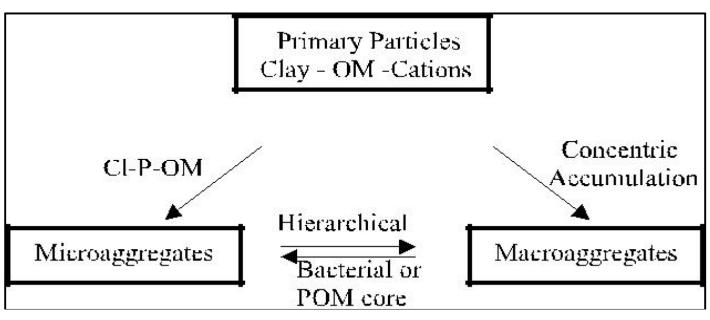

Fig 1: Some possible scenarios of aggregation. Organic matter (OM), particulate organic matter (POM), clay (Cl), particle (P).

Macroaggregates may initially form through accumulation of microaggregates or around POM or bacterial cores, decomposing or breaking down later into micro-aggregates. Microaggregates may initially form by the progressive bonding of clay, SOM and cations, or as turnover products from macroaggregates. Pri-mary particles can accumulate on outer layers of aggregates. Aggregates are secondary particles formed through the combination of mineral particles with organic and inorganic substances. The complex dynamics of aggregation are the result of the interaction of many factors including the environment, soil management factors, plant influences and soil properties such as mineral composition, texture, SOC concentration, pedogenic processes, microbial activities, exchange-able ions, nutrient reserves, and moisture availability. Aggregates occur in a variety of manners and sizes. These are often grouped by size: macro-aggregates (>250 mm) and microaggregates (< 250 mm). Different size groups differ in properties such as binding agents and carbon and nitrogen (N) distribution

3. Impact of soil structure on soil properties

Effect of soil types on soil structure

Soil aggregation is managed by several mechanisms in various soil types. The rate and stability of soil aggregation normally growths with organic matter and clay surface area and CEC. The low SOC in soil or clay concentration, soil aggregation might be subjugated by cations, although the character of cations in aggregation could be nominal in soils with high SOC or clay concentration. The Al – humus complexes and non-crystalline Al^{3+} hydroxides are predominant aggregates as these compounds are able to protect SOC from microbial decomposition and stabilize aggregation in Oxisols and Ultisols soils. The aridisols exhibition high aggregate stability related with carbonates (Boix-Fayos *et al.*, 2001) [3].

Effect of soil pH on soil structure

The soil pH is measured by acidity or alkalinity in soil. The negative surface charge on clay particles escalations with pH increasing particle repulsion. In accumulation to the effects on plant growth, metal ion solubility, microbial activity and clay dispersion are also influenced by soil pH. Major aggregates in soil for kind of high pH and high carbonate concentration (Boix-Fayos *et al.*, 2001) [3]. Lime is frequently additional to the soil to increase pH often resultant in increased microbial activity and crop yields, and contributing to higher SOM and increased aggregation (Haynes and Naidu, 1998) [16]. Therefore, governing pH in soil is the chief component of dispersive clay and clay particles often flocculate at great pH values (Haynes and Naidu, 1998) [16].

Effect of soil texture on soil structure

Soil texture is referring to the relative percentage of sand, silt and clay. Soil texture has a significant impact on soil aggregation. In the coarse-textured soils, the SOC has a better influence on structure whereas with accumulative clay content the kind of clay is more important as compared to the quantity in formative aggregation. The clay concentration is physically affects aggregation by soil swelling and dispersion. The probable of swelling-induced disaggregation was decreased at low clay levels. Accumulative clay concentration is accompanying with improved SOC stabilization (Sollins *et al.*, 1996) [37].

Effect of soil porosity on soil structure

Soil consists of three forms of pores which are micropores, mesopores and macropores in soil. The airs are filled macropore in soil in which supply oxygen to soil fauna and flora. The decrease in macropores occasioned in the development of anoxia conditions and interferes with crop growth and development. An extensive range of pore sizes is in well-aggregated soils and within aggregates (Dalal and Bridge, 1996) [6]. Huge pores (>30 mm) include bio-pores, cracks and inter-aggregate pores. The pore space, size and amount is influence SOC and its income; equally, SOC and soil texture can influence porosity. Bio-pores are important for improving gaseous and water diffusion influencing decomposition. Small pores can protect SOC from decomposition by limiting microbial access and through control of gas diffusivity and water availabil-ity (Thomsen *et al.*, 2003) [41]. In swelling soils, porosity is related to soil moisture content and swell/shrink characteristics. Tillage causes short-term increases in porosity, but long-term decreases in aggregation.

Effect of soil water on soil structure

Soil water are referred is the pore space are filled with water. Structure and texture in soil are encouragement of water flow, availability and storage in soil. The soil aggregation and interconnected pores increase bypass flow in soil and this can consequence in increased infiltration and decreased runoff, the movement of water deeper into the soil profile and increased leaching (Nissen and Wander, 2003) [30].

4. Impact of soil structure on mediators of aggregation

Carbon (C) is found in all living organisms and is the major building block for life on earth. It is present in the soil organic matter, plants and animals, geologic deposits, atmosphere as carbon dioxide (CO_2) and dissolved in sea water. The sources of C in soil are SOC or SIC, effect its composition and concentration in soil, which in try influences its effectiveness in soil aggregation through relations by cations and soil particles.

Effect of soil organic carbon on soil structure

The SOC generates regions of heterogeneity in the soil, foremost to ''hot spots'' of aggregation. The increased SOC is related to increased soil aggregation. The chemical properties of SOC define their charge and complexation capacities and stimulus decomposition rates (Schulten and Leinweber, 2000) [35] which have direct belongings on soil aggregation. The aggregate binding impact of labile carbon is quick but transient, whereas slower decomposing SOC has shrewder effects on aggregation, nevertheless the things may be lengthier lived. The segregation of the eagerly decomposable labile carbon fraction within aggregates upsurges stability and strength by tumbling its decomposition. However, Intensifications in microbial biomass are accompanying with upsurges in structural stability in soil.

Effect of soil inorganic carbon on soil structure

The SOC increases microbial respiration and carbon dioxide and is a source of calcium and magnesium ion. The soil inorganic carbon occurs in soil as primary and secondary minerals. The primary or lithogenic carbonates create from parent rock material and is the source material for the formation of secondary carbonates when they are dissolved and translocated by water with organic acids and carbon dioxide since soil and stratosphere. The secondary or pedogenic carbonates form when liquefied carbon dioxide precipitates carbonate and bicarbonate with Ca^{2+} and Mg^{2+} since outdoor the system. Under such conditions of reduced moisture or improved pH, cations, bicarbonate (HCO_3), dissolved carbonates and CO_2 can react with available cations to form secondary carbonate coatings on primary soil particles. The effect of carbonates on structure is moderated by SOC. The improves in SOC outcomes in increased dissolution and precipitation of carbonates in soil. The SOC sequestration in the soil is governed by the degree of physical, chemical and physico-chemical stabilization of organic carbon inside the aggregates (Debasish-Shah *et al.*, 2011) [8].

Effect of soil particulate organic matter on soil structure

The POM is comprised of large particles of organic matter (250 –2000 mm) that exist as free POM light fraction or encrusted with soil particles, which in try offers physical protection from decomposition. The LF in soil is normally associated with clay and polyvalent cations to form soil aggregates. The POM can act as a nucleus for macro-aggregate formation with material accumulating around the

POM. Macro-aggregates have a great concentration of low density POM. Within macro-aggregates, the decomposition of carbon in obstructed organic matter (OOM) may chief to relative enrichment of recalcitrant carbon (C_R). Disruption of organic matter within aggregates results in the exposure of inert carbon (C_L) making it available for microbial decomposition (Plante and McGill, 2002) [31]. The POM may be an important agent in binding microaggregates to form macroaggregates. As microorganisms decompose the POM, they pro-duce extracellular polysaccharides that act as a binding agents. Yong, (2007) [45] described that conversion of annually cultivated land to forage grasses has potential to increase C and N sequestration. Organic C, total N, POM-C, and POM-N content in 0-5 cm layer were significantly greater in alfalfa field than in adjacent cropland, but in the entire 0-20 cm profile, there were significant differences in SOC, POM-C and POM-N. However there was no difference in total N between alfalfa and crop soils.

Effect of carbohydrates, polysaccharides and humic substances on soil structure

The part of carbohydrates in refining soil structure is flexible, relating to the source and nature of the carbohydrates as well as aggregate properties and environmental factors. Carbohydrates creating from plants are frequently coarser sized and occur in the sand fraction, although carbohydrates formed through microbial activities (Schulten and Leinweber, 2000) [35] in finer and are present in clay and silt fractions. The microbial resulting carbohydrates incline to be resistant to rottenness. The decreased tillage through conservation till or no-till, manure additions and cover crops are related with enlarged concentrations of carbohydrates and enhanced structure in soil.

The polysaccharides are freely mineralizable and performance as temporary binding agents initiating aggregation, but may not have long-term stability (Kay, 1998) [19]. Polysaccharides are powerfully adsorbed into mineral surfaces and to bind soil particles. Polysaccharides may also form a gel-like substance that turns as a glue to bind particles into aggregates (Haynes and Beare, 1997) [15].

The humic substances (HS) as the consequence of the soil chemical resistance and their association with the soil matrix and their soil physical protection. Marcos and Juan (2006) [6] reported that the cultivation leads to decrease in different SOC fractions like particulate organic matter, carbohydrate, humic acid contents. The humic substances are chemically and structurally much more stable than non-humic substances but the results showed a surprising decrease in humic substances under continuous cultivation. The hypothe-sized the distribution of HS, including fulvic acid (FA), humic acid (HA) and humin, in soil aggregates might reproduce the preliminary coating of particles with HS as compared to additional HS serving to bond particles together *(*Tarchitzky *et al*. (2000) [39]. The HAs may be adsorbed into clay particles by polyvalent cations, making them especially effective in overcoming clay dispersion.

5. Impact of soil cations on soil structure

The impacts of P on soil aggregation can be indirect, as the P availability affects shoot and root growth, and upsurges plant manufacture and ground shelter. The availability of P may also effects colonization of arbuscular mycorrhizal fungi (AMF), which affect root morphology and soil aggregation (Facelli and Facelli, 2002) [11]. The application of phosphates fertilizer may lead to the formation of Al^{3+} or Ca^{2+} phosphates, which act as aggregate bonding agents (Haynes and Naidu, 1998) [16].

The bivalent cation of calcium (Ca^{2+}) and magnesium (Mg^{2+}) improve soil structure through cationic bridging with clay particles and organic matter. In arid and semi-arid situations, Ca^{2+} and Mg^{2+} carbonates precipitate to form secondary carbonate coatings and bind primary soil particles together. Normally, Ca^{2+} is more effective as compared to Mg^{2+} in improving soil structure (Zhang and Norton, 2002) [46]. Amongst bivalent cations, Ca^{2+} can prevent clay dispersion and the accompanying disruption of aggregates by replacing Na^{2+} and Mg^{2+} in clay and aggregates, thereby adding to aggregate stability. The use of soil alterations containing Ca^{2+} and Mg^{2+}, such as lime and gypsum, can have profound effects on soil aggregation. Improved aggregate stability in limed soils proposes development of strong bonding involving Ca^{2+} bridges (Chan and Heenan, 2003) [5].

The polyvalent Al^{3+} and Fe^{3+} cations in the progress soil structure by cationic bridging and development of organo-metallic compounds and gels (Amezketa, 1999) [1]. The solubility and mobility of the Al^{3+} and Fe^{3+} cations is pH-dependent, with higher solubility at lower pH. The soil aggregates comprising Al^{3+} and Fe^{3+} and high-CEC clays incline to upsurge SOC incorporation.

The Na^{+} is an extremely dispersive agent resultant directly and indirectly affecting soil aggregation through diminished plant productivity. Exchangeable Na^{+} in the soil solution and at exchange sites contribute to repulsive charges that disperse clay particles. The increased dispersivity from Na^{+} can break up aggregates, assembly organic matter more available for decay. In calcareous-saline soils, the use of salt-tolerant plants improves soil physical properties due to favorable root growth and increased microbial respiration. The increase in carbon dioxide partial pressure in the rhizosphere increases calcium carbonate solubility that counters the adverse effects of high sodium (Qadir and Oster, 2002) [32].

6. Impact of biotic inspirations on soil structure

Plant classes**:** The joint impacts of the biochemical configuration and quantity of plant remains reimbursed to soils and chemicals free from plants affect the rate and stability of soil aggregation, and rate of aggregate throughput. Martens, (2000) [27] reported that the water-stable aggregates (WSA) of size distribution aggregate and mean weight diameter (MWD) are associated with biochemical composition of plant excesses i.e phenols, lignin, proteins, monosaccharide sugars, saccharides, phenols and alkaline ex-tractable humic acids in the soil and phenolic acids such as vanillin vanillic acid in the residue. The corn (Zea mays) remainders are great in phenols and upsurge aggregation then other crops, while uninterrupted corn declines microaggregates as compared to corn grown in rotation (Martens, 2000) [27]. The less soil aggregation of agriculture to soybean is accredited to low concentration of phenols along with low deposit arrival to the soil (Martens, 2000) [27].

Roots: The plants roots play an important character in the nutrient uptake and plant development and its penetration aptitude is unsafely affected by the soil structure due to improved soil strength and condensed number of macropores. Plant roots and their rhizosphere have several effects on soil aggregation. Roots catch and manipulate soil particles and release exudates, which effect in physical, chemical and biological alterations that impact aggregation. The soil aggregation inclines to rise with accumulative root length density, microbial relatives, glomalin, and percent cover significantly affect soil aggregate stabilization (Rillig *et al.*, 2002) [33]. Aggregate stability is greater in rhizosphere soil than in non-rhizosphere soil due to rhizodeposition, root mass, root density, size distribution, root turnover, root length, and hyphal growth (Caravaca *et al*., 2002) [4]. The rhizosphere multitudes a large population of micro- and macro-organisms that contribute to SOC and aggregation.

7. Impact of soil microorganisms on soil structure

Roots, fungi and bacteria increase aggregation by trapping soil particles and providing extracellular compounds that muddle particles together. It is often difficult to separate the multiple effects of organisms on aggregation.

Microbial motion: The impact of soil aggregate size on microbial movement depends on several factors. Bacteria are habitually related with clay and polysaccharides in microaggregates which have outcomes in lesser microbial biomass in microaggregates as compared to macroaggregates. The poorer bacteria/ fungi ratio in macroaggregates as compared to microaggregates advises that bacterial action might dominate in microaggregation whereas fungal movement dominates in macroaggregate development (Tisdall and Oades, 1982) [42]. The upsurges in macroaggregates are related with rises in fungal activities and fresh residues.

Soil fauna: The soil fauna is the main role in the deterioration and incorporation of organic matter and home-based is interstitial places in the soil. The soil compaction impulses the pore size availability and distribution which usually indications to the reduction of the proportion of large pores and affects the movements of nematodes and larger soil fauna. The organisms may improve soil aeration, porosity, infiltration, aggregate stability, litter mixing, improved N and C stabilization, C turnover and carbonate reduction and N mineralization, nutrient availability and metal mobility. Wolters, (2000) [44] reported the ingested soil undergoes numerous amendments counting physical realignment of clay particles and breaking of bonds within soil aggregates to alter microbial accessibility of organic matter. Movement of soil fauna is important in the formation of organo-mineral complexes and aggregation.

Fungi: The fungal hyphae progress aggregate stability by reorientation of clay particles, binding particles with extracellular polysaccharides, and enmeshing particles (Ternan *et al.*, 1996) [40]. The hyphae also an en-mesh microaggregate to form macroaggregates, signifying that aggregation rises with hyphal density (Haynes and Beare, 1997) [15].

8. Impact of soil environmental influences on soil structure

The high atmospheric carbon dioxide concentrations and the overall effect of elevated atmospheric CO_2 on soil structure are not very well understood. The increased atmospheric CO_2 may upshot the increase in photo-synthesis and ensuing increase in photosynthate, roots and microbial communities. The concurrent increases in nutrient demands may exceed the ability to meet the demands, subsequent in nutrient-limited systems, in-creased symbiotic communities or altering the chemical composition of plant compounds which outcome wider C/N ratio and increased lignin, tannins and phenolics, which decompose slowly. In environments with adequate nutrient supplies the increases in atmospheric CO_2 may result in increased SOM and aggregation, while in nutrient-limited environments the balance between availability of nutrients, plant demand and C turnover may limit the effect. Niklaus *et al*., (2001) [29] described that the increased decomposition rates due to enlarged temperatures, moisture and microbial activ-ity may have a greater influence on rapid income of SOC pool comprising plant and surface litter, than of slower fractions such as root, macro and microbial C resultant in the buildup of SOM and higher proportion of microaggregates.

Improving the soil organic carbon pool

The soil type, aggregating managers, soil management and environmental conditions interact to deter-mine aggregation in a soil. The soil management performs that diminish disturbance maximize SOC arrival to the soil, enhance productivity and rise the SOC pool. The appropriate need the soil amendments such as fertilizer, lime, manure and compost might increase the SOC pool and aggregation. The sustainable agricultural applies such as mixed cropping, cover crops and crop rotations may also improve the SOC pool. The management practices that diminish decomposition rates and CO_2 emissions also benefit to raise the SOC storage.

9. Management options for improving soil structure

Soil management

The soil management is the options to improve the soil aggregation essential goal for the accumulative prime plant production, growing the quantity of carbon input into the soil. The reducing disturbances and soil decrease the rate of carbon loss through the processes such as disintegration and erosion. The choice of soil management was improving physical properties such as soil texture, bulk density and maximum water holding in sustainable agriculture production (Kumar *et al*., 2016a) [21]. Soil management is improved management performs include mulches, tillage methods, residue management, amendments, soil fertility management and nutrient cycling.

Mulches

Mulches improve the total consumption of water due to formation of loose soil surface. The rain drops on mulched soil do not seal the particles as they do on unmulched soil. This sealing effect of rain drops results in more loss of water through erosion. The water infiltrated in soil could be exploited by crops there-by crop yields are increased. Mulches obstruct the solar radiation reaching and infiltration and soil evaporation are among the key processes that determine soil water availability to crops in semi-arid farming. Mulches improve soil structure through a variety of approaches. The organic carbon status of the orchards in the Eureka lemon for horticulture crops are increased by 1.55 times as higher by farmyard manure with mulch practices as compared to control without mulch practices in rainfed areas (Kumar *et al*., 2015) [20].

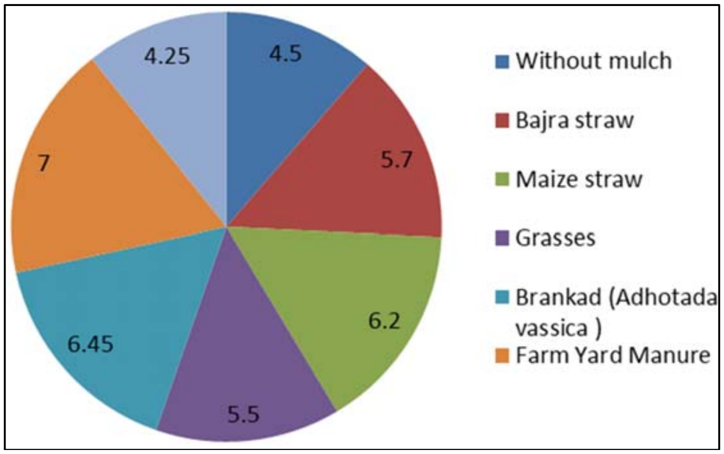

Fig 2: Effect of different mulches on soil organic carbon (g kg^{-1}) of eureka lemon in under rainfed areas.

Mulches were also increased the nutrient availability in soil under rainfed areas of Jammu (Kumar *et al.*, 2016b) [22]. Development of soil health and nutrient management of soil techniques through organics mulches materials like branker (*Adhotada vassica*) in locally available and biodegradable nature mulch enhance the available nutrients status of nitrogen, phosphorus and potassium content in soil for 8.83 % N, 10.81 % P and 8.44% K respectively higher than control in the standing crop of Eureka lemon (Kumar *et al*., 2015 and Kumar *et al*., 2017a) [20, 23]. Thus there is the limited population of domestic animals in the rainfed area and availability of farmyard manure is also limited. The locally available farmyard manure may not be enough for mulching.

Table 1: Effect of various mulches on soil properties of eureka lemon under rainfed situation.

Treatments	Available Nutrients (kg ha^{-1})		
	Nitrogen	Phosphorus	Potassium
Without mulches	255.50	14.21	128.52
Bajra straw	266.75	15.43	136.94
Maize straw	271.00	15.83	140.31
Grasses	264.25	15.12	132.45
Brankad (*Adhotada vassica*)	274.50	16.180	143.11
Farm Yard Manure	279.50	17.005	146.48
Black polyethylene	254.00	13.718	127.96
SE(m)	2.16	0.50	1.05
CD at (p=0.05)	6.47	1.51	3.17

The adding of mulch to soil surface reduces soil erosion, decreases evaporation, and keeps against raindrop effect and intensifications aggregate stability. Organic mulches improve the quantity of organic carbon and the modify temperature, moisture regimes and effect soil fauna (Kumar *et al.*, 2017b) [24].

Tillage

Tillage interrupts soil aggregates, compresses soil and disturbs plant and animal societies that contribute to aggregation and drops organic matter, cation exchange capacity, nutrient availability, microbial movement and faunal actions that contribute to soil aggregation (Plante and McGill, 2002) [31]. (Filho *et al.*, 2002) [12] described that the plowing then no-till management systems have more stable aggregates and SOC. Reduced tillage which have outcomes the higher macro-pores and bio-channels that encouragement water movement and availability, floating concerns around water quality. The strength and timing of tillage regulate the amount of the influence of tillage on organic matter.

Manure

Manure improves soil organic matter and soil structure as well as MWD, GMD, ASI, upsurges macro-aggregation and resistance to slaking but may be reduction stability of soil aggregates against the dissolution and dispersive actions (Whalen and Chang, 2002) [43]. The improves SOC have enlarged biological action, increased porosity and the associated lessening in bulk density. Manured soils also have high earth-worm population (Hansen and Engelstad, 1999) [14]. Munkholm *et al.* (2002) [28] reported that the un-manured soils frequently comprise less SOC and microbial biomass, and are denser as compared to manured soil, and aggregates are strong when dry, and weak when wet. In dissimilarity, the manured soils have resilient aggregates when wet and weak when dry. The differences among the soils when dry seem to be associated to differences in concentration of dis-persible clay, while the differences when wet are related to differences in the amount of organic binding and bonding material.

Compost

Compost is an organic amendment and to increase the soil organic carbon and to improve soil structure and lesser bulk density. Composting materials may increase soil aggregation, rhizosphere and aggregate stability (Caravaca *et al*., 2002) [4]. The impacts of compost accompaniments on soil structure can be short-lived though special effects are usually positive on structural properties (Debosz *et al.*, 2002) [9]. The soil physico-chemical properties and environmental situations regulate the influence of compost on soil aggregation; drought could boundary the efficiency of compost in aggregation (de Leon-Gonzalez *et al.*, 2000) [7].

Crop management

Soil management practice to increase SOC and aggregation comprises fertilization, feeding management, alteration from cultivation to native vegetation, in-collusion of cover crops, legumes and grasses, earth-worm inoculation and irrigation. The cultivation i.e. agriculture and horticulture reduces the total and microbial SOC pool and soil fauna but intensifications metabolic CO_2 (Saggar *et al*., 2001) [34].

Fertilizer

Fertilizers may also increase the soil structure as well as soil aggregation. The complications of the chemical and physical inspirations of fertilizers outcome in movable impacts of fertilization on soil aggregation. The fertilizer applications normally improve soil aggregation (Haynes and Naidu, 1998) [16]. The primary effect of enhanced nutrient management was on accumulative plant productivity, SOC and biological activity (Haynes and Naidu, 1998) [16]. Escalation in SOC through fertilizer use increases soil aggregation, MWD and ASI (Subbian *et al*., 2000) [38]. Fertilizer use also improves residue quality and quantity, but this does not necessarily increase SOC pool (Halvorson *et al*., 2002) [13]. The valuable possessions of fertilizer submissions usually offset any adverse effects of fertilization.

Crop rotations and cover crops

The cover crops upsurge carbon contribution to the soil, decrease erosion, intensification cation exchange capacity, development aggregate stability, improve water infiltration and recycle nutrients. The aggregate stability was dynamics differ between diverse crops, crop rotations and cover crops (Jarecki and Lal, 2003) [18]. The consequence of different crops tends to reflect the crop chemical composition rooting structure and ability to alter the chemical and biological properties of the soil (Martens, 2000) [27]. These effects tend to be short-lived in conventional tillage regimes and crop rotations may not affect aggregate stability (Filho *et al*., 2002) [12]. Thus cover crop residues may enhance microbial biomass, respiration, and N mineralization and shift microbial community (Schutter and Dick, 2002) [36].

Agroforestry

Agroforestry, the technique of introducing trees in farming has played a important role in enhancing land productivity and improving livelihoods in both developed and developing countries. The addition of leguminous trees in farming systems decreases soil erosion and the improving soil productivity. Thus agroforestry affects SOM, which in turn influences soil aggregation in comparison with conventional systems (Atsivor *et al*., 2001) [2]. Agroforestry systems that integrate tree production with crop and animal production systems are believed to have a higher potential to sequester C than pastures or field crops.

10. Conclusions

Soil structure embraces an energetic and disregarded role in sustainable food production and the well being of society. The land use and management is desirable to manage with improved compression on soil resources for sustainable food and fiber production whereas decreasing the opposing off-site environmental impacts of farming practices. The effect of soil structure assortments from global to highly restricted scale. Better-quality carbon sequestration in soil aggregates may decrease the rate of increase in CO_2 concentration in the atmosphere and related global warming. Developed soil structure increases nutrient recycling, water availability and biodiversity whereas falling water and wind erosion, and improving surface and ground water quality. Soil aggregation is the increased through management practices that reduction agro-ecosystem disturbances, progress soil fertility, rise organic inputs, increase plant cover, and decline SOC decomposition rate. Thus soil aggregation also tends to improve with increasing root length density and extensive fibrous roots produce highest levels of macro-aggregation. The soil fauna activity is important in the formation of organo-mineral complexes and soil aggregation. Augmenting the diversity and quantity of soil fauna and flora is the most important in educating soil structure. Hence the management practice is also increased the soil structure as well as soil aggregation and carbon stabilization in soil.

11. References

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