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INCORPORATED AGRICULTURE SYSTEMS' CHEMICAL PROPERTIES OF SOIL ORGANIC CARBON

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ABSTRACT

Soil organic carbon (SOC) fractions that are active play a critical role in the fertility of agricultural soil. Nor a result, the role of potassium application and straw integration in rice–wheat systems has not been well investigated, as has the interaction between these parameters. We wanted to see how potassium fertilization and straw integration affected soil organic carbon (SOC) sequestration, active carbon fractions, and crop yields over the long term. By analyzing long-term studies, this research assesses the impacts of CR inclusion on SOC and greenhouse gas emissions in Europe. For SOC and GHG emissions, the difference in response ratios (RRs) between the addition and removal of CRs was computed. The effect of environmental zones, clay content, and experiment duration on the RRs was examined. We also looked at the relationship between SOC RRs and agricultural yields.

Keywords: Organic, Soil, Chemical, Carbon, Agriculture

1. Introduction

In agronomic systems, soil organic carbons (SOC) play a key role in environmental sustainability and carbon storage, as well as in agricultural production.**[4]** As a baseline, this study uses soil carbon building from integrated agricultural systems that include cattle, crops, forest components, and a natural forest that has not been disturbed as a reference. In order to accomplish this, we must have a greater understanding of how climate and management effect storage and persistence.

By 2050, it is predicted that the world's population will have risen. For the world's food supply to keep up with the increased demand, it will undoubtedly be required to increase output in emerging nations, where the fastest rates of population growth are now occurring**[8].**Land degradation, water shortages, and increases in climate unpredictability and severe events as a result of climate change all challenge our capacity to grow productivity on current agricultural land. To fulfill the world's food demand, agricultural systems all around the world must adapt in order to produce more food while also increasing their ability to be environmentally sustainable.

In light of the increased interest in carbon storage and sequestration, scientists are paying special attention to how soil organic matter varies across different geographies, climates, and land-management practices, among other things. With respect to the various soil organic matter components, there are a number of physical and chemical characteristics connected with them. In order to have a better understanding of how soil organic carbon contributes to soil productivity,**[1]**we must first understand the quantity and composition of the various components of soil organic carbon. Even if the texture and structure of the soil play a significant influence in determining its potential to retain carbon, management options are more important in terms of influencing the actual quantity of organic carbon present in the soil. This chapter discusses the importance of soil organic carbon in agricultural systems, as well as the roles played by different soil organic carbon fractions in various soil activities of importance. **[5,10]**

Agriculture will be required to produce more food in an environment that is growing more volatile and in which our natural resource base is degrading as a result of population expansion and climate change, among other factors. In order to maintain soil organic carbon, an agricultural system's capacity to sustain soil physical, chemical, and biological properties, as well as ultimately production, is one of the most critical metrics of its ability to maintain soil organic carbon (SOC).**[10]**Understanding the factors such as climate and management that influence the storage and persistence of soil organic carbon is critical to the proper functioning of all soils, including arid and semi-arid environments. As a result of the growing interest in carbon storage and sequestration, researchers have been paying special attention to changes in soil organic carbon. Organic carbon in soil is made up of a number of different components that combine to form organic carbon. It is possible that the amount of soil organic carbon (SOC) will decrease in intensive agriculture systems. Integrating crop residues (CR) into the soil may be a long-term management method for sustaining soil organic carbon (SOC) levels while also boosting soil fertility. **[8]**

Conservation agriculture is one agricultural system that has been advocated as being capable of attaining the sustainable intensification necessary to fulfill global food demand, despite the fact that it is not without obstacles. As defined by the International Conservation Agriculture Organization, conservation agriculture is a system that incorporates minimal or no tillage with permanent soil cover (that leaves at least 30 percent of the soil covered between harvest and planting) and a diverse crop mix that includes legumes. To maintain the long-term viability of the CA system, other companion techniques such as integrated pest and nutrient management are frequently implemented into it on a site-by-site basis. The overall goal of conservation agriculture is to increase the sustainability of agricultural production by preserving and maintaining soil, water, and biological resources, allowing for the use of less external inputs to be used in the production of food **[10].** The features of CA can differ depending on where you live, and can range from local landholder systems that utilize manual tools to direct seed to large-scale automated systems that employ tractor-mounted direct seeders.

The green manure components can be sourced from either locally planted rapid growing green manure crops or harvested green manure crops grown abroad for absorption into the soil. **[4]**

The amount of nutrients delivered by plant materials is regulated by the pace at which they are produced and the quantities of nutrients present, which vary according on the climate, soil type, plant component, plant density, and management regimes. It has also been noted that the pace of biological decomposition and the subsequent release of nutrients vary with environmental circumstances such as temperature, moisture, aeration, pH, and other factors affecting microbial activity. The incorporation of legumes before to blooming provides immature legume biomass for rapid degradation. It has been found that immature plant material decomposes at a quicker rate than mature plant material.**[9]**The decomposition and mineralization of nutrients in the integrated legumes will undoubtedly have an impact on the chemical properties of the soil, which will have a beneficial effect on the soil's nutritional status and fertility. As a result, the purpose of this study was to assess the impact of included short duration legume fallow and nitrogen levels on the chemical characteristics of soil planted with two maize types.

2. Total soil organic carbon (TSOC)

Figure 1 depicts the total soil organic carbon (TSOC) recorded at various tillage depths over the course of four years of testing. In addition, it has been noted that organic carbon in the soil can serve as a useful indication of soil quality, which is necessary for a productive and sustainable agroecosystem. TSOC values in this study were larger than 1 percent generally, suggesting that the soil could support a sustainable crop production.**[3]**However, soil aggregates in 2013 and 2015 may be unstable due to TSOC values less than 2 percent, indicating that the soil aggregate may be unstable. Despite the fact that the removal of sweet corn biomass from the paddock has lowered the yearly TSOC to some extent, no significant change in TSOC from the original condition in 2009 has been seen as a result of the crop rotation that has been in place since then. In 2014 and 2016, there was a significant increase in total soil organic carbon (TSOC), indicating that legumes played an essential role in soil organic turnover and improvement. There was also dispute about whether soybean or peanut made a greater contribution to total solar output (TSOC). This could have occurred as a result of the soybean's poor growth performance during the experimentation period, according to some theories. **[2]**

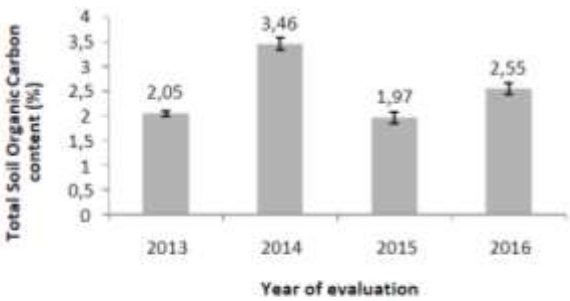

Figure 1. Total soil organic carbon (TSOC) observed in the period between 2013 and 2016.

3. Conservation Agriculture's Impact onthe Soil Organic Compounds

A soil's organic matter content is the sum of the inputs and losses of organic matter, such as biomass, decomposition, and leaching. To what degree and in which CA influences SOM is therefore dependent on the inputs and losses that it affects and is commonly quantified by SOC, When compared to more traditional farming methods, CA alters tillage techniques, residue management, and crop and fertilizer inputs.**[6]** There is a wide range of SOC differences between CA and traditional agricultural systems, depending on parameters including climate, soil type, baseline SOC and crop management, as well as the length of time since management change. This means that estimations of the amount of the shift following the switch to CA are wildly inconsistent.**[1]** An estimate of 0.15 Mg/ha/year has been observed in the mid-western United States, whereas estimates for tropical Brazil have ranged from +0.93 Mg/ha year. However, it is evident that CA systems typically contain greater levels of SOC than traditionally managed systems, particularly at the surface of the soil profile, in places where soil and climate conditions are conducive for biomass production and when negative yield implications are not detected. Sequestration rates vary widely, which implies that the extent of change is likely to be site-dependent. **[4]**The literature on CA's impact on soil properties has largely focused on NT and residue retention as opposed to conventional tillage and residue removal. More research has to be done on the influence of species diversification and methods like cover crops and intercropping on SOC change. While the impacts of management adjustments on soil characteristics can be enhanced by including all of the CA system's components, it is more common to see significant increases in SOC when these practices are combined with NT and stubble retention. **[6]**

4. Tilling Management

It has long been documented that tilling the soil results in losses of soil organic carbon (SOC), since agriculture breaks up the soil and exposes organic matter that had previously been sheltered inside soil macroaggregates to microbial breakdown and degradation. Aside from that, cultivation integrates and fractures plant material, making it more vulnerable to microbial assault. Reduced tillage or the introduction of no-till has the ability to reduce the quantity of SOC lost from the profile by decreasing the turnover rate of macroaggregates, enhancing the physical protection of particulate organic material, and minimizing soil to residue contact, among other benefits. In a Brazilian A crisol under cereal cropping, turnover times of 17 and 36 years were recorded in conventional and CA, respectively, as a result of the reduced disturbance in the NTCA system, as shown in the figure below. The fact that tillage has been seen to boost SOC stores in some circumstances when compared to CA systems should not be overlooked.**[3]**Remaining leftovers in places where inversion tillage is used may be buried in the ground, where inadequate soil aeration can inhibit decomposition, particularly in chilly, damp meteorological conditions.

5. Rotation of Crops

Depending on the type of crop, different C inputs may have different effects on the soil's mineralization rate and subsequent crop growth. SOC levels might be affected by the different crop rotations in CA and traditional farming systems, for example SOC stock in CA systems is frequently linked to the removal of monocultures and the inclusion of plant species in rotations that return higher amounts of residue to the soil. Root input, in particular, has been discovered to be critical in various systems.**[1]**Studies on the long-term contribution of cover crops or forage-based NT rotations to SOC stocks on a Brazilian Ferrosol, for example, indicated that SOC stocks were closely related to the root contributions of various plant species. Legumes can also provide extra nitrogen to the system, improving soil fertility and the consequent development of crop biomass.**[7]** Erosion, nutrient leaching, weeds, pests, and illnesses can all be reduced by maintaining residue cover, as can the primary crop's growth and biomass output.

6. Strategies for increasing the organic carbon content of soil

SOC plays an important role in the global carbon cycle and climate change because of its dynamic nature. Terrestrial ecosystems rely heavily on their soils for carbon storage and management. Many scientific advances have been achieved in the field of agroecosystem organic carbon dynamics and soil functional properties.**[2]** When it comes to soil health, organic matter and microbial activity—both of which are related to soil organic carbon—play a significant role. Sustainable agriculture and climate change mitigation policies will benefit from including organic carbon into all soil health management strategies. Climate change mitigation potential in agricultural soils is typically disregarded while planning for long-term agricultural gains from improving soil health. Assessing soil health in light of climate change mitigation might help farmers make private capital investments in farming techniques and deal with an expanding regulatory burden. Land with a high value may be further enhanced by soil evaluations. As a result of these advantages, soil health evaluations and activities may get political support. Monitoring soil organic carbon sequestration requires reliable and reproducible methodologies for assessing soil health. **[9]**

7. Manure and Fertilizer as a Comparative Study

Depending on the management, fertilization and manure addition can be a source or a sink of C. SOC can rise over time if organic C is added to the soil in the form of animal manure, municipal or industrial waste, or a combination of these sources. The use of manure as a management tool to maintain or boost SOC has long been advocated. **[4]**

In addition to providing more food for soil microorganisms, manure application also improves the structure of the soil, which enhances water holding capacity and allows for greater air exchange, resulting in a higher level of biological activity. Soil physical qualities, such as water holding capacity, can be improved by the addition of manure. There are more enzyme activity in manure plots compared to plots that use inorganic fertilizer. **[7]**GHG mitigation capacity may be reduced by the application of manure with a high N content, which may increase N2O and CH4 emissions, respectively. In order to maximize the benefits of manure additions to SOC storage and reduce GHG emissions, better management of animal manures, such as timing the application to coincide with crop absorption, is required.

8. Soil microbiology is affected by increased soil organic carbon (SOC)

Additional SOC in CA systems has the potential to supply microbial biomass and energy sources for soil microorganisms that would otherwise be unavailable in typical agricultural systems. Soil aggregates, soil moisture, and temperature can all be improved as a result of increased SOC or residue retention. This can also lead to an increase in microbial abundance. As a result of more diverse crop rotations, the variety of both fungal and bacterial communities can be enhanced through conservation agriculture. Since tillage is not used in CA systems using NT, it is common to see higher densities of fungal communities in the soil profile's surface. One of the most important impacts of increasing the quantity and variety of microorganisms in the soil is that it is more likely to include organisms that support plant development and decrease disease.**[3]** A possible way to boost P nutrition in NT corn cultivated on sandy loam soils in Canada and cotton fields on silty loam soils in the US is an increase in arbuscular mycorrhizal fungus populations. US researchers showed that essential enzymes related with N and P cycling were more abundant under CA, which corresponds to a higher availability of nutrients.

9. The SOC's Expected Future Requirements

CA agriculture has numerous advantages over traditional farm management approaches. Particularly appreciated and capable of allowing sustainable intensification in many cases is its capacity to assist decrease input costs, enhance soil physical, chemical, and biological qualities, and boost yields. As a result, there are several problems that need to be overcome in order for the CA system to be widely used. As a result, CA systems must be tailored to the specific agronomic, social and economic constraints that exist in each location and environment.**[9]**CA may not be a successful method of management if the system is not fit for an area or if the inputs necessary to ensure the success of CA systems are not accessible. Farmer's need access to a wide variety of tools and resources in order to determine whether CA principles are suitable for their business and effectively overcome some of the problems that can be linked to its use.

10. Confronted Difficulties

The absence of tillage, the stratification of immobile nutrients at the surface of the profile, poor plant establishment due to inadequate seeding equipment, decreased N availability, and the development of soil structural issues, such as a surface crust and compaction, can all be significant constraints on crop production in CA systems. SOC and residue cover, which promote soil fertility, reduce erosion and decrease weed populations, are difficult to build up in locations where poor yields are common.**[3]**By adapting the concepts of CA to local settings, these agronomic problems may be addressed in many cases. Consider this: Plant establishment and pest and disease stresses can be alleviated by the development of locally appropriate seeding equipment and the identification of local crop rotations and cover crops.

Plant biomass output may be increased by including legumes into cropping systems and applying fertilizers in the correct amounts. This will assist address the issue of N availability and enhance residue cover while improving soil fertility.**[6]**

When the primary crop isn't growing, cover crops can keep the soil covered and supply organic matter to the soil where agricultural residue output is minimal. Long-term, on-going NT systems can benefit from the use of strategic tillage, which is the technique of cultivating NT soils only on occasion in order to control weeds, pests, and diseases, stratify nutrients, and compress the soil.**[9]** Effective and regionally adaptable procedures must be developed via enough study before different geographical locations and farming systems may be effectively identified as suitable. Particularly essential is the identification of locally appropriate crop rotations and the increasing study into techniques such as the use of strategic tillage in order to understand the advantages and downsides and the best time of the tillage for different soils and climates. **[3]**

11. Conclusion

SOC content in many soils may be improved using CA systems if they are planned and tailored to the local requirements, and this can result in considerable increases in soil physical, chemical, and biological qualities and productive capacity compared to traditional agricultural systems. Increased adoption of CA will be impossible without taking into account farmers' financial capacity and resource availability, therefore the system must be tailored to the individual climates, soil types, and communities in which it will be used. This may need a more flexible approach to agronomic management approaches. There are a number of things to consider while designing a CA system, including the goals and limits of farmers in a specific location, as well as the socioeconomic factors that make CA cost efficient and appealing to farmers. Farmers will need institutional help adopting CA because of the first yield loss they may experience until their SOC grows and they learn how to handle CA systems efficiently. It is expected that this investment will bring long-term benefits to farmers and society as a whole, however, given the necessity to reverse the trend of agriculturally-induced soil degradation in order to ensure the sustainability of agro ecosystems.**[2]**Soil chemical characteristics in organic agricultural environments have changed over time, according to the analysis. When 15 tons of cow dung was applied at a rate of 15 tons per acre and crop rotation was implemented, the soil pH slowly rose. The soil chemical characteristics tested in this study showed a small improvement, but the amount of accessible P and the amount of exchangeable Al were much higher. To maintain organic soil quality, frequent application of cow dung and crop rotation may be necessary.

References

[1] Kassam, A., Friedrich, T., Shaxson, F., and Pretty, J. The spread of Conservation Agriculture: justification, sustainability and uptake. (2009)

[2] Dali Yu, Zhiguo Wen, Xiumei Li, Effects of straw return on bacterial communities in a wheat-maize rotation system in the North China Plain, PLOS ONE. (2018)

[3] C.M. Jiang, W.T. Yu, Alleviating global warming potential by soil carbon sequestration: A multi-level straw incorporation experiment from a maize cropping system in Northeast China, Soil and Tillage Research, (2017)

[4] Li, H., Gao, H., Wu, H., Li, W., Wang, X., and He, J. Effects of 15 years of conservation tillage on soil structure and productivity of wheat cultivation in northern China. (2007)

[5] Liu, C., Lu, M., and Fang, C. Effects of straw carbon input on carbon dynamics in agricultural soils: a meta-analysis. Global Change Bio. (2014)

[6] Mbuthia, L. W., Acosta-Martínez, V., D., Odoi, E., et al. Long term tillage, cover crop, and fertilization effects on microbial community structure, activity: Implications for soil quality. (2015)

[7] Ngwira, A. R., Aune, J. B., and Mkwinda, S. On-farm evaluation of yield and economic benefit of short term maize legume intercropping systems under conservation agriculture in Malawi. (2012)

[8] Palm, C., Blanco-Canqui, H., DeClerck, F., Gatere, L., and Grace, P. Conservation agriculture and ecosystem services: an overview. Agric. (2014)

[9] KUMAR, K. & GOH, K.M. Crop residues and management practices: effects on soil quality, soil nitrogen dynamics, crop yield and nitrogen recovery. (2000)

[10] Steinbach, H. S., and Alvarez, R. Changes in soil organic carbon contents and nitrous oxide emissions after introduction of No-Till in Pampean agroecosystems. (2006)