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Conservation Agriculture: Pathway towards Sustainability

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Abstract

The present agriculture practices will have a negative impact on the environment, release greenhouse gases, and cause climate change if it is not practiced in a sustainable way. Sustainable farming methods, on the other hand, can improve climate change resilience, biodiversity protection, and resource sustainability. Conservation Agriculture (CA) is one of such methods. CA is viewed as a potential system capable of improving quality of soil and ensuring stable yields. CA is a set of technologies that includes minimum disturbance of soil, permanent soil cover, diversified crop rotations, and integrated management of weeds, all of which are aimed at reducing negative effects of traditional farming practices like soil erosion, decline in soil organic matter content, soil physical degradation, etc. Furthermore, yield in CA is comparable or even more than that of conventional intensive tillage practices with significantly lesser costs of production.

Keywords: conservation agriculture, soil quality, conventional tillage

Introduction

"War and pestilence might kill large numbers of people, but in most cases the population recovers. But lose the soil and everything goes with it. This is what topples civilizations." The present agriculture practices will have a negative impact on the environment, release greenhouse gases, and cause climate change if it is not practiced in a sustainable way. Sustainable farming methods, on the other hand, can improve climate change resilience, biodiversity protection, and resource sustainability. Conservation Agriculture (CA) is one of such methods. Confronting climate change and a population of nine billion to feed by 2050, conservation agriculture is pivotal to future of food security.

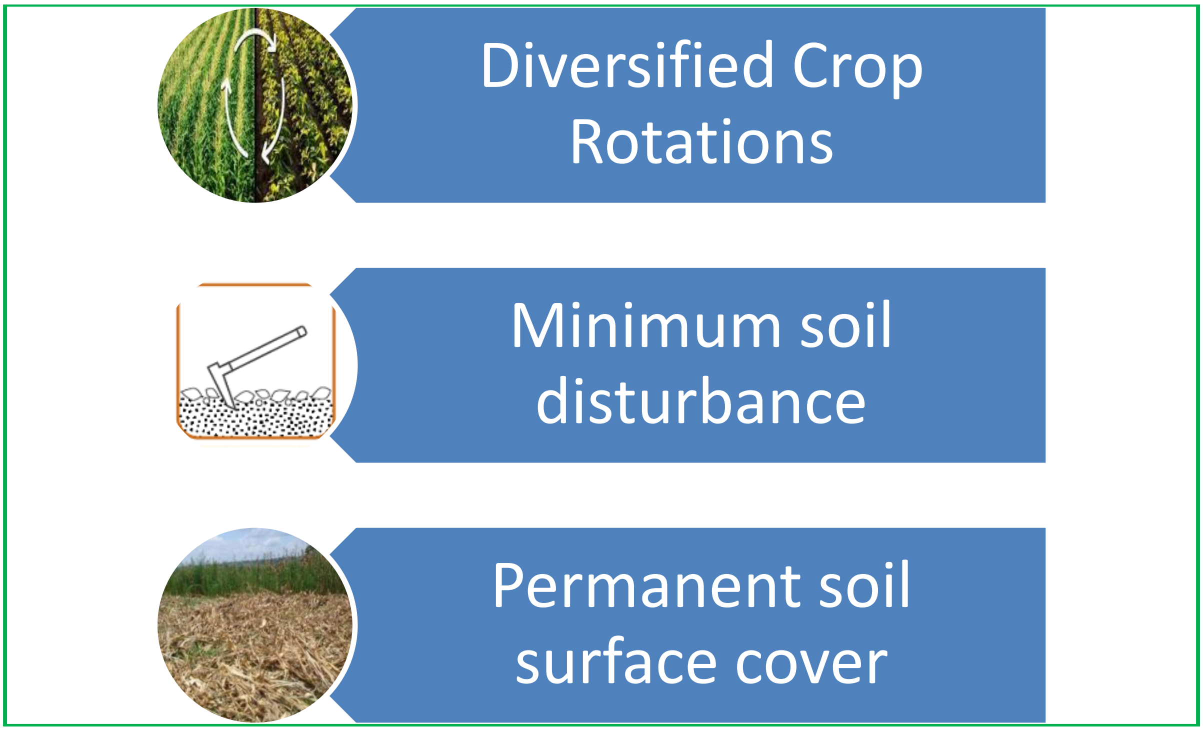
Soil quality

The central question when assessing a system of agricultural management for sustainability is: Which production system will not deplete the resource base, optimise soil conditions, and reduce vulnerability of food production though maintaining or increasing productivity? Soil quality is considered as a conceptual translation of the concept of sustainability to soil. Soil quality is a basic and fundamental criterion for determining the viability of any crop management practise for long-term sustainability. It refers to a soil's ability to function within its natural ecosystem boundaries in order to support agricultural productivity. It also supports human health and habitation by maintaining or improving water and air quality. By conserving resources, optimizing conditions of soil, and minimizing food production vulnerability, improved soil quality aids in the long-term sustainability of crop production systems. Better soil quality is linked to the soil's ability to regulate high productivity without degrading the soil or the environment in the agricultural production system. This can be accomplished by switching to CA, which is regarded as a viable system capable of improving soil quality and ensuring consistent yields. The physical, chemical, and biological characteristics of the soil can be used to determine its quality. Conservation agriculture effects various soil properties as mentioned in Fig. 1.

Principles of Conservation Agriculture

Conservation agriculture mainly based on three principles:

1. Diversified Crop Rotations,
2. Minimum soil disturbance, and
3. Permanent soil surface cover with crop residues and cover crops.



How CA affects Soil health

CA is a set of technologies that includes minimum disturbance of soil, permanent soil cover, diversified crop rotations, and integrated management of weeds, all of which are aimed at reducing negative effects of traditional farming practices like soil erosion, decline in soil organic matter content, soil physical degradation, etc. Tillage and burning of crop residue are common farming practices that have significantly degraded soil resource, resulting in a reduction in crop production capacity. Continued soil loss is expected to become critical for global agricultural production under conventional farming practices. But anytime we disturb the soil in our field, we pay a high price. Conventionally tilled soils generally retain only 30-40% of organic matter found in undisturbed soils. Soil cover with organic material and legume rotations may help to combat the loss of SOM and fertility. CA contributes to the enhancement of biodiversity in both natural and agro-ecosystems. CA provides a foundation for sustainable agricultural production intensification when combined with other good agricultural practices such as the use of quality seeds and integrated pest, nutrient, and water management, among others. Furthermore, CA systems produce yields that are comparable to, if not higher than, traditional intensive tillage systems, with significantly lower production costs. As a result, CA adoption is advantageous both for agriculture and the environment.

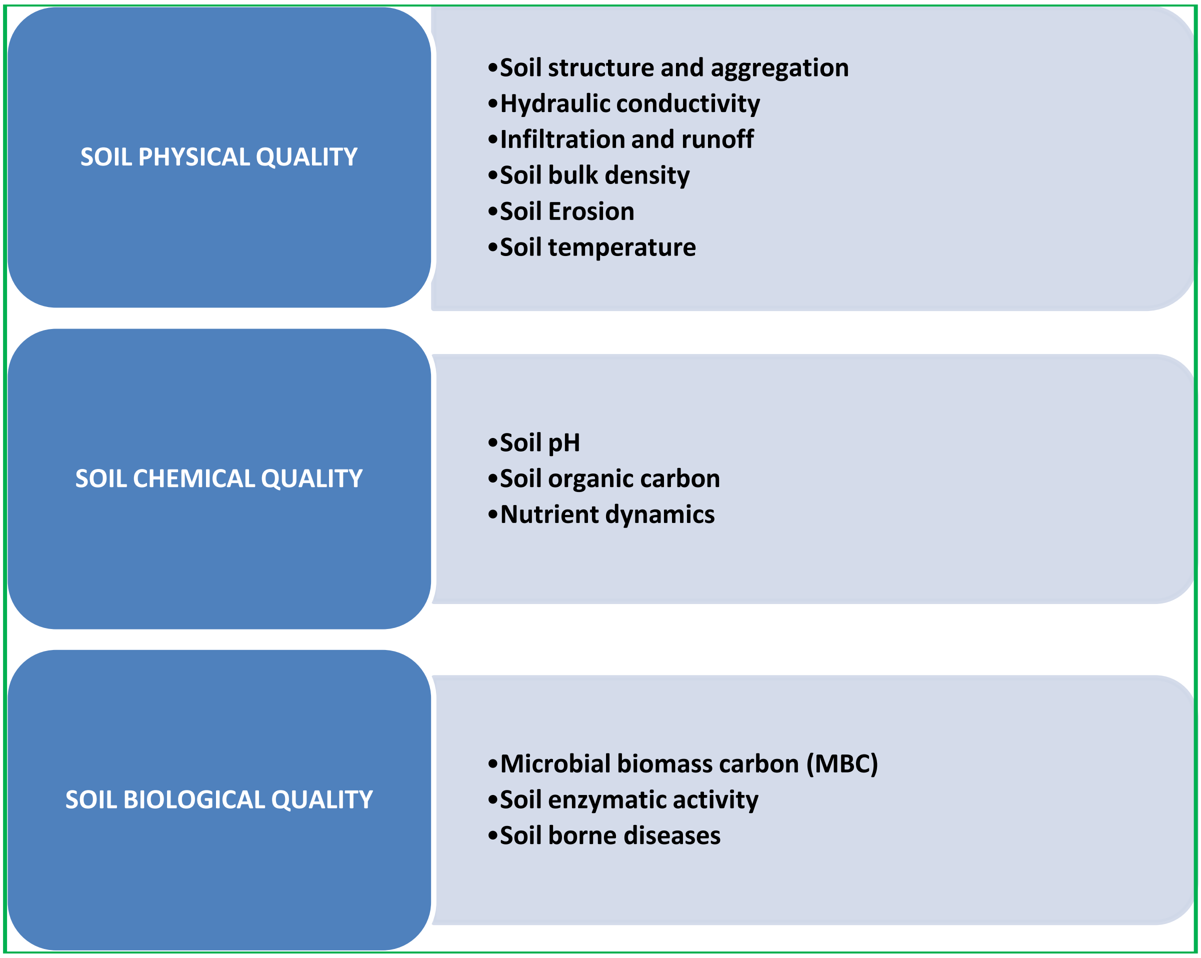


Fig. 1: Effect of conservation agriculture on soil properties

Soil physical properties such as bulk density, resistance to soil penetration, water content, infiltration, and aggregation improved as a result of CA practices (Moreira et al., 2020). Similarly, Nandan et al., 2019, Piazza et al., 2020 reported improvements in soil chemical properties such as available macro and micronutrients under CA. Under the CA system, soil biochemical properties such as microbial biomass carbon (MBC), enzymatic activities such as dehydrogenase, and others were significantly improved (Piazza et al., 2020). Soil carbon sequestration is another crucial strategy for improving soil health and mitigating climate change's adverse effects, which can be attained by conservation agricultural practices. Many studies have shown that ZT improves soil carbon content when compared to conventional tillage (CT).

Conclusion

Keeping in view the deteriorating soil health, long term sustainability and the agricultural practices accelerating the global warming, CA can serve as a key to the future of food security. Besides improving the physical, chemical and biological properties of soil, it helps in the carbon sequestration. CA contributes to the enhancement of biodiversity in both natural and agro-ecosystems. CA provides a foundation for sustainable agricultural production intensification when combined with other good agricultural practices such as the use of quality seeds and integrated pest, nutrient, and water management, among others. Furthermore, CA systems produce yields that are comparable to, if not higher than, traditional intensive tillage systems, with significantly lower production costs. So, the adoption of CA has both agricultural and environmental benefits.

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