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Conservation Agriculture: A Way to Improve Soil Health

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Modern agriculture is explained by high crop productivities that depend on systematic chemical inputs and improved machine technology. Conservation agriculture (CA) is the multidimensional and holistic approach that can be considered for achieving this total system intensification. Soil organic matter which is one of the major components of CA particularly occurs at the soil surface and is associated with improvements of structural, fertility, and biological aspects of soil relative to conventional agricultural systems. Conservation agriculture is rapidly gaining acceptance as a good farming practice to improve soil health. Conservation agriculture involves the minimum disturbance of the soil by tillage operation and increases organic matter by cover crop and crop rotation to benefit both the farmer and the environment. In conservation tillage, tillage is reduced (no-tillage) and crop residues are retained on the soil surface.

Effect of Conservation Agriculture on Soil Properties

A. Effect on soil physical properties

1. Effect on soil Aggregation: CA practices leave most of the crop residues on the soil surface, allowing improvement in soil aggregation and aggregate stability. It also protects surface aggregates against the effects of raindrops or splash erosion. CA which is dominated by minimal or no-tillage and crop residue retention is helpful for soil aggregation and the aggregate stability.
2. Soil moisture: The CA helps in the conservation of soil moisture by encompassing soil cover with crop residues and mulches approach. Due to the crop residues being left over in the field, there is increased infiltration and water-holding capacity.
3. Soil Temperature: Soil temperature is an important transient physical property of soil that affects crop growth and development and governs the physical, chemical, and biological processes of soil. It also influences the interspheric processes of gas exchange between the atmosphere and soil.
4. Water Infiltration and Hydraulic Conductivity: Hydraulic conductivity was higher in zero tillage compared to conservation tillage due to the larger macrospore conductivity as a result of the increased number of bio pores. CA enhances the rate of infiltration because of minimum disturbance of soil which results in better soil pores structure or porosity and enhances hydraulic conductivity.

5. Bulk density: the adoption of CA practices, there is a reduction in the intensity of tillage operations that results in a progressive reduction in soil compaction over time. The decrease in soil BD under CA could be due to higher SOC, better aggregation, increased root growth, and biomass.

B. Effect on soil chemical properties

1. Soil organic matter: Soil organic matter (SOM) plays a pivotal role in maintaining soil fertility, productivity, and sustainability. The CA practices usually increase the SOM content and nutrient availability by utilizing the previous crop residues or growing green manure or cover crops and keeping these residues as surface mulch rather than burning.
2. Soil nitrogen: Conservation tillage practice, crop residue management and crop rotation can strongly influence the nutrient dynamics of any soil through their effect on distribution, mineralization, transformation and recycling of soil nutrients.
3. Soil phosphorus: The concentration of nutrients like phosphorus and potassium was higher near the soil surface than tilled soil because P stratification in the soil is seen under different tillage systems where zero tillage system is associated with a higher concentration of P due to preferential movement of P in the soil. The higher values of available P under CA practices are largely due to reduced mixing of the fertilizer P with the soil leading to lower P-fixation.
4. Soil potassium: CA the highest amount of N, P, and K in 0-15 cm soil surface was recorded under PB planting while the minimum amount of available N, P and K were observed under conservation tillage. The recycling of the higher amount of crop residue from previous higher biomass yield in PB treatments leads to the addition of more nutrients compared to conservation tillage.

C. Soil biological properties

CA practices no-tillage coupled with residue retention which is the major cause of accumulation of the higher amount of soil organic carbon compared to conventional agriculture. Soil organic carbon present in CA systems serves as a good source of energy for soil microbes and positively affects the growth of microbes. CA practices' including the basic principles are widely tested and have the potential to reach the goal of safe productivity conserving or sustaining soil biodiversity. The impact of soil tillage over microbial parameters of soil is mostly determined through climate, location, and below as well as above environmental conditions.

Important the Adoption of Conservation Agriculture

The CA is a great challenge between the scientific community and the farmers to change the mindset and explore the opportunities that offer for natural resource management. The CA is considered a way to sustainable agriculture. A shift from the conventional method of farming that degrades soil quality to resource conservation practice.

Conclusion

CA involves the application of modern agriculture tools to improve production, enables not only the maximization of yield but also helps maintain the health and integrity of the agri-ecosystem unlike the traditional system which mainly aim to maximize yield often at the cost of the environment. Expansion of conservation agriculture can create of win-win situation.