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Popular Review

Conservation Agriculture, A way for Soil & water Conservation

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Introduction

Conservation agriculture (CA) identified by the practice of minimum soil disturbance, diversified crop rotations, and maintenance of organic cover reinforces ecosystems services through a number of interrelated pathways. The production of food in CA reinforces the provision ecosystem services. The regulatory services such as carbon sequestration, climate regulation, and control of soil erosion are strengthened through conservation agriculture.

Principles of Conservation Agriculture

- Disturb the soil as less as possible (Minimum Soil Disturbance)
- Crop Rotation and intercropping
- Permanent Soil Cover (Mulching)

Sowing of Lentil in rice residues

The effect of conservation agriculture on soil and water conservation

Effect of Reduced tillage on soil

- Due to reduced tillage, soil compaction will be decreases & soil micro flora activity will be increased.
- Higher nutrient availability and improves soil structure.
- Improved root growth and re-exposure of weed seeds due to reduced soil turning (Kassam and Friedrich.,2009)

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Effect of residue addition on soil

- Sowing of succeeding crop in previous crop residue act as mulch that suppress weed population due to allelopathic effect, reduces the soil water evaporation and addition of nutrients to the soil (Blanco-Canqui & Ruis., 2018).

CT (Lentil)

ZT (Lentil)

- Water holding capacity of the soil was high in un-ploughed soil than ploughed soil due to increased micro pores at top 0-10 cm of the soil (McVay *et al.*, 2006)
- Minimum tillage improved the structure and aggregation of the soil (Shukla *et al.*, 2003)

Effect of conservation agriculture on soil chemical properties

- Reduced soil N loss was recorded with minimum tillage and zero tillage soil (Dalal *et al*., 1992).
- The TOC, Amino nitrogen Bray's-P, Total-P, WEOC and BS were significantly higher at ZT compared to CT) Table 1

A: Case study: A comprehensive analysis of soil health indicators in a long-term conservation tillage experiment.

Materials and Methods

The plots are located in western Hungary, in a hilly region near the village of Dióskál (46°42′15″N, 17°02′50″E, 176–206m.a.s.l). The plots were tilled across the slope. The PT consists of moldboard ploughing (25–30 cm depth), harrowing and seed-bed preparation every year. The 32ha. study area was divided into four pairs of CT and PT plots of equal size (4ha). During the 17 years of study research, winter wheat maize (5x), oilseed rape (4x), spring barley (2x) and winter barley (1x) were produced in crop rotation (2004–2020).

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Table 1: Effect of tillage on soil indicators at 0–15 cm layer after 17 years of experiment with treatment (CT: conservation tillage; PT: Ploughing tillage) in Dióskál, Hungary.

Treatments	PT		CT		ANOVA	
	Mean	SD	Mean	SD	F value	Sig.level
Total organic carbon (g kg^{-1})	7.74	0.93	10.29	1.06	91.21	0.000
Microbial biomass carbon ($mgkg^{-1}$)	49.41	38.87	137.05	59.o7	32.99	0.000
Water extractable organic carbon ($mgkg^{-1}$)	207.32	18.26	289.06	28.96	59.63	0.000
Permanganate oxidizable organic carbon ($mgkg^{-1}$)	288.17	60.94	369.78	55.80	11.71	0.002
Amino-nitrogen ($mgkg^{-1}$)	120.10	8.91	136.88	9.60	19.67	0.000
Total phosphorous ($mgkg^{-1}$)	580.40	83.44	614.59	73.13	1.14	0.297
Available Phosphorus (Bray-P) $mgkg^{-1}$	32.23	9.97	38.62	10.11	2.43	0.133
Base saturation %	78.40	3.32	76.02	3.92	2.59	0.122

Juhos et *al* ., 2023

Results and Discussion

The TOC content significantly increased in the 0- 15 cm layer at CT sites (:10.29 gkg^{-1}) over 17 years as compared to that in PT (7.74 gkg^{-1}). The lower TOC content of PT soils is because ploughing improves the oxygen and water supply in the soil, thus accelerating the rate of microbial decomposition and mineralization of organic matter (Li, Chang, *et al.*, 2018). Microbial biomass significantly increased by 177% in the soil under CT. Increase of 80% in MBC in the fifth year of soil with no-tillage with crop residue (Franchini *et al.*, 2007). The BS decreased in the CT soil, but the difference was not significant that may be related to the decomposition of organic matter and more intensive mineralization in the CT which increased the potential acidity. The Increases in Bray-P and Total-P were +19.85% and +5.89%,

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respectively. Amino-N in the CT soils was significantly compared to the PT sites, indicating an increase of 13.96% *i.e.* related to the amount of organic matter and biological activity, Amino-N showed a strong positive linear correlation with WEOC, an adequate amount of C and N stimulates the decomposition process, releasing high amounts of organic carbon and nutrients in the soil. However, the active nitrogen content increased less than the carbon content because of CT. The C/N ratio was likely to increase, contributing to C stabilization (Yun *et al.*, 2012)

Conclusion

Practices of conservation tillage accumulates organic matter, helps in increasing biological activity and improve physico- chemical properties of soil. Conservation agriculture can be a solution for sustaining the production. It helps in mitigating the problems arises due to climate change. So, conservation agricultural practices have to be standardized for diversified cropping system.

Abbreviations: BS (Base Saturation), TOC (Total Organic Carbon), WEOC (Water extractable organic Carbon), MBC (Microbial Biomass), ZT (Zero Tillage), CT (Conventional Tillage)

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