



Tropentag, October 5-7, 2011, Bonn

“Development on the margin”

Zero Tillage and Residue Level Impact on Carbon Dynamics in the Rice-Wheat Systems of the Lower Amu Darya Region, Uzbekistan

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Abstract

Improved land management practice is a potential solution to increase productivity and long-term sustainability of land use systems. Conservation agriculture methods where combination of zero tillage with residue retention and introduction of alternate wetting and drying technique for growing rice can increase water productivity and soil quality. This study is based on the field research in a rice-wheat cropping rotation which was conducted during 2008–2009 in the Khorezm region of Uzbekistan. Studied treatments comprised of two tillage systems (zero tillage (ZT) and conventional tillage (CT)), two residue level retention (25 % and 100 %) and two irrigation methods (flooded and alternate wetting and drying). Indicators for soil biological processes such as soil organic carbon (C_{org}), permanganate oxidisable carbon (C_{ox}), carbon management index (CMI), dehydrogenase activity (DHA), roots biomass and soil CO₂ borne respiration were investigated. Stratified soil sampling was followed through all seasons at four levels, from soil surface down to 30 cm. After three cropping seasons (rice-wheat-rice) results on C_{org} showed no significant difference between the treatments ($p < 0.05$). Root biomass at 0–5 cm depth was significantly higher in conventionally planted rice (3.68 mg cm³), compared to conservation treatments (2.02 mg cm³ (ZT100) and 2.41 mg cm³ (ZT25)) and C_{org} was found to be positively correlated with root biomass (R=0.74). Soil physical conditions, such as anaerobic environment explained higher DHA of the soil at 0–5 cm depth and showed a significant difference of CT from ZT100 with values 222.18 and 189.27 $\mu\text{g INF g}^{-1} \text{soil day}^{-1}$, respectively. Based on CMI, CA treatments were about 20 % lower the CT. This confirmed the success of farmers' practice in management of soil carbon by incorporation of 25 % residues during tillage and a rather slow accumulation of soil C in CA treatments with no tillage. This study was an investigation of the potential pitfalls of CA as a potential upscaling technology and results will contribute in developing adapted fertiliser recommendations for farmers of the Khorezm region.

Keywords: Rice, Uzbekistan, wheat, zero-tillage