

Medium-term effects of conservation agriculture for in-situ soil and water management and crop productivity in the northern Ethiopian highlands

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In the northern Ethiopian highlands, croplands yield extremely high volumes of storm runoff and are the major contributor to sediment load in the rivers. A medium-term tillage experiment was carried out (2005 to 2010) on a Vertisol to quantify changes in runoff, soil loss and crop yield due to Conservation Agriculture (CA) in the sub-humid May Zegzeg catchment. A randomized complete block design with 3 replications on permanent plots of 5 m by 14 m was used for three tillage treatments, (i) derdero+ (DER+), permanent raised beds with 30% standing crop residue retention and no-tillage on the top of the bed, (ii) terwah+ (TER+), ploughed once at sowing with 30% standing crop residue retention and furrows made at 1.5 m interval, and (iii) conventional tillage (CT) with a minimum of three tillage operations and removal of crop residues. Tillage operations in the three treatments were done using the local ard plough mahresha. Crop rotation included wheat, grass pea, and hanfets (wheat and barley sown together). Glyphosate was sprayed starting from the third year (2007) at 2 L/ha before planting to control pre-emergent weed in DER+ and TER+. Runoff and soil loss were measured in collector trenches at the lower end of each plot. Local farmers evaluated crop stands. Significantly different ($p < 0.05$) 4-yr mean soil losses of 14, 17 and 26 t/ha, 5-yr mean runoff depth of 76, 95 and 118 mm, and 5-yr runoff coefficient of 19, 24 and 30% were recorded from June to September for DER+, TER+ and CT, respectively. The mean farmers' evaluation of crop performance in the last three years (2008-2010) showed a significant higher score for DER+ (6/8) followed by TER+ (5.6) and least for CT (4.8/8), and improvements in crop yield were observed; however, a period of at least four years of cropping was required before they became significant. DER+ and TER+ are newly developed versions of local tillage practices, using the local ard plough, we recommend to be implemented widely on Vertisols.

Key words: derdero+; terwah+; permanent raised bed; crop residue; conservation agriculture, soil conservation, water conservation

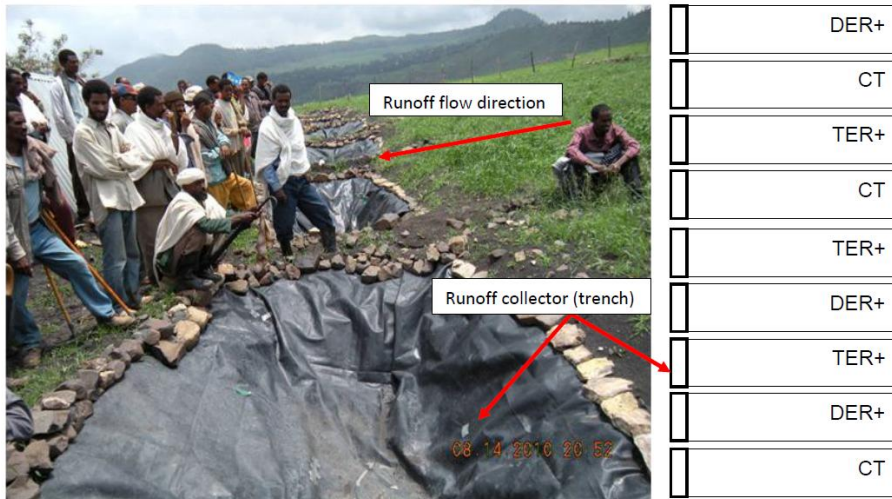


Figure 15: layout of the experimental plot at May Zegzeg, northern Ethiopia in August, at the middle of the rainy season (a), and DER+ at harvesting (b). DER+ is derdero+, TER+ is terwah+, CT is conventional tillage practice.



Figure 16: overview of crop residue left on *derdero+* and *terwah+* planting systems at May Zegzeg experimental site, northern Ethiopia. DER+ is *derdero+*, TER+ is *terwah+*, CT is conventional tillage practice. Note that only 7 out of 9 plots are shown in the photo.

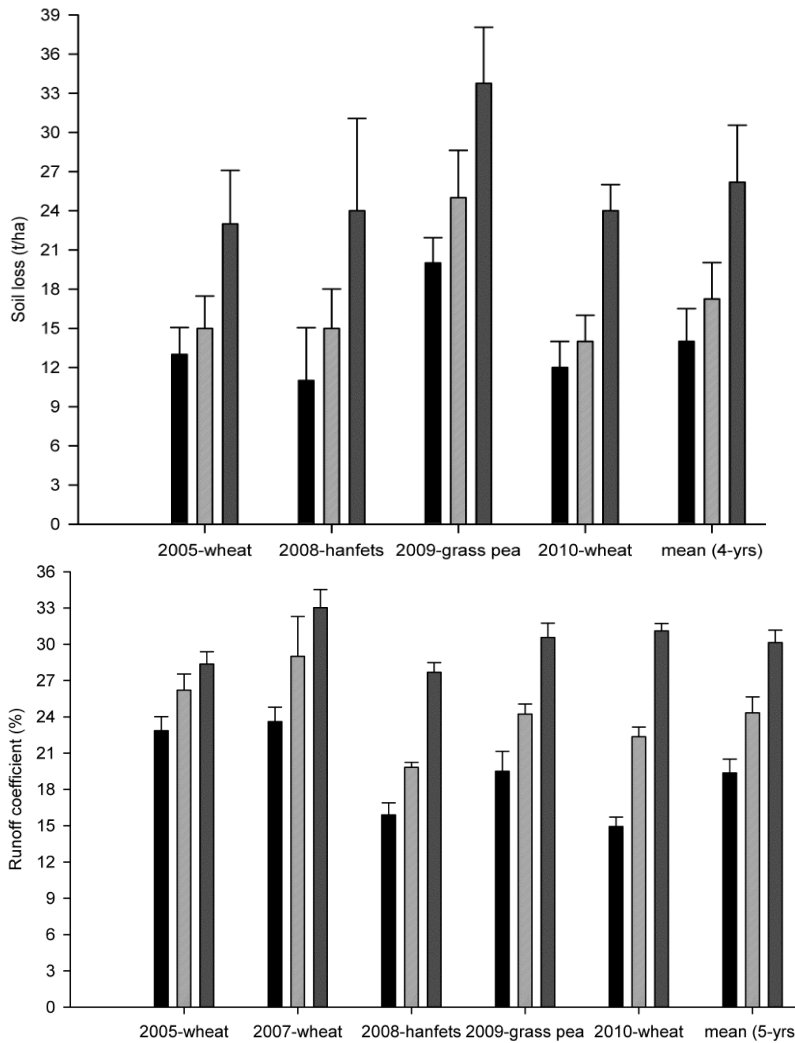


Figure 17: mean yearly runoff (a), runoff coefficient (b) and soil loss (c) from each treatment throughout the growing period ($n = 3$). DER+ is *derdero+*, TER+ is *terwah+*, CT is conventional tillage practice. The bars shown represent standard error of mean ($p < 0.05$). Note that runoff for 2006 and soil loss for 2006 and 2007 were not measured.