Tillage and Drainage Impacts on Soil and Water Quality under Corn-based Cropping Systems in the Eastern Corn Belt

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INTRODUCTION

- Agricultural soils are often being tested under different management practices with the aim of improving crop yield. The present project has two sets of studies: (i) drainage-tillage experiment at the Waterman Farm (WF) at Columbus, Ohio, and (ii) farmer-owned on-farm assessment of soil properties.
- Objectives of this study were to assess the effects of tillage and drainage on greenhouse gas (GHG) fluxes and soil, and water quality.

MATERIALS & METHODS

- The experimental layout was a factorial design comprising of two tillage and two drainage levels with three replications at the WF. Treatments were tile drained, undrained and no-till (NT), chisel till(CT).
- The GHG fluxes were monitored from 12 plots in 2011, 2012, and 2013 seasons using Photoacoustic System (PAS), and Soil Organic Carbon (SOC) was measured by dry combustion method.
- Soils were collected from on-farm sites under different tillage practices and analyzed to investigate tillage-effects.

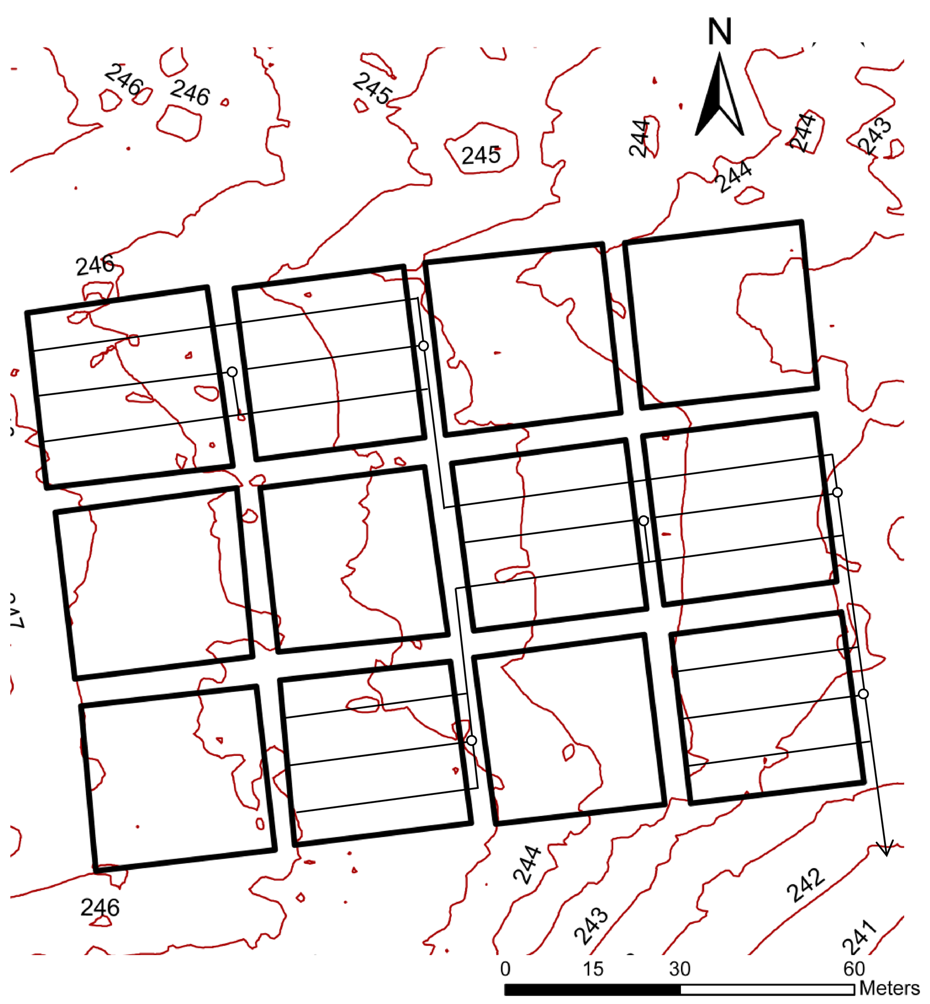
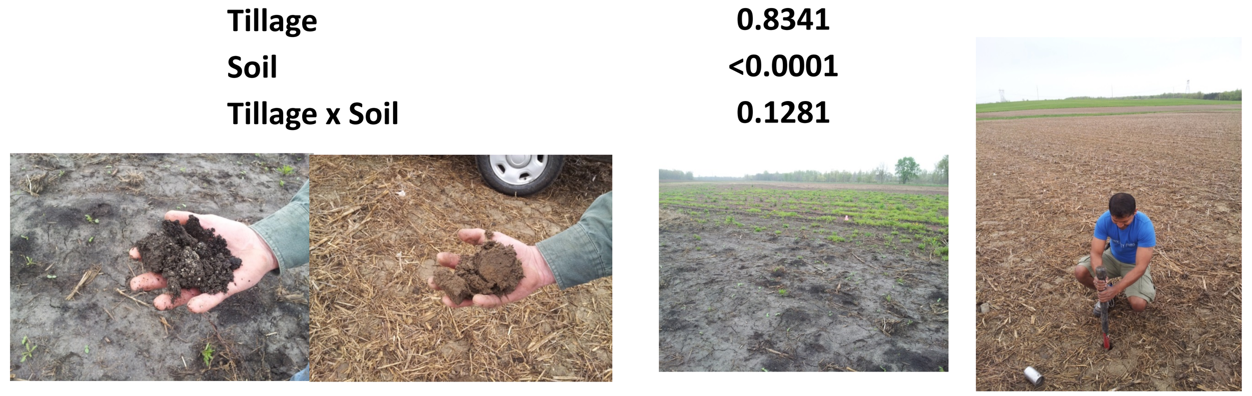


Fig. 1. Drainage plots at the Waterman Farm.

Table. 1. Organic (Mc) versus mineral (CrB) soil for 0-10cm.

	Bulk Density (Mg m^{-3})	
	Mc	CrB
NT	0.45c	1.14a
CT	0.31d	0.66b
	Analysis of Variance (P > F)	
Tillage	< 0.0001	
Soil	< 0.0001	
Tillage x Soil	0.0036	
	pH	
	Mc	CrB
NT	7.3a	7.3a
CT	7.4a	7.5a
	Analysis of Variance (P > F)	
Tillage	0.2438	
Soil	0.8737	
Tillage x Soil	0.4555	
	EC (μs cm^{-1})	
	Mc	CrB
NT	633a	228b
CT	599a	273b
	Analysis of Variance (P > F)	
Tillage	0.8341	
Soil	<0.0001	
Tillage x Soil	0.1281	



RESULTS & DISCUSSION

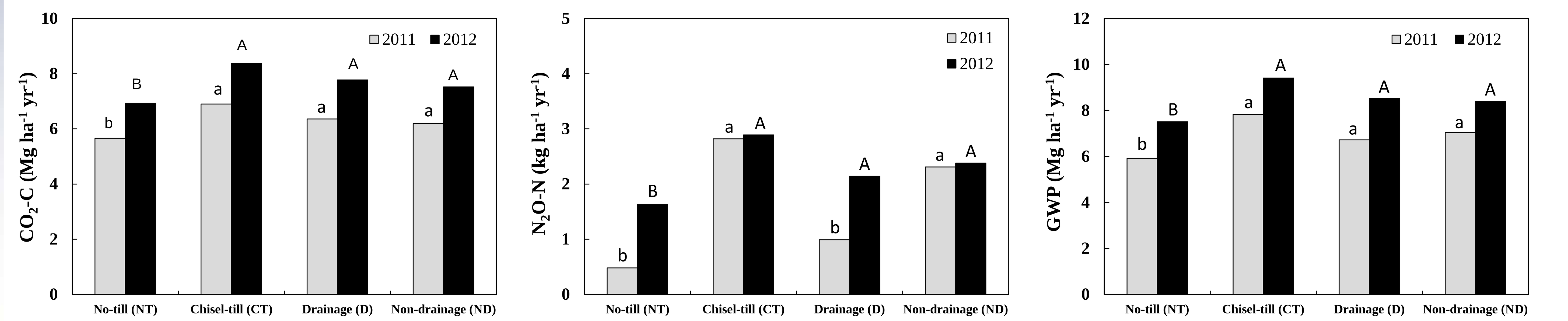


Fig. 3. Annual CO_2, N_2O, and GWP under NT and CT, D and ND for 2011 and 2012.

- Annual CO_2-C flux was 17.5% lower from NT (6.29 Mg ha^{-1} yr^{-1}) compared to that under CT (7.63Mg ha^{-1} yr^{-1}) and 3% higher from D (7.06 Mg ha^{-1} yr^{-1}) compared to that under ND (6.85 Mg ha^{-1} yr^{-1}).
- Similarly, the N_2O-N fluxes were also lower under NT vs. CT system (1.05 vs. 2.85 kg ha^{-1}yr^{-1}) and under D vs. ND (1.56 vs. 2.34 kg ha^{-1}yr^{-1}).
- The global warming potential (GWP) under NT (6.71 Mg ha^{-1} yr^{-1}) was 22.1% lower than that under CT (8.62 Mg ha^{-1} yr^{-1}). However, values were similar under D and ND (7.62, and 7.72 Mg ha^{-1} yr^{-1}, respectively).
- Drain flow in 2012 was much less than that in2013, and drain flow under NT was higher compared to that under CT.

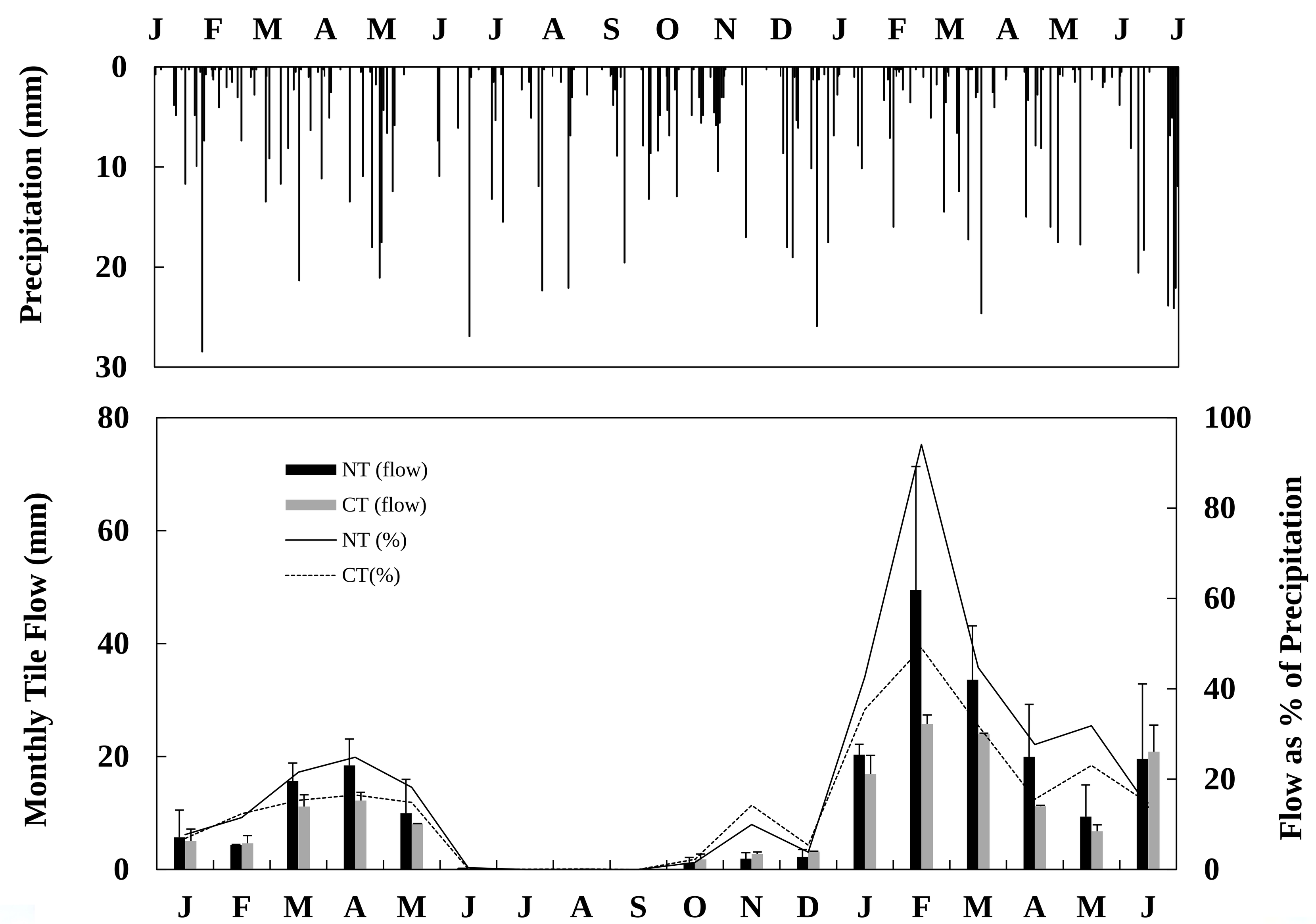


Fig. 4. Monthly drain water flow and drain flow in percentage of precipitation and daily precipitation

CONCLUSIONS

- Soils under NT with drainage system emitted lower emissions of GHGs compared to that under CT.
- Subsurface drainage lowered C-emissions compared to that under ND system.
- Tillage affected BD but not pH and EC.
- Corn yield was related to soil properties and drainage flow (data not shown).

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