Impact of Conservation Management Practices on Greenhouse Gas Emissions in Semi-arid, Intensively Cropped Regions of Texas

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Introduction

Agriculture accounts for less than 10% of the United States' greenhouse gas (GHG) production[1], but is the major source of nitrous oxide (N_2O) pollution. Due to these potential effects on our climate, research has begun to understand the ways by which GHG production from agricultural soils can be mitigated by soil management practices. Additionally, research into the potential of agricultural soils to be a sink for certain GHGs has begun.

Objective: Determine the ability of conservation management practices to mitigate carbon dioxide (CO_2) and N_2O production from intensely cropped soils.

Materials and Methods

Location: Lubbock, Texas (2016)

Cropping system

- Continuous cotton (*Gossypium hirsutum*)
- Variety: DP1321

Field Design

- Nitrogen (N) rate: 167.97kg ha^{-1} as urea ammonium nitrate (UAN, 32-0-0)
- N treatments: 1) 100% Pre-plant (PP); 2) 100% Side-dressed (SD); 3) 40%PP 60%SD; 4) No-N (Control)
- Mgmt: 1) Conventional (CT); 2) No-Till (NT); 3) No-Till with wheat cover (NT-W)

Sample Times

- Monthly
- 24 and 72/96hrs post N-Fertilizer application

Flux Measurements (CO_2, N_2O)

- Gasmet DX-4040 portable FTIR (Fourier Transform Infrared) multi gas analyzer integrated with a Li-Cor 8100-103 20-cm survey chamber
- Flux rates were calculated by fitting a linear regression to gas concentrations versus sampling time, significance based on $R^2 \geq 0.7$

Data Analysis

- Treatment factor significance was determined using ANOVA (p<0.05) in SAS version 9.3

Results

Table 1: Pre-Season Soil Characterization

pH	OC	Total N	NO_3N	P	K	Ca	Mg	S	Na
	%	----------------------------			mg kg^{-1}	-----------------			
7.50	0.54	706	4.4	42	431	1941	816	12	31

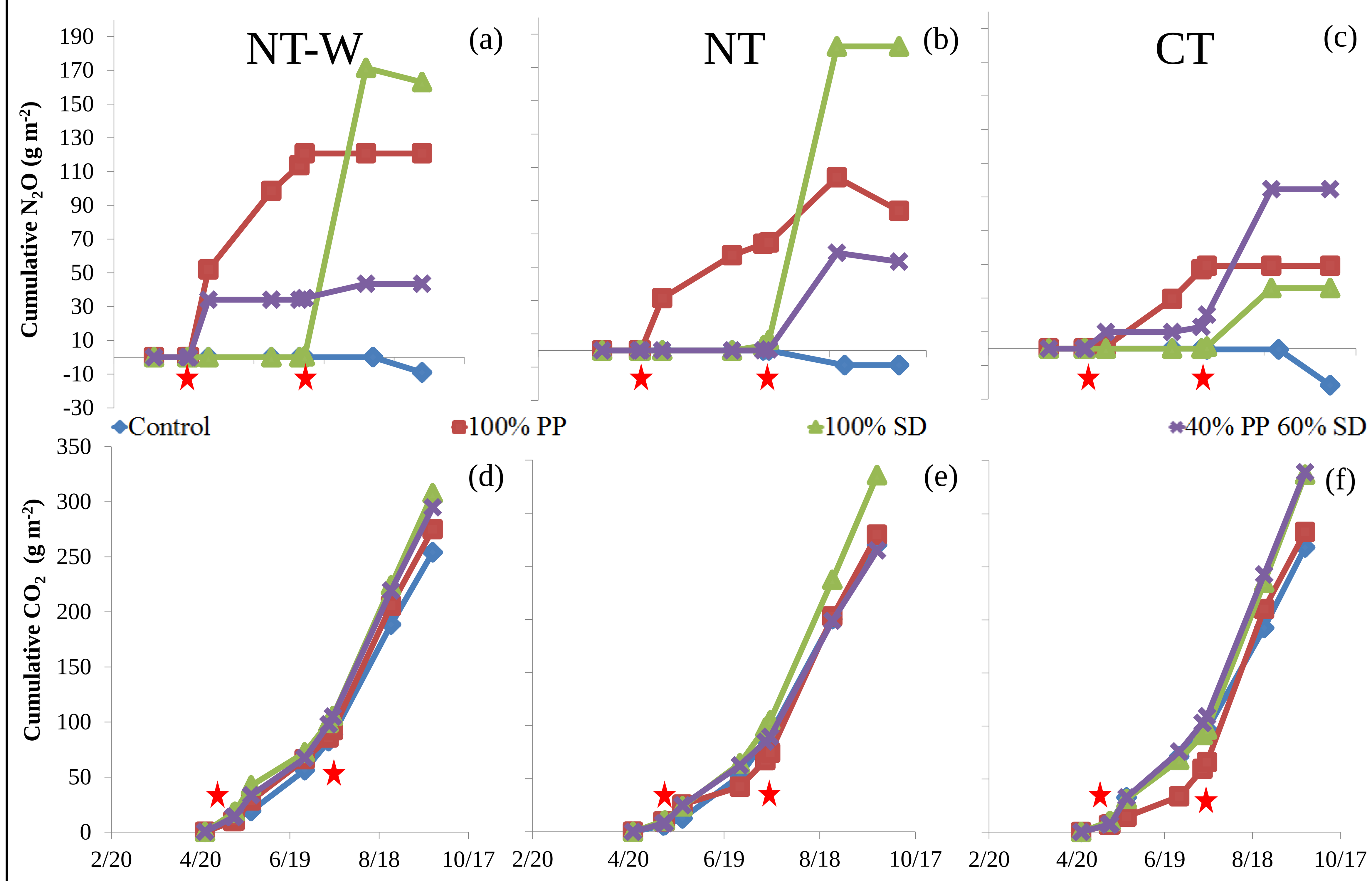

Figure 1: Average Cumulative Flux (g m^{-2}). NT-W: No-Till with wheat cover; NT: No-Till; CT: Conventional Tillage. Starred points are the dates of N-fertilizer application (May 10, 2016, July 13, 2016)

Table 2: Significance of differences between factors (9/23/16)

Factors	*P*-value	
	Cumulative	
	N_2O	CO_2
Tillage	0.546	0.492
Fertilizer	0.012	0.086
Tillage*Fertilizer	0.462	0.856

Discussion

Soil Properties (Table 1)

- The soil is an Acuff loam (fine-loamy, mixed, superactive, thermic Aridic Paleustolls).
- Total N and OC percentages of this soil are low, typical of soils in this area.

Cumulative Greenhouse Gas Fluxes

N_2O (Fig. 1a,b,c)

- Increases in fluctuations appear to follow fertilizer application.
- Sinks appear in late season measurements (Figure 1a,b,c). May be attributed to low mineral N content of the soil at these times[2].
- 100%SD generally produced the largest cumulative flux in both NT-W and NT.
- Fertilizer application has a significant effect on the cumulative N_2O flux (*P*-value $\leq$ 0.05) (Table 2).

CO_2 (Fig. 1d,e,f)

- Increases are consistent across treatments and cropping systems.
- Increase following the second fertilizer application may be due to high soil temperatures which have been reported to increase respiration rates[3,4]
- 100%SD produced largest cumulative flux for NT-W and NT, similar to 40%PP 60%SD in CT.
- Fertilizer application timing has a significant effect on the cumulative CO_2 flux (*P*-value $\leq$ 0.1) (Table 2).

Conclusions

- The observed increases in N_2O are associated with the addition of UAN to the soil.
- CO_2 flux follows a similar trend for all treatments and cropping systems.
- The final cumulative CO_2 and N_2O fluxes differ significantly between fertilizer treatments ($P \leq 0.1$, $P \leq 0.05$ respectively).
- N_2O sinks may be associated with periods of low soil N.

Literature Review

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