Impact of Weed Management and N Rate on Nitrous Oxide Emissions in Corn

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Introduction

Nitrous oxide (N_2O) is a potent greenhouse gas. Both weed management and nitrogen (N) fertilization are important for profitable corn production. N_2O emissions are known to increase with higher N rates and more soil moisture. Weeds compete with crops for soil available N and water, and could potentially reduce N_2O emissions while growing. However, after termination weed residues can increase soil moisture and encourage N cycling, which may contribute to higher N_2O emissions.

Objectives

1. To evaluate the impact weed management strategy has on N_2O emissions in corn at various N rates
2. To compare N_2O emissions between weed management strategies before termination and after termination

Materials & Methods

RCBD with 2x3 factorial treatment structure:

N rate (kg N ha^{-1})	Weed Management	
	Preemergence (PRE) + Postemergence (POST)	POST-only
0	PRE: saflufenacil (0.0164 kg ai ha^{-1}) + dimethenamid-P (0.146 kg ai ha^{-1}) POST: glyphosate (0.87 kg ae ha^{-1})	glyphosate (0.87 kg ae ha^{-1})
90		
180		

Two locations: Arlington, and Janesville, WI

2013					
Location	Planting Date	N applied	PRE applied	POST applied	Harvest
Arlington	4-Jun	4-Jun	4-Jun	5-Jul	14-Nov
Janesville	16-May	16-May	16-May	18-Jun	23-Oct

- N as urea and PRE applied just after planting
- POST application when weeds 10-15 cm
- Weed biomass sampled at POST timing, and terminated weed residue remained on soil surface

Gas sampling

Gas samples were collected from static chambers in each plot 1x/week until POST, 2x/week for two weeks after POST, and every 2-3 weeks until mid-September. Four samples were collected per hour (0, 20, 40, 60 min) from each plot. Samples were analyzed with gas chromatography to determine the concentration of N_2O, and gas fluxes (μg N_2O-N m^{-2} h^{-1}) were determined by linear regression of the four samples within collection timings. Total N_2O emissions (mg N_2O-N m^{-2}) for the duration of the study were determined by linear interpolation of the fluxes between sampling days and numerical integration using Simpson's rule (Jarecki et al., 2009).

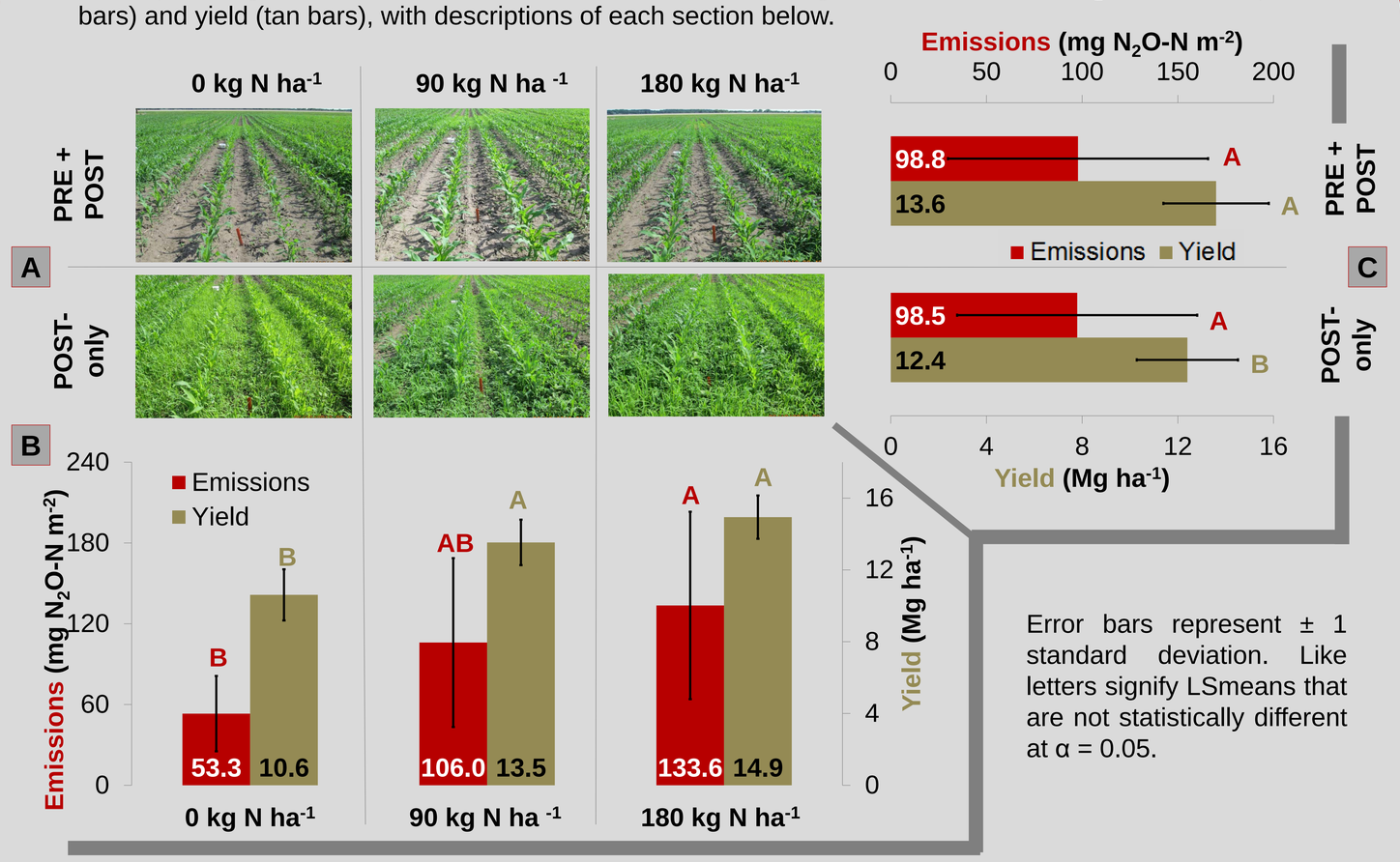
A static chamber during gas collection (far left) and one placed between corn rows at Janesville (left).

Statistical analysis

Data were subjected to ANOVA and analyzed using a mixed model with location treated as a random effect. Means were separated using Fisher's Protected LSD at α = 0.05.

Results

The interaction of weed management by N rate on N_2O emissions was not significant in this study (p = 0.6075). The figure below shows the main effects of weed management and N rate on N_2O emissions (red bars) and yield (tan bars), with descriptions of each section below.



Error bars represent ± 1 standard deviation. Like letters signify LSmeans that are not statistically different at α = 0.05.

A **Upper left.** Pictures of Janesville at 33 days after planting, just before POST application.

B **Lower left.** N_2O emissions and yield by N rate. Higher N rates significantly increased N_2O emissions (p = 0.0217) and yield (p = <0.0001).

C **Upper right.** N_2O emissions and yield by weed management. Use of a PRE significantly increased yield (p = 0.0118) but weed management strategy did not impact N_2O emissions (p = 0.9667).

D **Lower right.** There was no difference in N_2O emissions between PRE+POST vs. POST-only management strategies before termination (p = 0.9630) or after termination (p= 0.9348).

D

Weed Management	N_2O Emissions (mg N_2O-N m^{-2})	
	Before Termination	After Termination
PRE + POST	62.7 (A)	36.1 (A)
POST-only	63.3 (A)	35.2 (A)

Conclusions

Our results agree with previous research which shows that increased N rates contribute to higher N_2O emissions, and that corn yields improve with more N and the use of a PRE. However, the weed management by N interaction did not have an impact on N_2O emissions in corn these two site-years. Furthermore, a PRE+POST versus POST-only weed management strategy did not have an effect on emissions. Weeds did not significantly reduce emissions while growing, nor did they increase emissions after termination. Our conclusion from these early results is that herbicide management strategies may not significantly influence total N_2O emissions from corn production despite different levels of N fertilization. However, these are preliminary results and the study will be repeated in 2014.

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