N_2O emissions as influenced by N and weeds before and after POST glyphosate application

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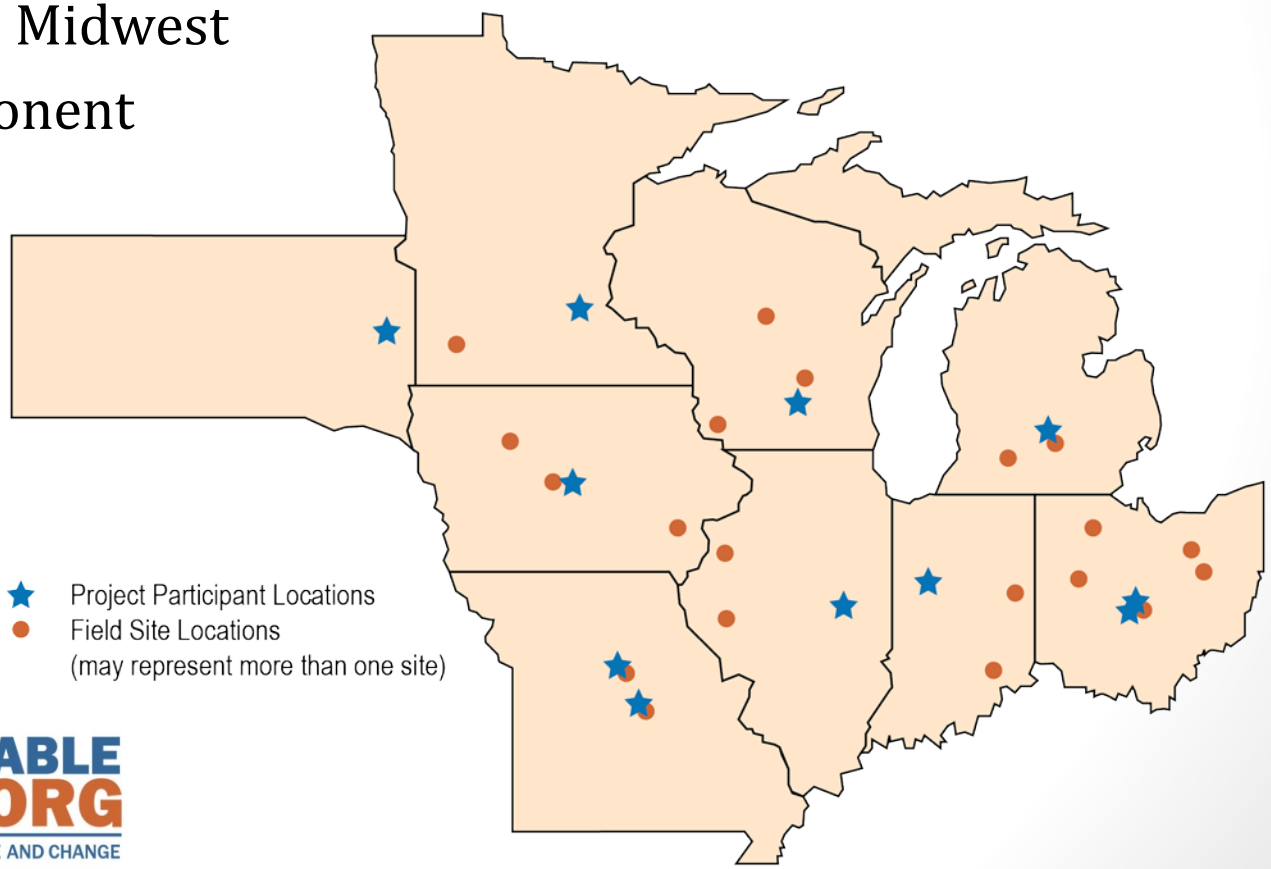
Why this research?

- USDA-NIFA Corn-Climate CAP
- Investigates C, N, water footprints in corn-based cropping systems in Midwest
- IPM component



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CROPS, CLIMATE, CULTURE AND CHANGE

Nitrous oxide

"N_2O is now the most significant ozone-depleting substance emission and the third most important greenhouse gas released into the atmosphere." –UNEP, November 2013

- GWP: 1 kg N_2O = 298 kg CO_2
- 5% of total emissions in US from N_2O
- 70% of N_2O from agricultural land management
- 8% total emissions from agriculture (100 million passenger vehicles)

http://www.epa.gov/climatechange/ghgemissions

N and Weeds

- More N = more N_2O emissions

  IPCC estimates 1% of N → N_2O

  200 kg N ha^{-1} → 2 kg N_2O-N ha^{-1}

- More soil moisture = more N_2O emissions

  Denitrification

  NO_3^- → NO_2^- → NO (*g*) → N_2O (*g*) → N_2 (*g*)

- Weeds compete for soil N and water
- Plant residue can encourage N cycling and increase soil moisture

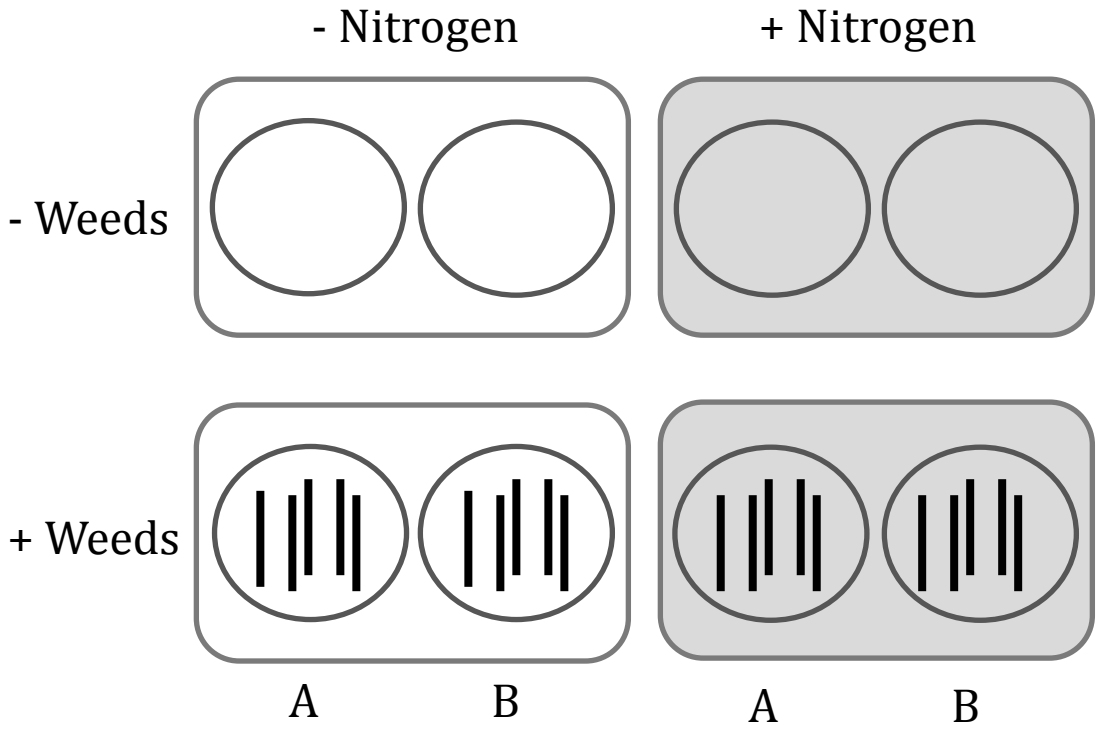
How does that affect N_2O?

Research Questions

- Do weeds reduce emissions while growing?
- Do dead weed residues increase emissions?
- Are cumulative emissions the same for a given rate of N independent of weed density?
- Should weed management be a consideration to generate models describing N_2O emissions from corn production?

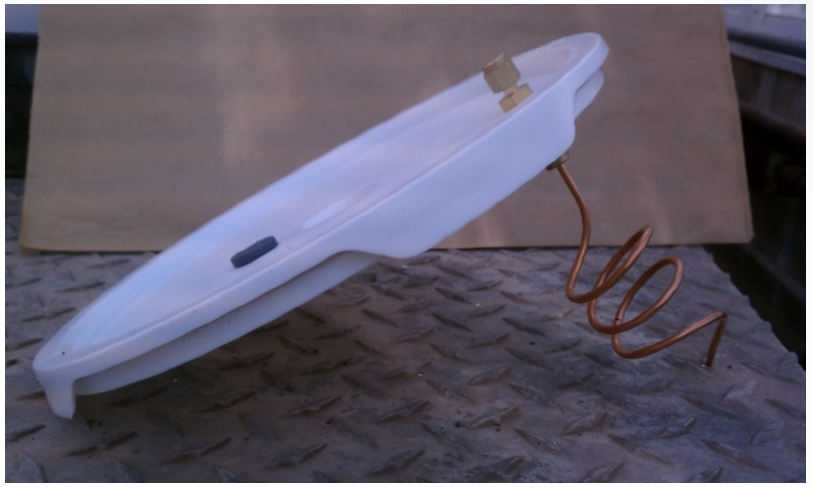
Greenhouse study

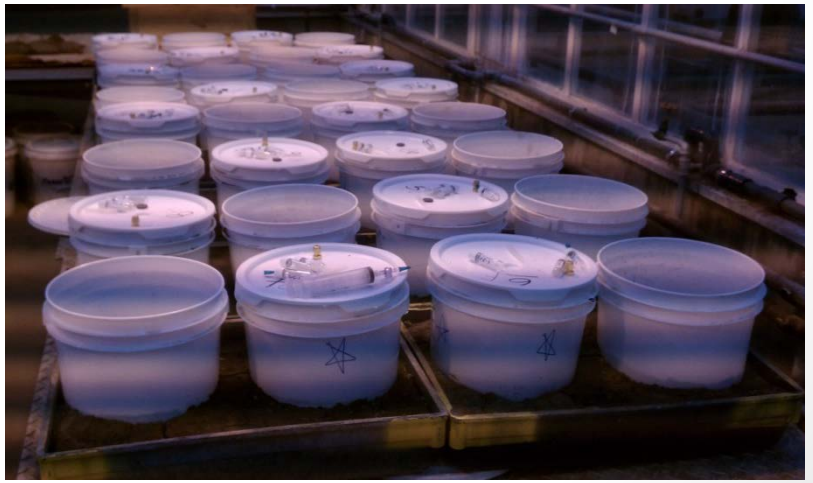
- 2x2 factorial CRD



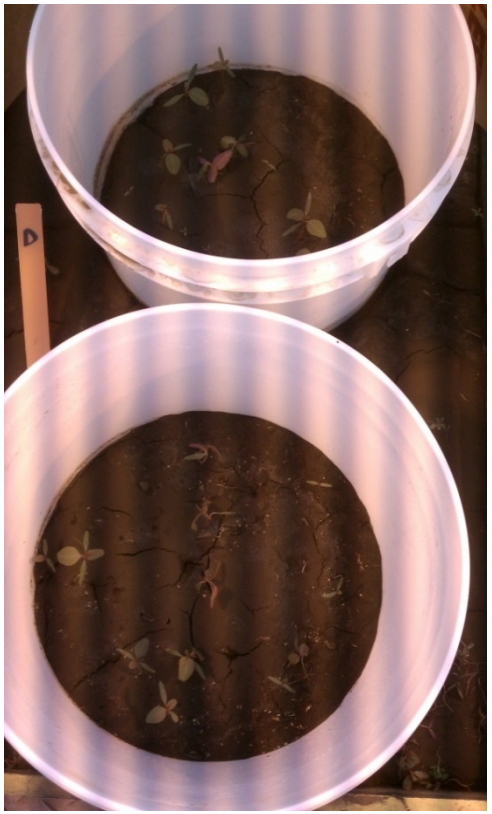
A→ Glyphosate applied ~wk 4 (gas sampling chamber)
B→ Biomass collected ~wk 4 (duplicate chamber)

Greenhouse study





Greenhouse study



14 DAP

21 DAP

27 DAP

Greenhouse study

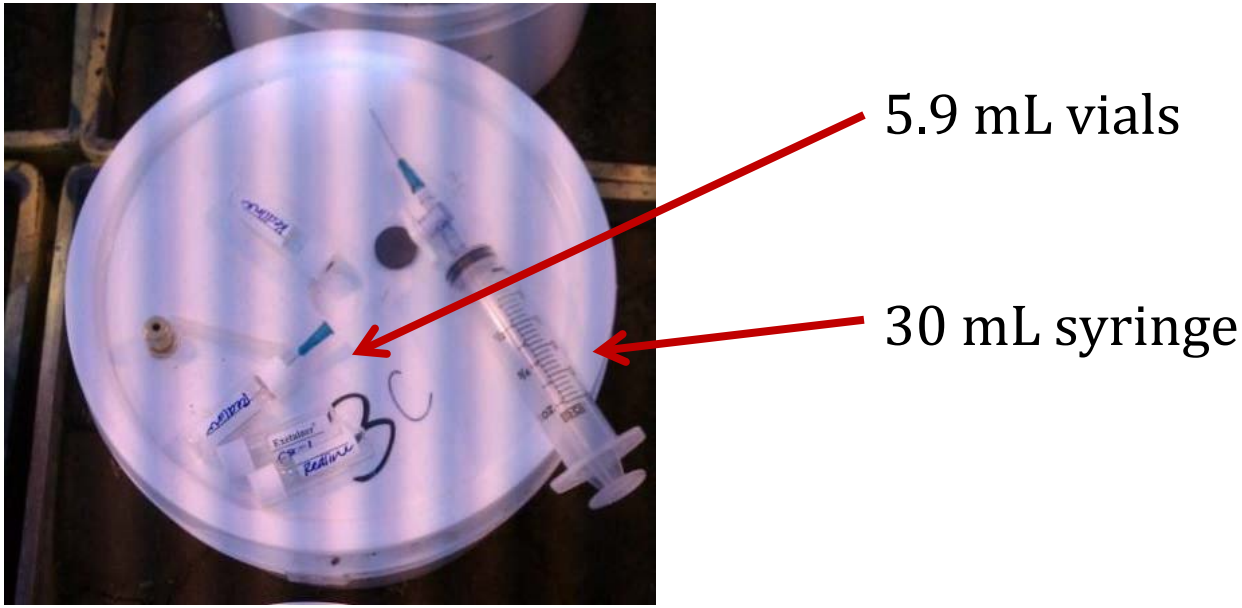
30 DAP/3 DAT

33 DAP/6 DAT

Field study

Gas sampling

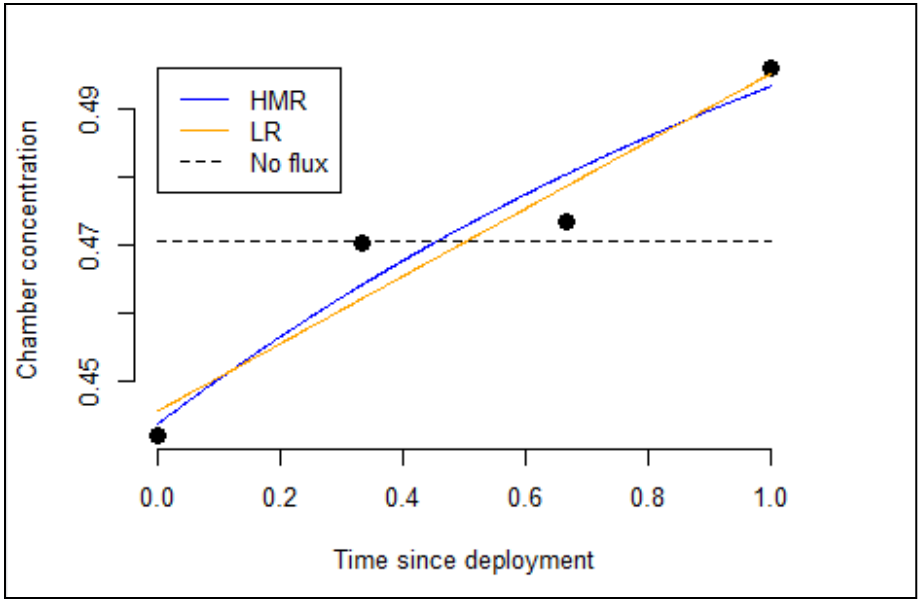
- Samples collected 2x/wk for 8 wks
- Four samples per hour—0, 20, 40, 60 min



- Gas chromatography to determine N_2O concentration

Treatment of Data

1. Linear regression of [N_2O] to determine flux

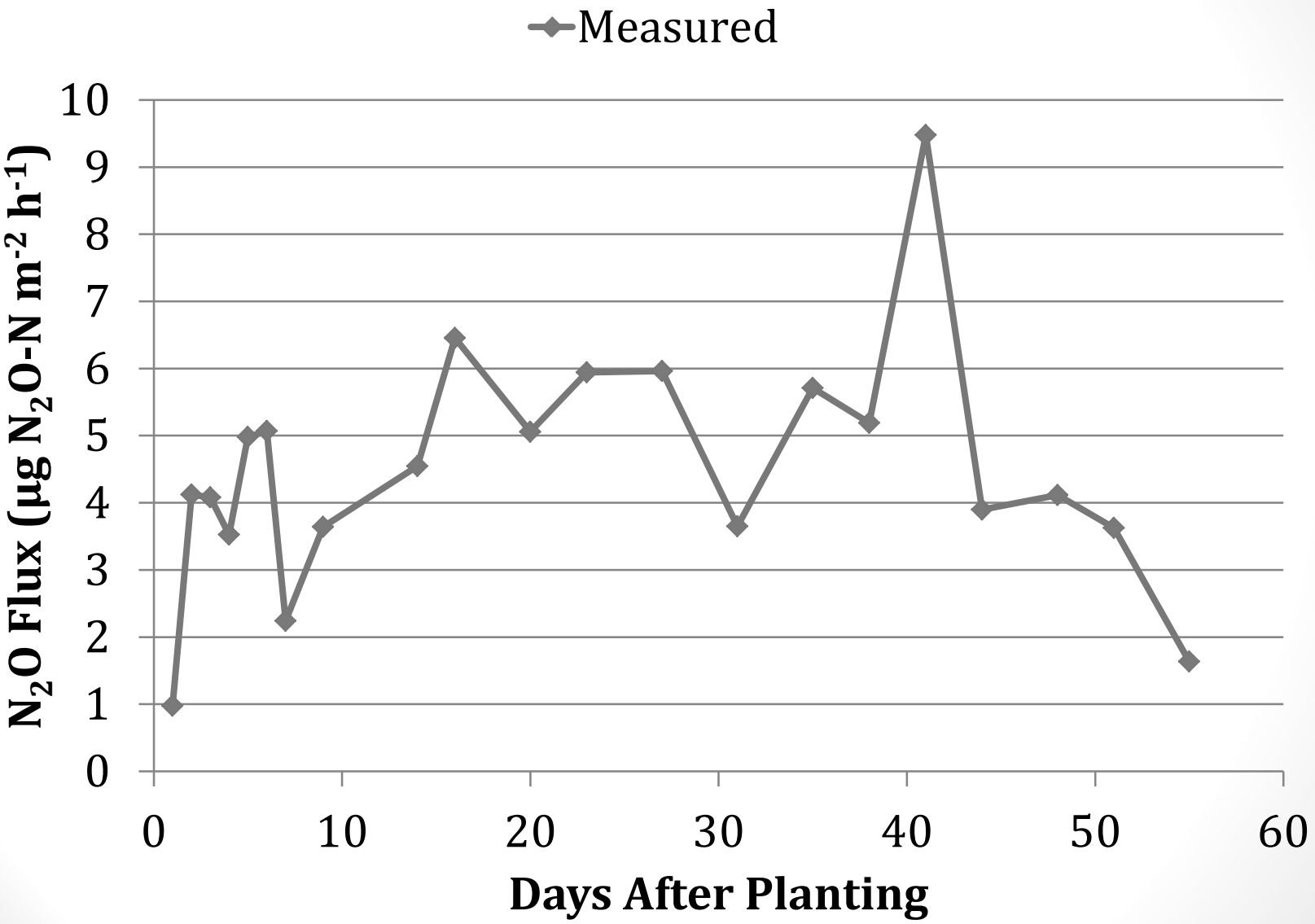


$\mu g\ N_2O\text{-}N\ m^{-2}\ h^{-1}$

2. Check for outliers within each sampling day

   Model→ N_2O = weed N weed*N

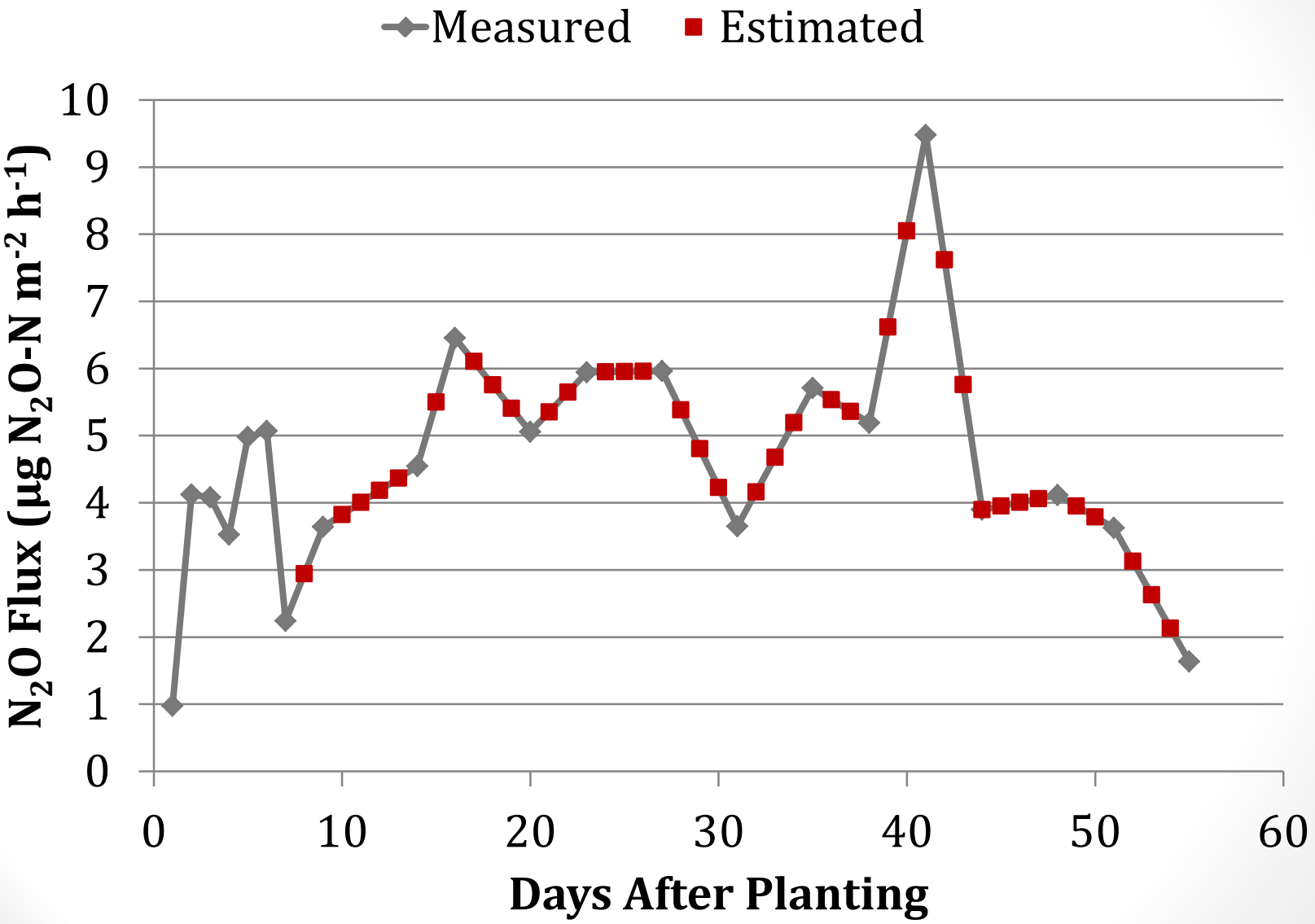
3. Linear interpolation between sampling days



Jarecki et al., 2009

GH1, chamber in +W+N

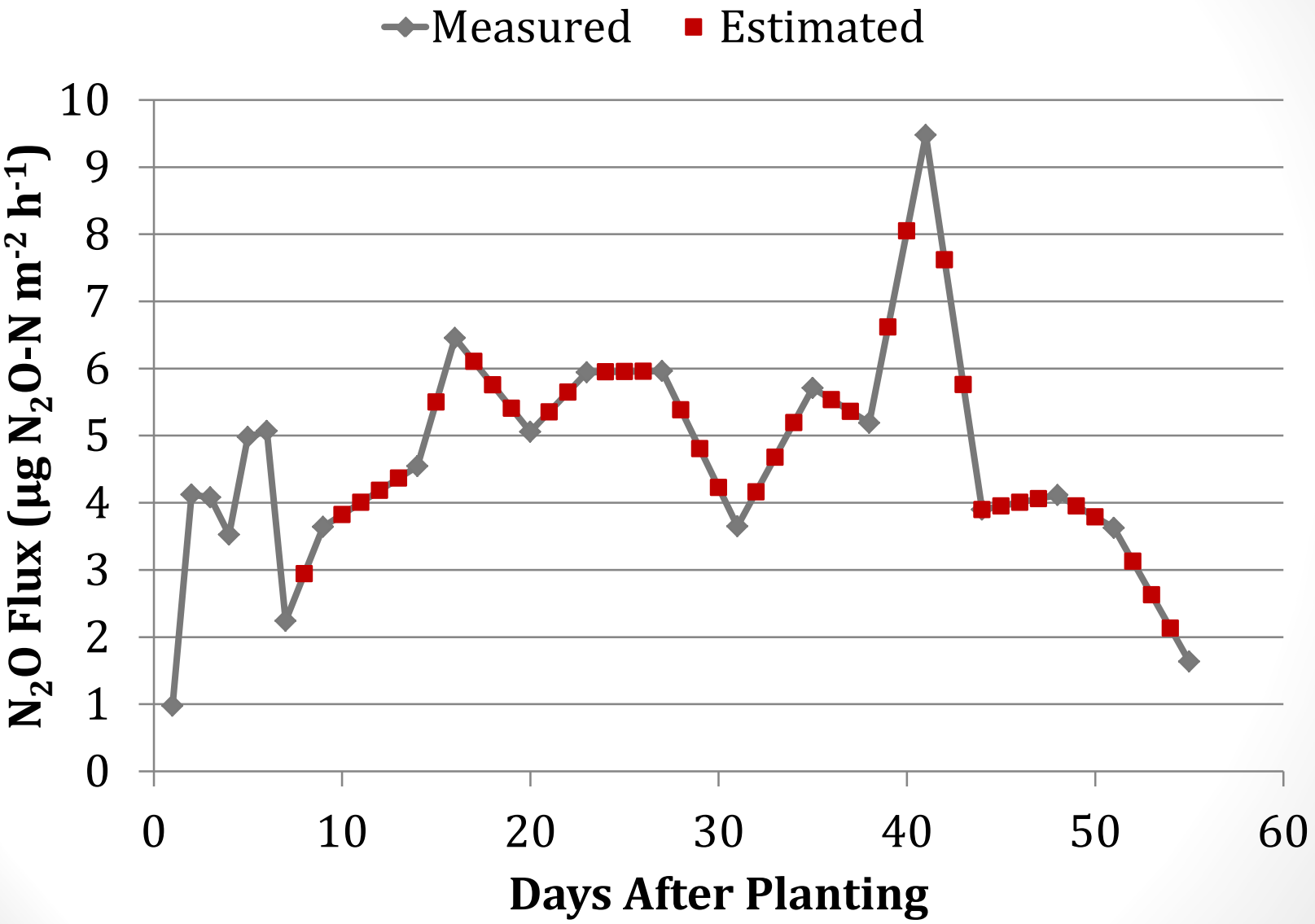
3. Linear interpolation between sampling days



Jarecki et al., 2009

GH1, chamber in +W+N

4. Numerical integration using Simpson's rule



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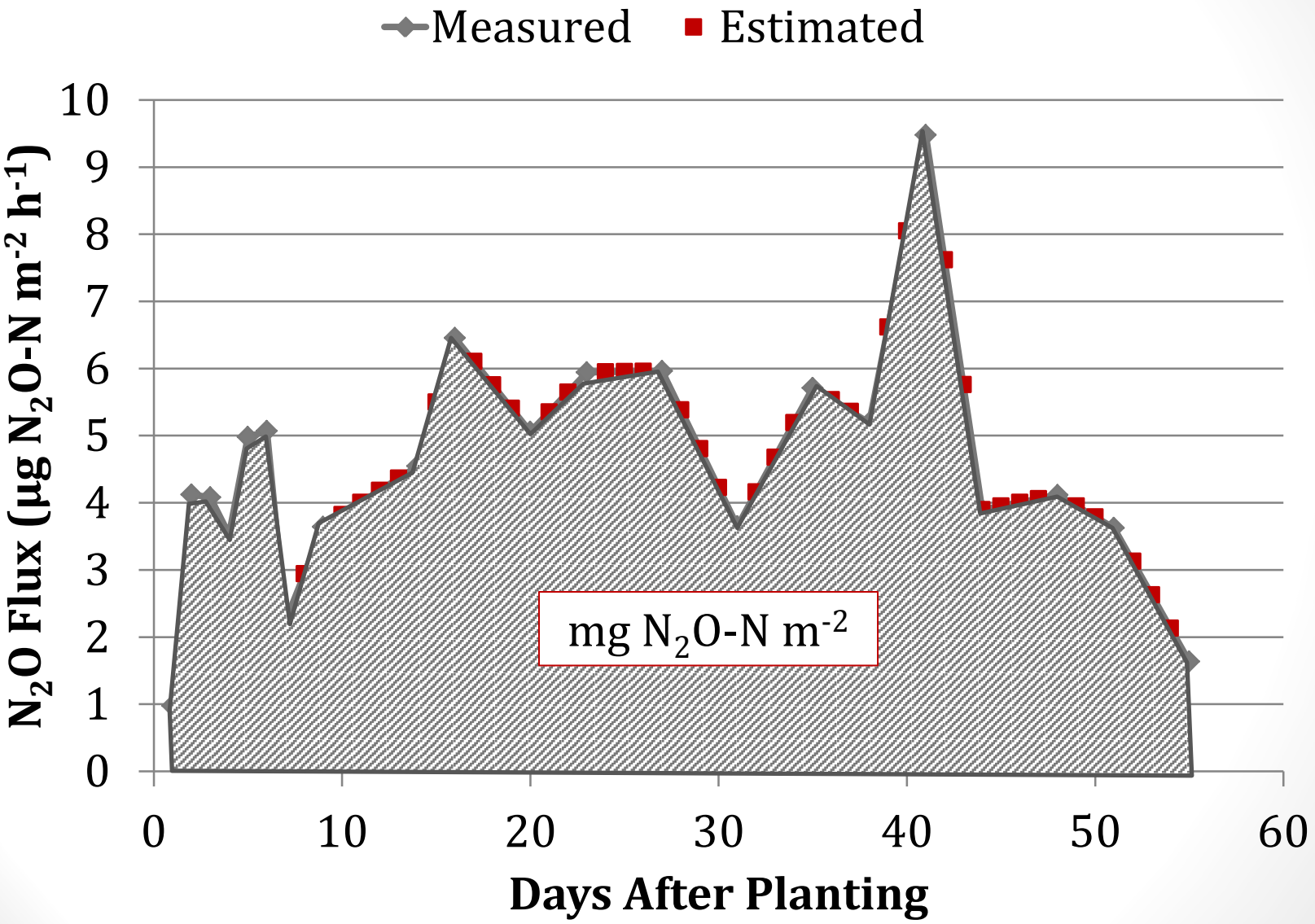


Jarecki et al., 2009

GH1, chamber in +W+N

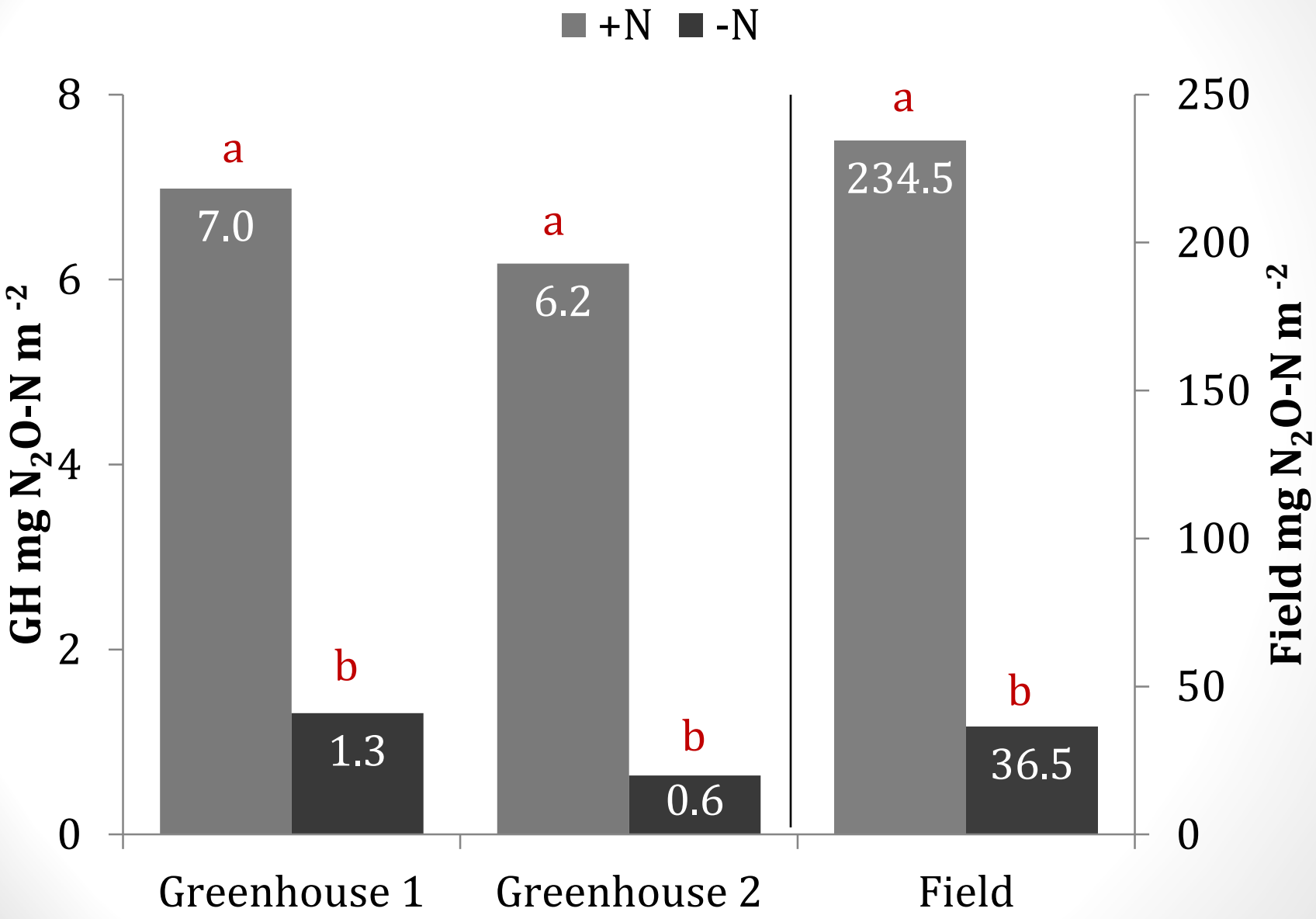
Results

Model→ N_2O = weed N weed*N

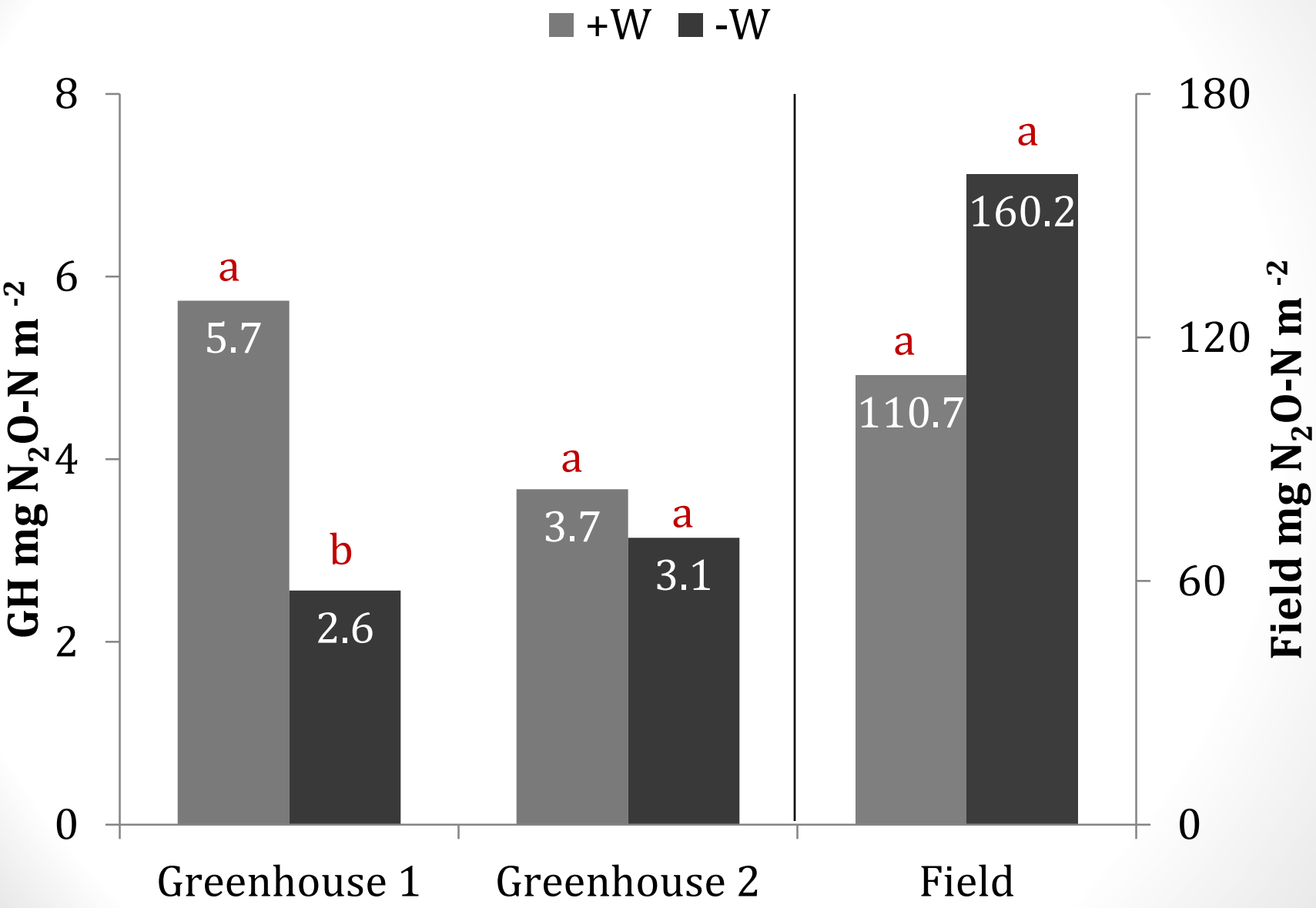
	P values		
Trial	**weed**	**N**	**weed*N**
Greenhouse 1	0.0021	<.0001	0.1166
Greenhouse 2	0.2186	<.0001	0.7646
Field	0.155	<.0001	0.1578

	Reference
mg N_2O-N m^{-2}	**35.1**
kg N_2O-N ha^{-1}	0.351
lb N_2O-N ac^{-1}	0.312

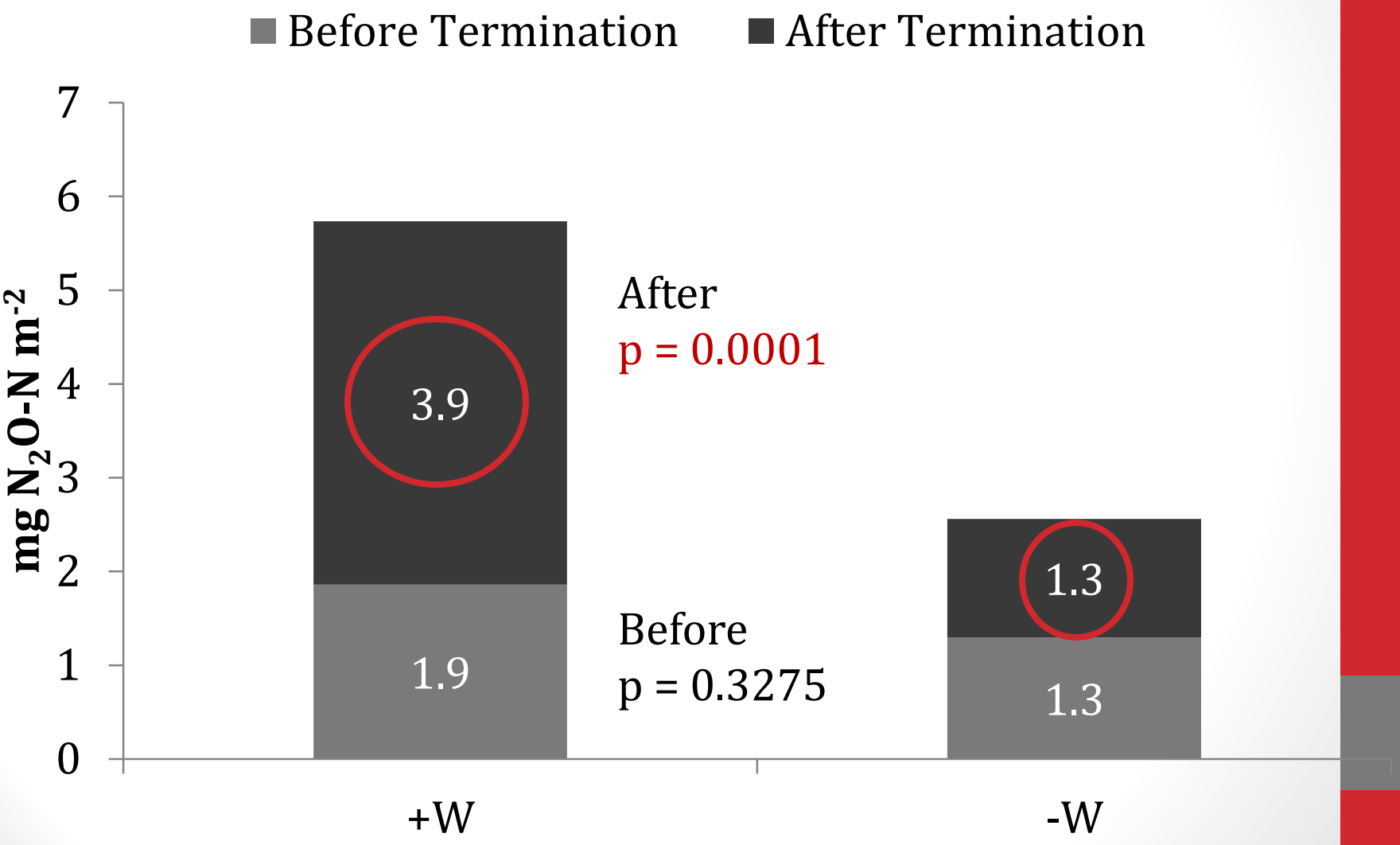
Total N_2O Emissions by N



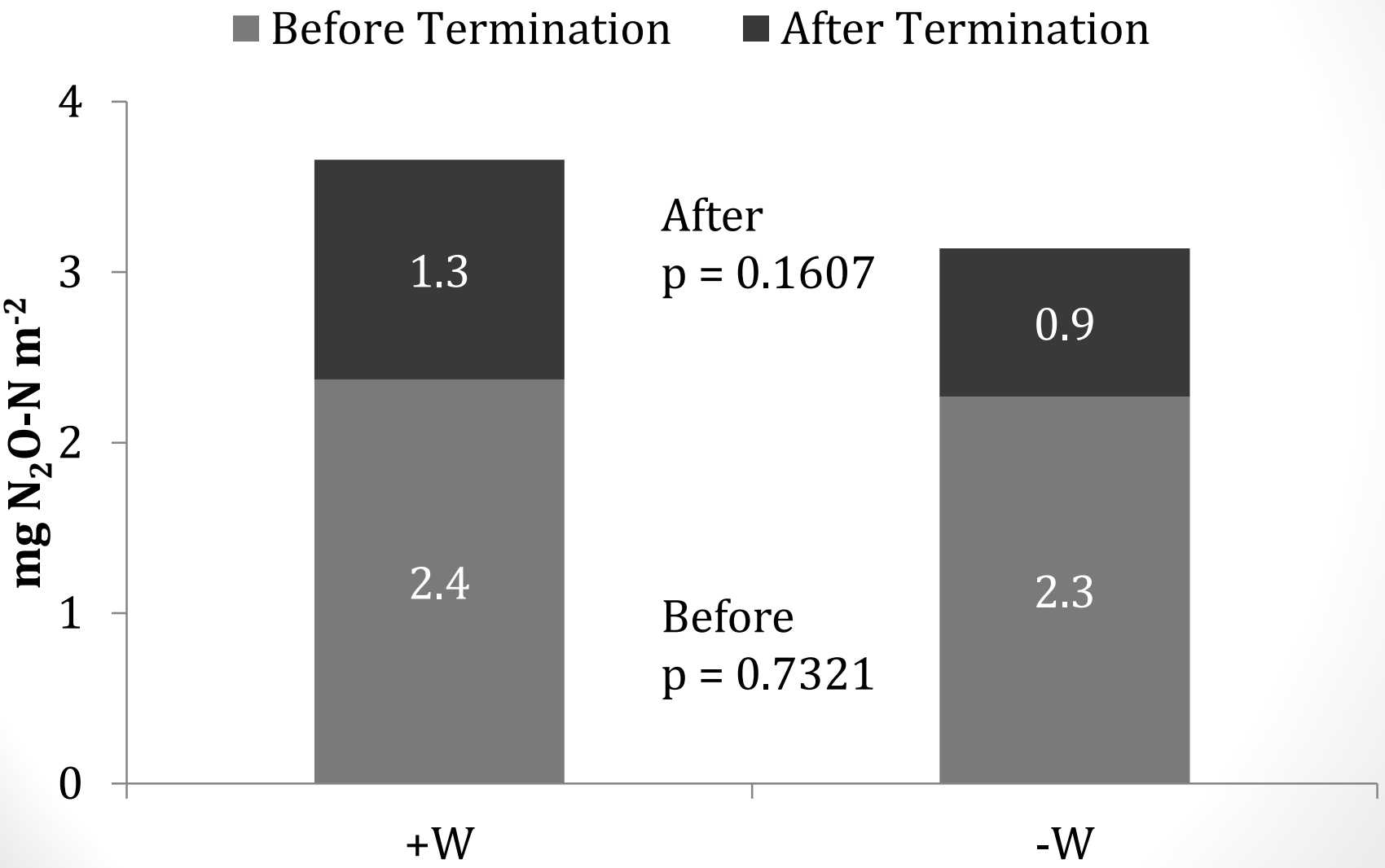
Total N_2O Emissions by Weed



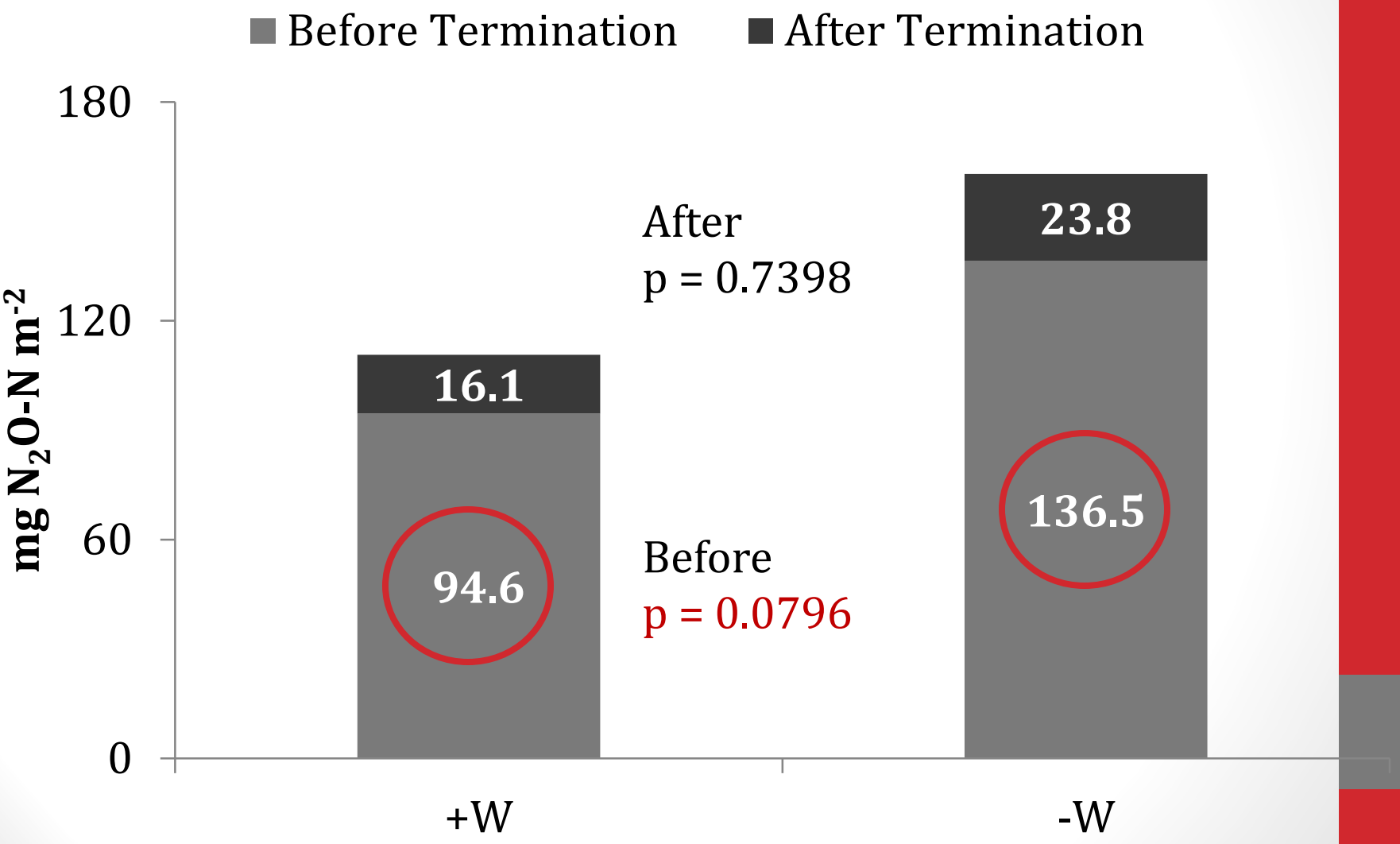
GH 1: N_2O Emissions by Weed Before/After POST



GH 2: N_2O Emissions by Weed Before/After POST



Field: N_2O Emissions by Weed Before/After POST



Conclusions

- No weed*N interaction in 2 GH and 1 field trial
- N fertilizer consistently increased N_2O emissions in all studies
- Effect of weed presence was variable:
  1. Weeds increased total N_2O emissions (p=0.0021) and emissions after termination (p=0.0001) in GH 1
  2. Weeds had no significant influence in GH 2
  3. Weeds reduced emissions in field before termination (p=0.0796), but no overall effect

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Questions?

Thanks to the graduate and undergraduate students and research support staff who helped with this project.

Funding Acknowledgements

This research is supported by the United Soybean Board, Award No. 1161, and is part of a regional collaborative project supported by the USDA-NIFA, Award No. 2011-68002-30190 "Cropping Systems Coordinated Agricultural Project (CAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems"

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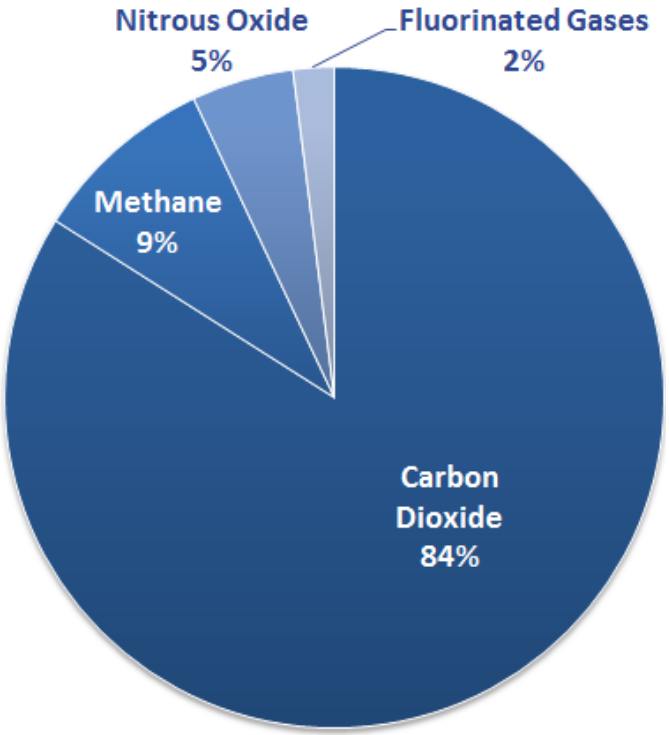
USDA
United States Department of Agriculture
National Institute of Food and Agriculture

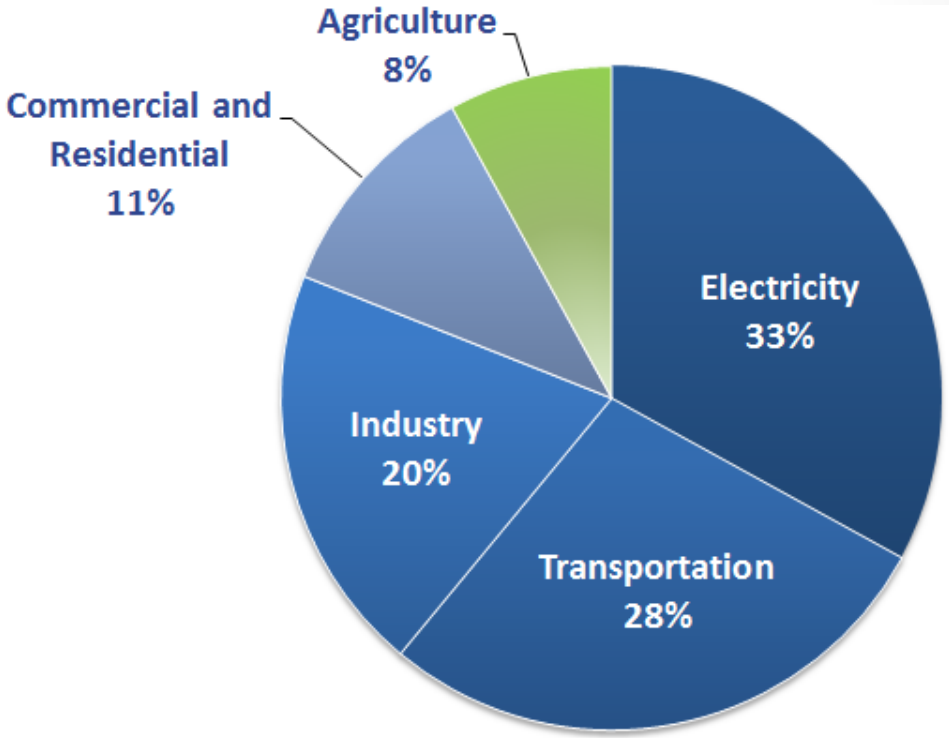
U.S. Emissions

Total Emissions in 2011 = 6,702 Million Metric Tons of CO_2 equivalent



Total U.S. Emissions

http://www.epa.gov/climatechange/ghgemissions/gases.html



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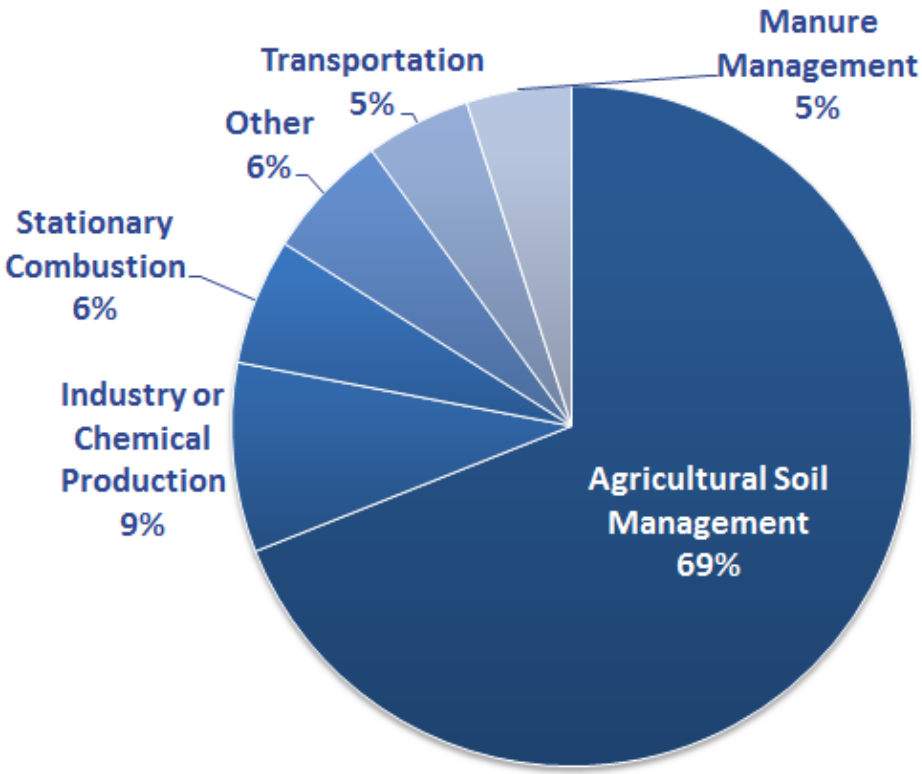
N_2O Emissions



N_2O Emissions

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