

No-Till Corn And Nitrification Inhibitors: A Best-Management Recipe

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Colleagues and Cooperating Farmers

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January 9, 2012

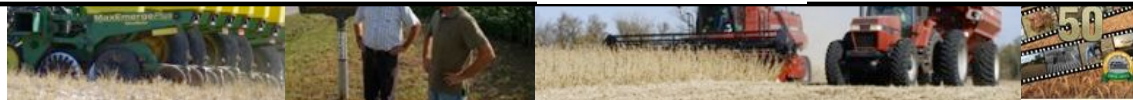


N₂O Background Information

- Nitrous oxide (N₂O) is a GHG with global warming potential (GWP) ~300 times greater than CO₂ that persists for > 110 years.
- Agriculture (mainly from N application) contributes ~75% of U.S. total N₂O emissions; excessive N application greatly increases N₂O emissions.



www.noaa.gov



Factors affecting N₂O emissions

- Soil Moisture
- Soil Temperature
- Nitrogen Rate and Timing (NO₃ and NH₄)
- Tillage
- Soil pH and Ca concentration
- Rate of plant N uptake or decomposition



Long-term Rotation and Tillage Plots

Silty clay loam, West Lafayette, IN 1975-2012



**Moldboard
plowed**

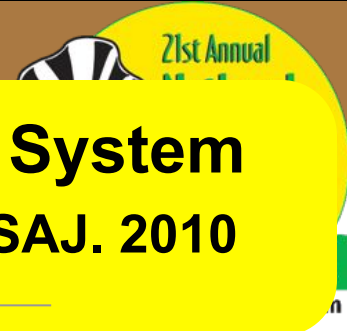
**Chisel
plowed**



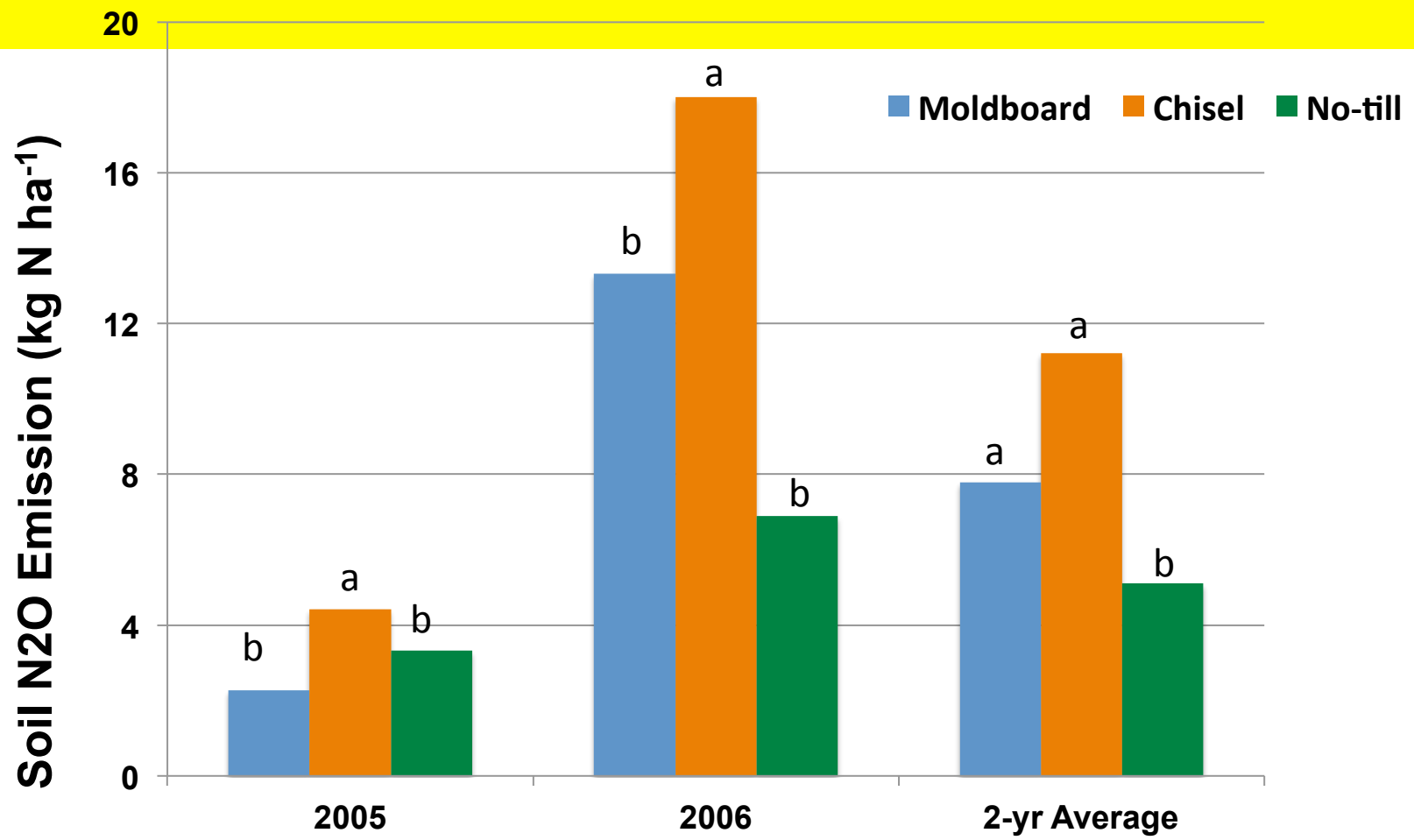


Plant Stand in No-Till Continuous Corn

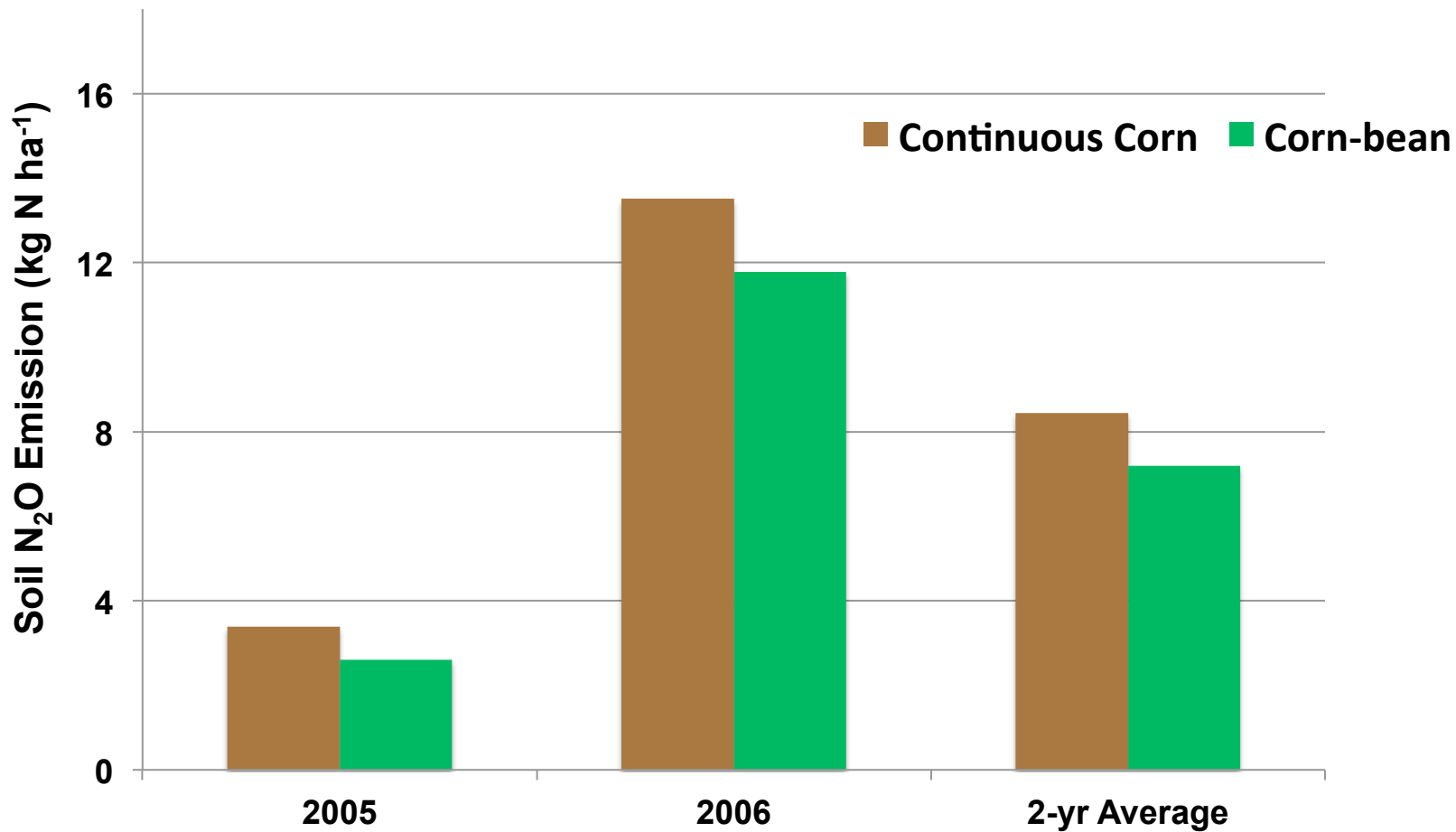




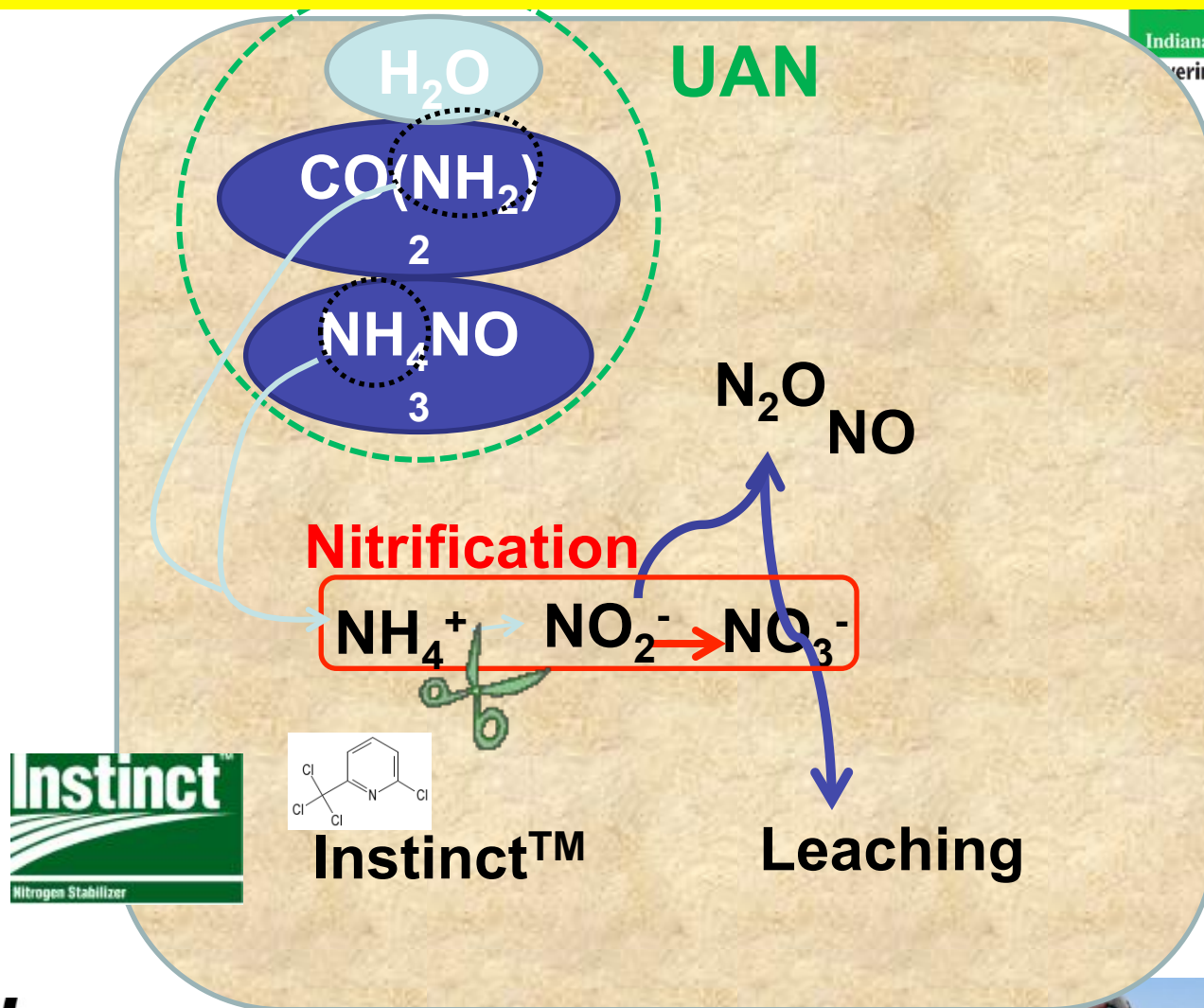
Soil Nitrous Oxide Emissions Due to Tillage System (West Lafayette, IN) Source: Omonode et al., SSSAJ. 2010



Soil Nitrous Oxide Emissions Due to Rotation (West Lafayette, IN); Source: Omonode et al., SSSAJ. 2010



Nitrogen losses from UAN with nitrification inhibitor



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Rate/Timing Study on N₂O in 2010 + 2011 Sidedress UAN +/- Instinct Application Compared to Pre-Emerge UAN +/- Instinct



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In-season Monitoring and GC Analysis of Greenhouse Gases (2010-12)

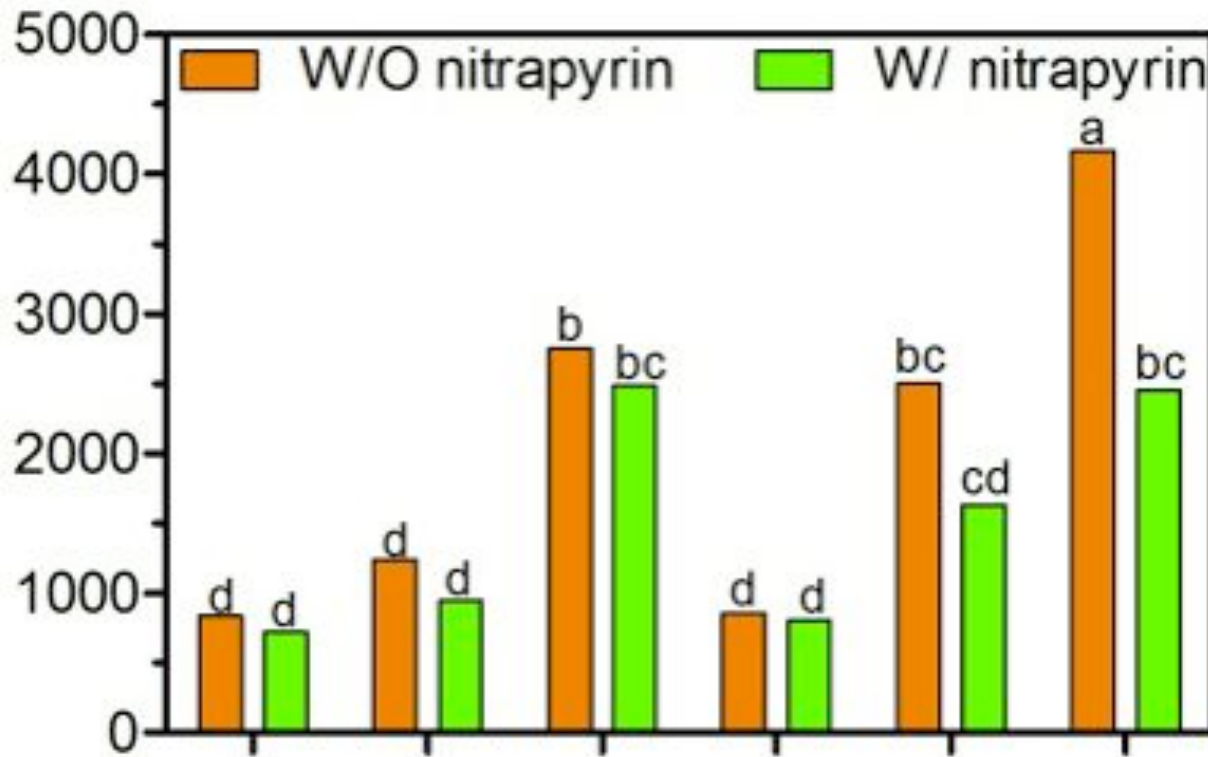


~ Gas vials from vented chambers at 0,10,20 and 30 minutes
~ CO₂, CH₄ & N₂O

Omonode, Burzaco, et al.
in cooperation with Doug
Smith, USDA-ARS



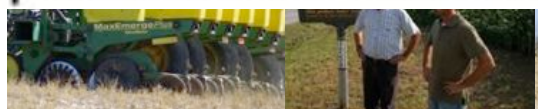
Q10 Adjusted Cumulative N₂O Fluxes (2010-11)



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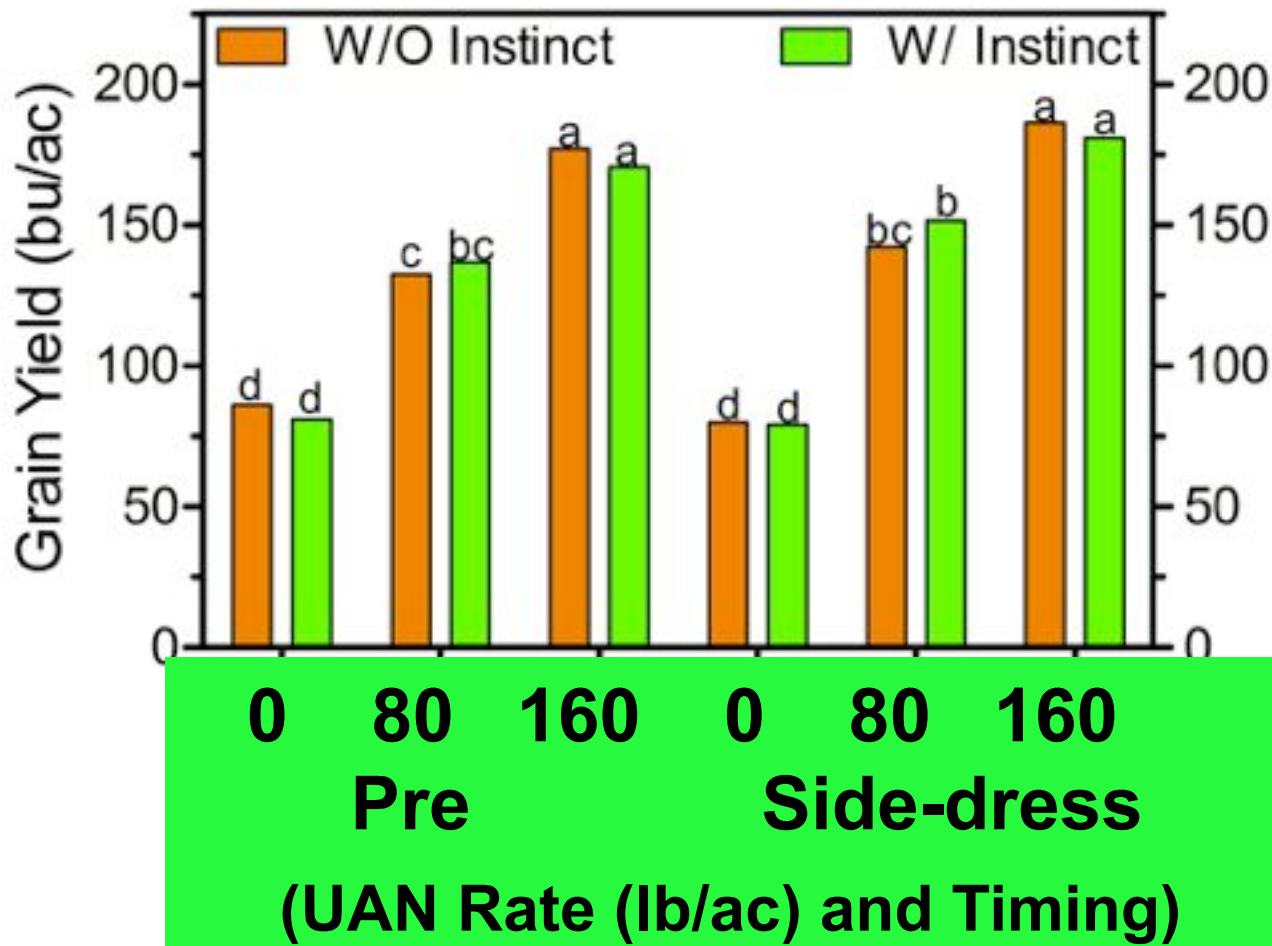
N-rate (lb/acre)	g/ha
0	800 c
80	1570 b
160	2960 a
Timing	
Pre-emergence	1490 b
Side-dress	2060 a
Nitrapyrin	
Without	2050 a
With	1500 b

N-Fertilizer added (lb/acre)
Timing (Pre-plant or Side-dress)





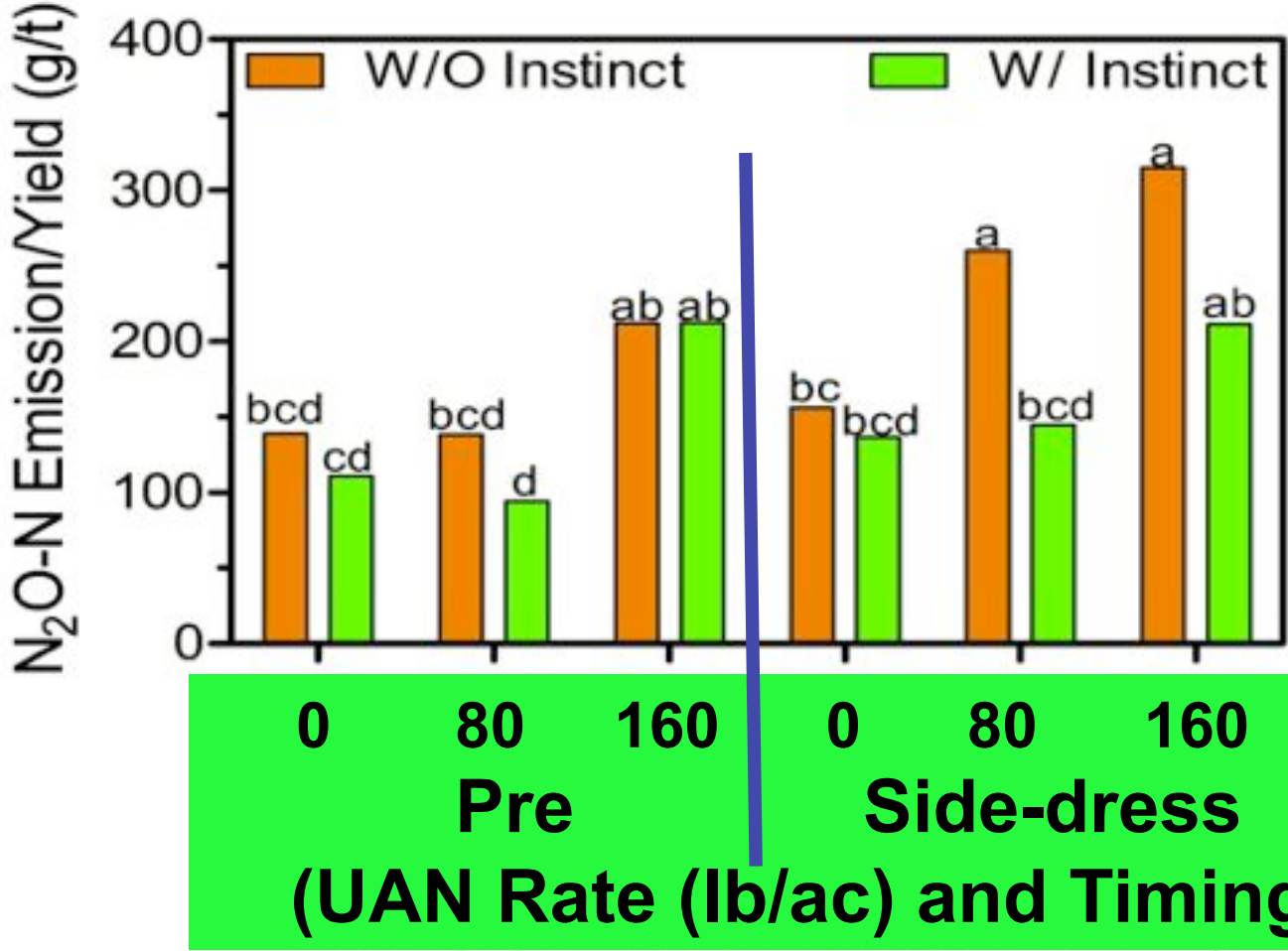
Instinct™ Effects on Corn Yields at 3 UAN Rates (West Lafayette, IN; mean of 2010-2011)





Nitrification Inhibitor Effect on Yield-Scaled N₂O Emissions

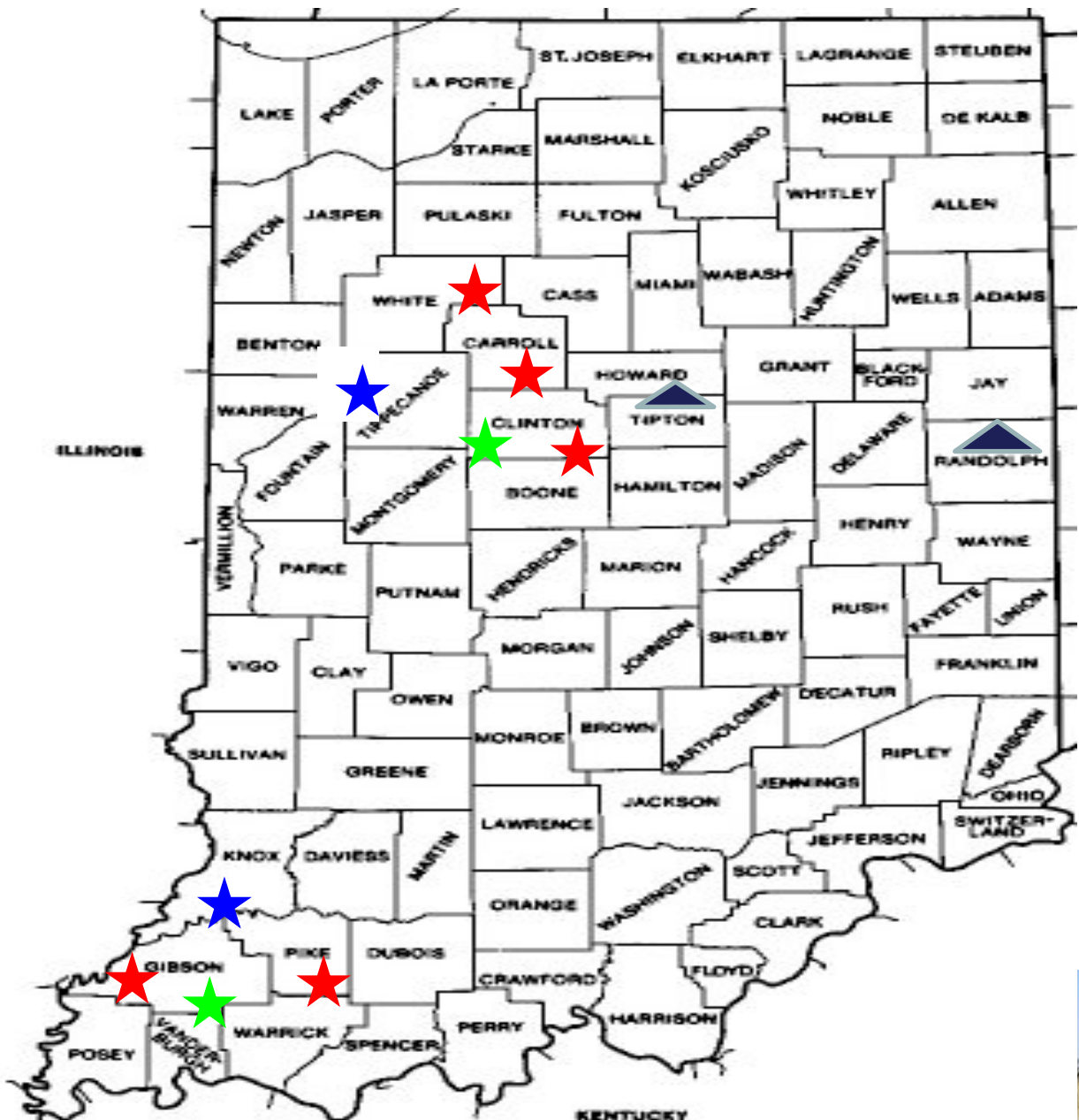
(mean of 2010 + 2011)



Burzaco and Vyn, 2012



On-Farm Experiments (2010-2012)



UAN Experiments:

- ★ Nitrification Inhibitor and Tillage
- ★ Nitrogen Rates
- ★ Nitrification Rate in Soil with UAN + Instinct

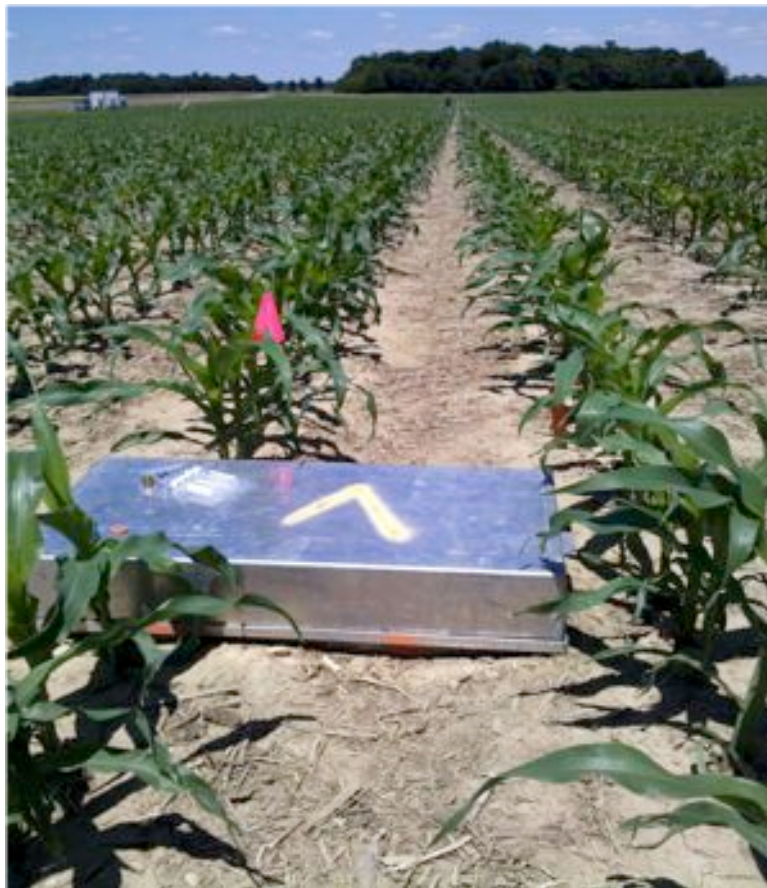
Manure Experiments

- ▲ Manure Timing and Instinct

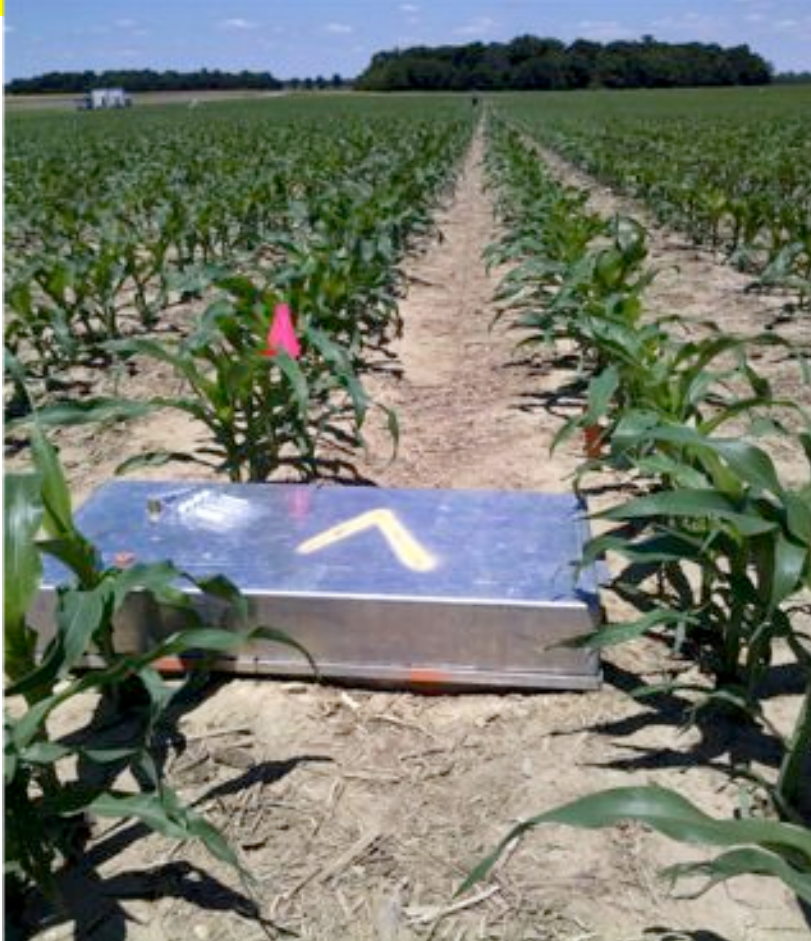


Sidedress UAN and Instinct™ Application (2010-2012)

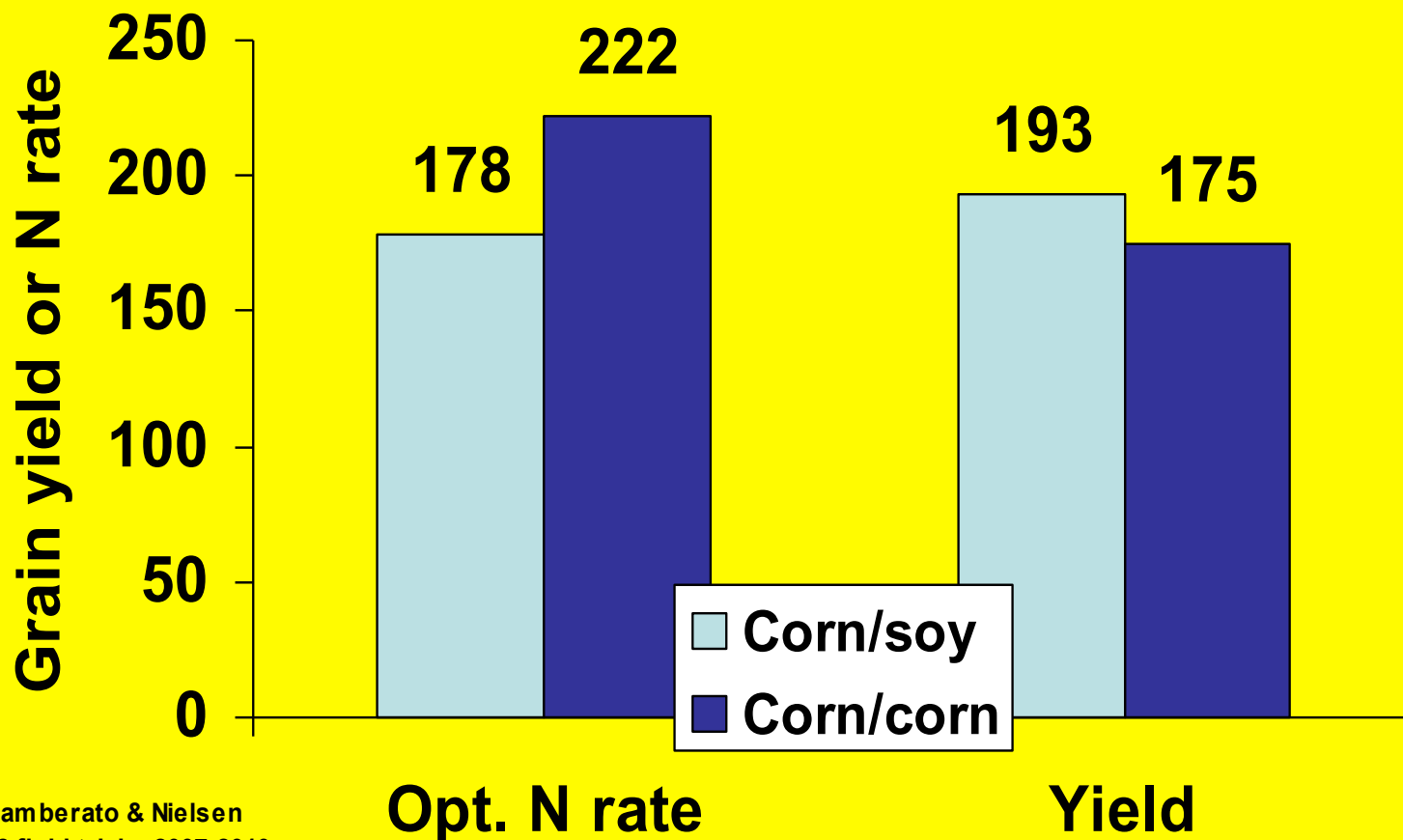
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Sidedress UAN and Instinct™ Application (2010-2012)



Crop Rotation Effects on Optimum N Rate and Grain Yield



Camberato & Nielsen
18 field trials, 2007-2010

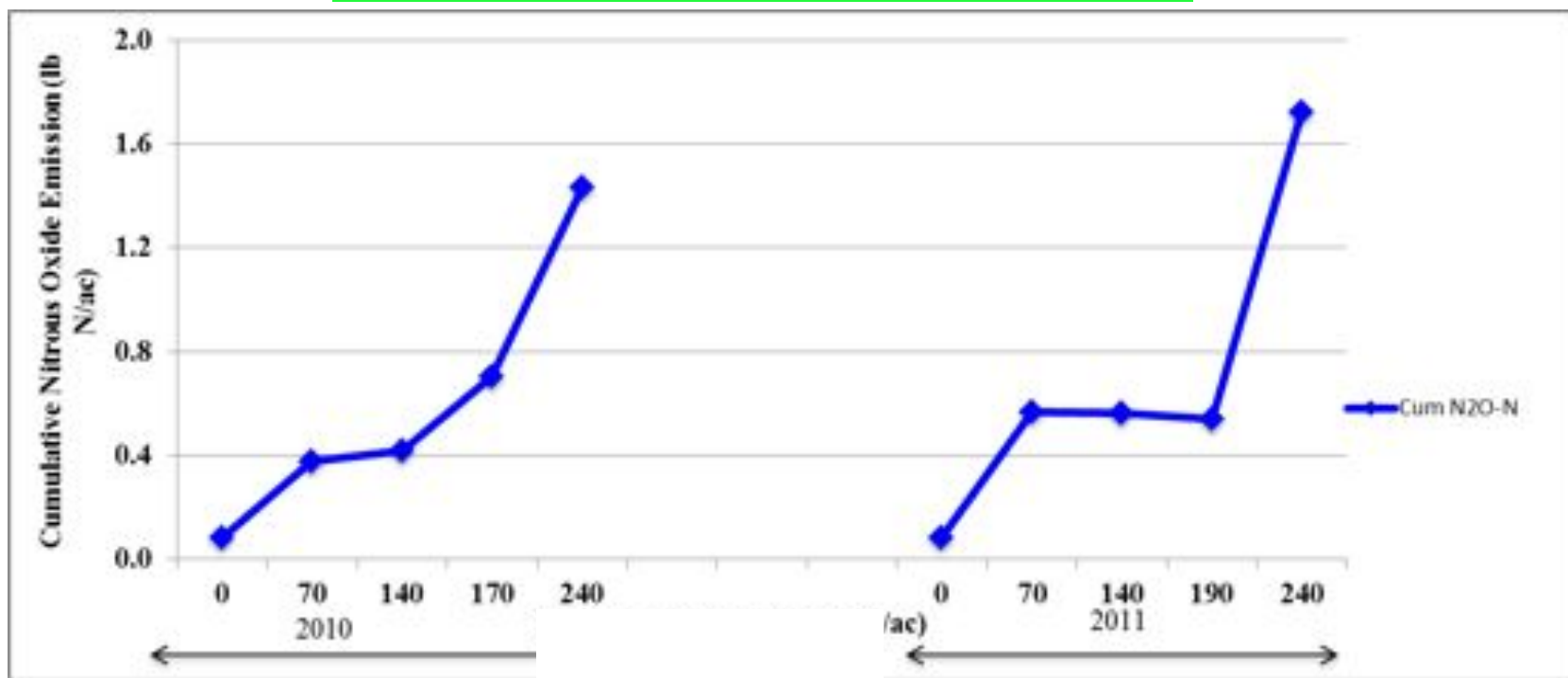
[Corn Nitrogen Rate Calculator](http://extension.agron.iastate.edu/soilfertility/nrate.aspx)

<http://extension.agron.iastate.edu/soilfertility/nrate.aspx>



Nitrogen (UAN) Rates and Nitrous Oxide Emissions in SW and EC Indiana

Cumulative Soil Nitrous Oxide Emissions (Knox Co., SW Indiana; 2010 and 2011)



UAN Rate (lb N/acre)

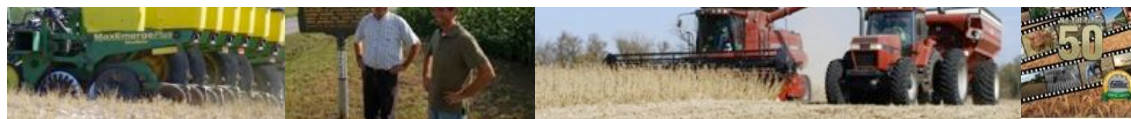
In collaboration with Bob Nielsen and Jim Camberato



Cooperators in EC and SW Indiana (2010 & 2011)

Cooperator	Location	Nitrogen Management				Prior Crop
		Type	Treatment combination	Rate (lb/ac)	Date Applied	
Jared Oyler	Camden, Carroll Co.	28%	NT+N ± NI	180	6/8/11	Corn
Dan Lahrman	Mulberry, Clinton Co.	28%	* (i) NT+N ± NI (ii) NT, RT ¹ +N± NI	180	6/3/11 6/2/11	Soybean
*Daniel Lamey	Haubstadt, Gibson Co.	28%	RT ² +N ± NI	180	6/1/11	Corn
*Greg Obert	Mackey, Gibson Co.	28%	(i) NT+N ± NI (ii) NT, RT ¹ +N± NI	180	6/8/11	Corn
Keith Breidenbaugh	Otwell, Pike Co.	32%	NT+N ± NI	180	7/5/11	Soybean
Tom Westfall	Reynolds, White Co.	28%	(i) NT+N ± NI (ii) NT, FT± NI	160	6/25/11	Soybean

* = Locations added in 2011; NI = Nitrification inhibitor (Instinct); NT = No-till; FT = Full tillage (Chisel plowing and tandem disking); RT¹ = Reduced tillage (field cultivator); RT² = Reduced tillage (turbo, 1 pass).

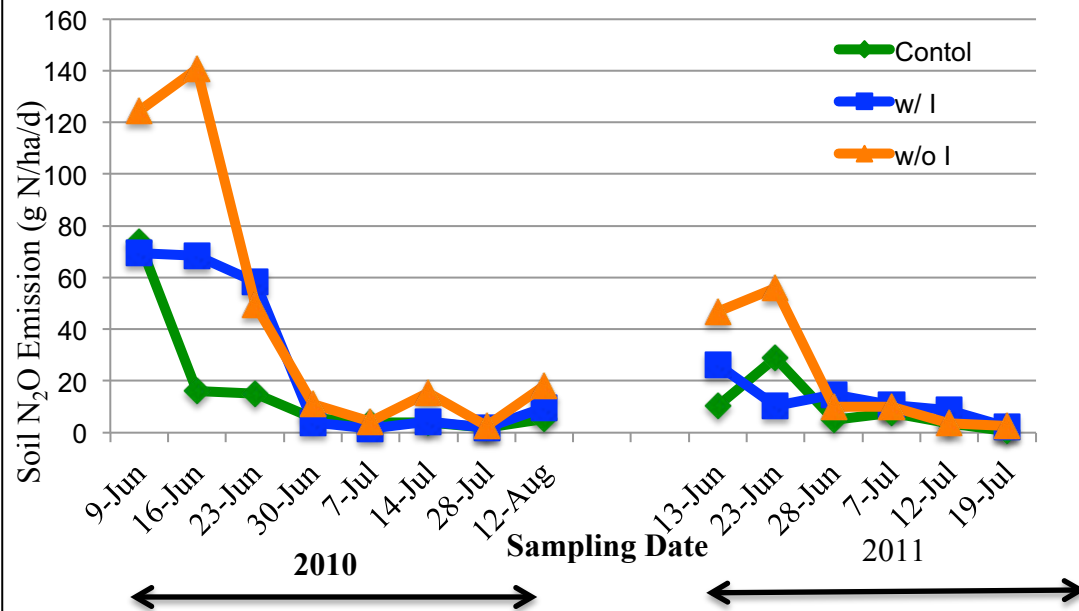


21st Annual National No-Tillage Conference

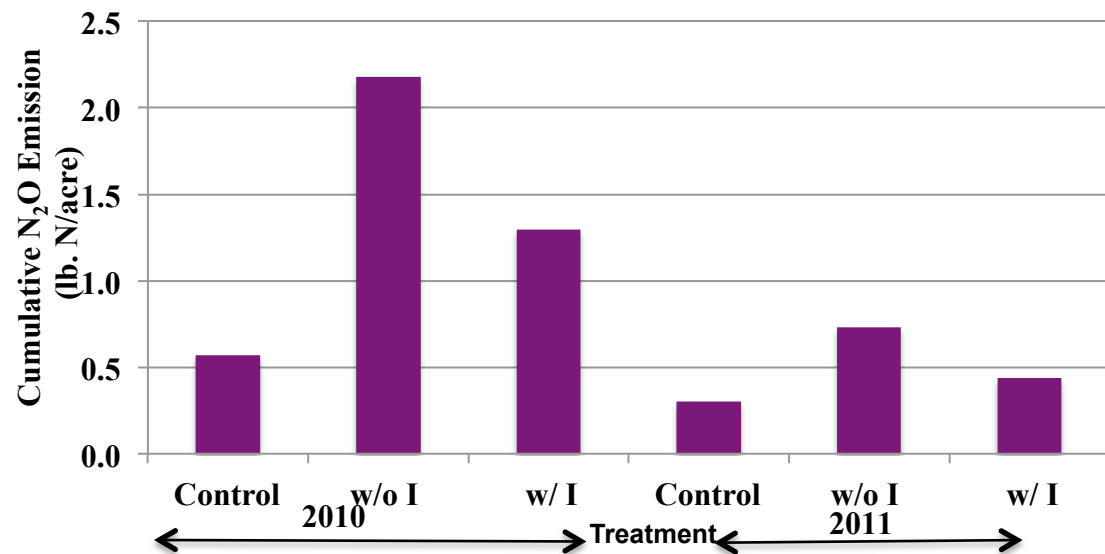
Indianapolis, Indiana * Jan. 9-12, 2013



21st Annual
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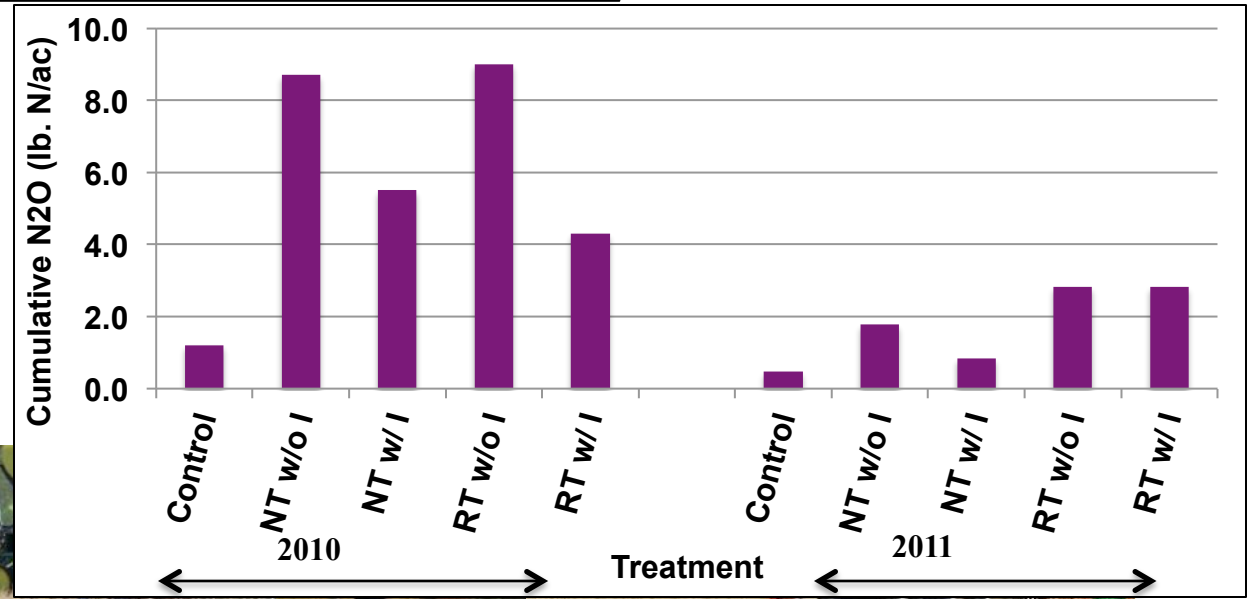
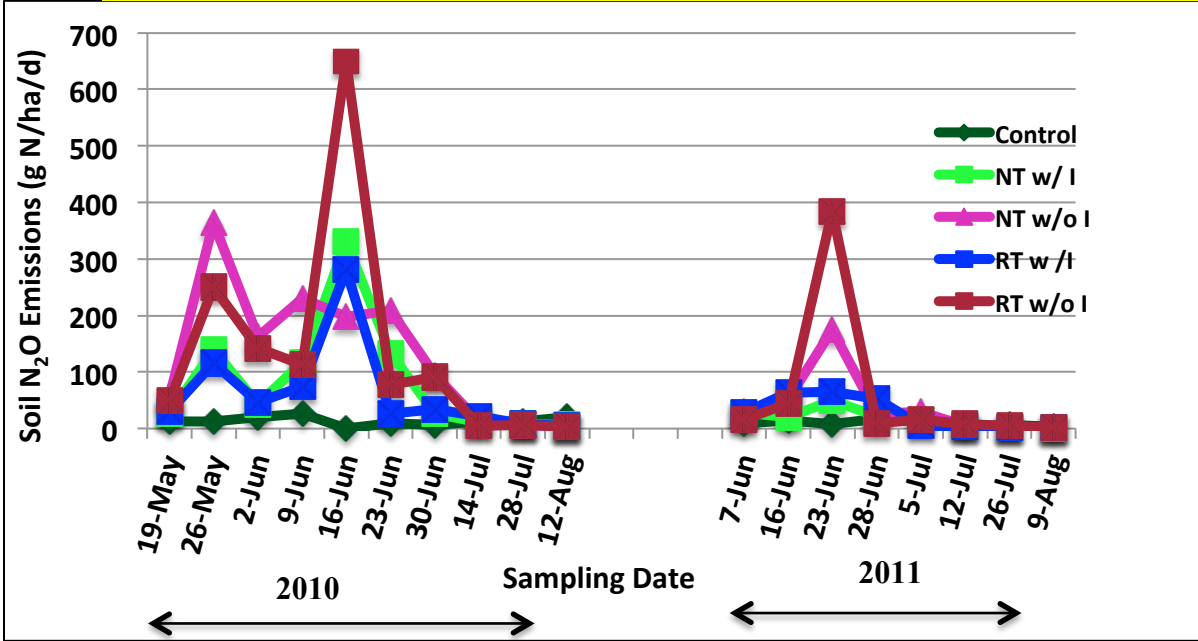
N₂O-N Emissions in On-Farm Trials with and without Instinct (e.g. 2010-011, Camden, Carroll Co.)



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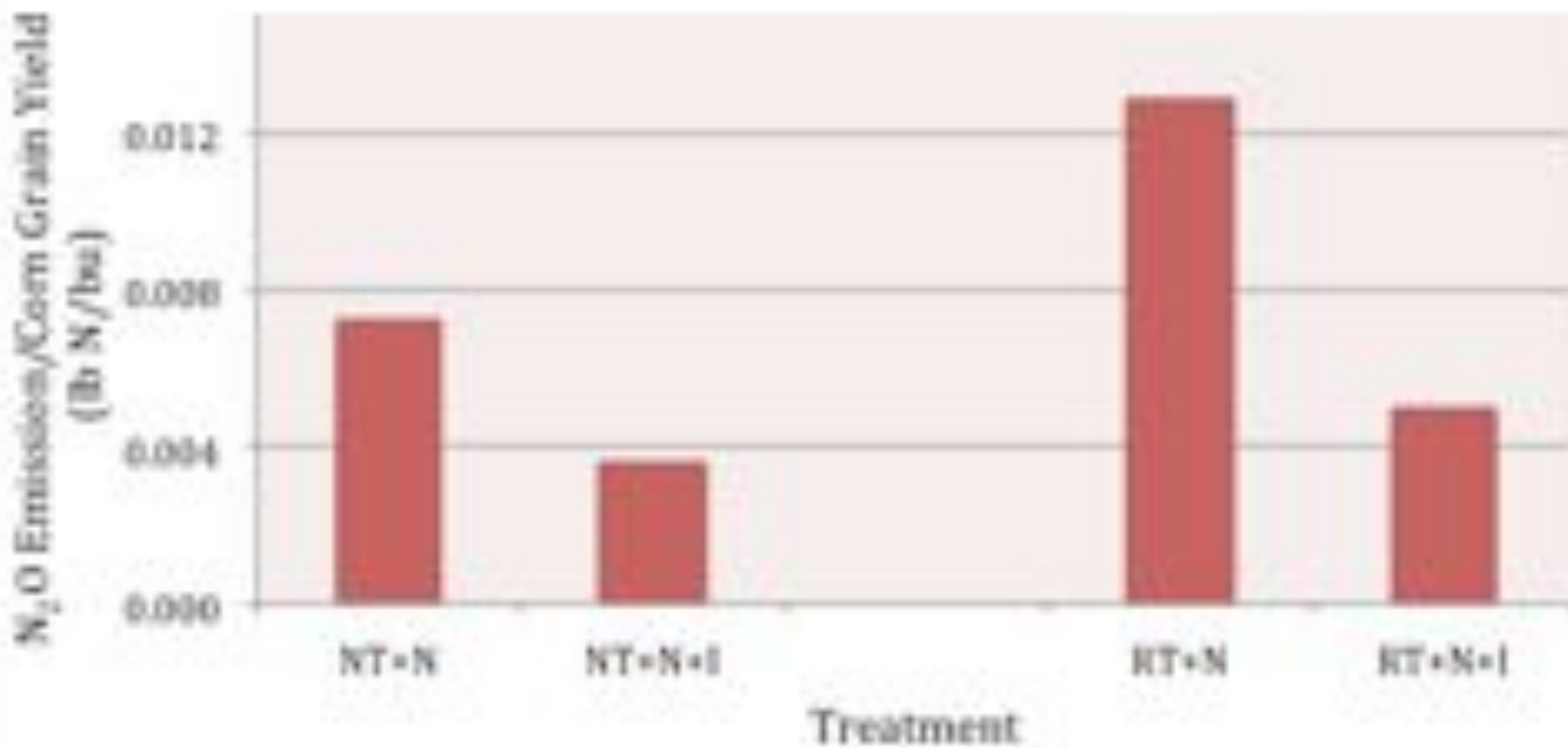


N₂O-N Emissions in On-Farm Trials with Tillage and Nitrification Inhibitor Variables (e.g. Clinton, 2010-2011)



Corn Production and N₂O Emissions in Perspective (2011)

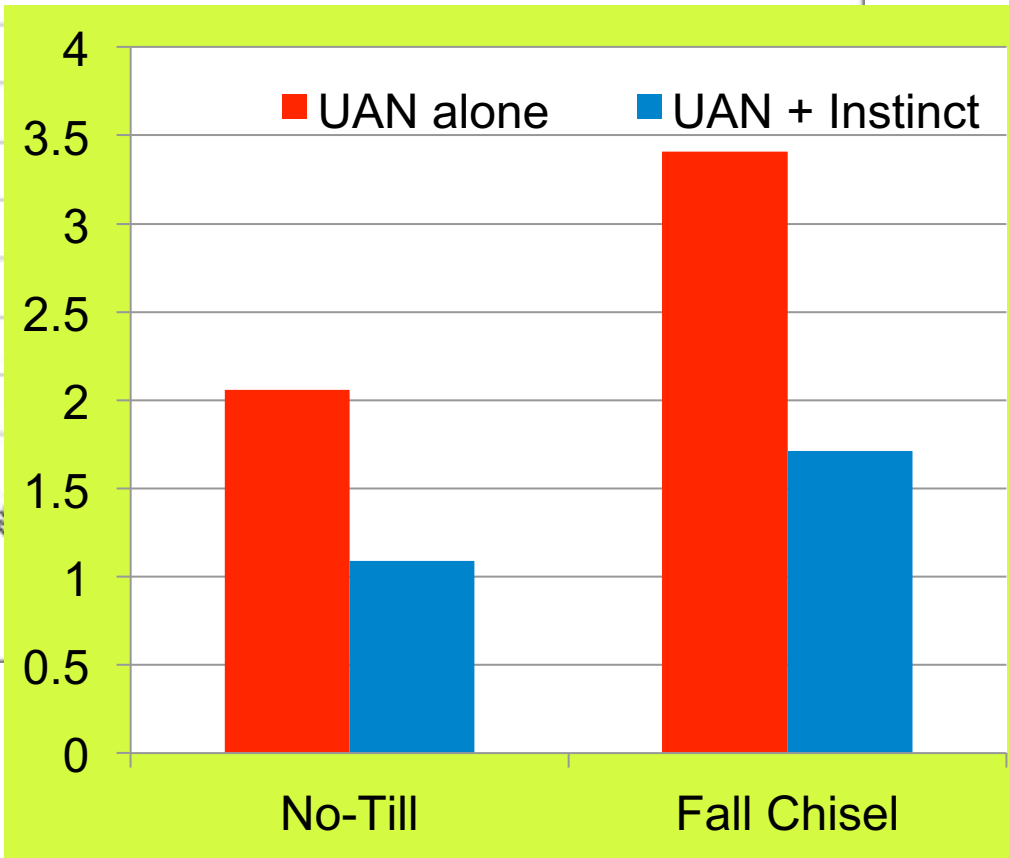
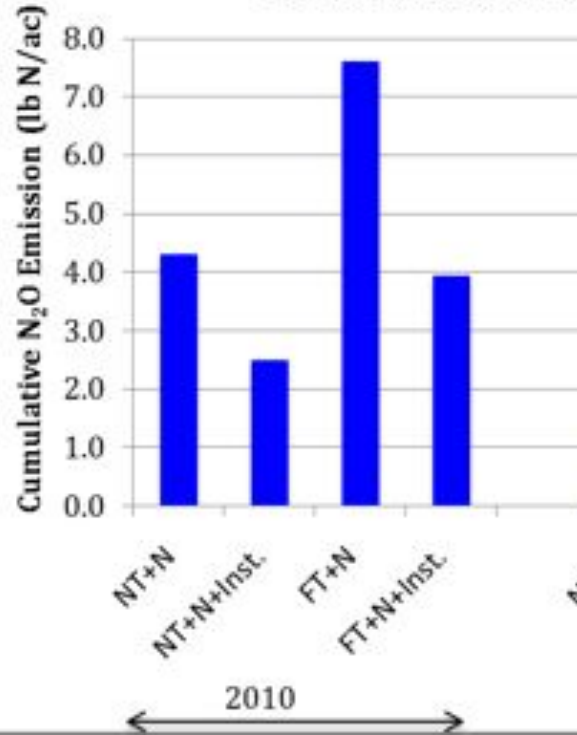
Nitrous Oxide Emission Per Bushel of Corn Produced (Clinton County)



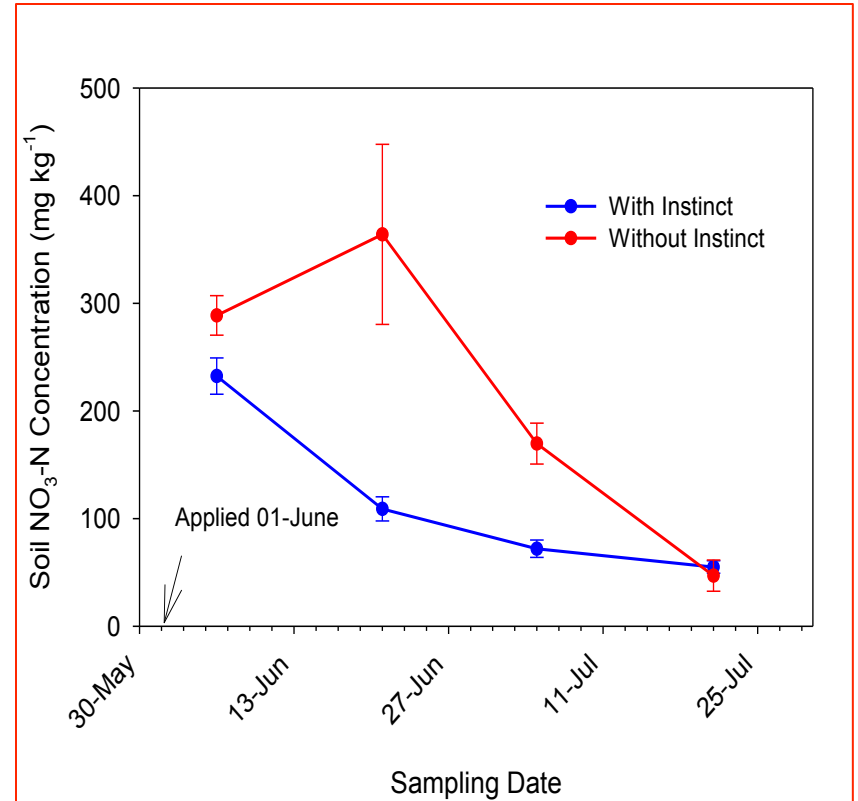
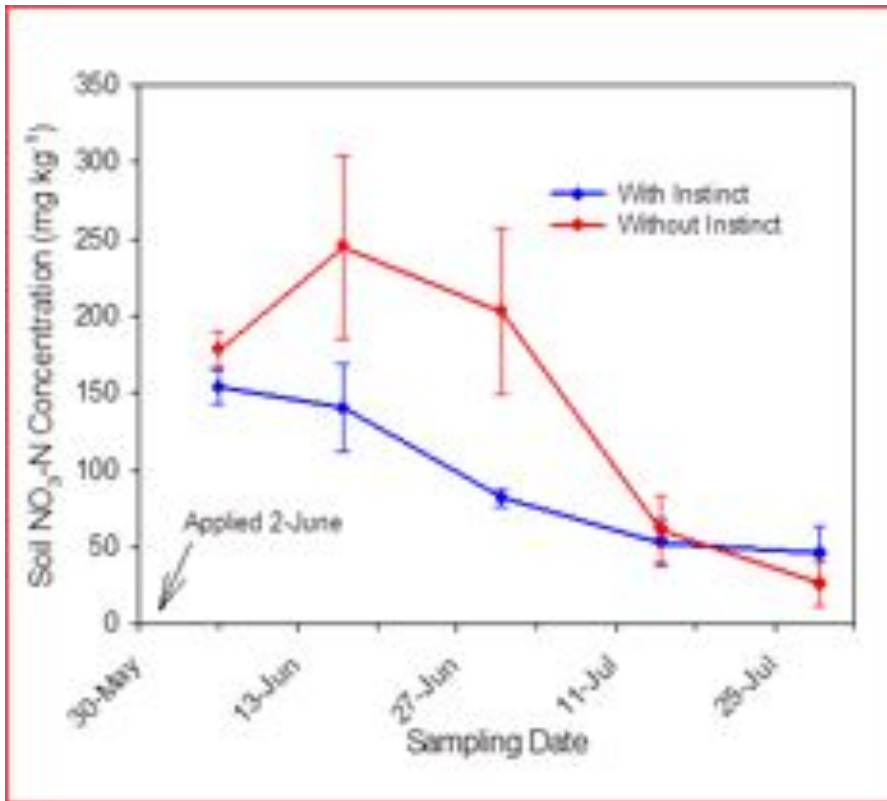
N₂O-N Emissions in On-Farm Trials with Tillage and Nitrification Inhibitor Variables (e.g. White County 2010-2012)

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Seasonal Nitrous Oxide Emissions Due to Instinct and UAN Application Under Full and No-Till Systems in White Co. (2010-2012)

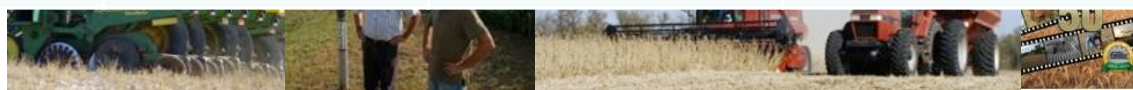


Instinct Effects on NO₃-N Concentrations in Injection Zone (8") with Time after UAN Application (2011) Clinton and Gibson Counties, Indiana



Summary: Emission Reduction (Across Tillage Systems) Due to Instinct in 2010 & 2011

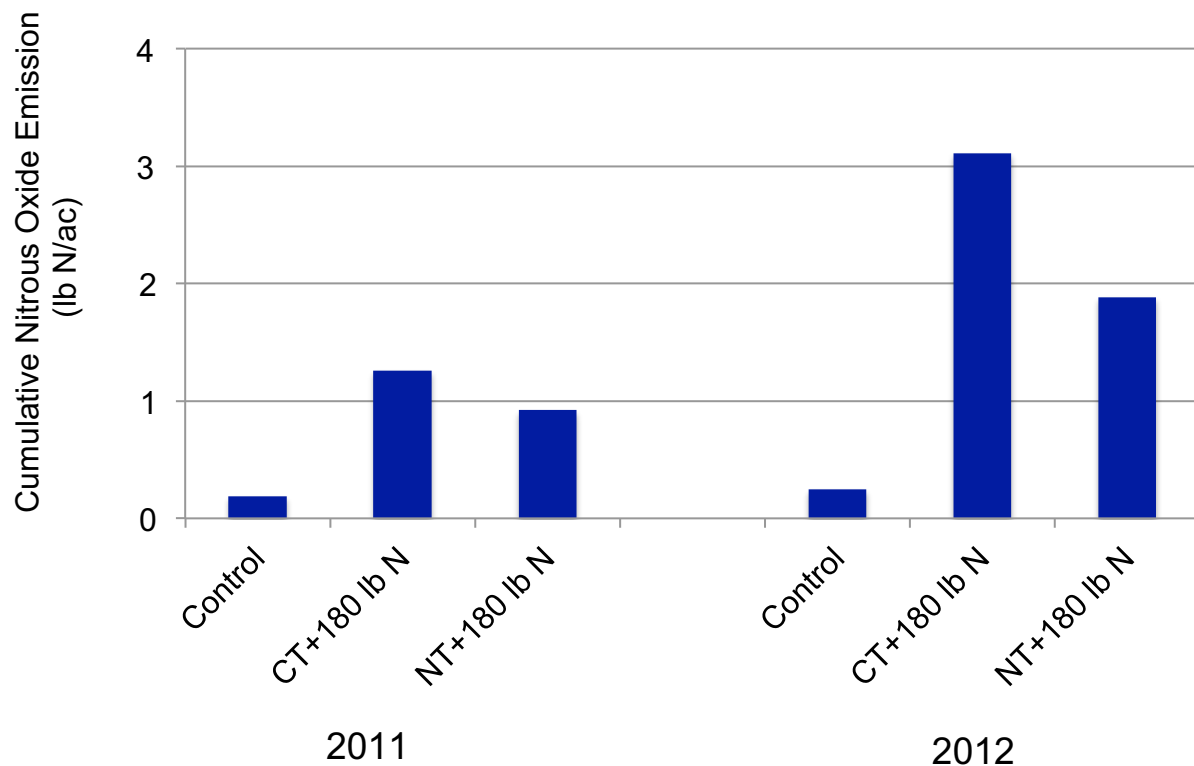
Location	Tillage System	Emission Reduction (%)	
		2010	2011
Carroll Co.	NT	40.7	39.9
Haubstadt, Gibson Co.	RT	NA	34.1
Mackey, Gibson Co.	NT	NA	8.6
¹ Mulberry, Clinton Co.	NT	NA	67.4
² Mulberry, Clinton Co.	NT, RT	55.4	41.8
Reynolds, White Co.	NT, FT	57.3	46.6



Farmers' Reported Corn Grain Yield +/- Instinct in 2011

Location	Treatment	Yield (bu/ac)	Difference (%)
Camden Co.	NT+N w/ I	164	2.8
	NT+N w/o I	160	
Haubstadt, Gibson	NT+N w/ I	227	0
	NT+N w/o I	227	
Mackey, Gibson Co.	NT+N w/ I	191	3.7
	NT+N w/o I	184	
	FT+N w/ I	218	6.4
	FT+N w/o I	204	
Mulberry, Clinton Co.	NT+N w/o I	233	1.3
	NT+N w/ I	230	
	NT+N w/o I	177	2.4
	FT+N w/ I	173	

Tillage Influence on Cumulative N₂O Emissions following Pre-plant NH₃



Sponsored by NCGA



Manure Placement Options



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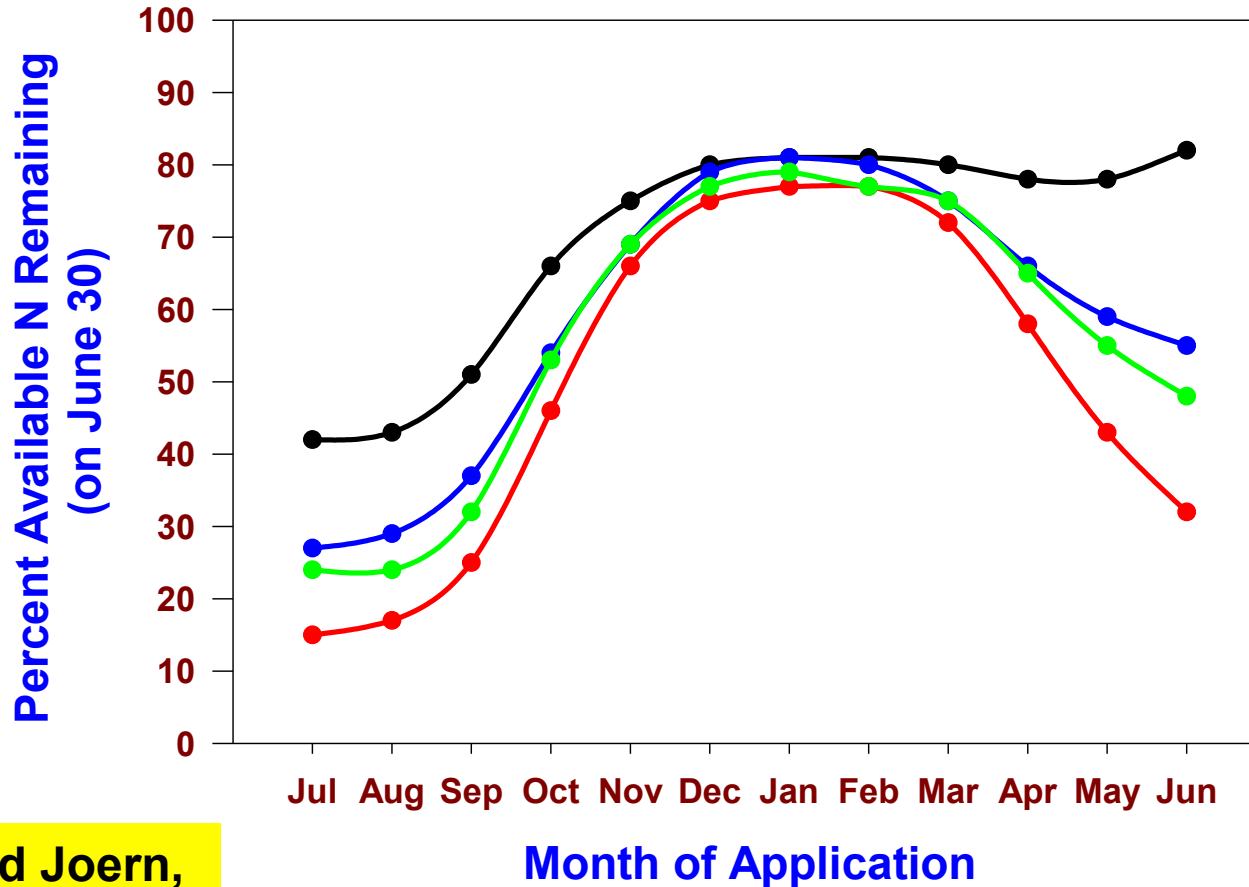


Hog Manure Application in 2012 near Farmland, IN



Time and method of application affect manure N availability

• Jan. 9-12, 2013
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Source: Brad Joern,
Purdue Agronomy



Tentative Conclusions:

1. Field studies with UAN: Higher N rates => increases N_2O
2. Field studies with UAN: Addition of Nitrapyrin (Instinct) => lowers N_2O , and improves corn plant N uptake (data not shown).
3. **No-till reduces N_2O emissions, and No-till plus Nitrification Inhibitor is even better!**

Future research:

1. Nitrapyrin + UAN: can we reduce N rate and maintain grain yield?
Investigate by examining smaller N rate increments on more site/years.
2. Tillage and N timing/placement impacts on both N_2O and NH_3 emissions simultaneously, and continuous 24 hour measurements of air quality in NH_3 application systems.
3. Investigations involving liquid manure sources, timing, and nitrification inhibitor on different soils, crop rotations and tillage systems.





Acknowledgments

Funding:

Dow AgroSciences (2010-2012)

Indiana Corn Marketing Council
National Corn Growers Association
Indiana Soybean Alliance
USDA-NIFA



FPPC

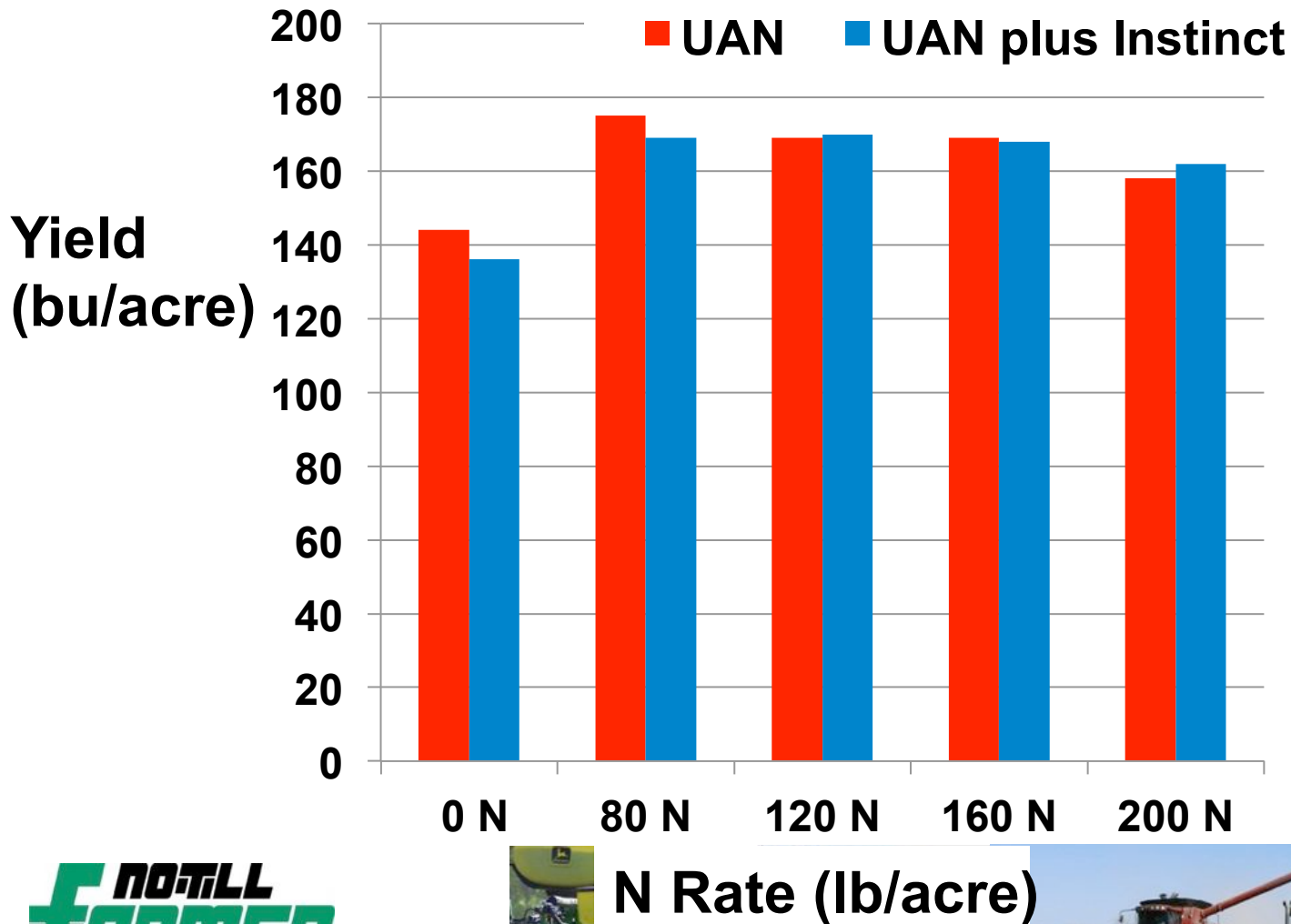
Farm Pilot Project Coordination, Inc.
Technologies for Nutrient Management

Field and Lab Assistance:
Indiana Farmers



Strip-till Corn Yield Response to Side-dress UAN with and without Instinct in 2012 (West Lafayette, IN)

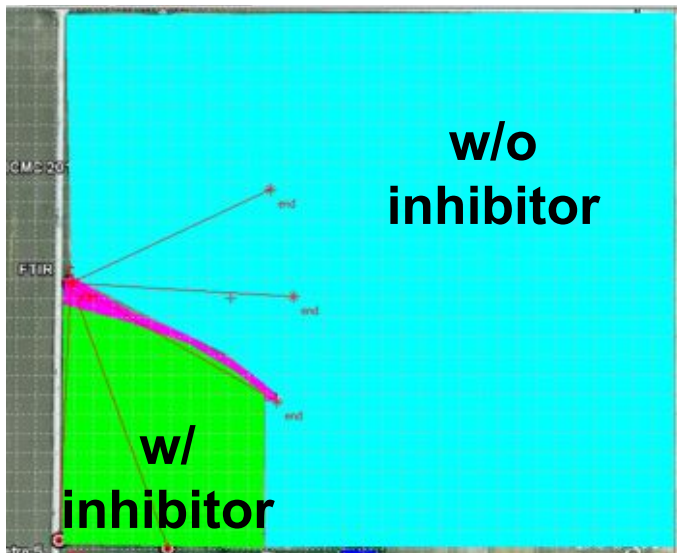
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Emissions from UAN application with and w/o nitrification inhibitor- 2011

Powering Up Your No-Till System

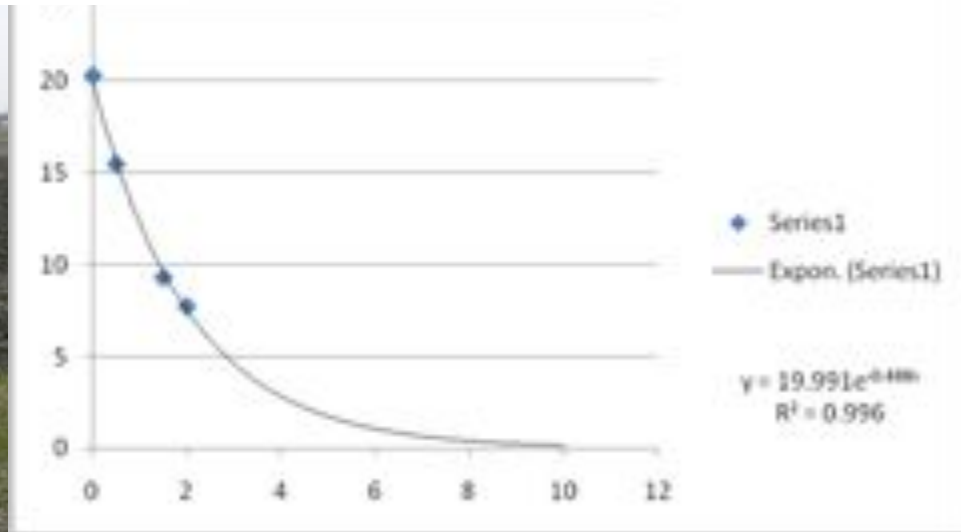
- Scanning FTIR along 5 paths
- Emissions every 1/2 hr
- 24 hr/day measurements for 20 days to determine diurnal variability and episodic emissions



Near-Infrared Analyzer for Trace Gas Emissions



NH_3
(lb/acre/day)



Hours from Application Start

**Diurnal
fluctuations in
wind speed, air
temperature,
NH₃ and N₂O
emissions after
UAN application
(R. Grant and C.
Johnston)**



**USDA-NIFA
2013-2015**

