

# Evaluation of Adapt-N in the Corn Belt

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# Background

- Optimizing fertilizer N rate is one approach to reducing fertilizer N loss from corn production
- Most Upper Midwest states use the MRTN approach to provide price adjusted N rate guidelines that are based on corn N response trials
  - Guidelines are general and do not provide responsiveness to variations in seasonal weather

# Background continued

- Adapt-N is a mechanistic model to provide field and season specific N recommendations
  - Information used:
    - Soil and management parameters
    - Anticipated yield
    - Actual and historical weather
  - Purported to be more accurate than general recommendations like MRTN
  - <http://www.adapt-n.com>

# Objective

- Compare the accuracy and profitability of N recommendations from MRTN and Adapt-N in Iowa, Indiana, and Wisconsin

# How did we conduct the evaluation?

# Site information

- 79 replicated field strip and small plot corn N response trials
  - Iowa, n = 24
  - Indiana, n = 15
  - Wisconsin, n = 40
- All trials conducted in 2013, except 2 Indiana trials conducted in 2014
- Previous crop was soybean, corn grain, or corn silage
- IN & WI: N applied sidedress with exception of small amount of starter N at some sites
- IA: N applied either just prior to planting or sidedress

# Additional details on WI sites

- 27 WI sites part of larger manure application timing trial at 3 locations
  - Manure source (none, raw, digested/separated)
  - Manure timing (early fall, late fall, spring)
  - 6 sidedress N rates were imposed on all manure/timing treatments

# N response models

- Regression models were used to fit the corn grain yield response to total N applied
  - Quadratic plateau, Quadratic, Linear plateau, Linear, T-group
- Economic optimum N rate (EONR) was calculated at a N:corn price ratio of 0.10

# MRTN rate recommendation

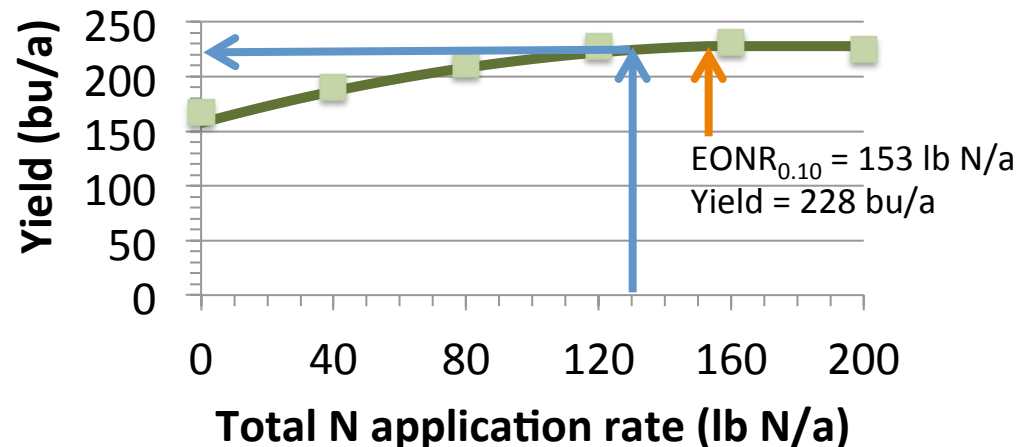
- MRTN recommended N rate determined at corn:N price ratio of 0.10 using
  - IA: Corn N rate calculator  
<http://extension.agron.iastate.edu/soilsfertility/nrate.aspx>
  - IA & WI: tabular versions published in extension recommendations
- Manure N credits subtracted from MRTN rate based on manure analysis of samples collected at application
- Corn yield at MRTN rate was determined using the N response model for each site

# Adapt-N rate determination

- Entering required site information in model
  - <http://adapt-n.cals.cornell.edu> or [www.adapt-n.com](http://www.adapt-n.com)
  - Geo-referenced location
  - Soil texture or soil series
  - Slope (<3, 3-8, >8%)
  - Soil organic matter
  - Rooting depth
  - Tillage system
  - Previous crop
  - Corn hybrid maturity
  - Planting date and population
  - Expected yield range
  - Starter fertilizer N
  - Manure application date
  - Manure NH<sub>4</sub>-N and organic-N

# Adapt-N rate determination

- Ran the model post hoc using
  - Actual sidedress N appl. date in IN & WI
  - June 1 as sidedress N appl. date in IA
- N rate obtained from Adapt-N was put into the yield response to N model to obtain yield

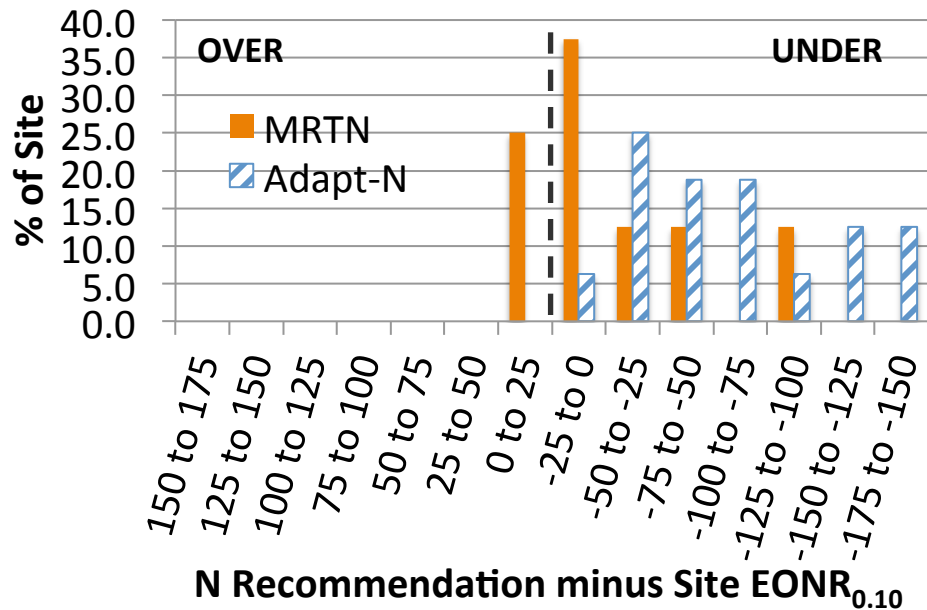


# Recommendation comparisons

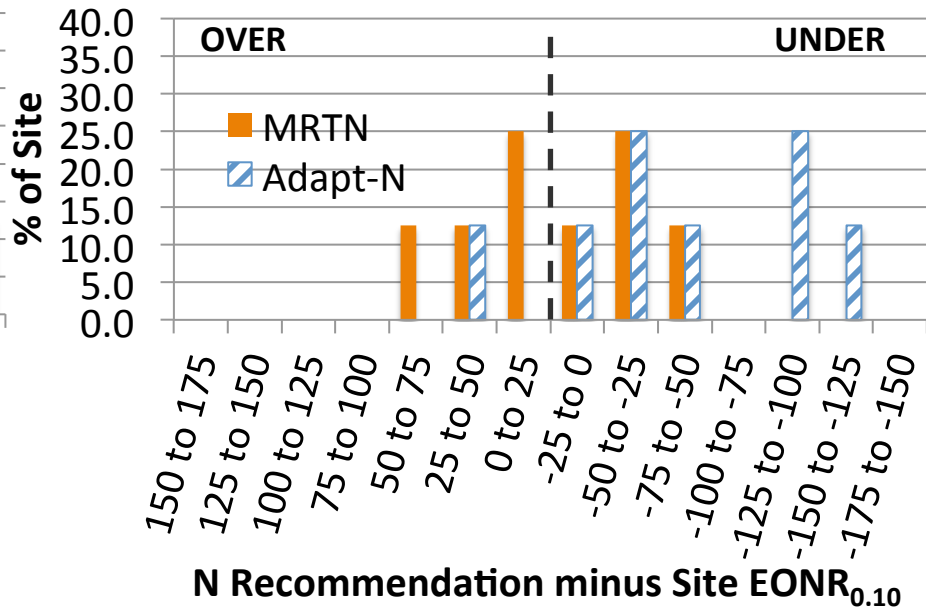
- MRTN – EONR or Adapt-N – EONR
  - Positive numbers = over application
  - Negative numbers = under application
- Profitability calculated using \$0.40/lb N and \$4.00/bu
- MRTN advantage =  
$$\text{MRTN profitability} - \text{Adapt-N profitability}$$
- Adapt-N subscription fee not included in costs

# Results

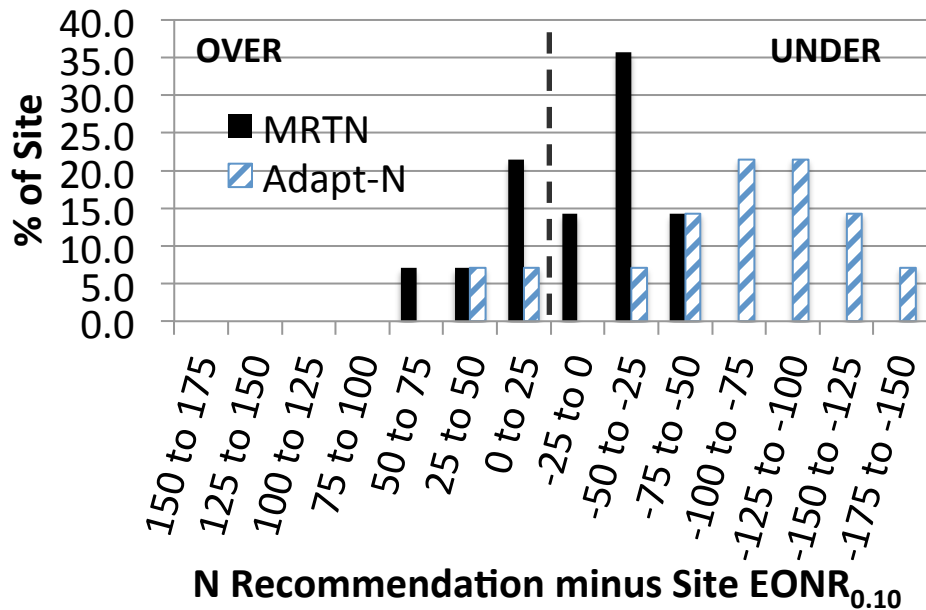
**IA: corn grain following soybean (n=16)**



**IA: corn grain following corn (n=8)**



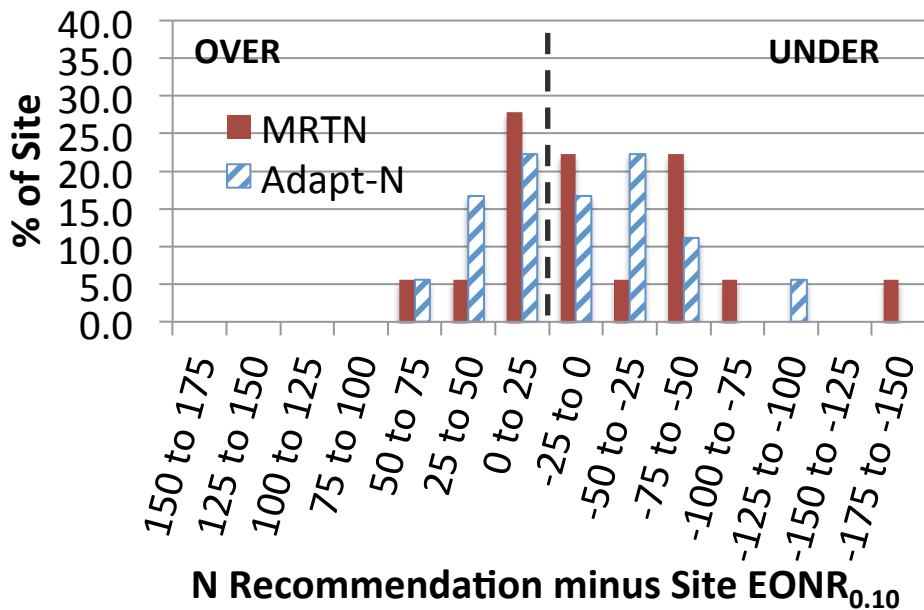
**IN: corn grain following soybean (n=14)**



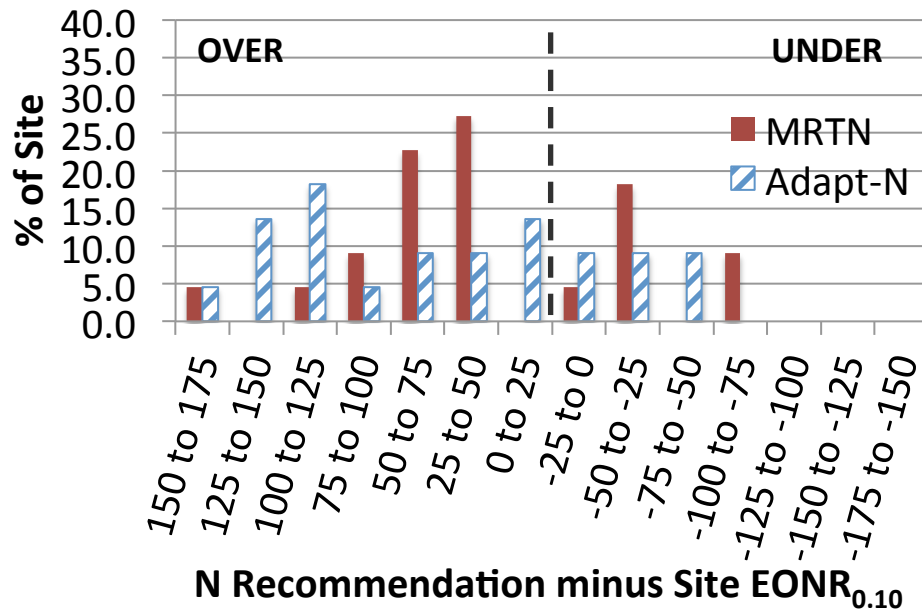
State	Frequency of sites ± 25 lb N/a of EONR		Frequency of sites under recommended	
	Adapt-N	MRTN	Adapt-N	MRTN
IA-SC	6	63	94	38
IA-CC	13	38	75	38
IN	7	36	86	50

----- % -----

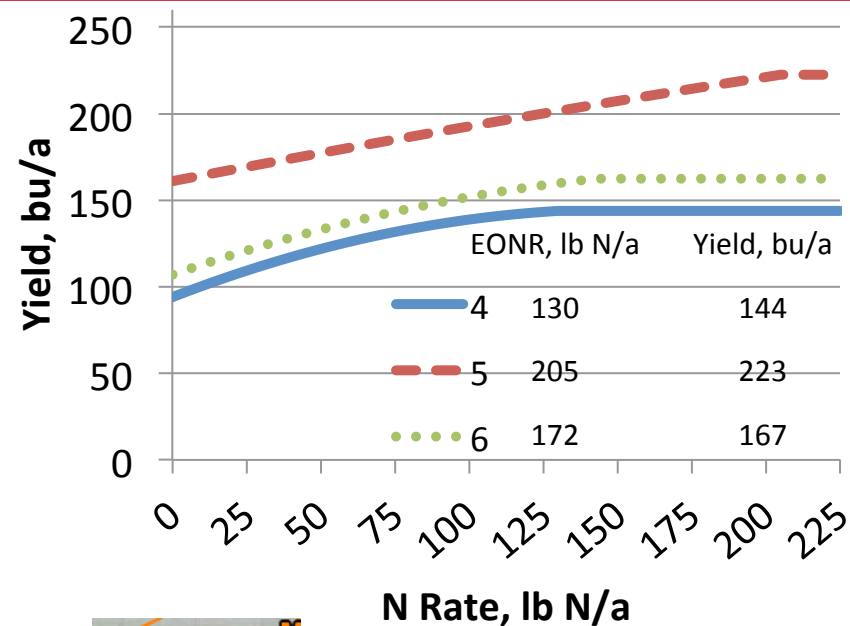
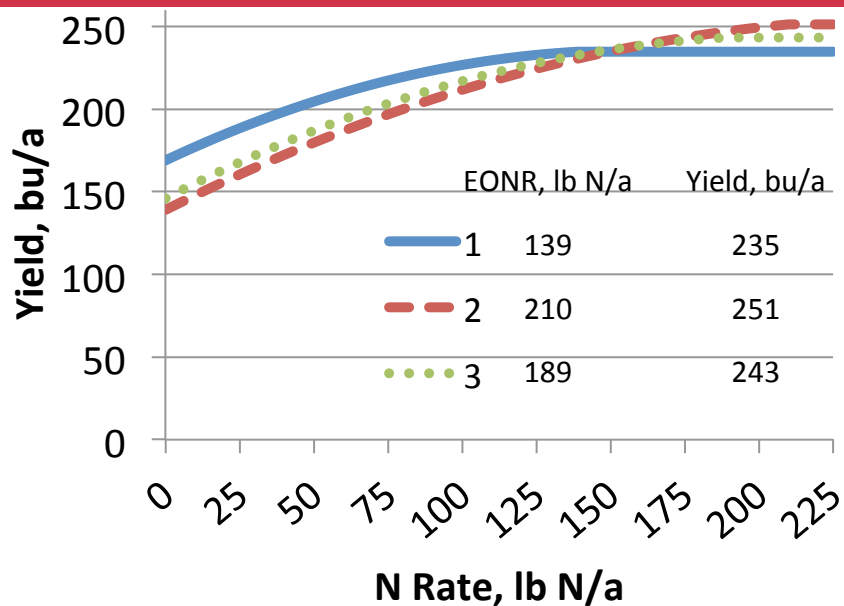
**WI: corn grain following soybean (n=18)**



**WI: corn grain following corn (n=22)**



State	Frequency of sites ± 25 lb N/a of EONR		Frequency of sites under recommended	
	Adapt-N	MRTN	Adapt-N	MRTN
	----- % -----			
WI-SC	39	50	39	39
WI-CC	23	5	18	27



Prev. crop corn silage

MRTN 165 lb N/a  
(155-180)

Adapt-N 130 lb N/a  
(122-142)

RSN from 2012  
Drought ??



A2

Prev. crop soybean

MRTN 120 lb N/a  
(105-130)

Adapt-N 145 lb N/a  
(132-154)

Site variability not  
captured in Adapt-N input  
parameters



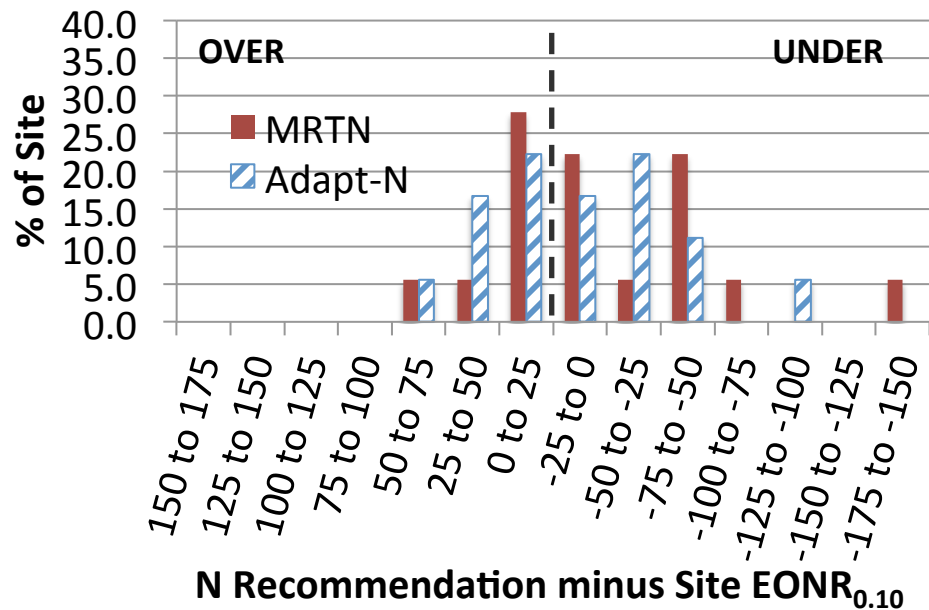
C2

Site	Timing	Source	Adapt-N	UW
A2	Early Fall	Raw	30	98
		Trt	30	120
	Late Fall	Raw	35	103
		Trt	35	124
	Spring	Raw	80	73
		Trt	105	104
C2	Early Fall	Raw	35	116
		Trt	20	59
	Late Fall	Raw	50	101
		Trt	40	87
	Spring	Raw	65	66
		Trt	80	74
S2	Early Fall	Raw	45	97
		Trt	35	116
	Late Fall	Raw	40	103
		Trt	35	125
	Spring	Raw	65	76
		Trt	70	91

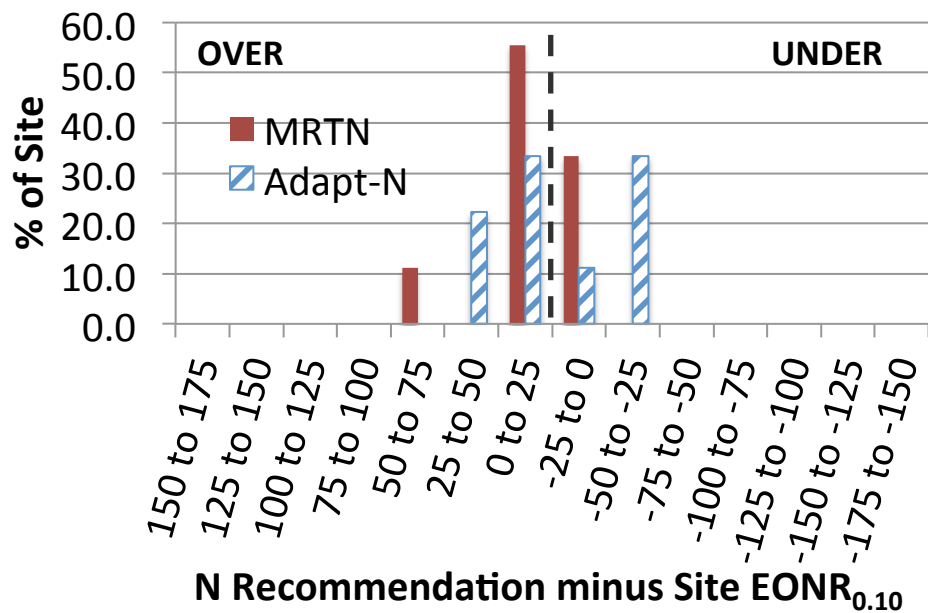
# Manure credits

- Credits similar for spring applications
- Profitability compared to site EONR for spring application
  - MRTN = -\$23/a
  - Adapt-N = -\$28/a

### WI: corn grain following soybean (n=18)



### WI: corn grain following soybean (n=9)



No Sites with Manure



# Profitability

State	Previous crop	n	Adapt-N - EONR	MRTN - EONR	MRTN Advantage		
					Mean	Min	Max
----- \$/acre -----							
IA	All	24	-85 (-74) †	-19 (-18)	66	-9	180
	Corn grain	8	-78 (-64)	-15 (0)	63	-9	141
	Soybean	16	-89 (-80)	-21 (-27)	68	-3	180
IN	All	15	-95 (-78)	-17 (-17)	77	-21	166
	Corn grain	1	-15 (-33)	-29 (-47)	-14	--	--
	Soybean	14	-100 (-82)	-16 (-15)	84	-21	166
WI	All	40	-24 (24)	-26 (5)	-2	-87	56
	Corn grain/ silage	22	-29 (51)	-29 (29)	0	-87	36
	Soybean	18	-19 (-9)	-23 (-25)	-3	-52	56

† Number in parenthesis is the N application rate, lb N/a, difference of the N recommendation system from the EONR.

# Summary

- Adapt-N under recommended N to greater extent than MRTN in IA & IN
- Adapt-N & MRTN under recommended N at similar frequency in WI
- Adapt-N did not reduce the variability in recommended N rates compared to site optima

# Summary

- MRTN more likely to be  $\pm 25$  lb N/a of EONR compared to Adapt-N
  - Except for corn after corn in WI
- MRTN more profitable than Adapt-N in IA & IN
- MRTN & Adapt-N had similar profitability in WI for all sites
  - Sites with large spatial variability in N response removed from data, MRTN was more profitable
- Cost of Adapt-N subscription not factored into these analysis

# Summary

- Adapt-N doesn't capture spatial variability in N response
  - Not enough input parameters to characterize zones within fields
  - Some input parameters seem to have little impact on N rate recommendation
- Adapt-N may not adequately model N loss
  - From excessive rainfall
  - Mineralization of manure N

# Acknowledgements

- Agronomic Technology Corp. for providing us with complimentary access to the Adapt-N service May-December 2014
  - Earlier access was publicly available for free
- Many cooperators in these trials
- Various funding partners