Should corn hybrid selection influence N fertilizer rate decisions?

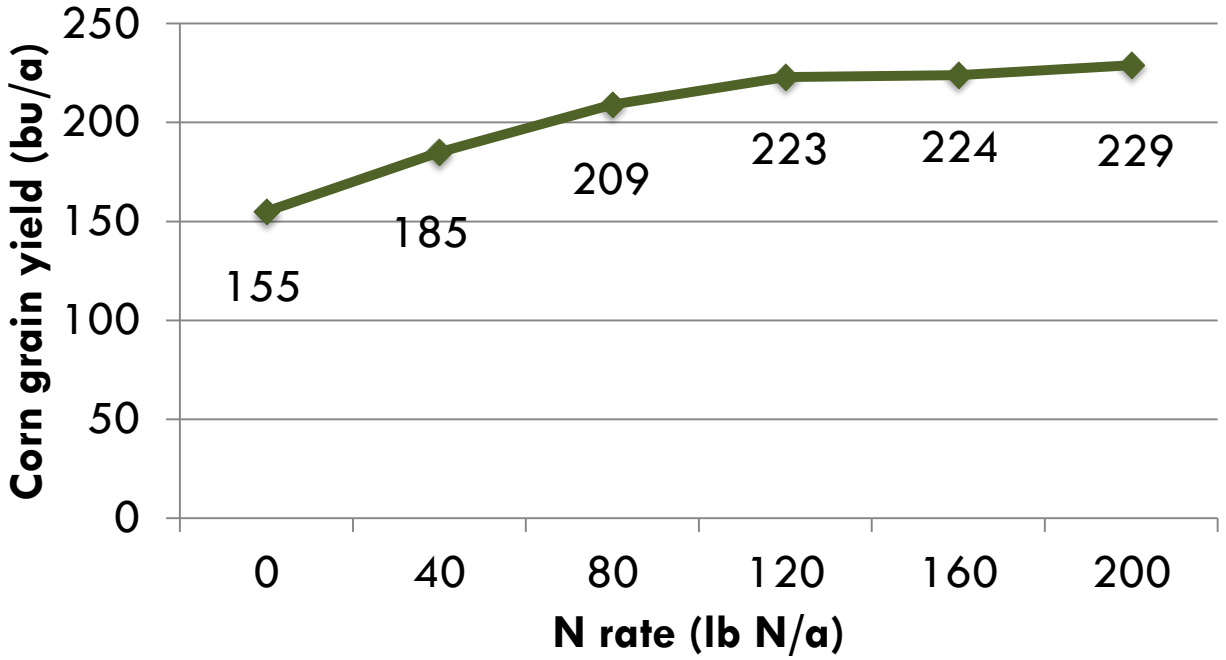
Carrie Laboski
Extension Soil Fertility/Nutrient Management Specialist

Soil, Water, & Nutrient Management Meetings
December 1-6, 2011

DEPARTMENT OF SOIL SCIENCE
University of Wisconsin-Madison

UW Extension

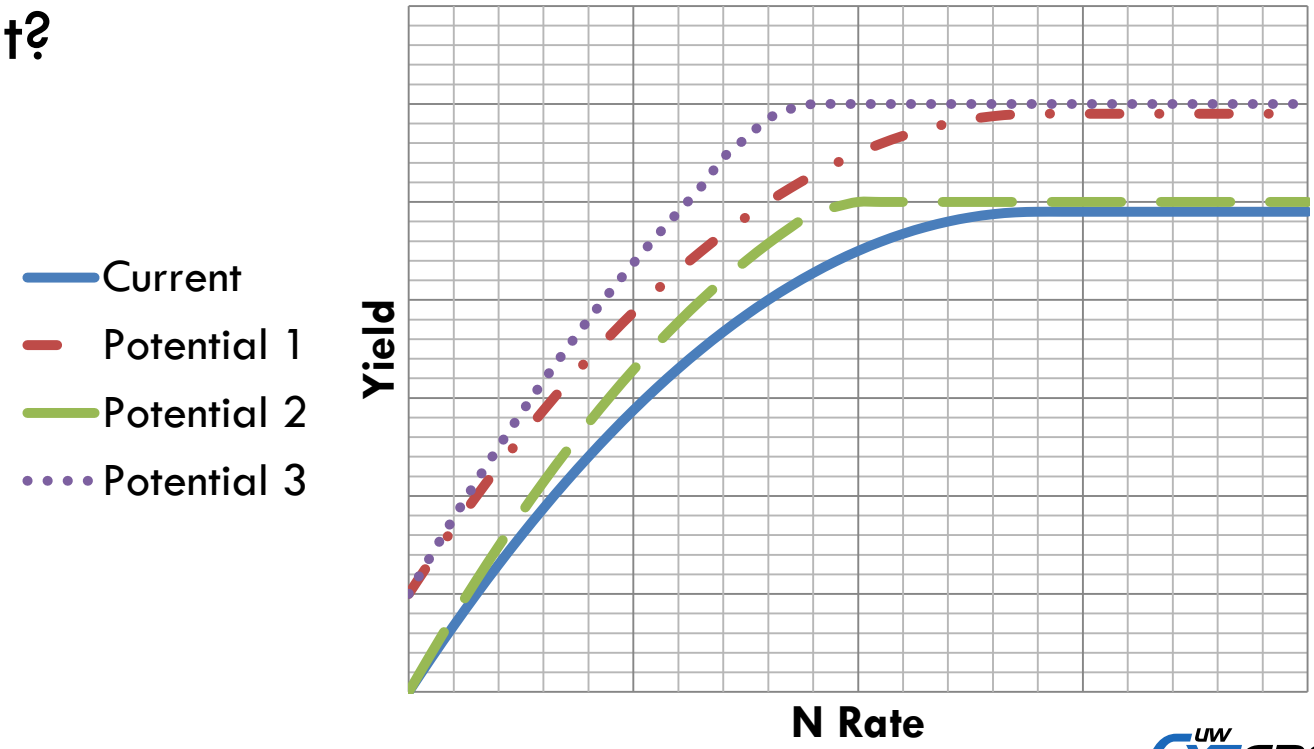
Background



- The first increment of N applied has the greatest efficiency and potential for economic return

Background

- CRW resistant hybrids have larger root system if not stressed by CRW larval feeding
  - Is more N needed to feed a larger plant, or is less N needed because the root system is more efficient?



Objective:

- To determine if corn hybrids with a transgenic CRW resistant gene vary in their NUE and N need compared to non-resistant hybrids

Methods & Materials

Site background & Experimental design

- Previous crop = corn
- Weather
  - 2008: Wet June; cool all-season
  - 2009: somewhat dry; cold
  - 2010: June & July wet; somewhat warmer July & Aug.
- Insecticide applied to all plots

Date	Root injury rating in border; 0-3 node-injury scale
7/24/08	1.12
7/27/09	0.19
7/26/10	1.50

- N x hybrid; full factorial, CRD
  - 4 replications
- 6 N rates
  - 0 – 200 lb N/a
  - Applied post emergence
- 8 Hybrids

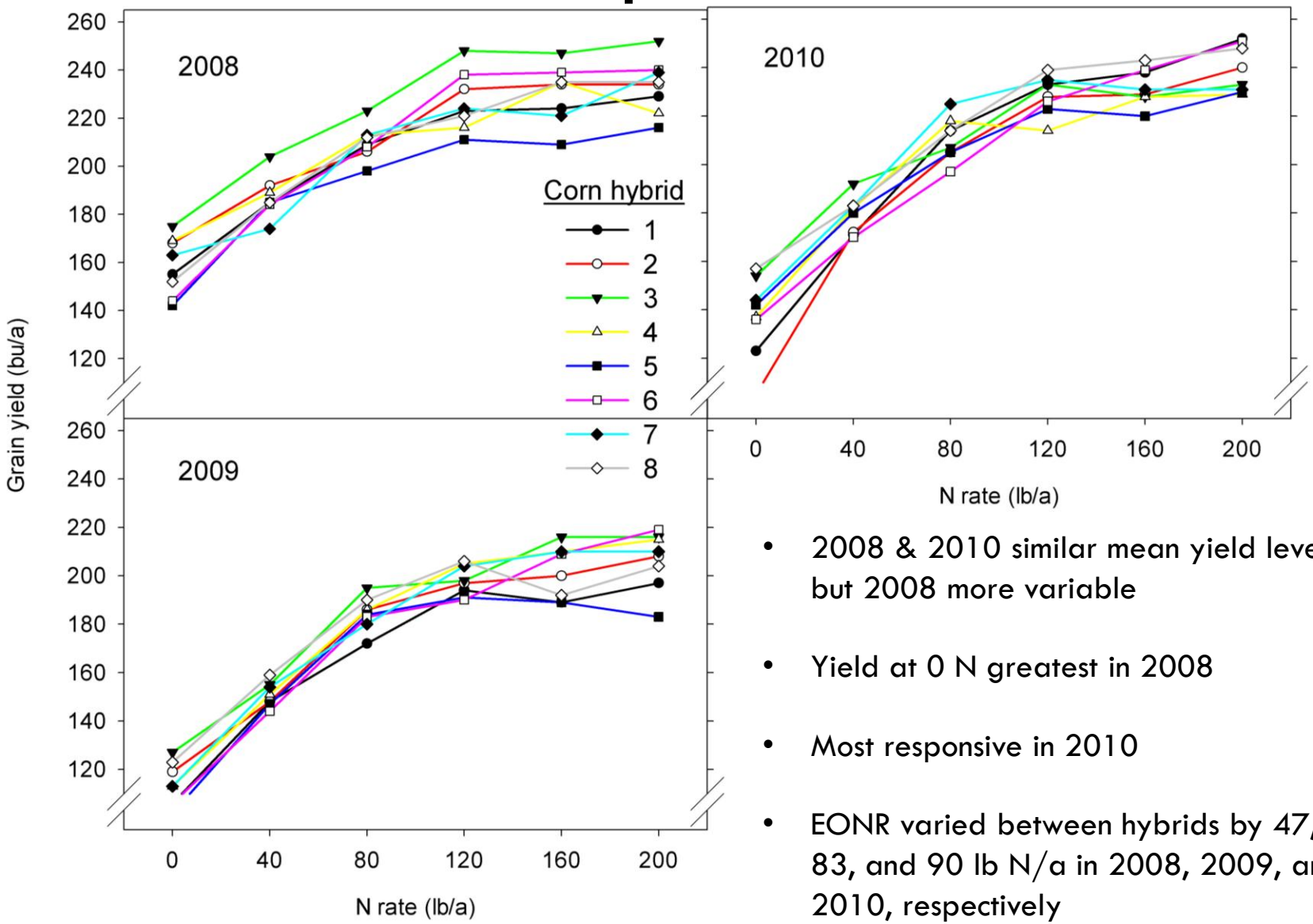
Hybrids

Hybrid	Hybrid i.d.	Brand	Hybrid	CRM	Traits
1	Bt-CR 1	Pioneer	P35F44	105	(CB & CRW) Herculex Xtra, Roundup Ready 2, Liberty Link
2	Isoline 1	Pioneer	P35F37	105	Roundup Ready 2
3	Bt-CR 2	DeKalb	DKC52-59	102	(CB & CRW) Yield Guard VT3, Roundup Ready
4	Isoline 2	DeKalb	DKC52-62	102	Roundup Ready 2

Hybrid	Hybrid i.d.	Brand	Hybrid	CRM	Traits
5	Standard Bt-CB	Northrup King (08/09)	N58-D1	107	(CB) Yield Guard
		Renk (10)	RK670	103	(CB) Yield Guard
6	Standard nontransgenic	Pioneer (08)	35A30	106	None
		Pioneer(09/10)	35F38	105	None
7	Bt-CR (Mon863) 1	Renk (08)	R698RRYGRW	104	(CRW) Yield Guard Roundup Ready
		DeKalb (09/10)	DKC55-4 (VT3)	105	(CB & CRW) Yield Guard VT3, Roundup Ready
8	Bt-CR (Mon863) 2	Dairyland	ST400	106	Roundup Ready, CRW

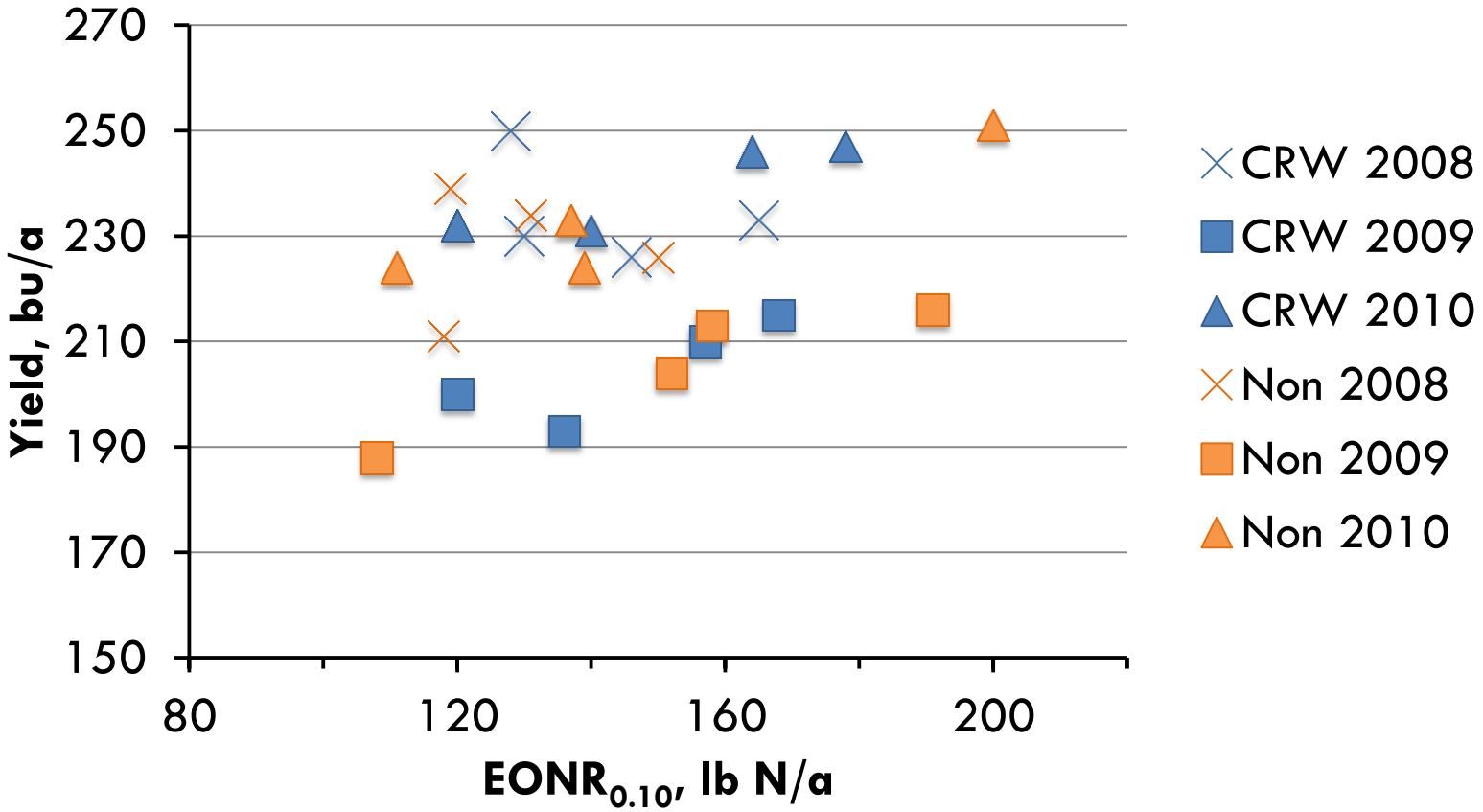
Results

Yield response to N



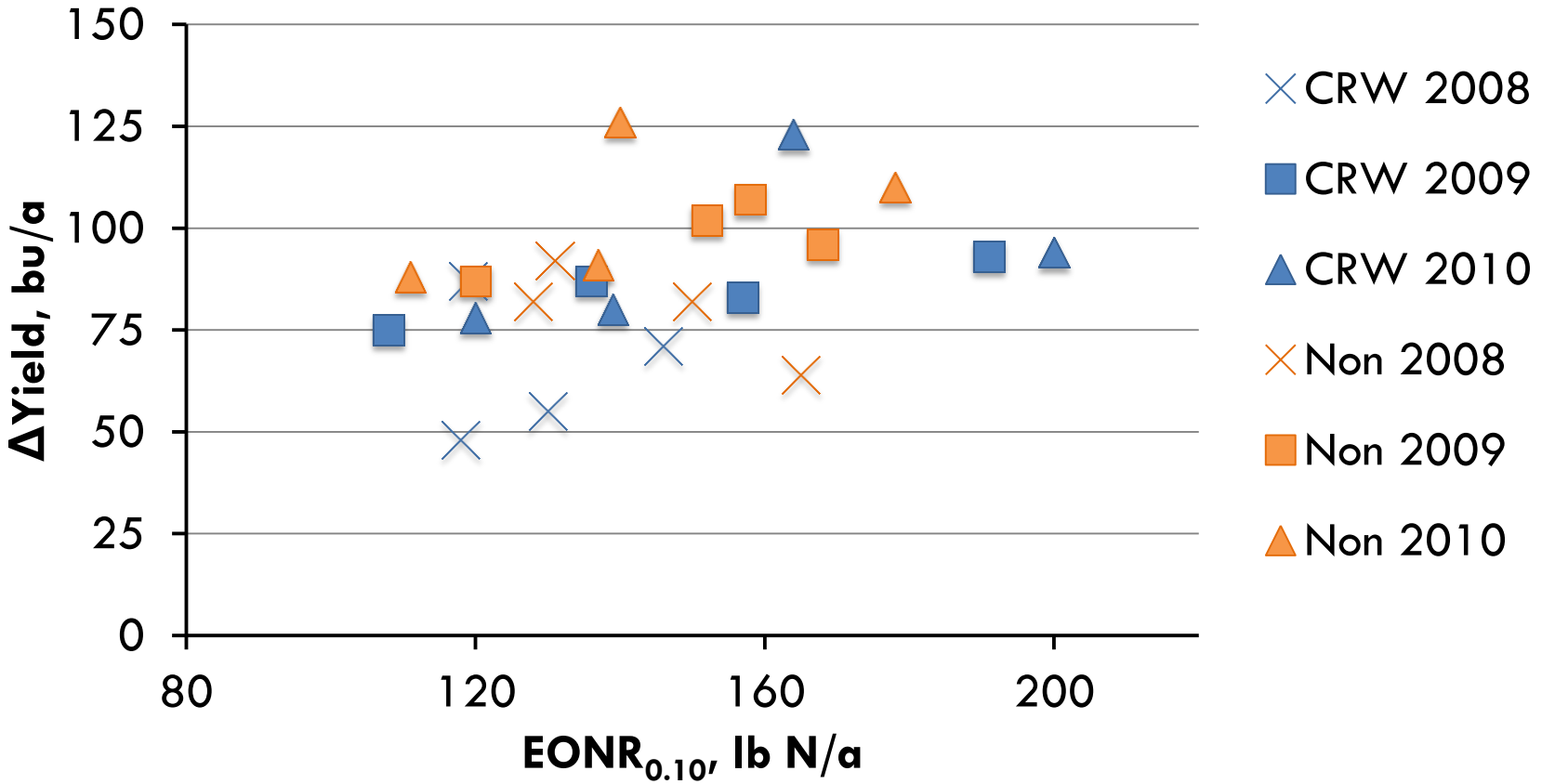
- 2008 & 2010 similar mean yield level but 2008 more variable
- Yield at 0 N greatest in 2008
- Most responsive in 2010
- EONR varied between hybrids by 47, 83, and 90 lb N/a in 2008, 2009, and 2010, respectively

Relationship between yield and N need



N required at $EONR_{0.10}$ can vary by 40-90 lb N/a between any two hybrids in the same field in one year

Relationship between yield increase (ΔYield) and N need



No relationship between the amount of N needed and the yield increase over no N

N use efficiency

Effect of CRW trait on RY, PFP, and ANFE

Hybrid	Relative Yield$_{200}$			Partial Factor Productivity$_{160}$			Agronomic N Fertilizer Efficiency$_{160}$		
	2008	2009	2010	2008	2009	2010	2008	2009	2010
	-------- % --------			----- bu/lb N fert. -----			--- Δbu/ lb N fert. ---		
CRW	68a	57b	60b	1.45a	1.26b	1.47a	0.44b	0.53a	0.57a
Non-CRW	67a	53b	54b	1.44a	1.27b	1.43a	0.47b	0.58a	0.62a
p	ns	ns	ns	ns	ns	ns	ns	ns	ns

For a given measure of NUE, values in each row followed by the same letter are not significantly different at the 0.10 probability level.

p values compare an isoline pair in each year. ns = not significant; * = $p<0.10$.

Effect of CRW trait on INUE, PE, and FNRE

Hybrid	Internal N Use Efficiency$_{160}$			Physiological Efficiency$_{160}$			Fertilizer N Recovery Efficiency$_{160}$		
	2008	2009	2010	2008	2009	2010	2008	2009	2010
	--- bu/lb N uptake ---			-- Δbu/Δlb N uptake --			Δlb N uptake/ lb N fert.		
CRW	1.01b	1.06a	0.94c	0.81	0.92	0.87	0.58	0.59	0.66
Non-CRW	1.03b	1.07a	0.92c	0.95	0.95	0.87	0.52b	0.61b	0.74a
p	ns	ns	ns	ns	ns	ns	ns	ns	ns

For a given measure of NUE, values in each row followed by the same letter are not significantly different at the 0.10 probability level.

p values compare an isoline pair in each year. ns = not significant; * = $p<0.10$.

N response CRW vs non-CRW hybrids

Year	Yield at 0 N		Yield at plateau N rate		Plateau N rate	
	CRW	non-CRW	CRW	non-CRW	CRW	non-CRW
	bu/a		bu/a		lb N/a	
2008	161	154	235	228	152	139
2009	115	110	206	206	160	164
2010	145*	130*	240	234	165	154

* CRW and non-CRW hybrids are significantly different for Yield at 0 N in 2010.

When averaged overall years, Yield at 0 N for non-CRW hybrids is significantly less than CRW hybrids.

Summary

- CRW traited hybrids are more efficient in using mineralized soil N in 0 N plots
  - However, this does not translate to significantly greater yield levels when fertilized or different N needs
- There can be a wide range in optimum N rates between hybrids planted in the same field
- True precision N management will be limited until we can more accurately estimate crop N need, soil N mineralization, and N losses
- The MRTN approach to N rate selection…
  - Averages N response in many fields with many hybrids
  - Thus, differences in N need are taken into consideration

Questions?

Thanks to:

- Todd Andraski
- Joe Lauer
- Fluid Fertilizer Foundation
- Wisconsin Fertilizer Research Program
- Brookside Lab
- Waters Ag Lab

Contact Info:

- Carrie Laboski
- laboski@wisc.edu
- 608-263-2795
- www.soils.wisc.edu/extension/