

Do Corn Hybrid Traits Affect Nitrogen Use Efficiency?

Wisconsin Crop Management Conference
January 12, 2011

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Background

- CRW 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?
- No specific research is published
 - A few studies on-going at other Midwest Universities

Objectives:

1. To determine if corn hybrids with a transgenic CRW resistant gene vary in their NUE and N need compared to non-resistant hybrids
2. Obtain additional N response info. for the Wisconsin database

Methods & Materials

Site background info.

- Previous crop = corn grain
- Spring chisel & soil finisher
- Plano silt loam

Soil Test	2008	2009	2010
P, ppm	107 (EH)	33 (EH)	91 (EH)
K, ppm	347 (EH)	163 (VH)	146 (H)
pH	7.1	6.9	7.1
OM, %	4.1	3.2	3.5
PPNT, lb N/a	69 (19 credit)	12 (0 credit)	37 (0 credit)

Experimental design

- N x hybrid in a full factorial – CRD
 - 4 replications
- 6 N rates
 - 0 – 200 lb/a in 40 lb/a increments
 - Applied 11, 23, or 27 day after planting
- 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

Plot details

- **Planting**

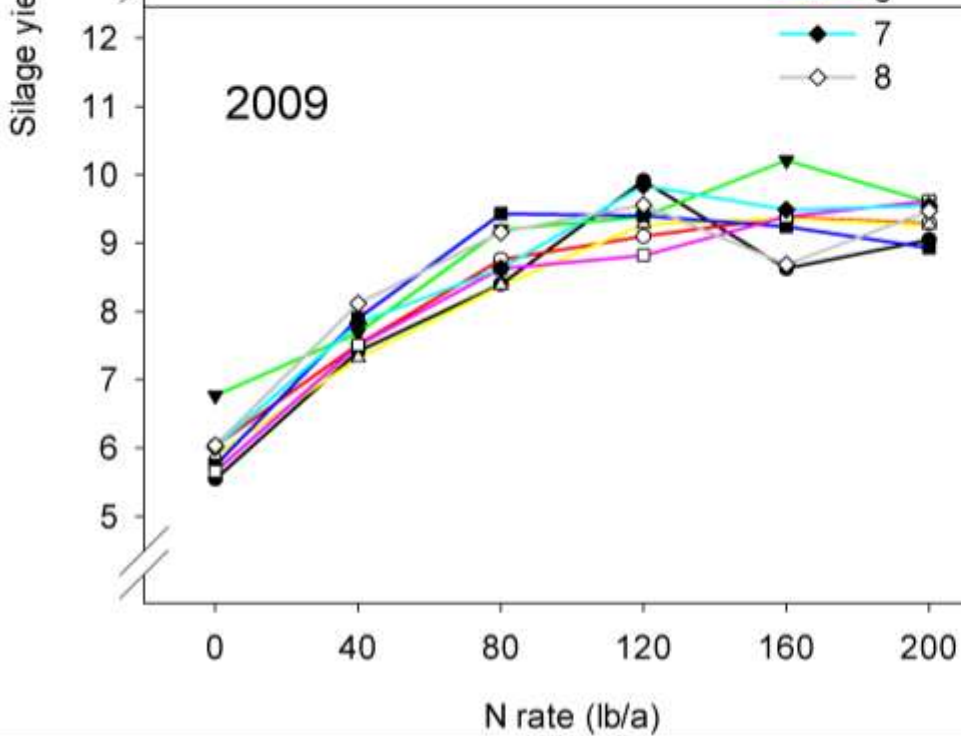
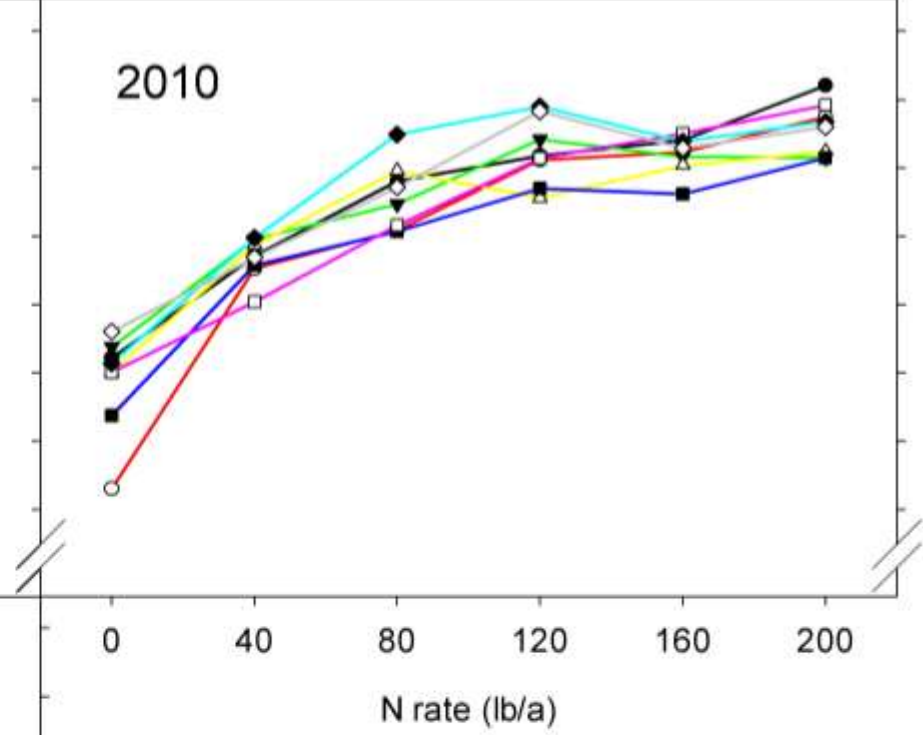
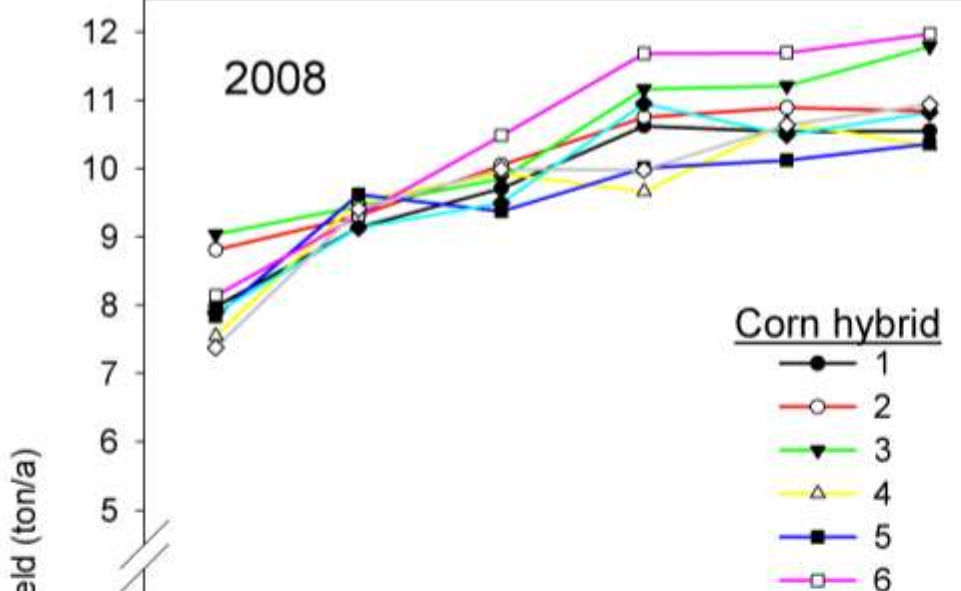
- May 5, 2008; May 12, 2009; May 5, 2010
- 33,600 seeds/a or 36,670 seeds/a
 - Thinned to 30,500 or 34,294 at V4-V5
- 3 gal/a 10-34-0 in furrow in 2008
- 4.4 lb/a insecticide in T-band (Fenitrothion)
 - To all plots
 - Border area - no insecticide

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

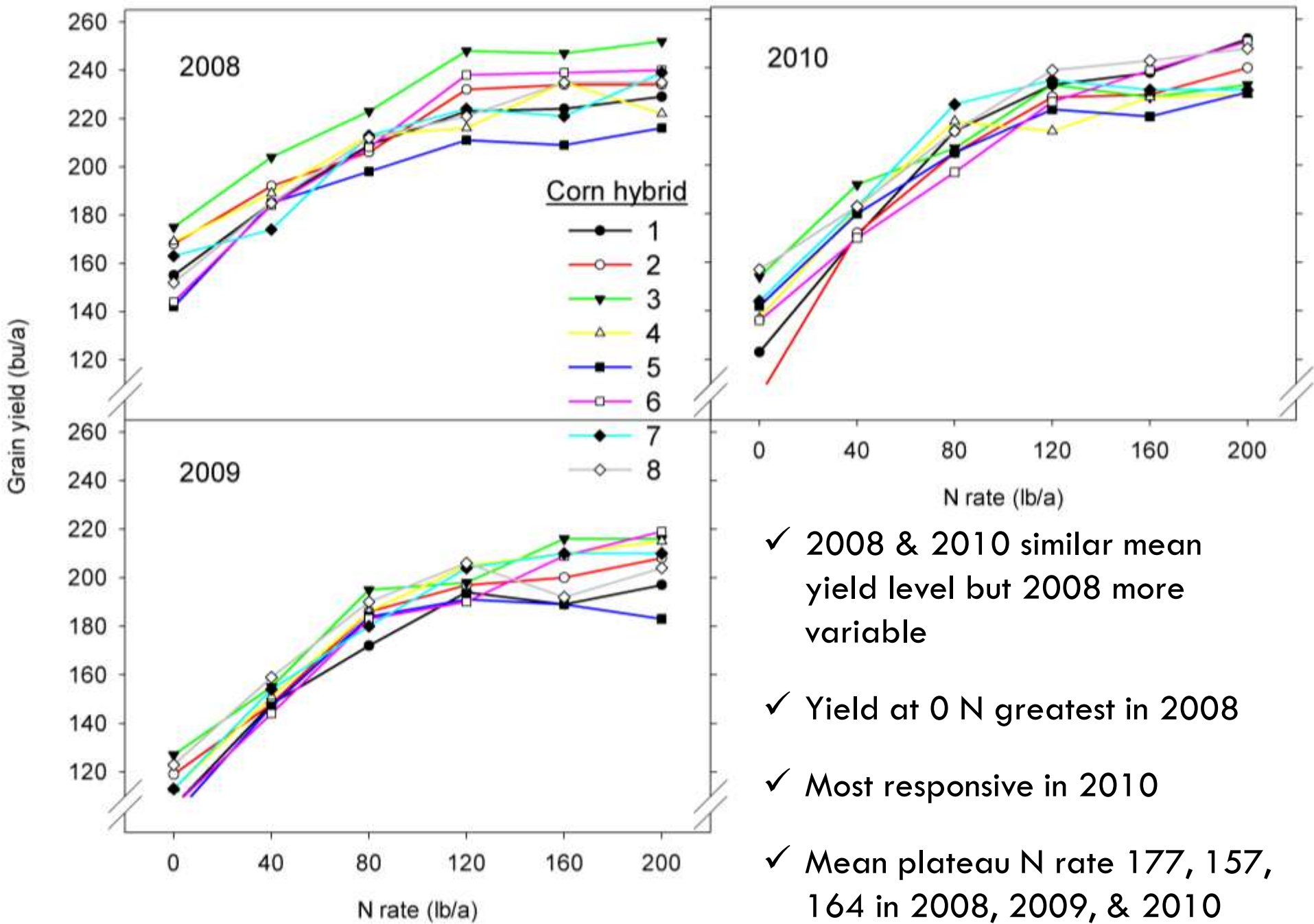
- **Weather**

- 2008: Wet June; cool all-season
- 2009: somewhat dry; cold
- 2010: July & July wet; somewhat warmer July & Aug.

Results



- ✓ Overall yield level lower in 2009
- ✓ Yield at 0 N greatest in 2008
- ✓ Hybrid 3 yielded well both 2008 & 2009, not 2010
- ✓ Mean plateau N rate 189, 126, 146 in 2008, 2009, & 2010



N use efficiency definitions

- Relative yield (RY)
 - $(\text{Yield at 0 lb/a} \div \text{Yield at 200 lb/a}) \times 100$
- Δ Yield (ΔY)
 - $\text{Yield at EONR}_{0.10} - \text{Yield at 0 lb/a}$
- Agronomic efficiency (AE)
 - $\Delta \text{Yield at EONR}_{0.10} \div \text{EONR}$
- Plateau N rate
 - N rate where yield no longer increases, based on yield response to N model

Effect of corn hybrid on relative yield and agronomic efficiency at Arlington, WI

Hybrid	Relative Yield ₂₀₀			Agronomic Efficiency _{0.10}		
	2008	2009	2010	2008	2009	2010
	----- % -----			----- bu/lb N -----		
1	68	54	49 cd	0.49	0.64	0.75
2	72	56	44 d	0.50	0.57	0.93
3	70	60	66 a	0.59	0.52	0.55
4	74	53	60 ab	0.38	0.63	0.78
5	66	56	62 ab	0.58	0.80	0.59
6	60	48	54 bc	0.80	0.58	0.58
7	68	54	63 ab	0.52	0.62	0.73
8	66	60	63 ab	0.49	0.64	0.51
P	0.56	0.46	<0.01	NA	NA	NA

Summary – isoline pairs

- Hybrids 1&2 (Pioneer)
 - CB-CRW hybrid needed more N in 2008 and 2010, and less N in 2009 compared to isoline
 - CB-CRW hybrid yielded less than isoline in 2008 & 2009
- Hybrids 3&4 (Dekalb)
 - CB-CRW hybrid needed less N in 2008 and more N in 2009 and 2010 compared to isoline
 - CB-CRW hybrid yielded more than isoline all years, but likely not always significant

Summary – comparison of all CRW vs non-CRW hybrids

Year	Yield at 0 N		Yield at plateau N rate		Plateau N rate		AE _{EONR0.01}	
	CRW	non-CRW	CRW	non-CRW	CRW	non-CRW	CRW	non-CRW
	bu/a		bu/a		lb N/a		bu/lb N	
2008	161	154	235	228	152	139	0.52	0.57
2009	115	110	206	206	160	164	0.61	0.65
2010	145*	130*	240	234	165	154	0.64	0.72

* 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.

- CRW traited hybrids 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.

Questions?

Thanks to:

- Wisconsin Fertilizer Research Program
- Fluid Fertilizer Foundation

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