Impact of Nitrogen Application Timing on Corn Production

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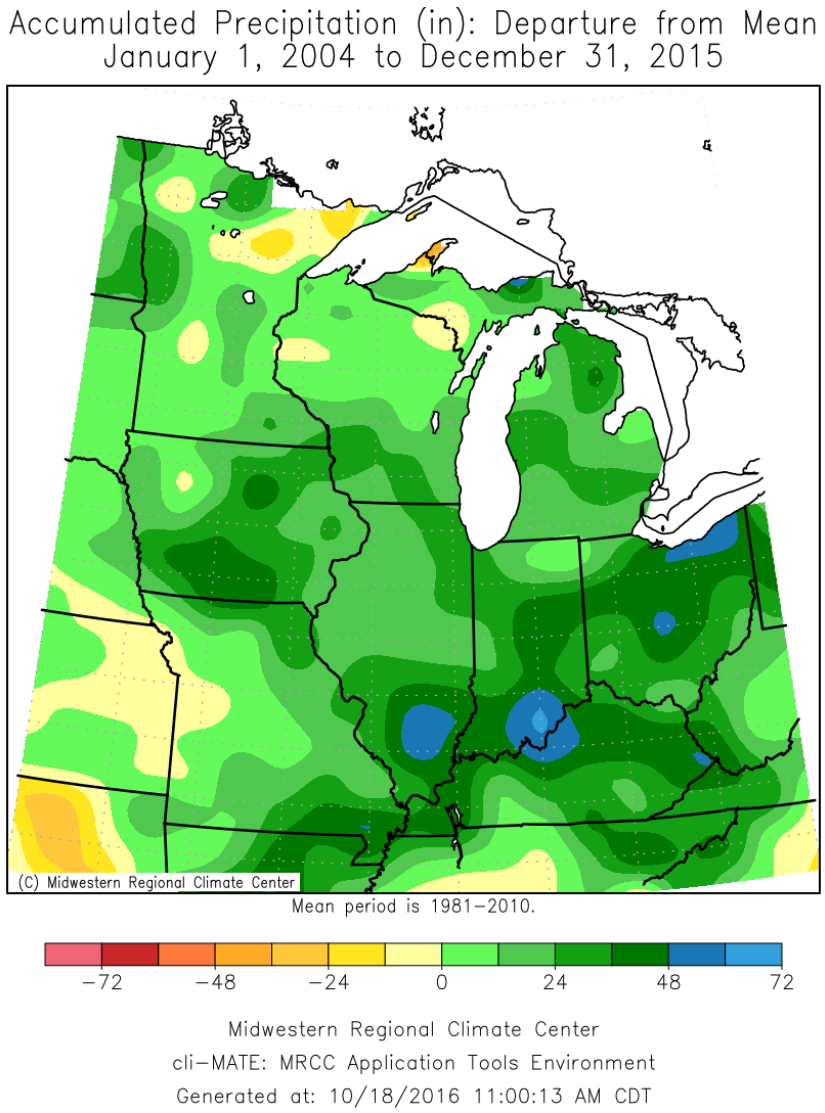
Summary Of Timing Studies

- Projects in 2004-2015
- Nine studies
- Sixty five site-years
- Nitrogen application timings
  - Fall, spring preplant, at planting, split/sidedress, mid-vegetative, late-vegetative

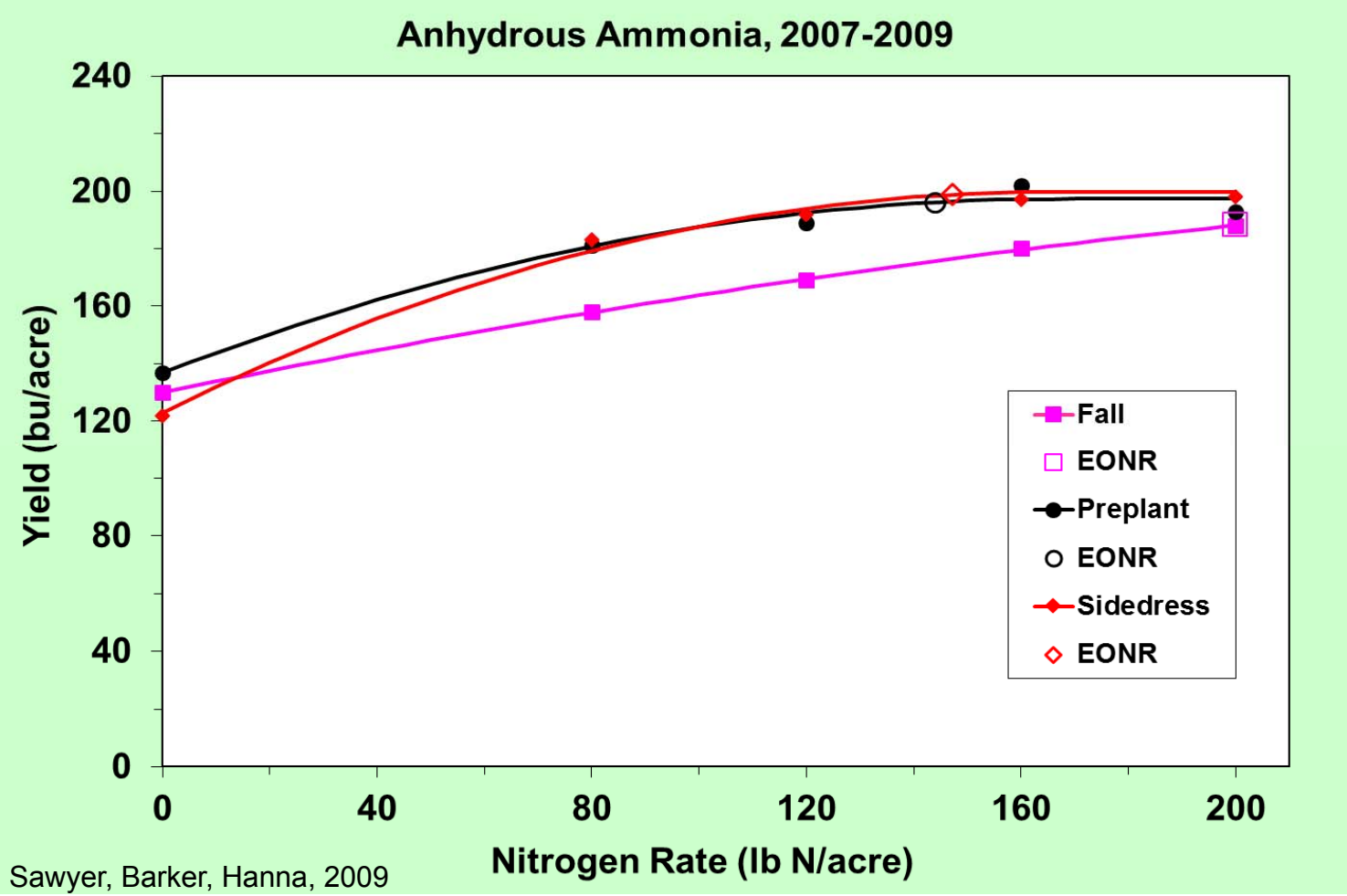
2004-2015 High Precipitation Period



Anhydrous Ammonia Timing Study

- Late fall (< 50°F), spring preplant (mid-April to mid-May) & split/sidedress (V2-V4 corn stage, early-mid June)
- Five N rates
- No nitrification inhibitor
- Corn following soybean
- Three years (2007-2009)
- Central Iowa

Preplant and Split/Sidedress
Anhydrous Ammonia

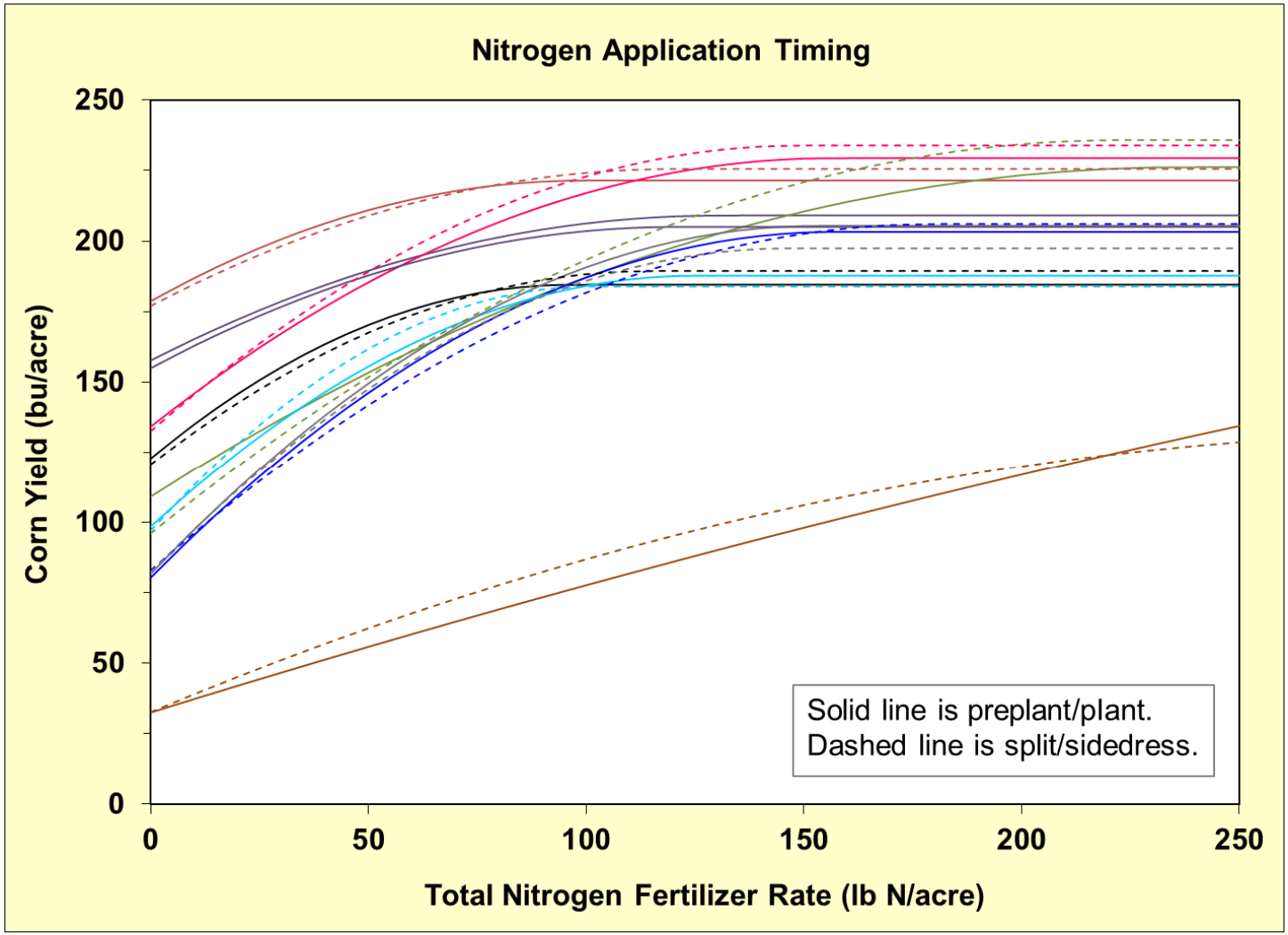


Sawyer, Barker, Hanna, 2009

Springtime Timing Studies

- Spring preplant or at-planting & split/sidedress
- Sidedress at V4 – V9 corn growth stage
- Six to eight N rates
- UAN, urea, ammonium nitrate
- Corn following soybean
- Two years (2014-2015)
- Nine site-years across Iowa

Preplant or At-Planting and Split/Sidedress



Sawyer, Lundvall, Hall, Barker 2015

Preplant or At-Planting and Split/Sidedress

		Mean EONR		Mean YEONR	
Category	Sites	Pre	Split	Pre	Split
		- - lb N/acre - -		- - bu/acre - -	
Split EONR 10 lb N/acre lower than Preplant	1	116	95	187	184
Preplant EONR 10 lb N/acre lower than Split	3	108	126	203	207
Preplant and Split EONR within 10 lb N/acre	4	153	147	217	217
Overall Mean	**8**	**132**	**132**	**208**	**209**
Chariton	1	250*	250*	134	129

Based on N response equations and 0.10 N:corn price ratio.
Sawyer, Lundvall, Hall, and Barker, 2015.

In-Season Sensor-Based Project

- Spring preplant or early sidedress (Pre-N)
- In-season mid- to late-vegetative SPAD meter-based high clearance (Post-sensing N)
- Four Pre-N rates plus sensor-based N
- UAN Post-sensing N product
- Corn following soybean
- Three years (2004-2006)
- Thirty on-farm sites across Iowa with field-length strips

N Applied Pre and Post-Sensing

N Application Treatment	Mean Total N Applied†	Number of Sites with Post-Sensing N Applied	Relative CM Value	Mean Yield‡
	lb N/acre	n		bu/acre
0	0	--	0.82	141d
60	60	--	0.93	177c
60+	115	28	---	185b
120	120	--	0.97	192a
120+	131	9	---	193a
240	240	--	1.00	197a

† Sum of Pre-N and Post-sensing N rate, averaged across all 30 SC sites.

‡ Mean yields are not significantly different when followed by the same letter ($P \leq 0.10$).

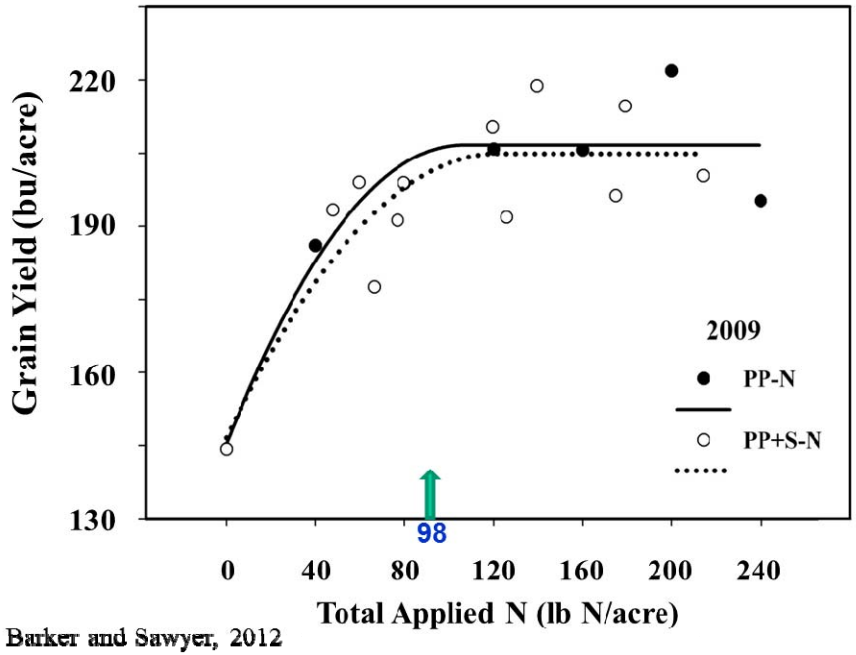
Hawkins, Lundvall, Sawyer, 2006

EONR(0.10) for Pre-N rates = 132 lb N/acre

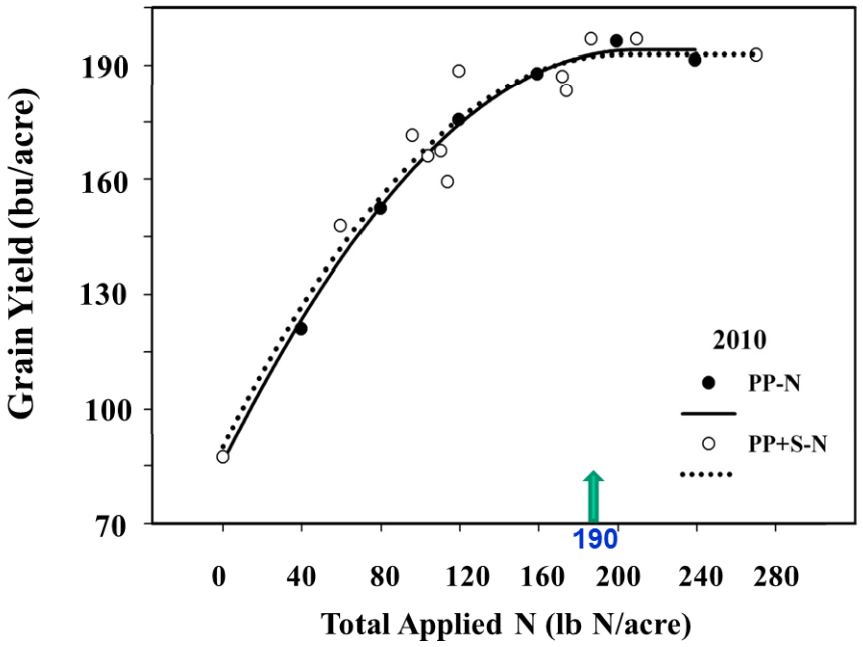
Mid-Vegetative Sensor-Based Timing Study

- Spring preplant urea (PP-N)
- Mid-vegetative (V10 stage) active canopy sensor-based application (PP+S-N)
- Seven PP-N rates plus sensor-based N
- UAN Post-sensing N product
- Corn following soybean
- Two years (2009-2010)
- Central Iowa, new site each year

N Applied Preplant and Mid-Vegetative Based on Canopy Sensing



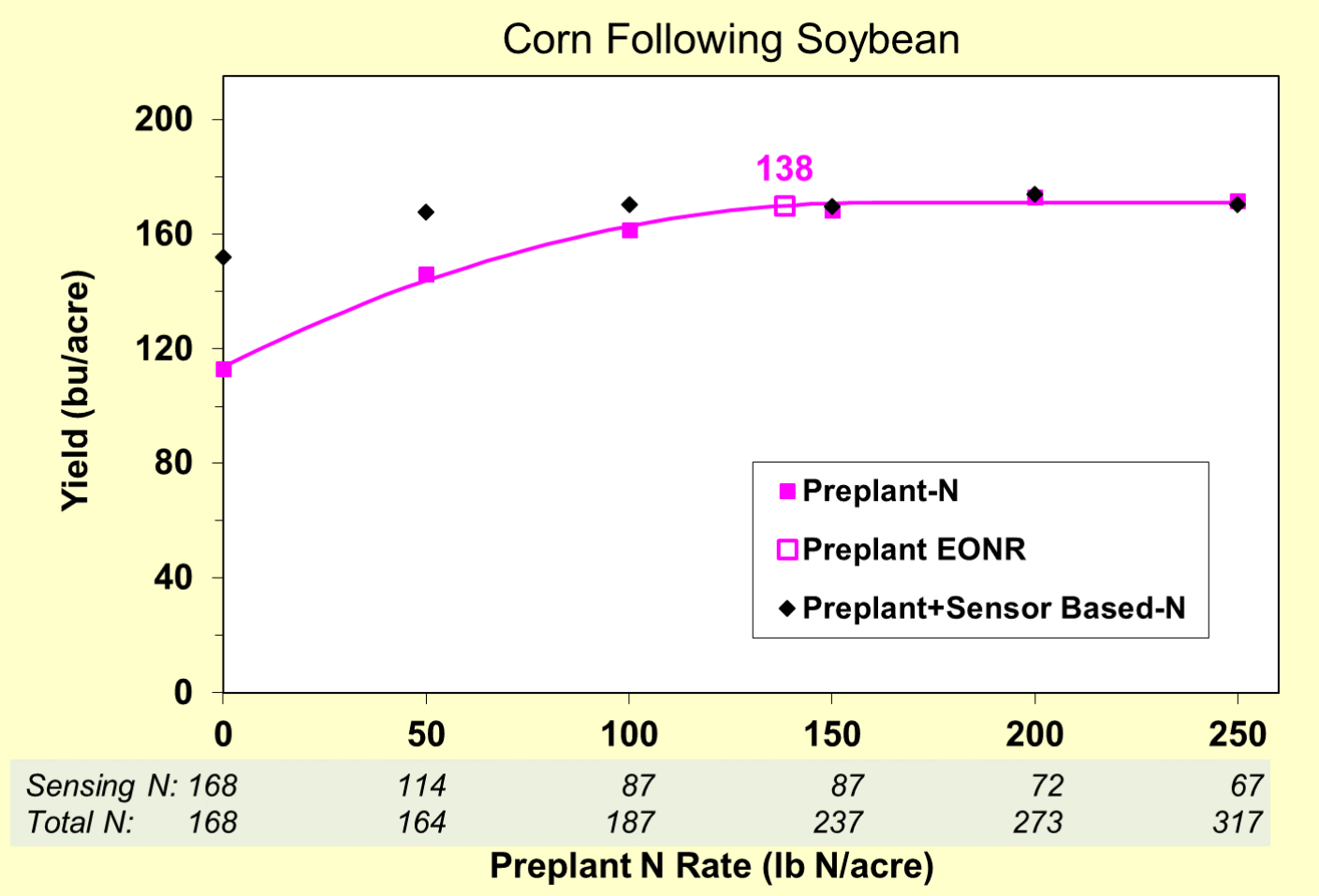
Barker and Sawyer, 2012



Mid-Vegetative Sensor-Based Timing Project

- Spring preplant UAN or urea
- Mid-vegetative active canopy sensor-based application (V10 stage)
- Six preplant rates plus sensor-based N
- Broadcast urea post-sensing N
- Corn following soybean
- Two years (2012-2013)
- Eight sites

N Applied Preplant and Mid-Vegetative Based on Canopy Sensing



8 SC Sites, 2012-2013. Barker and Sawyer, 2013. In-season N applied at V10 corn stage.

Mid-Vegetative Sensor-Based Demonstration

- Preplant N Rate (PP-N)
  - Farmer rate and product (Fall, Sp, Split, NH_3, NS, UAN)
- Preplant + In-Season Fixed Rate (PP+F-N)
  - Farmer rate + 100 lb urea/acre (46 lb N)
- Preplant + In-Season Sensor Rate (PP+S-N)
  - Farmer rate + 3 potential sensor-based rates
  - Un-calibrated NDVI (no relative index)
    - *1)* ≥0.85 no N; *2)* 0.85-0.50 100 lb urea/acre (46 lb N); *3)* <0.50 150 lb urea/acre (70 lb N)
  - Sensor-based N applied June 28–30, 2011
- Thirteen fields

Sensor-Based Demonstration SC

Application	1	2	3	4	5	6	
	- - - - - - - - - - - - - - - - - - bu/acre - - - - - - - - - - - - - - - - - -						
PP-N	218	213	211	212	212	198	
PP+F-N	217	214	199	194	223	193	
PP+S-N	219	206	209	222	205	198	
Sign. (0.05)	NS	NS	NS	NS	NS	NS	
	- - - - - - - - - - - - - - - - - - lb N/acre - - - - - - - - - - - - - - - - - -						
PP-N	159	161	160	160	160	160	
PP+F-N	205	206	205	205	205	205	
PP+S-N	209	212	208	209	206	210	
NDVI	0.699	0.674	0.691	0.693	0.703	0.682	

Barker and Sawyer, 2011

Sensor-Based Demonstration CC

Application	7	8	9	10	11	12	14
	- - - - - - - - - - - - - - - - - - bu/acre - - - - - - - - - - - - - - - - - -						
PP-N	204	209	199	214	224	214	231
PP+F-N	202	213	199	221	224	217	245
PP+S-N	210	211	198	---	223	---	---
Sign. (0.05)	NS	NS	NS	NS	NS	NS	*
	- - - - - - - - - - - - - - - - - - lb N/acre - - - - - - - - - - - - - - - - - -						
PP-N	120	195	208	192	192	250	200
PP+F-N	165	240	254	237	238	295	246
PP+S-N	167	244	255	---	230	---	---
+ Manure PP	Yes						Yes
NDVI	0.717	0.690	0.696	0.723	0.714	0.696	0.719

Barker and Sawyer, 2011

Time of Nitrogen Application Summary

- Fall anhydrous ammonia less efficient than spring or split/sidedress
- Generally, no difference in corn yield or EONR between springtime N application timing; preplant, split/sidedress, or mid-vegetative
- If a springtime timing difference, not consistent between preplant and sidedress
- Even in extremely wet and N responsive conditions, similar corn yield and EONR