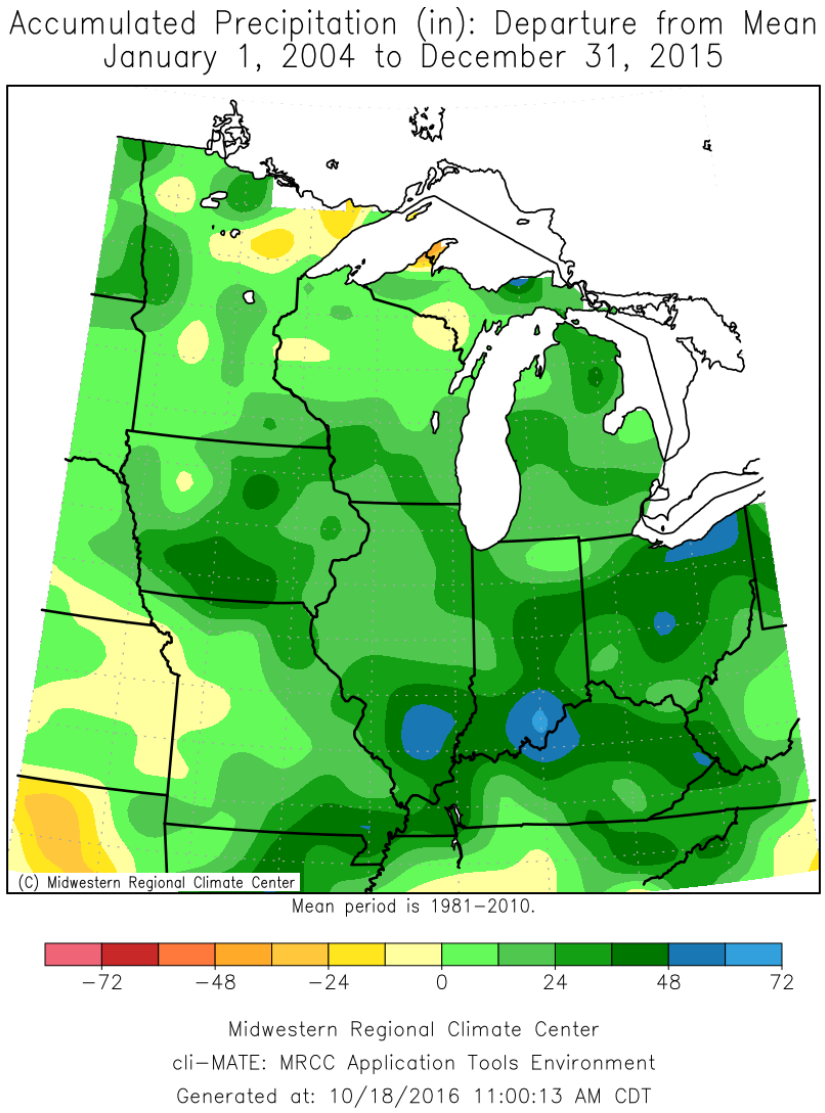
# Impact of Nitrogen Application Timing on Corn Production

John E. Sawyer
Daniel W. Barker
John P. Lundvall
Department of Agronomy
Iowa State University

# 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

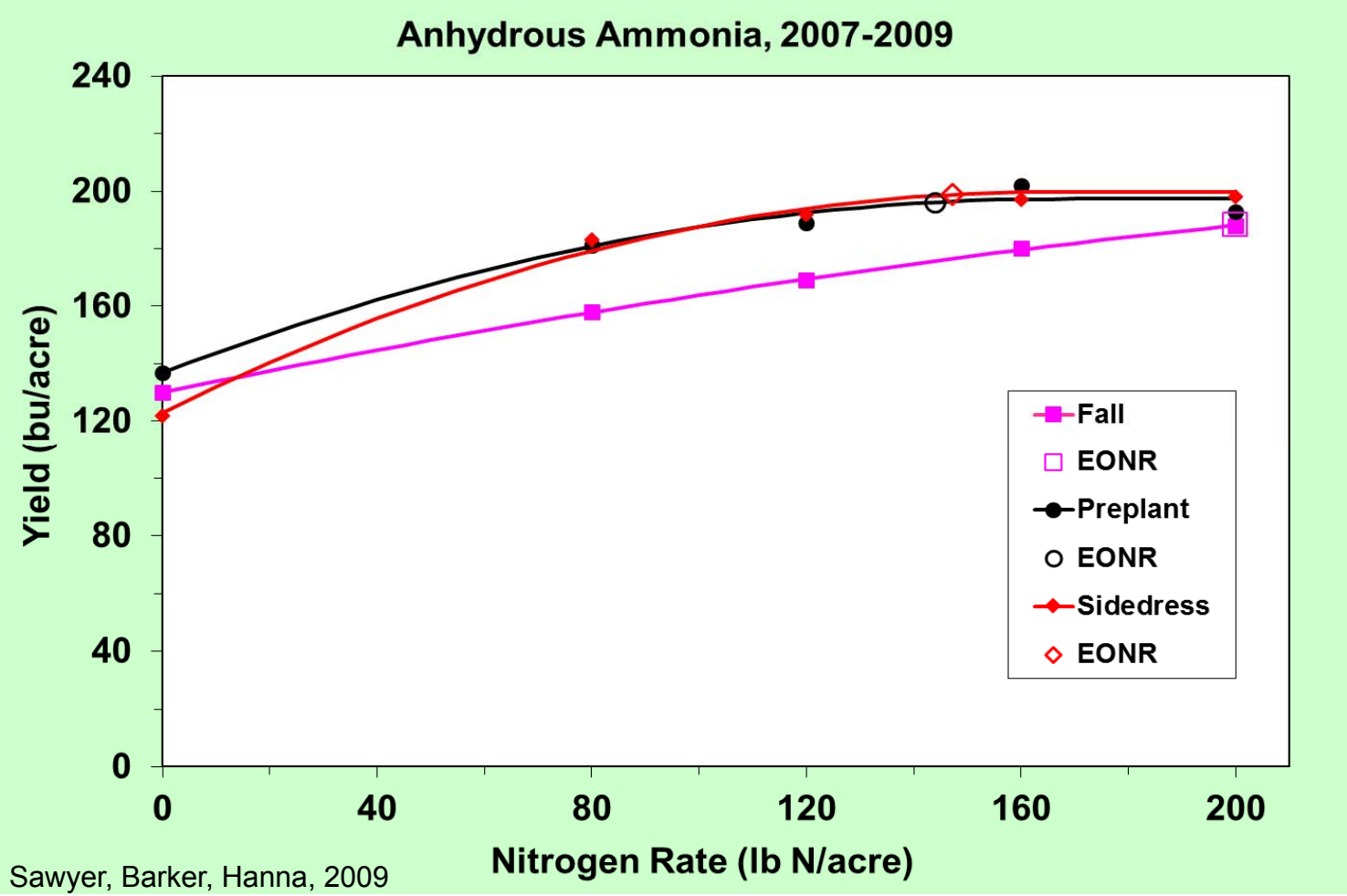
# 2004-2015 High Precipitation Period



# 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

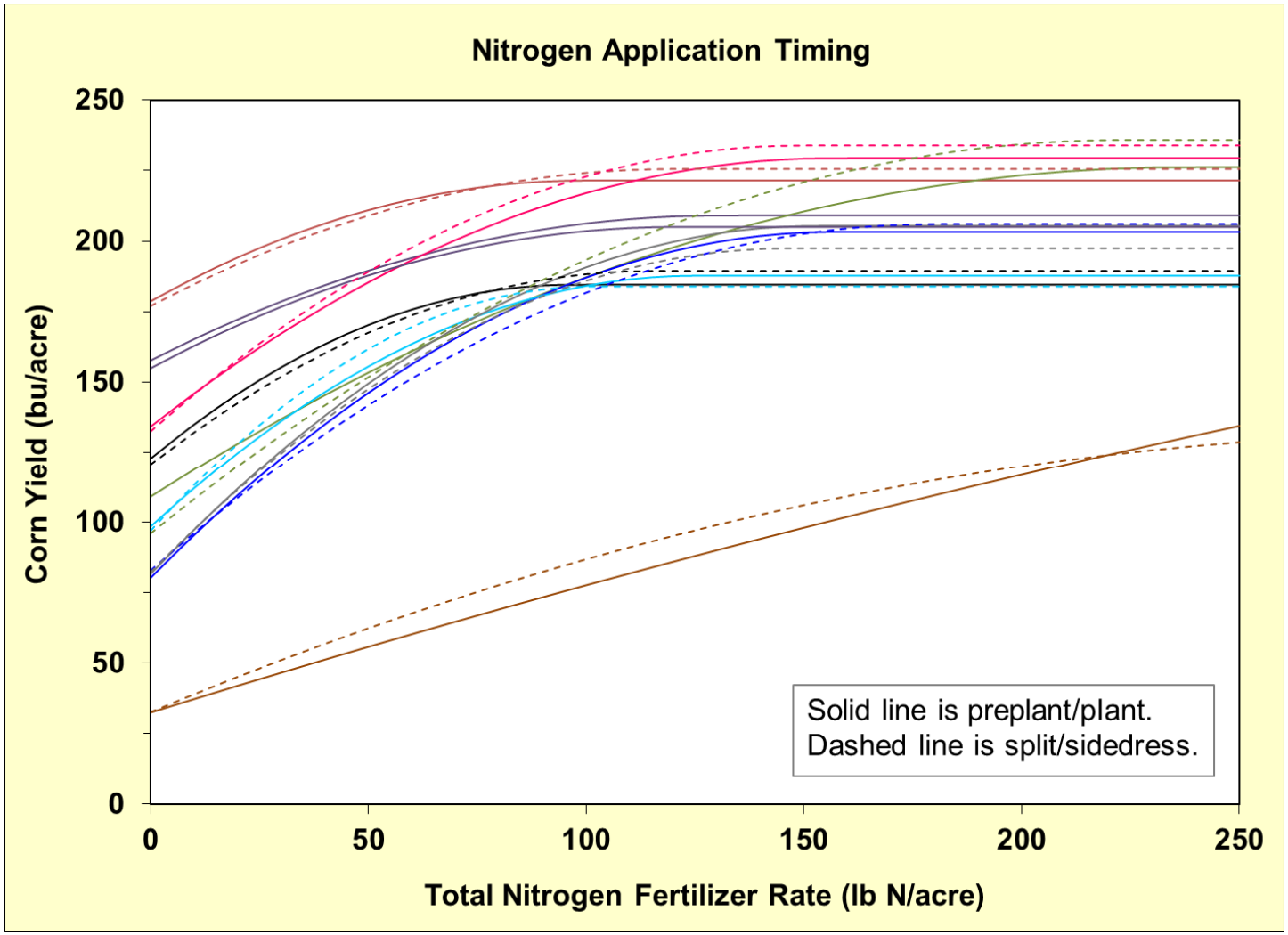



Sawyer, Barker, Hanna, 2009

# 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

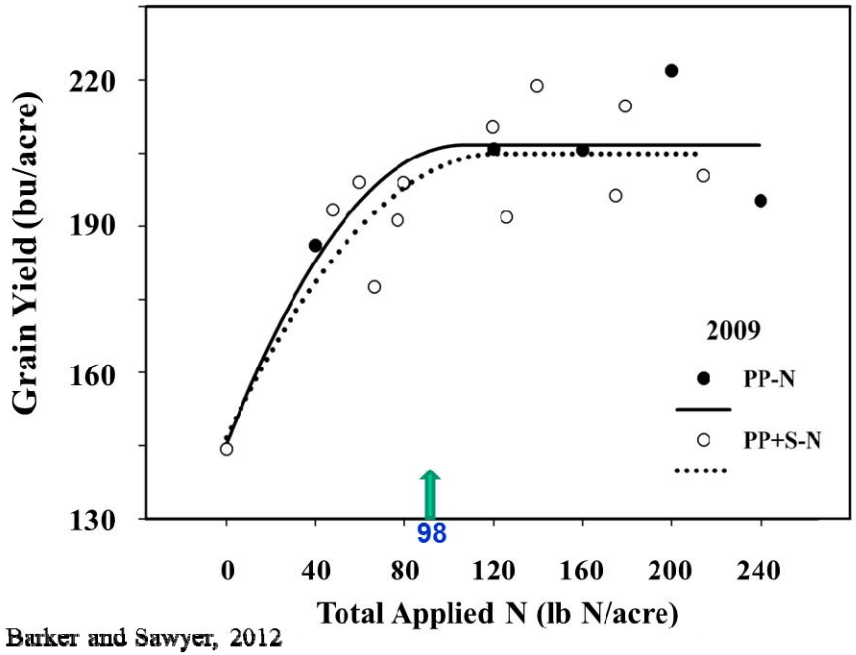


EONR(0.10) for Pre-N rates = 132 lb N/acre

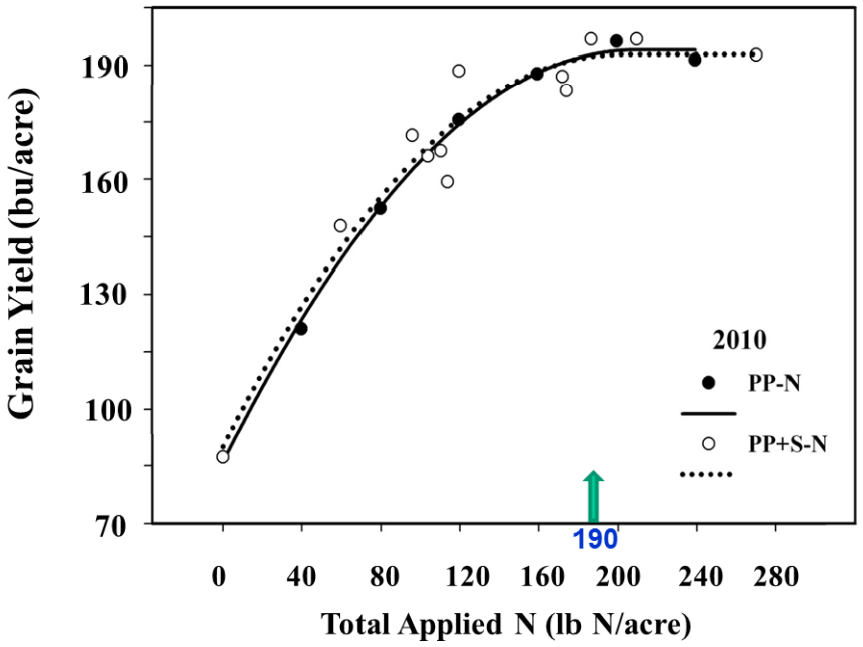
# Mid-Vegetative Sensor-Based Timing Study

- 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



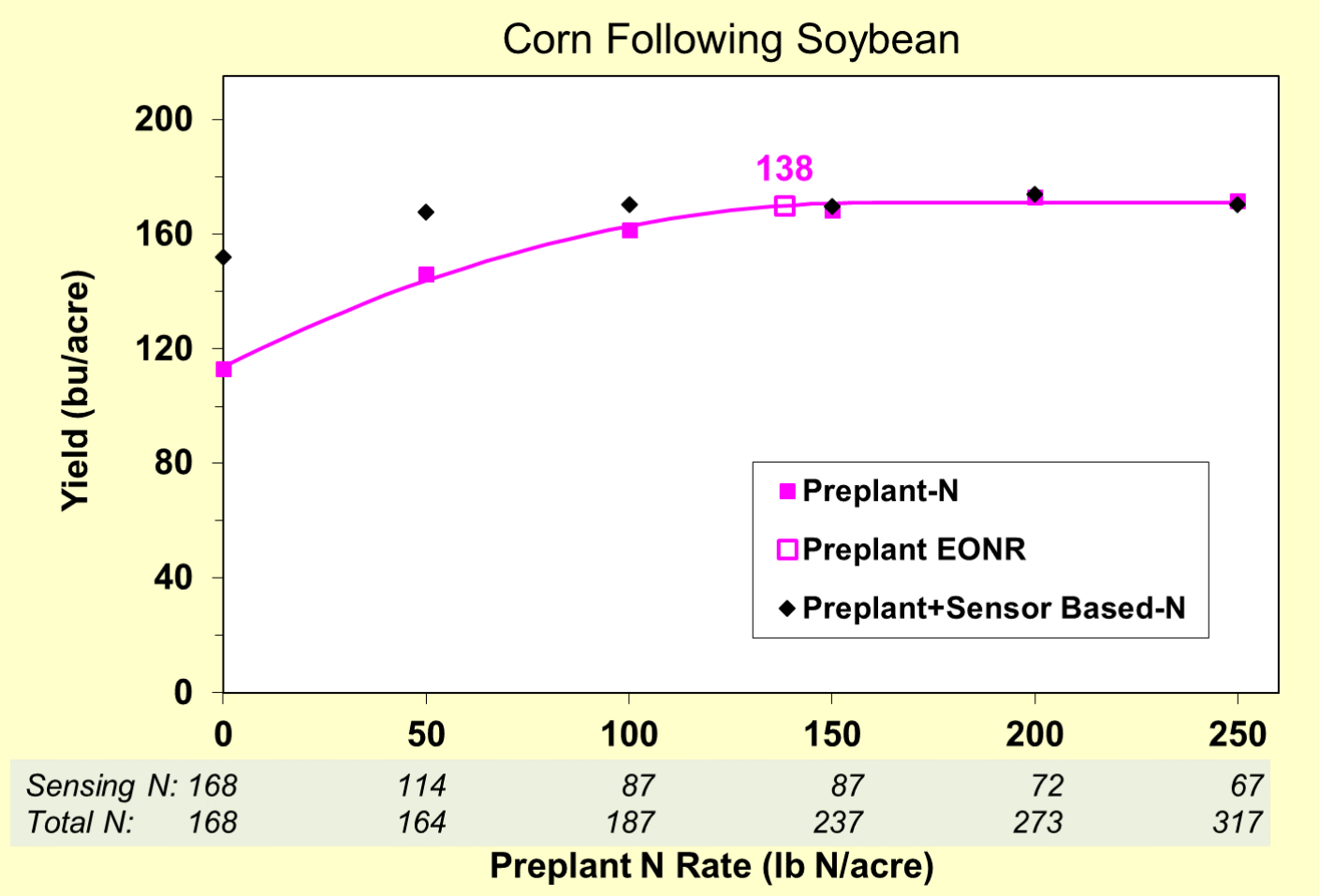

Barker and Sawyer, 2012



# 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