

New Technologies for In-Field Nitrogen Management

Daniel Barker, Ph.D.
Assistant Scientist III, Soil Fertility
Department of Agronomy
Iowa State University

Nitrogen Management On-Farm Trials

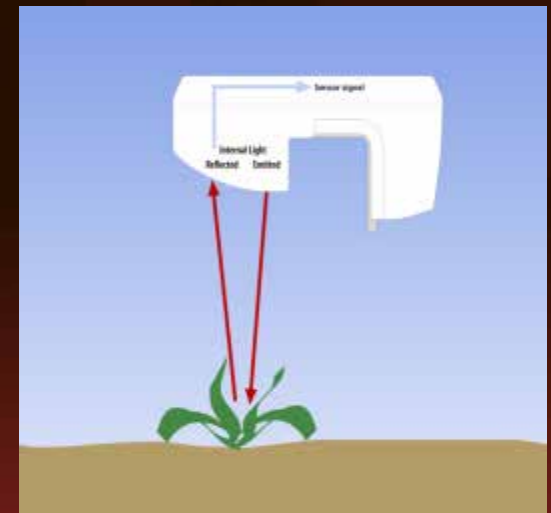
A Partnership Between

- AgVantage FS Co-op in Waverly, Iowa
- Iowa Learning Farms
- ISU Agronomy Department, Soil Fertility Group

What are these new technologies?

Commercially Available Active Canopy Sensors

- Minolta SPAD-502 meter
 - Konica Minolta/Spectrum Technologies
- GreenSeeker
 - NTech/Trimble
- Crop Circle/OptRx
 - Holland Scientific/AgLeader
- CropSpec
 - TOPCON

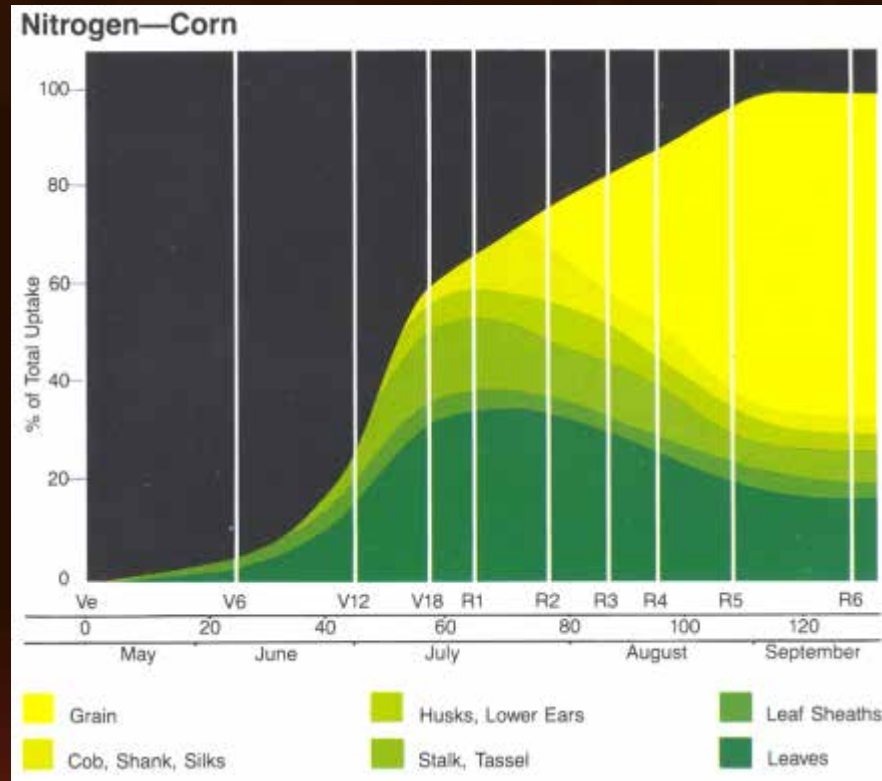


Sensing Corn to Determine N Sufficiency



- Corn plant must be N deficient to “see” N stress
- Does not indicate excess available N

Target N fertilization with corn N need

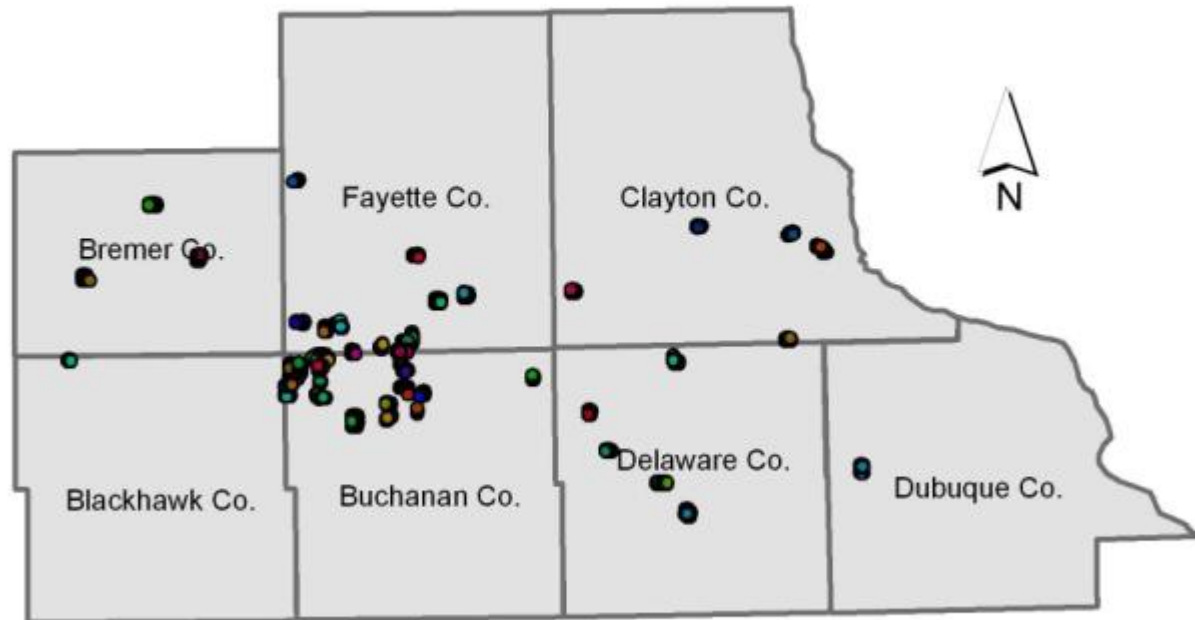


Corn growth and development (Abendroth et al., 2011)

On-Farm N Strip Trials

- Located in NE Iowa.
- Application of urea w/ Agrotain broadcast from early to mid-vegetative stages in corn.
- Strategies: Rescue-N and Split-N
- Field sites: 28 field scale trials in 2011 and 2012.
- Objective: Compare yield response to in-season N, and test remote sensing techniques for applying variable rate nitrogen.

Northeast Iowa on-farm demonstration of post emergence applied N fertilizer to corn, 2011.



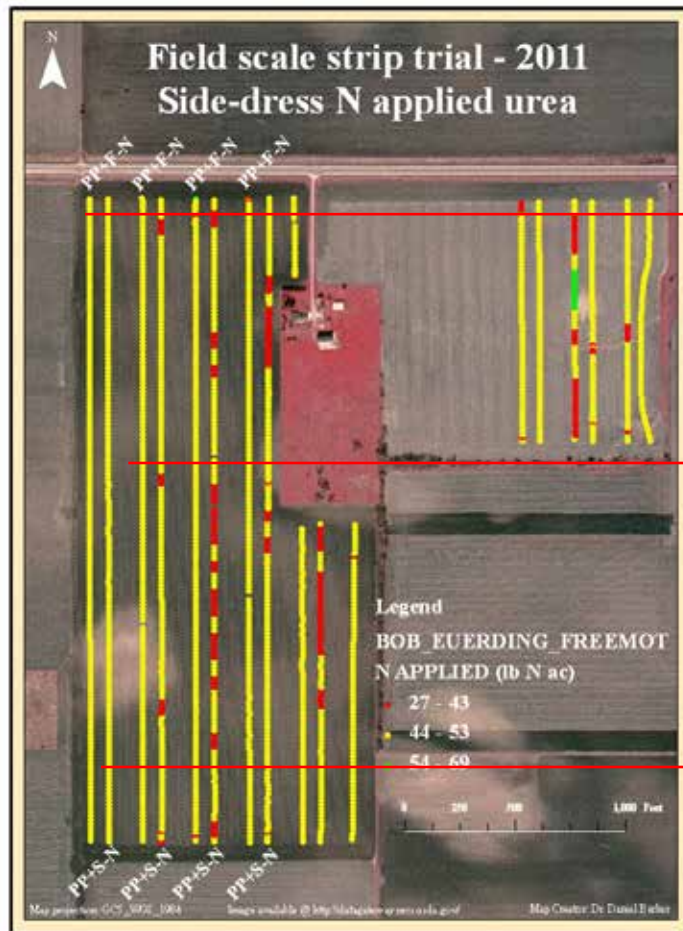
Map projection: GCS_WGS_1984

Image available at <http://datagateway.nrcs.usda.gov/>

On-Farm Strip Trial Methods

- Preplant N Rate (PP-N)
 - Farmer rate and product (Fall, Sp, Split, NH₃, 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 + sensor-based rates
 - Un-calibrated NDVI (no relative index)
 - ≥ 0.85 no N; 0.85-0.5 100 lb urea/acre (46 lb N); < 0.5 150 lb urea/acre (70 lb N)

On-farm field design

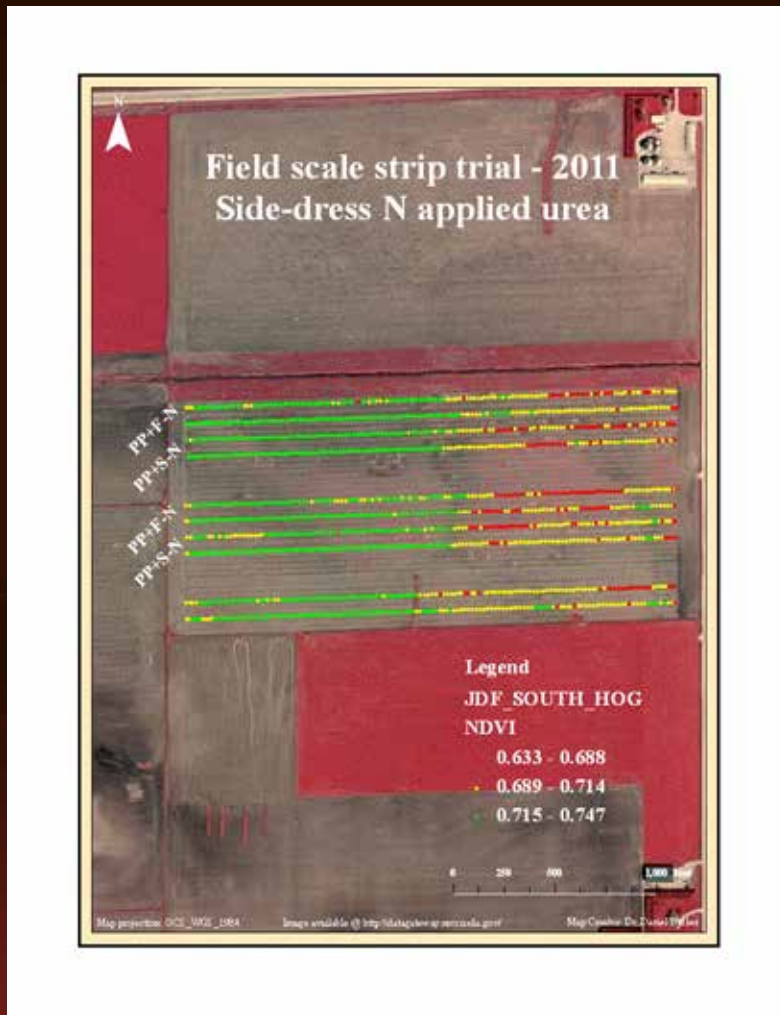


Pre-plant + Flat N
(PP+F-N)

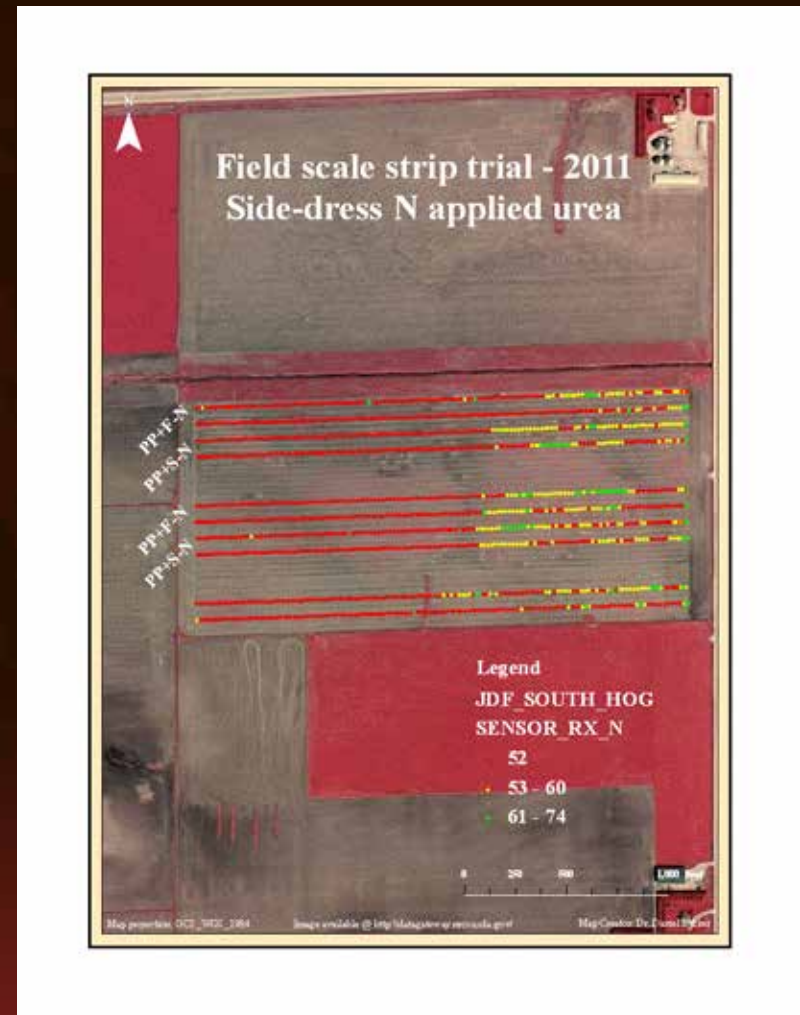
Pre-plant N
(PP-N)

Pre-plant + Sensor N
(PP+S-N)

NDVI map



Sensor N-Rec map



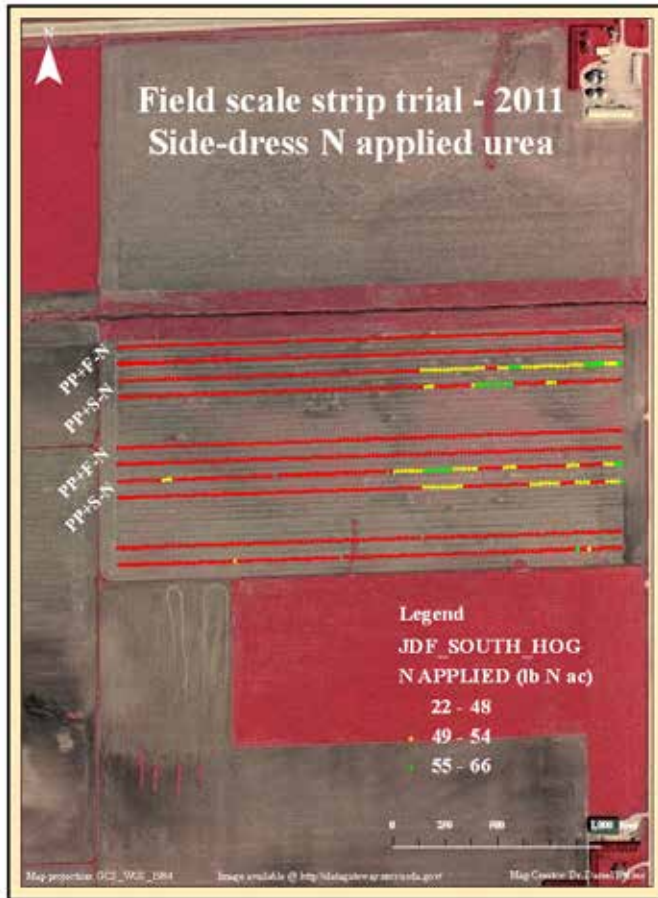


Table 1. Post applied urea on-farm demonstrations, 2011.

N Strategy	Obs.†	NDVI	Total N lb N ac ⁻¹	NUE bu corn lb N ⁻¹	Yield‡ bu ac ⁻¹
Site #7					
PP-N	4	-	120	1.71	204
PP+F-N	4	0.715	165	1.23	202
PP+S-N	4	0.717	167	1.26	210
Treatment Contrast			Statistics (<i>p</i> > <i>F</i>)		
PP-N vs. PP+F-N	-	-	-	<0.0001	0.810
PP-N vs. PP+S-N	-	-	-	<0.0001	0.409
PP-F-N vs. PP+S-N	-	0.550	0.002	0.403	0.295
PP-N vs. PP+F/PP+S	-	-	-	<0.0001	0.728

† Number of field length strips.

‡ Dry yield as reported by yield monitor.

Observations:

- Sensors need a wider operating range
ex: minimum rate of 0 vs. 50 lb N

Table 1. Rescue-N Strip Demonstrations, 2011.

N Treatments	Obs.†	NDVI	Total		
			Applied N lbN/ac	NUE bu/lbN	Yield‡ bu/ac
PP-N	51	-	172	1.2	209
PP+F-N	43	0.694	218	1.0	207
PP+S-N	48	0.696	217	1.0	209
Stats (P<0.05)§		NS	*	*	NS

† Number of field length strips.

‡ Dry yield as reported by yield monitor.

§ * indicates means are statistically different.

Rescue N strategy

- Field scouting the weeks prior to V10.
Are N deficient corn plants present in the field?
- Set operating range of the applicator needs to be reduced. Ex: 0-50 lb N vs. 50-100 lb N
Are growers willing to pay for monitoring with no fertilizer application?
- Growers wanting to adopt precision ag technologies can partner with ag business and scientists to meet their goals.

2012 Results

- 14 on-farm sites
- Data still being analyzed
- Iowa Learning Farms, March 20 Webinar.

Small Plot Research in 2012

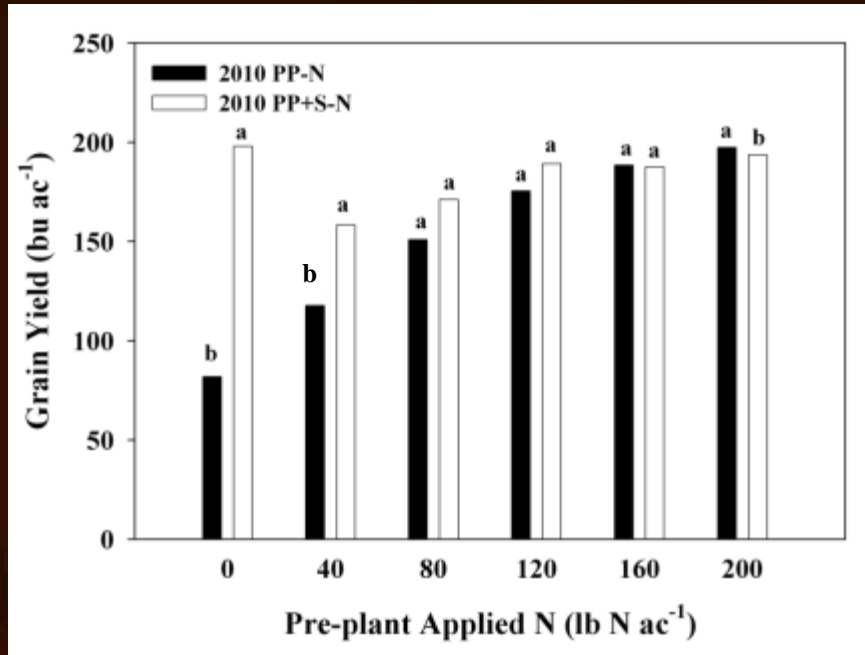
- ISU Research and Demonstration Farms.
- Application of urea w/ Agrotain broadcast from early to mid-vegetative stages in corn.
- PP-N: Preplant N PP+S-N: Preplant + Sensor N
- Strategies: Rescue-N and Split-N
- Field sites: 6 sites (CC and CS rotations) in 2012.
- Objective: Use active canopy sensors to vary in-season N application and compare applied N rate, grain yield, and NUE with preplant applied N.

A contrast of extreme years

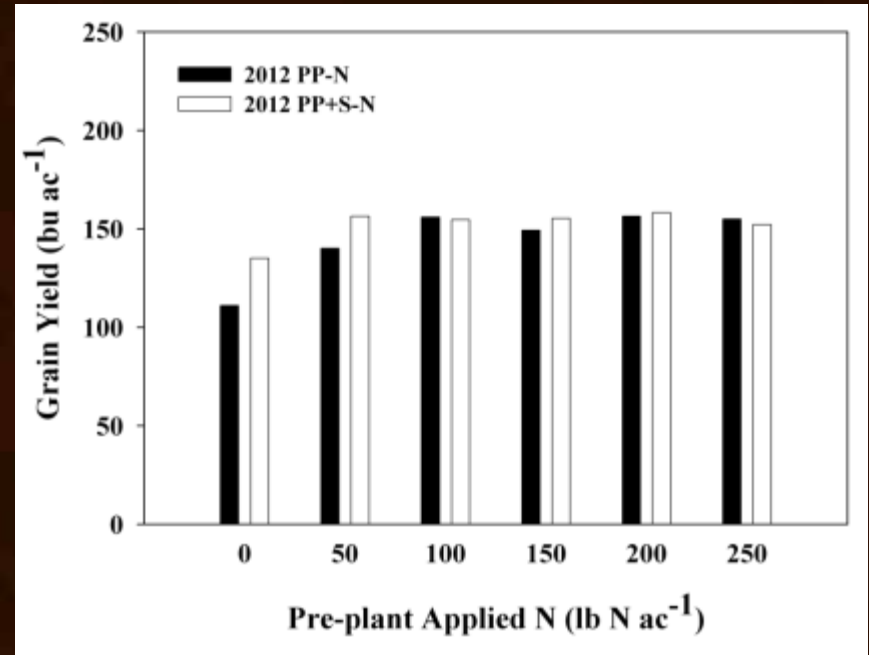
2010 vs. 2012

- N Source: UAN dribbled between the rows in 2010 and Urea w/ Agrotain broadcast over the canopy in 2012
- Ames in 2010 vs. Kanawha, Crawfordsville, and Nashua in 2012
- Different hybrids across sites
- Each in a CS rotation
- Means for 2012 (not yet statistically analyzed)

Wet year



Dry year



In both years

- when moderate to high PP-N is applied, little to no response to in-season N
- when corn N need is high, N applied in-season can be utilized by the plant
- flexible N management offers greater benefits

Summary

Utilize on-farm N trials to achieve your goals

- good record keeping is needed
- compare known vs. new N fertilizer strategies (sensors)
 - ex: explore N source, timings, and spatial placement
- using sensors can be simplified using two strategies
 - ex: Rescue-N and Split-N
- adopt crop monitoring as an N management practice
- partner with professionals for an easier learning curve