DEVELOPING SIDEDRESS NITROGEN RECOMMENDATIONS FOR CORN USING AN ACTIVE SENSOR

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Introduction

- The basis for developing currently used N recommendations for corn (*Zea Mays* L.) includes:
  - preseason soil samples and past management practices (AASL; Penn State Ag Analytical Services Lab)
  - Presidedress Nitrate Test (PSNT) soil samples collected at the 6th-leaf growth stage (V6)
  - Chlorophyll meter readings at V6 using a SPAD-502 meter (Minolta Corp.)
- Active sensors, including the Crop Circle ACS-210 sensor (Holland Scientific, Inc.), provide an opportunity to make on-the-go N recommendations for corn at sidedress
- The success of using an active sensor for sidedress N recommendations depends on a quantifiable relationship between economic optimum N rate (EONR) and canopy reflectance or an index based on canopy reflectance

Objectives

- Quantify the relationship between sidedress EONR for corn and reflectance from a Crop Circle ACS-210 sensor
- Evaluate the success of current methods for developing N recommendations based on observed EONR

Conclusions

- Relative GNDVI was a better indicator of EONR than N recommendations based on AASL, PSNT, or a SPAD meter
- When N fertilizer was not applied or Manure was applied at planting, EONR was strongly related to Relative GNDVI (Fig. 1)

Methods

- Four field sites were selected in each of two years
- Soil types were typical of central Pennsylvania (Table 1)
- Corn was planted following corn (-CC), soybean (-SC), or alfalfa (-AC) for various tillage and manure application histories (Table 1)
- Preplant N, as a whole-plot treatment, included: a Control, 56 kg ha^{-1} N as NH_4NO_3, and Manure (37 - 122 kg ha^{-1} available N)
- Split-plot treatments included: 0, 22, 45, 90, 135, 180, and 280 kg ha^{-1} N applied at the V6-7 growth stage and 280 kg ha^{-1} N applied immediately after planting, applied as NH_4NO_3
- Each split-plot was 9.1 x 4.5 m and part of a RCBD design with four blocks
- Soil samples were collected prior to planting from the Control preplant treatment and at V6 from the 0 split-plot treatment for each preplant treatment
- The AASL N recommendation was determined based on previous crop and manure management
- The PSNT N recommendation was determined based on soil samples collected at V6
- The SPAD meter N recommendation was based on readings collected at V6
- Canopy reflectance data were obtained at V6 for 590 and 880 nm wavelengths using the Crop Circle ACS-210 sensor, six to eight readings per second
- The Crop Circle sensor was mounted on a boom 60 cm above and perpendicular to the corn leaf canopy
- Mean reflectance was determined for each split plot
- GNDVI was determined for each split plot:

$$GNDVI = \frac{NIR_{880} - VIS_{590}}{NIR_{880} + VIS_{590}}$$

- Relative GNDVI was determined for each of 24 site / preplant combinations:

$$\text{Relative GNDVI} = \frac{GNDVI_{\text{0 split plot}}}{GNDVI_{\text{280 at planting}}}$$

- Relative SPAD was determined following a similar approach
- A quadratic-plateau function was used to describe grain yield response to V6-7 N application for each of 24 site / preplant combinations
- EONR is based on \$0.078 kg^{-1} corn (\$2 bu^{-1}) and \$0.66 kg^{-1} N fertilizer (\$0.30 lb^{-1}), see poster #51-5 for other price ratios

Results

- Results from RS-CC, 2005 illustrate results when EONR > 0, a quadratic-plateau grain yield response to the V6-7 N application was observed for all three preplant treatments (Fig. 2)
- At RS-CC, 2005, EONR was: 105 kg ha^{-1} N for the Control, 93 kg ha^{-1} N for NH_4NO_3, and 139 kg ha^{-1} for Manure
- EONR was: 93 - 200 kg ha^{-1} when the previous crop was corn (-CC), 0 - 55 kg ha^{-1} when the previous crop was soybean (-SC), and 0 when the previous crop was alfalfa (-AC) (Table 2)
- Deviations from observed EONR for the AASL-, PSNT-, and SPAD-derived N recommendations are provided in Fig. 3
- EONR was strongly related to Relative GNDVI when fertilizer was not applied or Manure was applied at planting (Fig. 4)

Results

Table 2

Preplant		2005				2006				
Treatment	Site	EONR	N recs. based on AASL	PSNT	SPAD	Site	EONR	N recs. based on AASL	PSNT	SPAD
		kg ha^{-1}					kg ha^{-1}			
	RS-CC					RS-CC				
Control		105	160	180	158		202	160	185	156
NH_4NO_3		93	104	0	149		161	104	200	159
Manure		139	96	121	0		188	73	182	130
	RS-SC					RS-SC				
Control		49	110	0	0		55	110	210	170
NH_4NO_3		0	54	0	0		55	54	202	0
Manure		49	46	82	0		55	30	172	139
	RS-AC					AIR-AC				
Control		0	71	0	0		0	71	162	0
NH_4NO_3		0	24	0	0		0	24	0	0
Manure		0	19	0	0		0	0	0	0
	AIR-SC					AIR-CC				
Control		0	110	0	0		134	160	240	223
NH_4NO_3		0	54	0	0		100	104	168	0
Manure		0	73	0	0		122	27	168	133

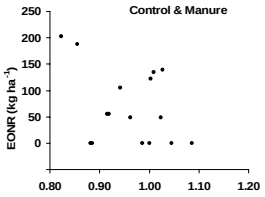

Figure 5

- The Control and Manure data are combined in Fig. 1
- EONR was more strongly related to Relative GNDVI (Fig. 1) than Relative SPAD (Fig. 5)

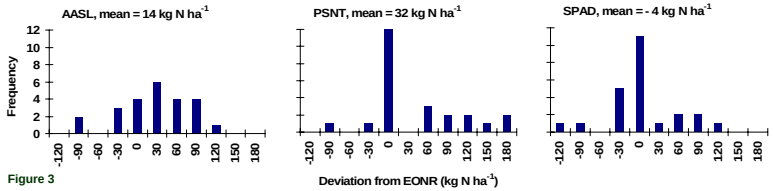

Figure 3

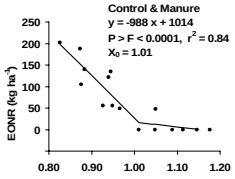

Figure 1

Table 1

Site	Soil Series	Usual Crop Rotation	Previous Crop	Tillage	Manure History	Corn seed Hybrid	Corn seed Population
							plants ha^{-1}
2005							
RS-CC	Murrill (Mu)	Corn / SB	Corn	Chisel / Disk	No	Pioneer 36B08	70,148
RS-SC	Murrill	Corn / SB	SB	Chisel / Disk	No	Pioneer 36B09	70,148
RS-AC	Hagerstown (Ha)	Alfalfa	Alfalfa	MB / Disk	No	Dekalb DKC53-34	64,467
AIR-SC	Ha & Opequon	Corn / SB	SB	No-Till	Yes	Seedway E-538	69,160
2006							
RS-CC	Murrill	Corn / SB	Corn	Chisel / Disk	No	Pioneer 34H39	70,395
RS-SC	Mu & Ha	Corn / SB	SB	Chisel / Disk	No	Pioneer 34H40	70,396
AIR-AC	Hublersburg	Alfalfa	Alfalfa	No-Till	No	Dekalb DKC54-51	74,100
AIR-CC	Ha & Opequon	Corn / SB	Corn	No-Till	Yes	Dekalb DKC54-52	74,101

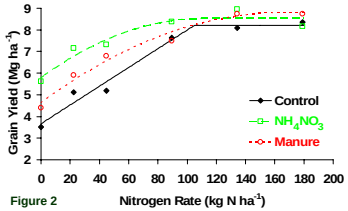

Figure 2

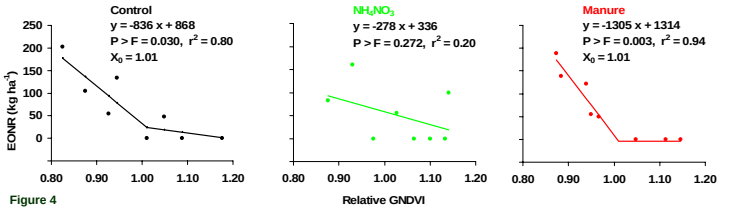

Figure 4