Fluid Fertilizers to Manage In-Season N Using Site-Specific Management Zones and On-the-Go Active Remote Sensing

Tim Shaver, R. Khosla and D.G. Westfall Department of Soil and Crop Sciences





Introduction: med low med high

Management Zones are delineated on farm fields by classifying the field into different sections or zones.

Based on the research conducted in Colorado*

* CSU, USDA-ARS, Centennial Ag Inc.

Site-Specific Management Zones (SSMZ)

In Colorado, we have developed and evaluated four techniques of delineating MZs:

- Each technique uses a unique set of soil, yield, and/or remotely-sensed data layers
- \checkmark

Level of technological expertise ranges from simple to complex



After extensive evaluation of our MZ techniques we have concluded that the SCMZ technique is the best



Soil Color based Management Zones (SCMZ):



Involves three data layers:

Bare soil imagery

Topography

Farmer's experience

The three data layers

Bare Soil Aerial Imagery
Topography
Farmer's experience
are stacked as GIS layers
to delineate the zone

Traits such as dark color, low-lying topography, and historic high yields were designated as a zone of potentially high productivity or high zone

GIS Layers





Soil Color Based Management Zones

- Accurately characterizes grain yield into high, medium and low productivity in 9 out of 10 site-yrs
- ✓ Accurately characterizes soil properties within each zones
 - Enhances net \$ return (\$13 to \$27/ac) as compared to traditional N management
- Enhances nitrogen use efficiency
- ✓ Reduces nitrogen leaching, etc



SCMZ

However, within each management zone there is still significant microheterogeneity, which could be quantified and potentially managed using active remotesensors



SCMZ

Scale of Heterogeneity within zones* Low zone: 30 to 120 bu/ac

Med zone: 120 to 200 bu/ac

High Zone: 200 to 300 bu





*Irrigated corn production in Colorado



At the beginning of this work, we had some questions:

- Could we use active remote sensors
- Handheld or tractor mounted
- To quantify variability in crop canopy within management zones
- Manage such variability with in-season management
- To enhance grain yield, MUE and net S return



The objectives of this on-going study are:

1. Determine the effectiveness of active remote sensors across Site Specific Management Zones (field study).



2. Determine which commercially available active sensor performs best in our region and at which corn growth stage (field study and green house study).

Three active remote sensors NTech's GreenSeekerTM "Red" (~ 650nm) NTech's GreenSeekerTM "Green" (~ 510nm) Holland Scientific Crop Circle "Amber" (~ 590nm)



2. Determine which commercially available active sensor performs best in our region and at which corn growth stage (field study and green house study).



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- 3. Develop an in-season N fertilizer recommendation algorithm on the basis of NDVI readings collected from the active remote sensors across management zones for Colorado.
- This is work in progress
- Once developed it will be incorporated into Green Seeker's N recommendation algorithm for Colorado



Specific Objective:

The portion of on-going study presented today:

To evaluate two commercially available active remote NDVI sensors:

NTech's GreenSeekerTM (red)

Holland Scientific's Crop CircleTM (amber)

on the basis of their performance in quantifying N variability for various corn growth stages under field conditions.



Methods:

Sensors:

NTech's GreenSeekerTM red unit Holland Scientific's amber Crop CircleTM

Sites:

2 site years, both located at the Agricultural Research Development and Education Center (ARDEC) Fort Collins, Colorado

Sensor readings at 4 growth stages: V8, V10, V12 and V14

N rates (kg/ha): 0, 50, 100 and 175 (4 replications of each)



Sensor reading output is NDVI: NIR-VIS

Where: NIR = near infrared and VIS = visible light wavelength (Red or Amber)



Methods:

Analysis:

Sensors data were evaluated using linear plateau regression.

>NDVI sensor readings were correlated with N application rates for each growth stage to determine which sensor (and at what growth stage) best characterized N variability.

► NDVI sensor readings were also correlated with grain yield to determine how well NDVI readings explained grain yield.









Corn grain yield across 4 fluid Nitrogen application rates at site year 1



Corn grain yield across 4 fluid Nitrogen application rates at site year 1



Corn grain yield across 4 fluid Nitrogen application rates at site year 2



















Amber and Red NDVI correlation with nitrogen application rates across site years.





Results:

The highest correlations (NDVI vs N application rates) were observed at growth stages V12 and V14 for site year 1 and V12 for site year 2.

➢ Growth stages V12-V14 are most likely be the best opportunity to acquire in-season NDVI readings for the most accurate determination of crop vigor and in-season N management

The amber (crop circle) and red (Green Seeker) NDVI correlations with N application were not significantly different.

Results...

Green seeker sensor appears to saturate sooner (high NDVI values) and may limit its application under thick crop canopy covers

Both sensors fail to differentiate agronomically significant yield differences for site year 1

Overall both sensors performed equally well under field conditions

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Thank You

Raj Khosla raj.khosla@colostate.edu

Tim Shaver timothy.shaver@colostate.edu

Dwayne Westfall dwayne.westfall@colostate.edu

