Proximal Sensing of Plant Nitrogen Status in Corn to Improve Nitrogen Management

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INTRODUCTION

A nutrient use survey showed that corn was the most fertilized crop in the US with 97% of the planted area fertilized with commercial sources of N (AREI Updates, 1996).

Efficient N management can be achieved if farmers are aware of all sources of N available to the crop.

Traditionally, the N requirement of the crop is determined from reasonable estimates of:

- Yield
- Residual soil nitrate-N
- Soil organic matter
- N credits from:
  - irrigation water
  - legumes
  - manure

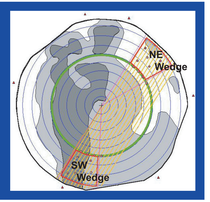
Since the plant is an integrator of its environment, it may be much easier to allow the crop to indicate its N status rather than attempting to predict the N supply capability from the previously listed sources.

OBJECTIVE: Investigate the use of the N Reflectance Index (NRI)

- to assess the nitrogen status of an irrigated corn canopy
- to recommend the timing of in-season N applications

MATERIALS AND METHODS

- 2.75 ha truncated wedge areas were established within predefined management zones for a commercial center pivot irrigated corn field
- Soil type and residual soil NO_3-N in the 0-1.5 m profile:
  - NE Wedge: fine sand, 23 kg/ha
  - SW Wedge: loamy sand/sandy loam, 193 kg/ha



Ground based and aerial remote sensing techniques were utilized

Spectral Wavebands

Green (G)	520 to 600 nm
Red (R)	630 to 690 nm
Near-Infrared (NIR)	760 to 900 nm

Ancillary data included leaf area and SPAD measurements

NITROGEN REFLECTANCE INDEX (NRI)

- Bausch and Duke (1996)
- Based on canopy reflectance measured in the green (G) and near-infrared (NIR) portions of the electromagnetic spectrum

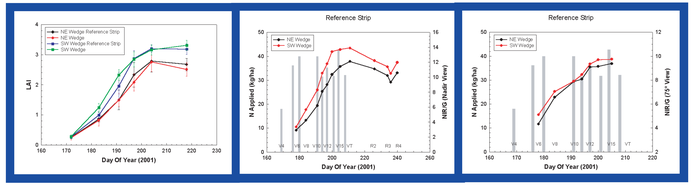
$$NRI = \frac{(NIR/G)_{target}}{(NIR/G)_{reference}}$$

NITROGEN SUFFICIENCY INDEX (NSI)

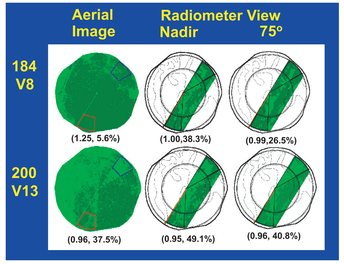
- Peterson et al. (1993)
- Based on SPAD chlorophyll meter measurements

$$NSI = \frac{SPAD_{target}}{SPAD_{reference}}$$

RESULTS



307 kg N/ha Applied To The Reference Strip In 9 Applications During Vegatative Growth



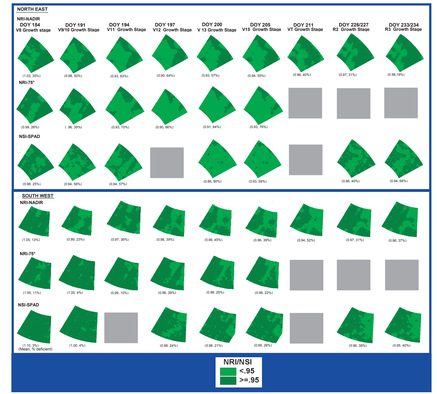
Nitrogen Applied to SE Half of Field

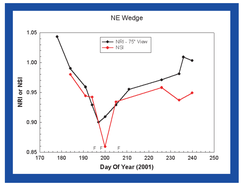
April25 (183): 5.6 kg/ha preplant with P and K
May 16-17 (136-137): 28 kg/ha at planting
Additional N (kg/ha) applied via fertigation

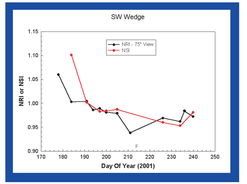
a. Area between the two wedges (farmer decision)
1. July 2 (183): 67.2
2. July 9 (190): 33.6
3. July 14 (195): 33.6
4. July 17 (198): 33.6
5. July 23 (204): 44.8
Total: 212.8

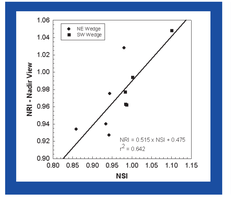
b. NE Wedge
1. July 14 (195): 33.6
2. July 17 (198): 33.6
3. July 25 (206): 33.6
Total: 100.8

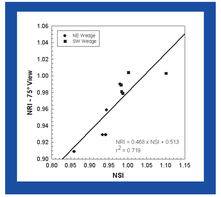
c. SW Wedge
1. Aug 2 (214): 33.6
Total: 33.6











ULTIMATE GOAL: To spatially apply the correct amount of N fertilizer to the crop when a nitrogen deficiency is detected.

CONCLUSIONS

1. Measurable differences in leaf area existed between the two wedge reference areas.
2. The NIR/G ratio was different for the two wedge reference areas - moreso for the nadir view than the 75° view.
3. Reference areas must be associated with different soil types to adequately normalize SPAD and spectral data.
4. Applying N "as needed" by the crop reduced N application compared to the farmer's practice
   - NE Wedge - 112 kg/ha
   - SW Wedge - 179 kg/ha

REFERENCES

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