Fertilizer and Ag Lime Grants
Progress Report on:

Spectral radiometer to control variable-rate N applications for corn

Peter Scharf, Eduardo Souza, and Ken Sudduth
Department of Agronomy and Department of Biological Engineering, Univ. of Missouri and
USDA Agricultural Research Service

Accomplishments for 2001:

- Our goal for this project is to support ongoing research that would ultimately lead to variable-rate sidedress or late applications of N based on a spectral radiometer mounted on the applicator. The spectral radiometer measures the color of the crop (in this case, corn) and responds by applying more N where the crop is lighter green.
  - One of the obstacles to variable-rate applications based on a spectral radiometer is that the readings from the spectral radiometer depend not only on the color of the corn, but also on time of day (sun angle) and cloud cover.
  - The radiometers that we are using sense not only the light reflected from the corn, but also the light from the sky. The proportion of the incoming light that is reflected back by the corn can then be measured. Correcting for variations in incoming light intensity takes out most of the variability from sun angle and cloud cover. Our past experience is that, even after correcting for the intensity of incoming light, reflectance measurements are still dependent on sun angle and cloud cover.
  - Our specific goal for this project is to develop correction factors so that we can get the same reading off the same plants regardless of time of day or cloud conditions.
- We measured reflectance from corn with two different spectral radiometers
  - Crop Circle measures at four different wavelengths (460, 550, 670, 800 nm)
  - Cropscan measures at eight different wavelengths (510, 560, 610, 660, 710, 760, 810, 760-900)
- Spectral radiometers were mounted in a stationary position above corn plants and readings were taken throughout the day (every 2 seconds for Crop Circle, every 2 minutes for Cropscan). Corn plants were anywhere from 1 to 6 feet tall at the time that readings were taken.
  - Readings started in May with corn grown in the greenhouse and moved in pots to Sanborn Field.
  - Readings continued from June to October on corn planted at MU's Bradford Farm east of Columbia. Corn was planted about every two weeks starting at normal planting time and continuing throughout the summer and fall. Thus we had knee-high to head-high corn all season long on which to make measurements.
  - We ended up with over 60 days of readings from morning until night.
  - The results from all 60 days have been compiled into one computer file for the Crop Circle spectral radiometer, and analysis is proceeding.
  - Approaches for data analysis include:
    - Developing equations that can be used to correct for the effects of sun angle and cloud cover on reflectance at individual wavebands.
    - Understanding reflectance indexes which use more than one wave band, and the extent to which these indexes automatically correct for sun angle and cloud cover

effects.

- We do not yet have results that are ready to present.

Objectives for 2002:

- Complete analysis of data collected in 2001.
- Develop methods to correct for sun angle and cloud cover in reflectance measurements from spectral radiometers.
- Apply these correction methods to spectral radiometer data collected in field-length N rate experiments in corn over the past three years.