Relationship of Active-Optical Sensor Readings with Sugar Beet Yield and Quality, Sunflower Yield and Spring Wheat Protein

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ABSTRACT

A series of nitrogen rate experiments were established in sugar beet (*Beta vulgaris, L*), sunflower (*Helianthus annuus, L*), and spring wheat (*Triticum aestivum*, L) in 2012. Two active-optical sensors were used in sugar beet and sunflower at the 6 leaf stage and again about two weeks after the first reading. The sensors were used at flag leaf (Zadoks 37) in spring wheat. Sensor readings were related to sugar beet yield and recoverable sugar per acre. Sensor readings were related to both confection and oil sunflower yield. The ratio of sensor readings at high N rates and the sensor ratio when the grain protein level was 140 g kg-1 was about 0.95 at two sites using two different spring wheat cultivars. Use of active optical sensors may be useful not only in yield prediction, but also with quality parameters associated with nitrogen nutrition.

INTRODUCTION

Active-optical sensors emit specific wavelengths of light and have the ability to read the light reflected from their emittance. The light emitted is related to either biomass or chlorophyll content. Sensors using red (R) and near infrared (NIR) light record the NDVI (normalized difference vegetative index ((NIR-R) / (NIR + R)). Sensors that use a red-edge light source use red-edge (RE) NDVI. ((NIR-RE) /(NIR + RE) . To pool data from several sites of the same crop, the concept of INSEY (in-season estimate of yield was introduced (Raun, 2005). INSEY is the sensor reading divided by growing degree days from planting.

There is an extensive data base from active-optical sensor research for wheat yield, but not for wheat protein. There is not a great sensor data base for either sugar beet or sunflower.

OBJECTIVES

Determine the effectiveness of active-optical sensors for estimating wheat protein, sugar beet yield and sugar content, and sunflower yield.

MATERIALS AND METHODS

Two locations each of spring wheat, sugar beet and sunflower were established in 2012.

Sugar beet sites were near Amenia, ND and Crookston, MN.

Spring wheat sites were near Gardner, ND and Valley City, ND

Sunflower (oil seed) site was located near Valley City, ND. A confection sunflower site was located near Cummings, ND

Each experiment was established as an N rate plot, with six treatments (control, 44, 88, 132, 168 and 220 kg ha^{-1} for wheat and sunflower, and control, 33, 66, 99, 132 and 165 kg ha^{-1} for sugar beet.

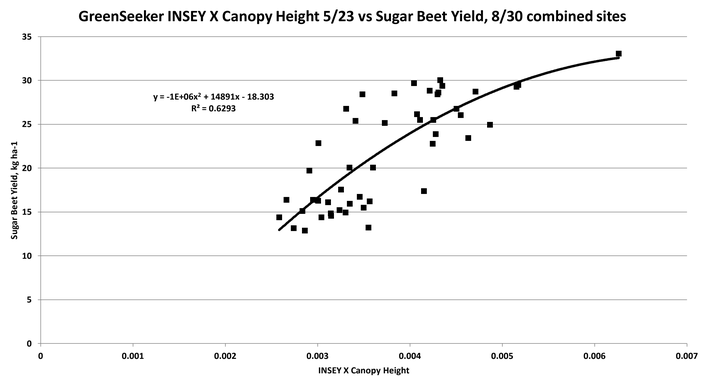
Sensor Readings

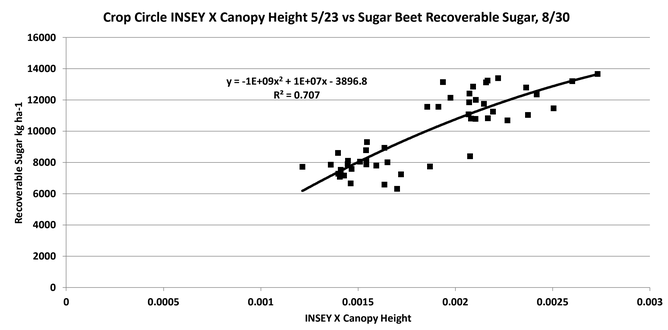
- Greenseeker (N-Tech Industries, distributed through Trimble) and Holland Scientific Crop Circle Sensor-470 were used for the study.
- Greenseeker emits visible and near infrared light as below:

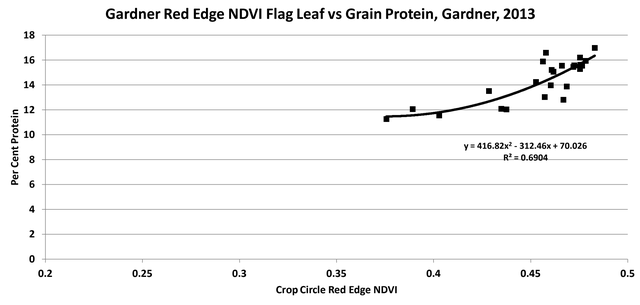
- Crop Circle-470 emit three bands visible, red edge, and near infrared . Ratios calculations follow:

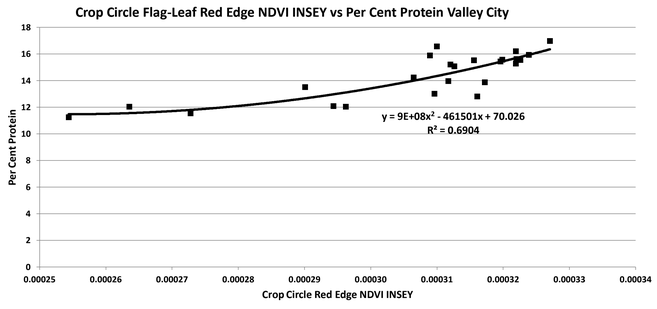
- Approximately 45 readings /row from each plot were taken with each sensors The NDVI values were averaged for each plot as well as for each treatment.
- Both sensors, Crop Circle-470 and Greenseeker were used at 5-8 leaf stage and about 10 days to 14 days in sugar beet and sunflower. In spring wheat, the sensor was used at flag leaf (Zadoks 37). .

RESULTS

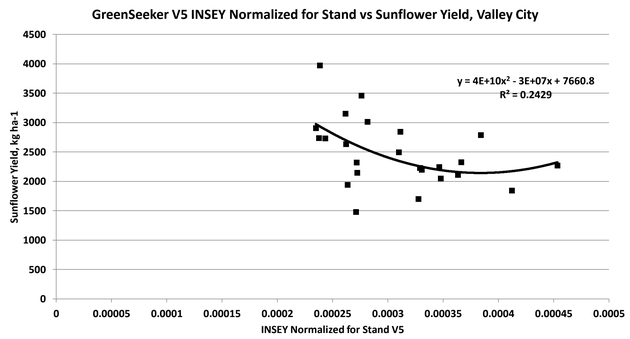


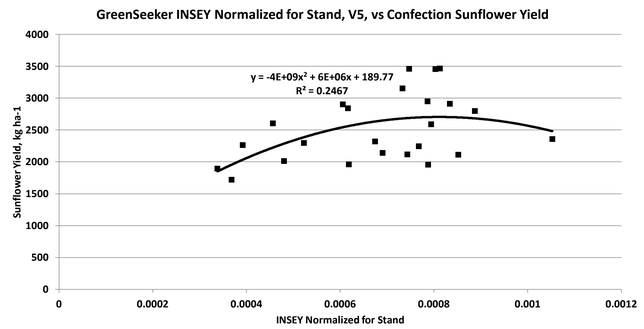






At each location, reading at 14% protein divided by high reading is approximately 0.95.





SUMMARY

Relationships between both red NDVI and red edge NDVI were recorded in sugar beet yield, sugar beet quality, spring wheat protein, and sunflower yield with both the GreenSeeker and Crop Citcle sensors. These sensors can be used to develop algoirthms relationg sensor readings, yield and quality parameters of these crops.

REFERENCES

Raun, W.R., J.B. Solie, G.V. Johnson, M.L. Stone, E.V. Lukina, W.E. Thomason, and J.S. Schepers. 2001. In-season prediction of potential grain yield in winter wheat using canopy reflectance. Agron. J. 93:131-138.

ACKNOWLEDGEMENTS

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