Evaluation of Canopy Reflectance for Optimizing Nitrogen Rates in Corn

(Interim Report)

Purpose:

Site specific application of nitrogen to corn is motivated by increasing costs and environmental concerns associated with nitrogen. Spectral reflectance of a corn canopy has been proposed as a means to discern spatial variation in soil nitrogen supply and corn responsiveness to additions of nitrogen fertilizer. Optical sensors that measure Normalized Difference Vegetation Index (NDVI) have been developed and are being commercially used; but their ability to improve nitrogen use efficiency on a field scale has not been thoroughly tested in Ontario.

The objective of this study was assess whether corn responsiveness to nitrogen fertilizer can be determined spatially using an optical sensor to measure NDVI .

Methods:

Field scale trial (3 replicates) conducted over 2 years - 2006 (Ariss ON), 2007 (Conestogo, ON), with locations chosen based on crop history and production background that increased the probability of nitrogen responsiveness.

Optical sensors (Green Seeker units) were mounted to the front of the tractor in order to scan four rows of corn (see Figure 1). Optical sensing (NDVI) measurements were taken at various stages from approximately the 6^{th} to the 12^{th} leaf stage.

Prediction of required N rates required both the NDVI measurement from the specific plot in question (which had received little or no nitrogen) as well as a “saturated” measurement taken from a strip down the length of the field which had 210 kg N/ha applied prior to planting. The ratio between these two measurements provided the input to the rate determination step.

Various nitrogen rates were applied to bordering plots and yields were recorded from each of these plots. This allowed for an estimation of the amount of fertilizer nitrogen that was required at each plot down the length of the field. This optimum N rate was then compared to the predicted N rate based on the optical sensor measurements (NDVI).

Figure 1. Tractor mounted optical sensors for evaluating corn plant size and colour.

Results:

Optical sensing (NDVI) measurements did not correlate with corresponding spatial measurements of corn yield response to nitrogen. As a result, feasibility of spatial nitrogen application based on NDVI is questionable. This concern is further accentuated by the fact that, in this study, the addition of starter nitrogen (30 kg N/ha) largely eliminated spatial differences in NDVI until the 10-12 leaf stage. In Ontario, substantial yield benefits to starter nitrogen have been demonstrated in corn, and growers would be reluctant to forego starter nitrogen use.

Summary:

Although the ability exists for growers exists to construct an application unit that would sense the corn and apply nitrogen in a site specific manner (see Figure 2)

Figure 2. On-the-go optical sensing and application of UAN.

Next Steps

Ontario researchers involved in this project will continue to monitor the large amount of U.S. based work in this area. As additional technological developments surface there may be an opportunity to apply them to Ontario conditions. The other future step maybe to mount the GreenSeeker sensors on high clearance sidedress equipment in order to examine the possibility that the sensors will perform better in much more advanced corn (i.e. post 12 leaves) than was used in this study.

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