Using Early-Season Dark Green Color Index (DGCI) and SPAD to Predict Corn Yield

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INTRODUCTION

- Crop sensors can help growers manage late-season N applications
- Late-season N applications difficult in rain-fed environments
  - Delay N application further due to rain
  - Lack of moisture may prevent incorporation
- Early detection of N deficiency could help improve N management in rain-fed environments
- Soil plant analysis development (SPAD) is a non-destructive measure of leaf color (Fig. 1)
- New technologies using the dark green color index (DGCI) are also available (Fig. 2)
- Limited field testing of DGCI at early-season growth stages

OBJECTIVES

1. Use DGCI and SPAD to detect different N application rates at multiple growth stages.
2. Measure the relationship between DGCI and yield as well as SPAD and yield at multiple growth stages.

METHODS

Ohio Field Experiments in 2013 and 2014:
- Hoytville (NWARS) and S. Charleston (WARS)
- Five N rates (0-269 kg N ha⁻¹)
  - Injected at sidedress (V4) as 28-0-0 UAN
  - Measured DGCI and SPAD at V6 and R2
Michigan Field Experiments in 2014:
- Richville (SVREC) and East Lansing (SCFR)
- Six N rates (0-280 kg N ha⁻¹)
  - 40% preplant incorporated as 46-0-0 urea
  - 60% surface banded at sidedress (V4) as 46-0-0 urea treated with stabilizer
- Measured DGCI and SPAD at V6 and R1

STATISTICS

Data were analyzed within each site-year using PROC MIXED in SAS 9.4, with means separated using Fisher’s Protected LSD (α=0.05). Data were normalized within site-year prior to linear regression analysis (PROC REG).

RESULTS AND DISCUSSION

Table 1. DGCI and SPAD values at each N rate within a site-year at V6. Values followed by the same letter within a column for each site-year similar (P ≤ 0.05).

<table>
<thead>
<tr>
<th>N Rate</th>
<th>V6</th>
</tr>
</thead>
<tbody>
<tr>
<td>kg N ha⁻¹</td>
<td>NWARS, 2013</td>
</tr>
<tr>
<td>0</td>
<td>0.633a</td>
</tr>
<tr>
<td>67</td>
<td>0.638a</td>
</tr>
<tr>
<td>134</td>
<td>0.632a</td>
</tr>
<tr>
<td>202</td>
<td>0.643a</td>
</tr>
<tr>
<td>269</td>
<td>0.651a</td>
</tr>
</tbody>
</table>

Table 2. DGCI and SPAD values at R1-2 and grain yield at each N rate within a site-year. Values followed by the same letter within a column for each site-year are similar (P ≤ 0.05).

<table>
<thead>
<tr>
<th>N Rate</th>
<th>R1-2</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>kg N ha⁻¹</td>
<td>NWARS, 2013</td>
<td>NWARS, 2014</td>
</tr>
<tr>
<td>0</td>
<td>0.399c</td>
<td>28.4d</td>
</tr>
<tr>
<td>67</td>
<td>0.688a</td>
<td>46.0a</td>
</tr>
<tr>
<td>134</td>
<td>0.703a</td>
<td>55.1b</td>
</tr>
<tr>
<td>202</td>
<td>0.692a</td>
<td>57.9a</td>
</tr>
<tr>
<td>269</td>
<td>0.735a</td>
<td>59.3a</td>
</tr>
</tbody>
</table>

CONCLUSIONS

SPAD was more successful at detecting N application rate than DGCI. Detection of differences at V6 varied by site-year, but was more consistent at R1-2 for both technologies. Regardless of stage, the r² values were 0.18-0.24 greater (P ≤ 0.01) for SPAD than DGCI when related to yield based on regression analysis performed across site-years.

Fig. 2. GreenIndex® app

Fig. 3. Relative yield vs. relative DGCI (A) and relative yield vs. relative SPAD (B) at V6. Relationship across site-years was significant (P ≤ 0.01) for both DGCI and SPAD.

V6 Growth Stage (Table 1)

- DGCI detected N application in two site-years
- SPAD detected N application in four site-years

R1-2 Growth Stage (Table 2)

- DGCI detected multiple N rates in four site-years
- SPAD detected multiple N rates in all site-years

Relationship to Grain Yield (Fig. 3 and Fig. 4)

- Related to yield at V6 and R1-2, r² greater with SPAD
- Yield separation was similar to SPAD values (Table 2)