In-season N Fertilization Strategies using Active Sensors

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Abstract
The objectives of this project were to measure corn yield response to nitrogen (N) fertilizer when applied during the V10 corn growth stage, and compare yield and N use efficiency between pre-plant N (PP-N), pre-plant + sensor N (PP+S-N), split N strategy (SNS), and rescue N strategy (RNS). The study was conducted using two crop rotations (corn-soybean and continuous corn) at multiple research farms. In-season applied N was urea treated with Agrotain®.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences
In-season N Fertilization Strategies using Active Sensors

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Introduction
The objectives of this project were to measure corn yield response to nitrogen (N) fertilizer when applied during the V10 corn growth stage, and compare yield and N use efficiency between pre-plant N (PP-N), pre-plant + sensor N (PP+S-N), split N strategy (SNS), and rescue N strategy (RNS).

The study was conducted using two crop rotations (corn-soybean and continuous corn) at multiple research farms. In-season applied N was urea treated with Agrotain®.

Materials and Methods
The first year of this research at the ISU Northern Research Farm was 2012. The soil at this location is Canisteo clay loam. The study area was soybeans in 2011. Tillage is fall chisel plow and spring disk/field cultivation before planting. The farm superintendent chose the corn hybrid (Pioneer 0448XR planted at 35,000 plants/acre). Pest control practices are those typical for the region and rotation. Soil is sampled for routine soil tests, 0-6 in. depth (STP = 22 ppm, STK = 355 ppm, pH = 6.18, and organic matter = 5.3%).

The active sensor used was the Holland Scientific, Crop Circle ACS-210. In-season N application was conducted during the V10 corn stage. The PP-N application was urea fertilizer broadcast applied and incorporated before planting (0 to 250 lb N/acre in 50 lb increments). The PP+S-N application was the PP-N rates (0 to 250 lb N/acre in 50-lb increments) plus broadcast urea at the V10 growth stage (in-season N rates determined by the sensor). The SNS was the 75 lb N/acre PP-N rate plus broadcast urea at the V10 growth stage with in-season N rates determined by the sensor (75 lb N/acre rate minimum). The RNS was the 150 lb N/acre PP-N rate plus broadcast urea at the V10 growth stage with in-season N rates determined by the sensor.

Corn was harvested with a plot combine. Yields were corrected to 15.5 percent moisture content.

Results and Discussion
Comparison of the three different N application strategies (PP-N, RNS, and SNS) indicated the same yield (average 143 bu/acre). However, N use efficiency measured as the partial factor productivity (PFP) was lower with the RNS vs. PP-N and SNS. No significant differences were found between N use efficiency measured as the agronomic efficiency (AE).

The agronomic optimum PP-N rate was 48 lb N/acre producing 140 bushels/acre (Figure 1). This is lower than most years for a corn-soybean rotation, due to drought conditions in 2012. The PP+SN strategy applied twice as much N fertilizer as the PP-N, with similar yield and a higher agronomic optimum N rate (104 lb N/acre producing 136 bu/acre). This study will continue in 2013.

Acknowledgments
Appreciation is extended to Dave Rueber, and the research farm staff for their assistance.
Table 1. Grain yield and N use efficiency comparison of pre-plant N (PP-N), rescue N (RNS), and split N (SNS), 2012.

<table>
<thead>
<tr>
<th>N Strategy</th>
<th>Pre-plant N rate</th>
<th>Sensor N rate</th>
<th>Grain yield</th>
<th></th>
<th>N use efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lb N/acre</td>
<td></td>
<td>bushels/acre</td>
<td>PFP†</td>
<td>AE‡</td>
</tr>
<tr>
<td>PP-N</td>
<td>150</td>
<td>-</td>
<td>141</td>
<td>0.94</td>
<td>0.17</td>
</tr>
<tr>
<td>RNS</td>
<td>150</td>
<td>57</td>
<td>144</td>
<td>0.69</td>
<td>0.14</td>
</tr>
<tr>
<td>SNS</td>
<td>75</td>
<td>75</td>
<td>143</td>
<td>0.96</td>
<td>0.19</td>
</tr>
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</table>

Contrasts

<table>
<thead>
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<th></th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP-N vs. RNS</td>
<td>NS</td>
</tr>
<tr>
<td>PP-N vs. SNS</td>
<td>NS</td>
</tr>
<tr>
<td>RNS vs. SNS</td>
<td>NS</td>
</tr>
</tbody>
</table>

†Partial factor productivity (PFP) calculated as (yield with N applied ÷ by amount of N applied).
‡Agronomic efficiency (AE) calculated as [(yield with N applied – yield with no N applied) ÷ by amount of N applied]. Yield with no N applied was 115 bushels/acre.

Figure 1. Nitrogen fertilizer response of pre-plant N (PP-N) and pre-plant plus sensor N (PP+S-N). The plateau N rates are reported as agronomic optimum N. A linear plateau regression model describes the relationship between total applied N and grain yield.