Starter Fertilizer Uptake in Corn

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Objective
Evaluate the impact of phosphorus and additional Nitrogen when applied as a starter fertilizer on plant uptake and yield in corn. The objective of this study was to provide research-based information to base phosphorus and nitrogen timing decisions that may help improve the overall return per acre by making nutrients plant available at the optimum time.

Background
Previous studies have shown little effect of phosphorus fertilizer on corn yield (Fulford et al., 2016; Fulford et al., 2018). Another study has shown an effect of phosphorus fertilizer on plant tissue phosphorus levels (Wade et al, 2019). Phosphorus was not applied as a starter fertilizer in these studies. With the relative immobility of phosphorus to move in the soil, this study was to determine if the timing of the application resulted in the same elevated phosphorus levels in plant tissue as well as a more consistent yield response when added with the additional nitrogen.

Crop Year: 2023  
Location:  40.2647, -83.3451  
County/Town: Union County  
Soil Type: Wetzel silty clay loam  
Drainage: Tiled  
Previous Crop: Soybeans  
Tillage: Vertical tilled in Fall  
Soil Test: Grid sampled Spring 2022  
Planting Date: 5/17/2023  
Seeding Rate: 33,500 seeds/acre  
Harvest Date: 11/13/2023

Methods
A completely randomized block (RCB) design was used with two treatments replicated four times across a 16-acre field. Asgrow 6544 and Asgrow 646-30 corn was planted on 30-inch row spacing at a fixed seeding rate of 33,500 per acre with a 16-row John Deere ExactEmerge planter. Eight rows of each hybrid in one 16-row pass. All plots received starter fertilizer of 7.5 gallons per acre of 27-0-0-2S and 2.5 gallons per acre of 12-0-0-26S. These were applied using a 360 BANDIT Planter Liquid Placement System. Fertilizer was placed three inches away from seed furrow on both sides at a depth of three-quarters of an inch. One treatment consisted of no additional starter fertilizer and the other was ammonium polyphosphate (10-34-0) starter at a rate of 7.5 gallons per acre. The banded 10-34-0 was applied using the same 360 BANDIT Planter Liquid Placement System. Forty-foot-wide planting passes were made with GPS guidance and two passes with an eight-row harvester were made in each plot. Field conditions were dry providing good soil/seed contact. Whole plant samples and stand counts were collected at the V4 growth stage. Plant samples were weighed, dried then sent to a lab for nutrient concentration analysis. Plant nutrient uptake was calculated based on emergence.
counts, plant dry matter (DM), average plant moisture, and lab results. Yield and grain moisture were measured by a calibrated yield monitor.

Results
An analysis of variant (ANOVA) was used with Fisher’s Protected Least Significant Differences (LSD) test at alpha 0.1. There was a significant yield difference between the two starter fertilizer treatments regarding yield (see Table 1). This may be explained by the deliberate location of the starter fertilizer being more plant available in the early growing and plant development stages.

The rainfall between planting and the V4 whole-plant sampling date can be characterized as dry, limiting starter phosphorus and additional nitrogen availability to the corn within those strips. Additionally, soil temperatures warmed quickly in this time frame, promoting soil mineralization including available soil P and nitrogen to the corn. Consequently, it was expected that the starter fertilizer would not impact dry matter and nutrient uptake at V4.

![Table 1 – Dry matter, plant moisture, P uptake, N uptake, emergence, grain moisture, and yield.](image)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Avg dry matter per plant (g)</th>
<th>Avg plant Moisture</th>
<th>P Uptake (lbs/acre)</th>
<th>N Uptake (lbs/acre)</th>
<th>Emergence (Plants per acre)</th>
<th>Grain Moisture</th>
<th>Yield* (bu/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Starter P</td>
<td>1.8</td>
<td>87.9%</td>
<td>0.6</td>
<td>4.7</td>
<td>32,265</td>
<td>25.7%</td>
<td>212 a**</td>
</tr>
<tr>
<td>Starter P</td>
<td>1.7</td>
<td>88.0%</td>
<td>0.5</td>
<td>3.2</td>
<td>32,537</td>
<td>25.4%</td>
<td>222 b</td>
</tr>
<tr>
<td>LSD:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.0</td>
</tr>
<tr>
<td>CV:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.1%</td>
</tr>
</tbody>
</table>

* Dry yield was standardized based on 13% moisture.
**Treatment means with the same letter are not significantly different.

Summary
No significant differences existed between the two treatments regarding dry matter per plant, average plant moisture, phosphorus uptake at V4, nitrogen uptake at V4, or emergence. A significant difference of 10 bu/ac existed with the 10-34-0 treatment compared to the control (no additional starter).

The soil test P for this field was 35.02 in the spring of 2022. This is within the maintenance range of soil test P (Culman et al, 2020). The probability of a yield response of additional starter P at this level was low (Johnson et al, 2015). At this soil test P level, there would be a moderate to high probably of a yield response to starter nitrogen (Johnson et al, 2015). With this knowledge, operators with this type of equipment and technology could see advantages to...
applying additional starter fertilizer. While no difference was observed at V4, given the yield response, one may assume that this additional nitrogen and phosphorus was utilized at a later growth stage. Further studies may be needed with sampling at multiple growth stages to determine the effects of the timing and placement of additional starter fertilizer.

References


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