Effect of Starter Fertilizer on Soybean Growth, Nodulation, and Yield

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**Introduction**

Variation in Ohio weather patterns has caused soybeans (*Glycine max*) to be planted both early and late in the growing season. Starter fertilizer is usually not recommended for soybean production; however, starter fertilizer applications may be beneficial in cool, moist soils where nutrient availability may be limited (Osborne and Riedell, 2006). Starter fertilizer may supply nutrients and increase soybean yield and biomass under these conditions, which are associated with earlier planting dates.

**Objectives**

The objectives of this experiment were to:
1. Evaluate the effect of starter fertilizer on nodulation, biomass production, and tissue nutrient concentrations.
2. Evaluate the effect of starter fertilizer on grain yield.

**Methods**

- Field studies were conducted in 2013 and 2014 at the Western Agricultural Research Station (WARS) near South Charleston, Ohio. An additional location was added in 2014 at the Northwest Agricultural Research Station (NWARS) near Hoytville, Ohio.
- Randomized complete block with split-plots and four replications.
- Main plot factor of planting date
  - Before May 1\(^\text{st}\), May 1\(^{\text{st}}\) to 30\(^{\text{th}}\), June 1\(^{\text{st}}\) to 30\(^{\text{th}}\), and after June 30\(^{\text{th}}\).
- Split-plot factor of starter fertilizer application
  - None (Control), urea, triple super phosphate (TSP), urea + TSP, and diammonium phosphate (DAP)
- Asgrow 3231 (3.2 maturity group) seed treated with Acceleron®
- Planted at 358,000 seeds ha\(^{-1}\) in 76 cm rows
- Starter fertilizer application banded 5 cm by 5 cm at planting
- Applied at 34 N kg ha\(^{-1}\) and 45 kg P\(_2\)O\(_5\) ha\(^{-1}\)
- DAP applied based on P\(_2\)O\(_5\)
- Harvested with a Massey Ferguson 8XP plot combine and grain yield corrected to 13% moisture
- Measurements:
  - Five plants per plot were sampled at the V2 (second trifoliate) and R1 (beginning flowering) growth stages
  - Nodules were counted by hand, then biomass was dried and weighed
  - Uppermost trifoliate leaves were taken at R1 and analyzed for total N and P concentration by A&L Labs
- Data was analyzed using the general linear model procedure in SAS 9.3. Factors were considered statistically significant at \(\alpha = 0.10\).

**Results**

**Nodules, Biomass, and Nutrient Concentrations:**
- At NWARS, nodulation at V2 was significantly lower in the urea treatment in comparison to all other treatments (Fig. 1). V2 shoot biomass was also reduced in the control and TSP treatments (Fig 5), however, this may not be biologically significant. No other differences in nodulation, biomass, or nutrient concentrations were statistically significant.
- At WARS, there was a slight reduction in nodulation at R1 in response to starter fertilizer application in 2013 (Fig. 2). This decrease was seen in the urea, TSP, and DAP treatments. No other statistically significant differences in nodulation, biomass, or nutrient concentrations were seen in 2013 or 2014 at WARS.

**Grain Yield:**
- In 2013, planting date significantly influenced yield, with earlier plantings yielding higher in comparison to later plantings.
- There was a yield response to starter fertilizer in 2013, in which all treatments yielded higher than the control (Fig. 7). TSP and DAP treatments were statistically higher, indicating this yield response may be related to phosphorus applications.
- There was not a significant plant date by fertilizer interaction in 2013
- 2014 plots have not yet been harvested

**Conclusions**

While there were statistically significant differences seen in V2 and R1 nodulation, and V2 shoot biomass, these differences may not be biologically significant.

Starter fertilizer did increase yield by 243 and 238 kg ha\(^{-1}\) for TSP and DAP treatments, respectively. However, the soil phosphorus level was 33 mg kg\(^{-1}\), above the critical level in Ohio, and this was only for one site-year of the study. It will be important for growers to consider if potential yield increases justify application costs. Observing similar yield responses to starter fertilizer in 2014 may have a significant impact on this decision.

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