Response of Soybean to At-Plant or In-Flower Nitrogen Applications

Harold D. Watters, Ohio State University Extension, Field Specialist Agronomic Systems

Objective

- To determine if nitrogen applied to soybeans may increase yield.
- To determine the appropriate timing for the nitrogen application.

Background

Crop Year: 2014
Location: Western Agricultural Research Station, field K north
County/Town: Clark/ South Charleston
Soil Type: Kokomo SiClLo
Drainage: Pattern tiled
Previous Crop: Corn
Tillage: No-till
Soil Test: pH 6.7, BpH 6.9, CEC 16.9, OM 2.4%, P 34 ppm M3, K 126 ppm
Planting Date: May 28
Variety: Seed Consultants SCS9328RR
Seeding Rate: 165,000 seed/A in 15-inch rows
Harvest Date: October 26

Methods

The trial was established as a randomized complete block, with eight treatments, replicated four times. Planted with a Kinze seven-row, 15-inch spacing planter. Harvest was accomplished with a Massey 8XP plot combine with on-board scales and moisture meter. Five rows of the seven planted were harvested for yield. Yield was calculated in bushels/acre at 13% moisture. Soybean nodule ratings were taken July 25 at soybean growth stage R3, using a 1 to 5 scale, with a 5 being the nodule number in the untreated check. For each treatment five plants were dug and then used as the basis for comparison to the untreated check for nodule rating.

- Treatments:
    - Untreated check
    - Rhizobia seed inoculant – Novozymes Optimize
        - seed treated immediately before planting
    - Nitrogen at plant – 75 lbs N/A as 28% UAN solution
    - Nitrogen at plant – 150 lbs/A as 28% UAN solution
    - Nitrogen at plant – 300 lbs/A as 28% UAN solution
    - Nitrogen at full flower, R2 – 75 lbs/A as urea
    - Nitrogen at full flower, R2 – 150 lbs/A as urea
    - Nitrogen at full flower, R2 – 300 lbs/A as urea

Results

Results for soybean yield with an estimate of nodulation are shown in Table 1.

Table 1. Effects of applied nitrogen at planting or at full flower on soybean yield and rhizobia nodule rating, So. Charleston, Ohio 2014.

Nitrogen treatment	**Yield (bu/A)**	**Nodule rating (1-5 scale)**
Untreated check	65.6	5.0
Rhizobia inoculant seed applied	69.4	4.8
75 N at plant	73.0	4.0
150 N at plant	72.6	3.6
300 N at plant	68.4	1.3
75 N at flower	68.9	4.4
150 N at flower	73.1	4.3
300 N at flower	72.5	3.8
LSD (0.10)	**4.7**	**0.9**

Summary

Significant differences are noted in the trial as shown in Table 1 (p= 0.0996). Treatments above 70.3 bu/A are significantly higher than the check. The C.V. (coefficient of variance) was relatively low at 5.5. The nodule rating indicates that if we apply nitrogen at planting, then we can expect lower rhizobia numbers and as rates increase the nodule rating decreases. With the delayed application, higher levels of nitrogen are required to reduce rhizobia number from that of the check (p>0.0000).

Although soybean yield levels did increase with nitrogen applications, an economic evaluation may discourage the practice. Table 2 shows economic comparisons of the treatments. Values are based on a nitrogen price of $0.50/lb of N and soybean price of $10/bushel.

Table 2. Soybean yield, product cost and return from applied N, So. Charleston, Ohio 2014.

Nitrogen treatment	**Yield (bu/A)**	**Product cost ($/lb)**	**Net value of applied N ($/A)**
Untreated check	65.6	0	$656.36
Rhizobia inoculant seed applied	69.4	$1.00	$692.51
75 N at plant	73.0	$37.50	$692.98
150 N at plant	72.6	$75.00	$651.09
300 N at plant	68.4	$150.00	$534.31
75 N at flower	68.9	$37.50	$651.22
150 N at flower	73.1	$75.00	$655.99
300 N at flower	72.5	$150.00	$574.79

Shown in Table 2, we reflect on the economic costs of the practice. Economically the highest return is from the two treatments of seed-applied rhizobia or 75N at plant for approximately $693/A. From Table 1 above however we see that the rhizobia treatment is no different from the check, leading to a conflict. From another standpoint, nitrogen applied at planting reduced nodulation below that of the check.

In those situations when we do not expect sufficient rhizobia populations to provide adequate nitrogen, such as the first time planting soybeans in a field or after a long period of continuous corn, the Ohio Agronomy Guide has recommendations to improve yield. Use a seed applied rhizobia, and if soybeans do not have a dark green color by early July apply 75 N as urea (Ohio Agronomy Guide). From this work it would appear that an application of 75N would have minimal impact on the soybean-bacteria relationship.

Reference

Ohio Agronomy Guide 14th Edition, Bulletin 472. Chapter 5 Soybean Production, Dr. Jim Beuerlein and Dr. Anne Dorrance.

Acknowledgement

The author expresses appreciation to Bill Mullen of Seed Consultants, Inc. for seed, to the OSU Weed Science program for use of the Kinze planter, to Robert Mullen for statistical assistance and to the crew of the OARDC Western Agricultural Research Station and Manager Joe Davlin for assistance with planting, harvest and field support.

For more information, contact:
Harold D. Watters
OSU Extension
1100 S. Detroit St.
Bellefontaine, Ohio 43311
Insert watters.35@osu.edu

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES