# Nitrogen Fertigation on Soybeans

Gene Stevens, Steven Hefner, and Chris Moylan

## Introduction:

Nutrient requirements for soybeans are greatest as seeds are developing during reproductive pod fill. This peak nutrient demand period physiologically coincides with decreased efficiencies in both symbiotic nitrogen (N) fixation and root efficiency (Brun, 1978).

Large N applications during vegetative growth stages limit N fixation and fail to consistently increase grain yields (Flannery, 1986). However, smaller N applications during flowering and pod fill have been reported to augment plant N status and increase soybean yield and/or quality by extending the pod fill period.

Research conducted in Georgia showed average yield increases of 2.5 bu/a with fertigation N and 2.0 bu/a with foliar spray applied during reproductive growth stages (Gascho. 1993). The greatest yield increase from mid-season N applications in a single growing season was 9 bu/a. Protein content in soybean seed was significantly greater in plots that had received foliar spray applications during pod development.

Yield increases with soybeans can be obtained from narrowing row widths and increasing plant populations. Cooper and Jeffers (1984) report that the potential yield advantage of the narrow row system over wider rows was minimized or eliminated under N stress situations.

Our primary goal is to determine if foliar N applications during reproductive growth stages can promote grain yields in Missouri. Secondary objectives are to identify how soybean yield and quality are influenced by a) foliar N applications on soybeans grown on different soils, b) N applications in combination with irrigation water (fertigation), and c) N and row spacing interactions.

## Materials and Methods:

Experiments were initiated in southeast Missouri in 1995 on both Reelfoot sandy loam and Tiptonville silt loam soils. On the Reelfoot soil, feed grade urea was foliar applied with ground spray boom equipment. On the Tiptonville soil, feed grade urea was injected into a linear move irrigation unit. Nitrogen applications varied by soybean growth stage and total fertilizer N applied in the season. Nitrogen was applied to plots in 20 lb N per acre increments as follows:

a) 0 lbs N check
b) R4 (full pod)
c) R4 + R5 (beginning seed)
d) R4 + R5 + R7 (beginning maturity)

Spray solutions were adjusted to pH 4.0 with an acidifying adjuvant (LI700). Additional irrigation events without N were applied when soil tensiometers measured -50 cbars. Plots were planted into 38-inch and 6.5-inch rows at both locations. The Tiptonville test was a split-plot design with N applications in main plots and row spacings in subplots. The Reelfoot was a randomized complete block design.

Visual maturity ratings scored both leaf defoliation (% def) and green color (% green) of soybeans as the season ended. Yield was collected with a small plot combine.

**Results and Discussion:**

Visual observations of soybeans throughout the season showed no leaf burn when feed-grade urea was applied through a spray boom or overhead system.

Significant visual differences in maturity were measured on the Tiptonville soil (Table 1). On September 11, 1995, the greatest amount of defoliation occurred in plots which did not receive nitrogen (49%). With three applications of 20 lb N per acre, defoliation declined to more than half (22%). In addition to slowing defoliation, nitrogen applications kept the leaves that remained on the plant greener in color. No significant differences in maturity ratings were found in the Reelfoot soil. Soybeans on the Reelfoot soil were more mature than those at the Tiptonville soil. In retrospect, an earlier rating may have provided more valuable information.

Table 1. N management effects on soybean maturity on September 11, 1995.

| N management | Tiptonville | | Reelfoot | |
|---|---|---|---|---|
| lbs N / a | % Def | % Green | % Def | % Green |
| 0 | 49 | 47 | 78 | 51 |
| 20 | 43 | 50 | 72 | 46 |
| 20 x 2 | 34 | 56 | 65 | 54 |
| 20 x 3 | 22 | 65 | 74 | 45 |
| $LSD_{.05}$ | 19 | 14 | ns | ns |

Soybean yields were increased significantly with mid-season N fertigation. An significant interaction ($p = 0.07$) between N application and row spacing occurred. On the Tiptonville soil, nitrogen fertigations improved yields more dramatically in narrow rows (Table 2). A single application of 20 lbs N/a improved yields by 10 bu/a. Cooper and Jeffers (1984) demonstrated similar row spacing effects by limiting N, and thereby eliminating soybean yield increases with narrow row production. Nitrogen applications numerically increased grain yields in narrow rows on the Reelfoot soil as well. On the lighter textured soil, two 20 lbs N/a applications increased grain yields by 9 bu/a. However, variation was great enough to override significant treatment differences.

On the Tiptonville soil, seed weights (grams/100 seeds) were significantly influenced by both N quantity and row spacing. Seed weights were increased with each increase in N applied. Seed weight samples receiving three 20 lbs N/a applications were approximately 0.66 grams/100 seed heavier than the check. Row spacing also influenced seed weight. Seed samples from narrow rows averaged 0.8 grams/100 seed less than those from wider rows. No statistical differences for seed weights were found on the Reelfoot soil where field variability was much greater.

Table 2. N management and row width effects on soybean yields (bu/a).

| N management | Tiptonville | | Reelfoot | |
|---|---|---|---|---|
| lbs N / a | 6.5 inch | 38 inch | 6.5 inch | 38 inch |
| 0 | 53 | 57 | 23 | 24 |
| 20 | 63 | 56 | 26 | 24 |
| 20 x 2 | 58 | 58 | 32 | 22 |
| 20 x 3 | 62 | 60 | 30 | 25 |
| $LSD_{.05}$ | 5.5 | | ns | |

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Dr. Peter Scharf
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Dept. of Agronomy
Columbia, MO 65211