SOYBEAN FACTS

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# Sulfur Fertilization of Soybeans in Michigan

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**Introduction:**
Interest in applying sulfur fertilizer to soybeans has increased in recent years. Soil and climatic conditions favorable for sulfur mineralization don't always occur during the early stages of crop development, especially when planting early into cool soils. Also, industrial sulfur emissions have declined significantly over the past 20 years, reducing annual sulfate deposition rates in Michigan. Sulfur is an essential plant nutrient playing a key role in protein synthesis and photosynthesis.

The Michigan Soybean Promotion Committee funded a two-year research project (2006 and 2007) to evaluate the effectiveness of sulfur starter fertilizer and sulfur foliar fertilizer on soybean growth, nutrient uptake and yield under Michigan conditions.

**Procedures:**
Five S starter response trials were conducted across the state in 2006 and 2007. Each year, 2 experimental sites were located on MSU research farms in Ingham (CSS) and Montcalm counties (plot size 15' by 50') with the remaining 3 sites on producers' fields (strip-plots dependent on field size and producer equipment) in Clinton, Ingham (Mason), Monroe, and/or Tuscola counties. Two of the on-farm sites were implemented by collaborative extension educators in their respective counties, and Gehl et al. conducted on-farm sites in Clinton and Ingham counties. Sites were located on coarse-textured soils with a minimum- or no-till cropping system.

At the research farm sites, starter fertilizer was applied 2" to the side and 2" below the seed as urea (46-0-0) and ammonium sulfate (21-0-0-24) dry granular products. Starter fertilizer treatments for both years included a control (no starter), 25 lb N/ac, 25 lb N + 5 lb S/ac, 25 lb N +10 lb S/ac, 25 lb N + 20 lb S/ac, and 10 lb S/ac applied as gypsum. The foliar S treatment was applied at a rate of 2.5 lb/ac of S as 8-0-0-9S at the V3 and again at the V5 growth stages in 2007. Treatments at the on-farm sites consisted of soil-applied or foliar applied S rates of 0, 5, 10, and 20 lbs S/ac.

Plant growth at the MSU research farm sites was evaluated by measuring plant height and relative chlorophyll meter (CM) readings at approximately V3-V5 and R1. Yield data was also collected from all sites.

**Results:**
Visual differences were observed among fertilizer treatments at the research sites early in the growing season and during early reproductive development in both years. Plant height differences among treatments were evident during the R1 stage at the Ingham and Montcalm sites in 2006 and at the V3 and R1 stages at these sites in 2007. While the differences were not numerically great, they were large enough to be noticeable in the field and may have reflected early plant response to applied treatments.

Trends similar to that observed in plant height were found in relative leaf CM measurements. In 2006, CM readings taken at V3 showed significant treatment effects at only the Montcalm site, where the 25N+20S treatment had significantly higher CM readings than the control. In 2007, the V3 CM readings were significantly different among treatments at both the Ingham (CSS) and Montcalm sites. Relative CM readings were greatest for those plots with N or N+S compared with the control, foliar, or gypsum plots. As the growing season progressed, the visual differences among the plots became less pronounced and no differences in relative leaf chlorophyll were detectable by the R1 stage in either year.

Correct interpretation of the yield response data to fertilizer treatment is critical to diagnosing actual crop response to S starter fertilizer. Yield results from the research farm sites are given in Tables 1 and 2. While yields at each of the sites ranged from 1.8 to 7.2 bu/ac among treatments, differences were significant at only the Montcalm site in 2006 and 2007. At this site in 2006, the 25N+10S treatment yielded 57.5 bu/ac, which was 7.9 bu greater than the 49.6 bu/ac average for the 25N treatment.

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However, the 25N+10S treatment did not yield greater than the control (55.1bu/ac), indicating that the response at this site may have been a negative response to the N-only fertilizer application. At the Montcalm site in 2007, the 5S foliar treatment yielded 50.4 bu/ac, which was greater than the control (45.9 bu/ac), the 10S gypsum (43.7 bu/ac), and the 25N+10S (43.2 bu/ac) treatments. However, the 5S foliar treatment did not yield greater than the 25N (46.9 bu/ac), indicating that the response at this site may have been due to N rather than S. Additionally, inconsistency in the yield response to S fertilizer level is indicative that the differences observed may have been due to field variability unrelated to treatment.

**Summary:**

A total of 10 site years of data were collected during this study, with a soybean grain yield response evident for only 2 site years (one in each year). The responsive site was at the Montcalm research farm in both 2006 and 2007 – an irrigated site with relatively low organic matter and coarse soil. Even at that site, however, yield response to the treatments applied could not be determined as a positive yield response to S fertilizer. The most apparent treatment response at Montcalm was that for the 5N+5S foliar treatment in 2007 – a finding that may be indicative of a response to N on irrigated, relatively high-yielding soybeans similar to that reported in previous research.

**Conclusion:**

Based on the findings of our research, the addition of S as a starter fertilizer or a foliar fertilizer for soybeans would not be recommended for Michigan growing conditions.

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**Table 1. Soybean yield response to starter fertilizer treatments including sulfur and/or nitrogen at research sites in 2006. Treatments labeled with the same letter are not different at $\alpha$=0.1.**

| | Location | | |
|---|---|---|---|
| Treatment | Ingham (Mason) | Clinton | Montcalm |
| lb/ac | | bu/ac | |
| Control | 54.9 | 49.9 | 55.1ab |
| 25N | 53.1 | 50.1 | 49.6b |
| 25N+5S | 53.0 | 46.0 | 53.4ab |
| 25N+10S | 53.9 | 51.9 | 57.5a |
| 25N+20S | 49.8 | 50.3 | 53.4ab |
| 10S | 52.8 | 51.2 | 54.7ab |

**Table 2. Soybean yield response to starter fertilizer treatments including sulfur and/or nitrogen at research sites in 2007. Treatments labeled with the same letter are not different at $\alpha$=0.1.**

| | Location | | |
|---|---|---|---|
| Treatment | Ingham (Mason) | Ingham (CSS) | Montcalm |
| lb/ac | | bu/ac | |
| Control | 37.0 | 37.2 | 45.9bcd |
| 25N | 39.7 | 39.9 | 46.9abcd |
| 25N+5S | 39.4 | 39.5 | 48.3ab |
| 25N+10S | 37.8 | 39.1 | 43.2d |
| 25N+20S | 39.0 | 35.9 | 47.5abc |
| 5N + 5S FOL | 37.5 | 33.9 | 50.4a |
| 10S | 38.0 | 35.3 | 43.7cd |

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