

Plant nutrition effect

1. Experimental Protocol

Initial soil was characterized for texture (39% sand, 38% silt, and 13% clay), pH (6.92), organic matter (1.68%), nitrate (3.54 ppm), sulfate (3.92 ppm), phosphorus (23.2 ppm), potassium (117.2 ppm), calcium (1560 ppm), magnesium (140 ppm), sodium (15 ppm), and cation exchange capacity (9.34 meq/100g). Soybean emergence occurred on May 15th, followed by harvest on October 10th. During this period, the average maximum temperature was 86°F, and the average minimum temperature was 60°F. On 19 days, temperatures surpassed 95°F. From May 1st up to the harvest, the total precipitation reached 13.7 inches, supplemented by an additional 8.8 inches through irrigation. After crop maturity, plots were harvested by collecting the central 2 rows of each plot with a combine, and seed yield was recorded and then adjusted to 130 g kg⁻¹ moisture basis. In addition, 10 plants per plot were collected and segmented into lower, middle, and upper sections based on the number of nodes. The seeds from each section were analyzed using near-infrared spectroscopy for protein content. The fertilization treatments, sources, and amounts are presented in Table 1.

Table 1. Fertilization treatments, total amount of S (lb/a), fertilizer sources, application time and source amount.

Treatment	Total S (lb./a)	Fertilizer source	Time	Source amount (lb./a)
Gyp_0	0	Gypsum (17% S)	Pre-planting	0
Gyp_5	5	Gypsum (17% S)	Pre-planting	29.5
Gyp_10	10	Gypsum (17% S)	Pre-planting	59.0
Gyp_20	20	Gypsum (17% S)	Pre-planting	117.6
Gyp_30	30	Gypsum (17% S)	Pre-planting	176.5
AMS_10	10	AMS (24%)	Pre-planting	41.6
AMS_10_Split	10	AMS (24%)	$\frac{1}{2}$ Pre-planting + $\frac{1}{2}$ R2 or R3	20.8 + 20.8

2. Statistical analysis

To assess the effects on seed yield of the seven fertilization treatments at the plot level, data was analyzed using generalized linear mixed model. To accommodate the yield data distribution that ranges from zero to potentially infinity, we assumed a Gamma distribution with the log link function. To evaluate the effects on seed protein of the fertilization treatments at the plot and vertical section of the canopy, data was analyzed using generalized linear mixed model. For the protein data we assumed a Normal distribution with the identity link function.

3. Results

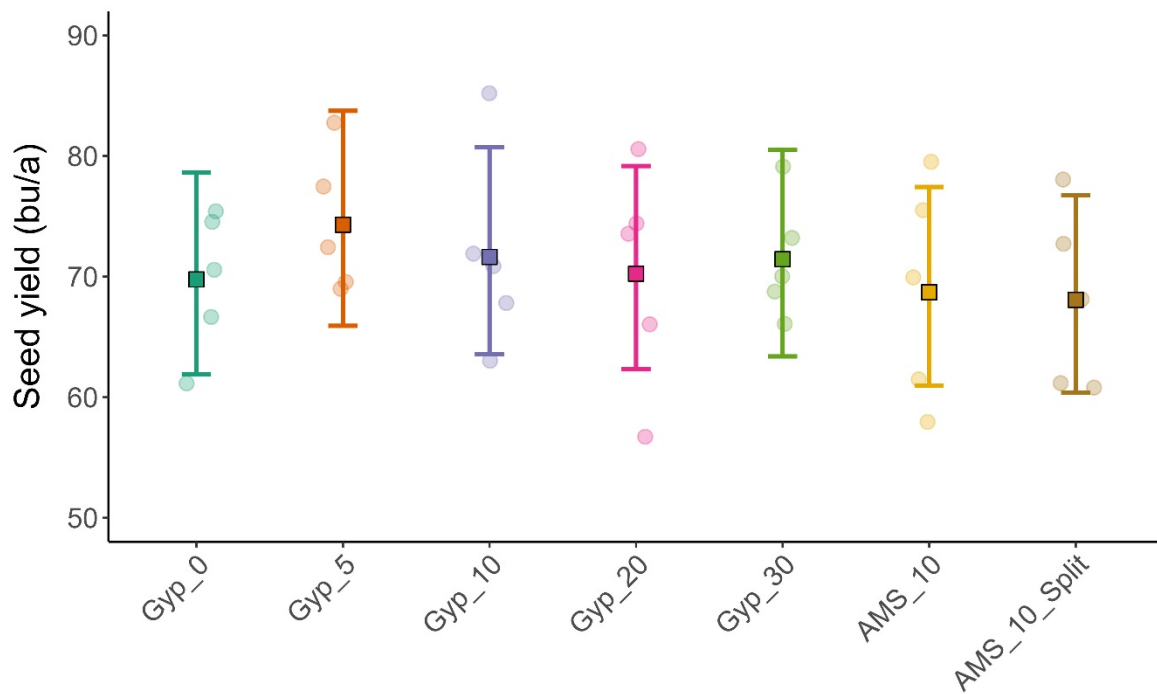


Figure 1. Soybean seed yield (bu/acre) across seven fertilization treatments. Each point represents an individual measurement, while the bars indicate the 95% confidence intervals around the expected treatment effects.

➤ Seed yield varied from 68 to 74 bu/a, and averaged 71 bu/a across all treatments. However, considering the 95% confidence interval, there were no significant statistical differences between treatments (Figure 1).

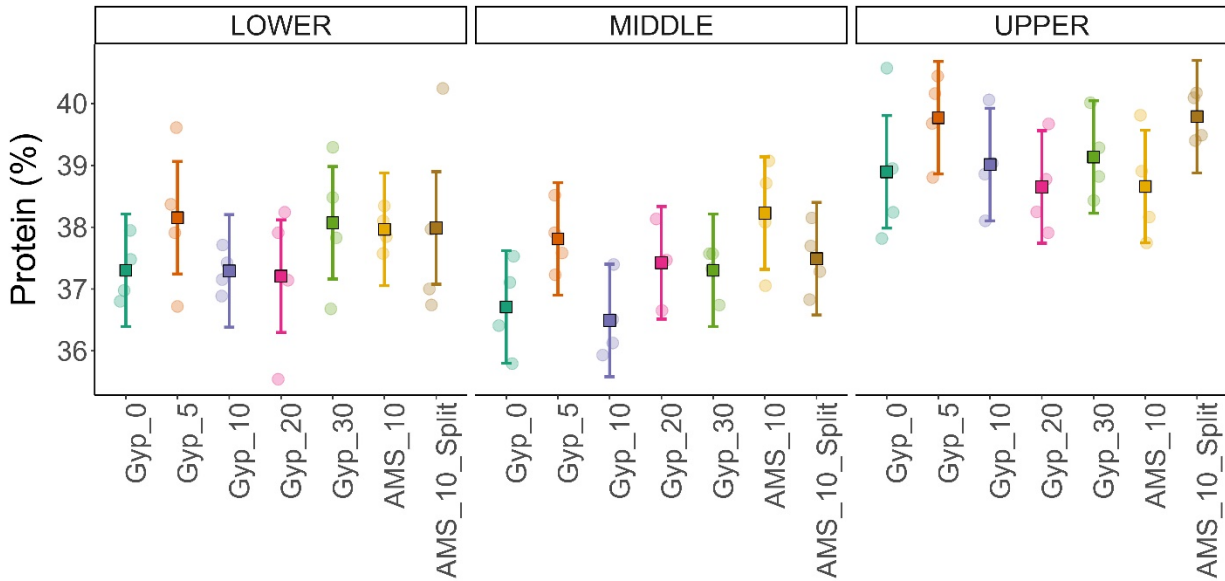


Figure 2. Soybean seed protein content (%) across seven fertilization treatments and three vertical sections of the canopy. Each point represents an individual measurement, while the bars indicate the 95% confidence intervals around the expected treatment effects.

➤ The upper section of the plant contributed the most to the total protein content, with an average of 39%, which was higher compared to the middle and lower sections that both averaged 37%. However, when considering the 95% confidence interval within the same vertical section, no significant statistical differences were observed between treatments (see Figure 2).

➤ For the cultivar and planting date effect, the study showed little effect on planting dates, with yields ranging from 60 to 90 bu/acre, but with an overall average of for better yields with cultivars ranging from 3.4 to 4.2 maturity group, and with yields reducing when shorter (2.8) or longer (5.2) maturity groups were implemented to test the adaptability to this environment.

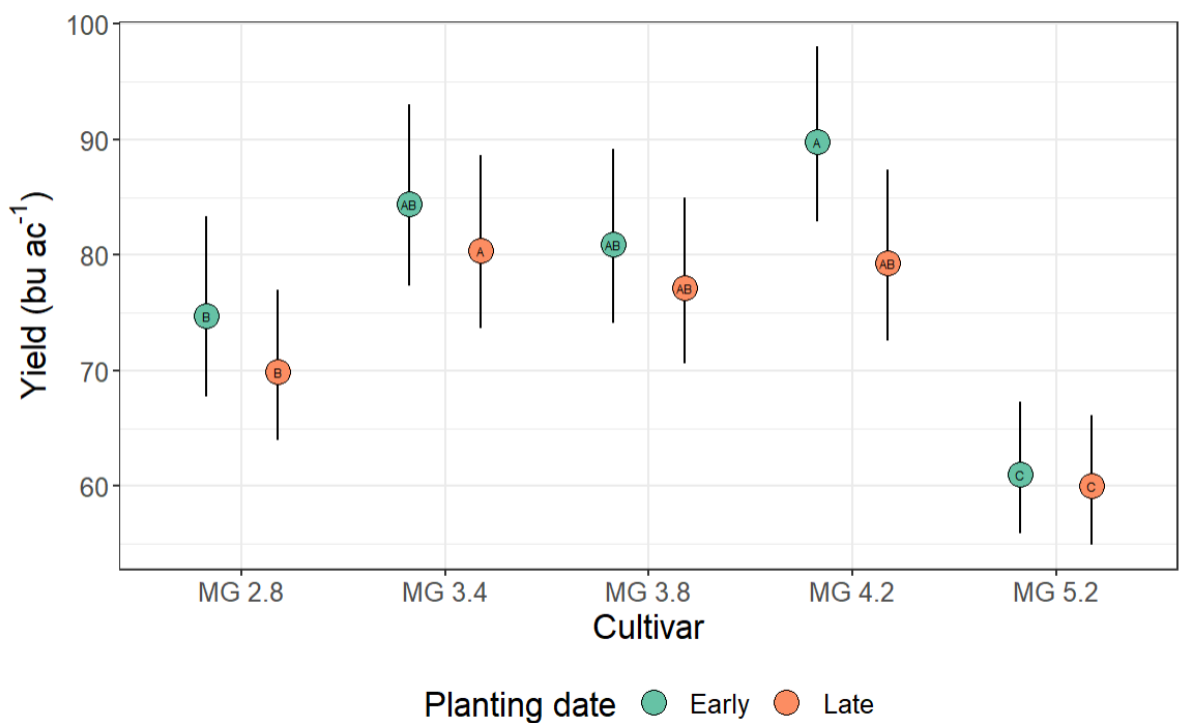


Figure 3. Soybean seed yield (bu/acre) across cultivars and for early (early May) and late (early June) planting dates during the 2023 growing season.

➤ Next steps on this project are to move forward with the analyses of seed quality and the dry down data to understand the influence of environmental conditions on these factors.