Do late season soybean management practices impact seed yields?

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Introduction

In soybean (*Glycine max* [L.] Merr.), maintaining favorable growth conditions (e.g., water, radiation, nutrients) during the seed filling period is crucial to avoid limitations that could reduce seed weight limitations and ultimately constrain seed yield. The objective of this study was to explore potential effects and identify if "late-season" management practices can contribute to increasing seed weight and seed yield in soybeans.

Materials and Methods

In the 2021 season, two soybean studies were conducted in Topeka (39.08° N, 95.77° W), and Kiro (39.09° N, 95.79° W). Soils were Eudora silt-loam (Topeka) and Muir silt-loam (Kiro), with 2 and 3% of soil organic matter (SOM, 0-6 in.), respectively. Right before planting, composite soil samples (6 cores) were taken from 0-6 in. depth to describe general soil fertility (Table 1).

Table 1. Soil fertility at the planting time of soybean at Topeka and Kairo locations. KS, 2021 growing season.

Site	pH	SOM	Sand	Silt	Clay	P	K
			%			ppm	
Topeka	6.8	2.0	32	56	12	17	228
Kiro	5.5	3.0	23	62	16	27	420

Table 2. General soybean crop management at Topeka and Kairo locations. KS, 2021 growing season.

Site	Tillage	Irrigation	Planting Date	Row spacing	Soybean Variety	Seeding Rate (seeds/ac)	Harvest
Topeka	Vertical	Yes	05/12/2021	30 in.	AG40X70	141,000	10/04/2021
Kiro	No-till	Rainfed	05/12/2021	30 in.	AG40X70	141,000	10/08/2021

Both, Topeka and Kiro (adjacent locations) accumulated approximately 23 inches of rain each during the growing season (**Figure 1**). Between June and September, both locations recorded 6 days with temperatures above *95 °F*.

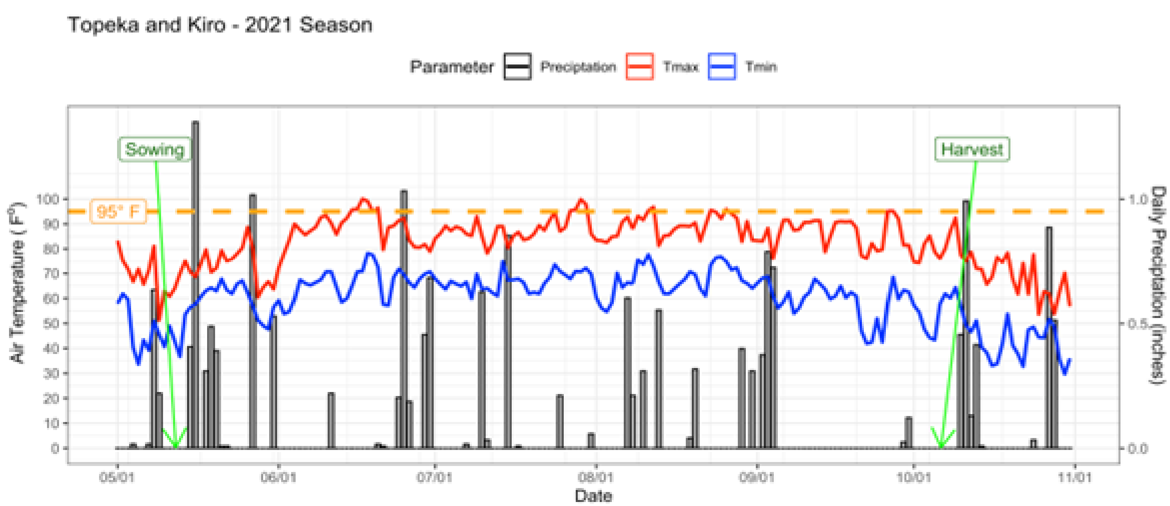

Figure 1. Daily precipitation in inches, and maximum and minimum temperatures (*°F)* at Topeka and Kairo locations. KS, 2021 growing season. Source: Kansas Mesonet (https://mesonet.k-state.edu/).

Plots were arranged in a complete randomized block design with four repetitions. Plots were 35 feet long at Topeka and 25 feet long at Kiro, and four rows spaced at 30 in in both locations. When needed, treatments were sprayed with handheld backpack sprayer. Treatments were applied at full pod formation (R4 stage) and consisted in different management practices:

- Fungicide protection late-season application
- Insecticide protection late-season application
- Full-foliar protection (fungicides+insecticides late-season application)
- N fixation longevity (inoculant late-season application)
- Plant nutrition -standard- (S late-season application)
- Plant nutrition -complete- (micros plus S late-season application)
- Nutrition -complete- + N fixation (combination of both for improving nutrition)
- Intensified inputs (all practices combined)
- Control condition (Standard practices)

At physiological maturity (R7 stage) plant samples were collected from 12.5 sq ft (5 ft x 30 inch) to determine aboveground biomass at the control treatment.

At harvest maturity (R8), an area of 18.75 sq ft in the two central rows of each plot was manually harvested to determine final seed yield.

Data analysis

The data analysis was executed by performing an analysis of variance (ANOVA) split by variable (seed yield, seed weight, and biomass) and location. For each ANOVA, a mixed model structure was considered, with treatment as the fixed factor and block as the random factor. Treatment effect were considered significant if p-value ≤ 0.05. Analyses were carried out using the *lme4* and *emmeans* packages of R software (R Core Team, 2020).

Results

Seed yield

Seed yield ranged between 54 and 85 bu/a at Topeka and between 63 to 88 bu/a at Kiro (**Figure 2**). No significant seed yield differences between treatments were observed at either of the locations (p-value > 0.05), averaging 66 bu/a for Topeka and 75 bu/a for Kiro.

Seed weight

Seed weight ranged between 0.28 and 0.33 lbs/1000 seeds at Topeka and between 0.27 to 0.37 lbs/1000 seeds at Kiro (**Figure 3**). No significant seed weight differences between treatments were observed at either of the locations (p-value > 0.05), averaging 0.30 lbs/1000 seeds for Topeka and 0.31 lbs/1000 seeds for Kiro.

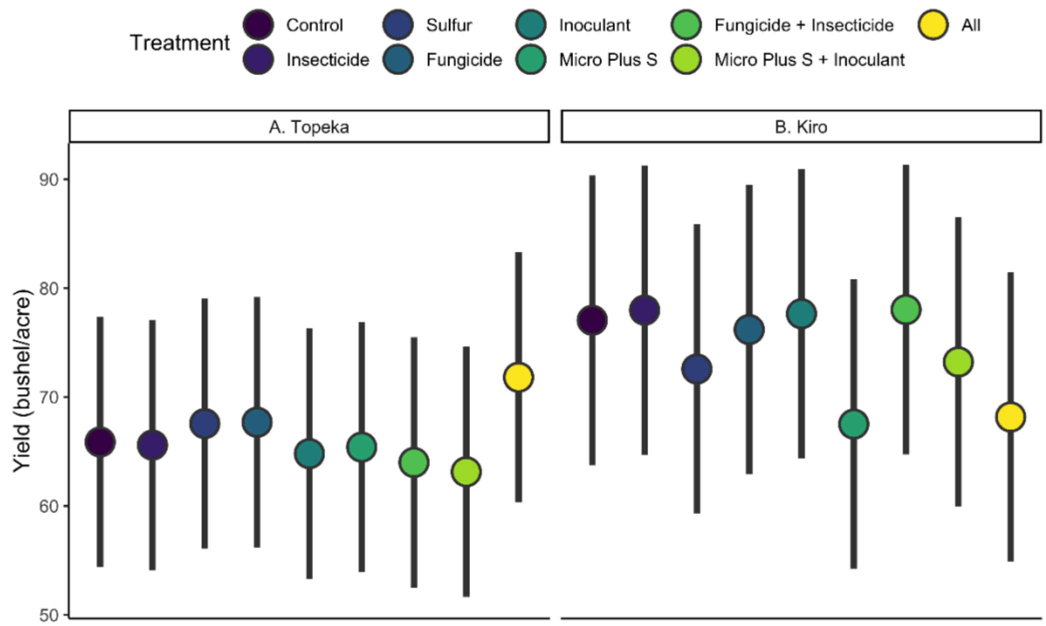

Figure 2: Seed yield (bu/ac) for each treatment at Topeka and Kairo locations. Vertical bars are the standard deviations. KS, 2021 growing season.

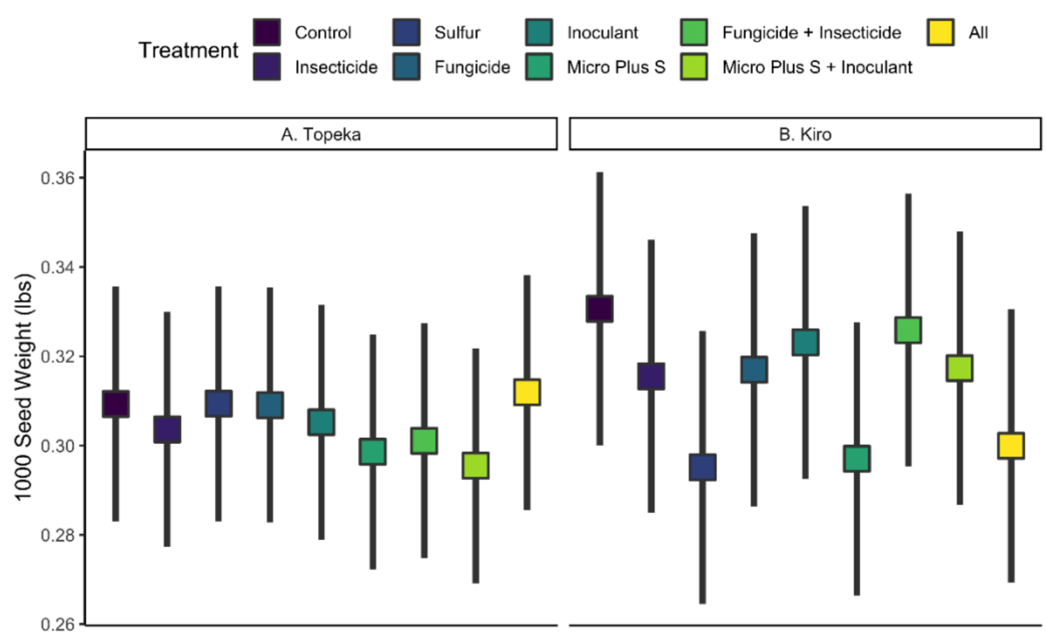

Figure 3: Final seed weight rate for each treatment at Topeka and Kairo locations. Vertical bars are the standard deviations. KS, 2021 growing season.

Plant Dry Biomass

Final dry biomass ranged between 6,346 and 12,354 lbs/a at Topeka and between 5,764 to 14,997 lbs/a at Kiro (**Figure 4**). No significant final biomass differences between treatments were observed at either of the locations (p-value > 0.05), averaging 9,102 bu/a for Topeka and 10,373 lbs/a for Kiro.

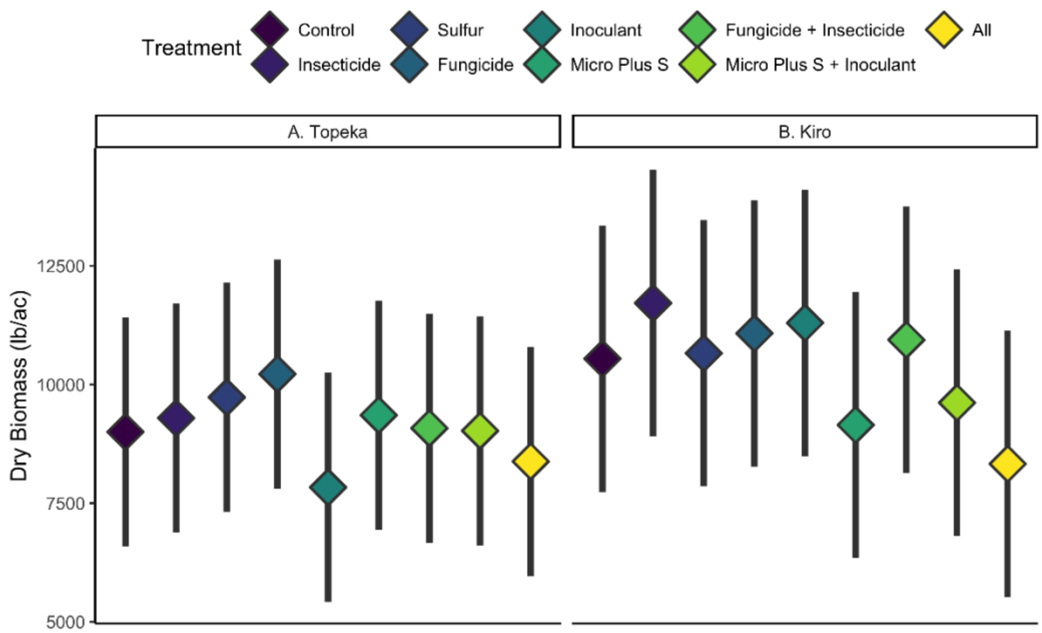

Figure 4: Final dry biomass at physiological maturity (R7) for each treatment at Topeka and Kairo locations. Vertical bars are the standard deviations. KS, 2021 growing season.

Conclusions

The tested late-season treatments did not impact seed yield, seed weight, or crop biomass production. Specific soil and weather conditions may be needed to observe differences between the tested treatments. Future research could consider exploring more environments across Kansas to identify specific production conditions that are responsive to late-season management practices.

References

R Core Team. 2020. R: A language and environment for statistical computing. R Foun-dation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.