Planting Date and Maturity Group Analysis for the Upper Midwest to Maximize Soybean Seed Yield

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Introduction

Soybean [*Glycine max* (L.) Merr.] planting date trends have steadily shifted earlier within the northern Corn Belt due to the higher yield potential associated with earlier planting (De Bruin and Pedersen, 2008; Gaspar and Conley, 2015). With this trend, many believe that growers have not adequately adjusted their soybean maturity group (MG) range to take advantage of the increased solar radiation available. In addition, logistical problems and the increased frequency of extreme spring weather events can delay planting into June or require replanting some years. Regardless of the planting or replant date, the goal within the northern Corn Belt should be to maximize solar radiation interception throughout the growing season to increase seed yield (Gaspar & Conley, 2015). Therefore, in theory, proper maturity group selection at various planting dates is a cost effective method to increase solar radiation interception and potentially seed yield, yet mature before the first hard fall frost. In addition, more precise yield loss estimates associated with delayed planting could help growers make equipment and logistical decisions during the spring.

However, limited published literature exists quantifying yield loss from delayed planting and analyses of proper MG selection across different planting dates for the Northern US is lacking.

Therefore the **objectives** of this study were to:

1. Quantify the yield loss associated with delayed soybean planting at different latitudes within Wisconsin.
2. Determine the proper MG selection across multiple planting dates at different latitudes within Wisconsin.

Material & Methods

Research was conducted in Arlington, Hancock, and Spooner, WI and St. Paul, MN during the 2014 and 2015 growing seasons using 14 different Pioneer varieties within 7 maturity groups. The St. Paul location data is not included in this poster.

Plot Dimensions and Layout: The trials were established in a RCBD in a split-plot arrangement with four reps. The whole-plot factor was five planting dates and the sub-plot factor was six different varieties within three maturity group's specific to each planting date (Table 1). Sub-plots measured 3.1 m wide (four, 76cm rows) by 6.4m long.

***Table 1.* Treatment components.**

Planting Date	Arlington	Hancock	Spooner
(Day of Year)	———— Maturity Group ————		
May 1st (121)	2.5, 2.0, 1.5	2.5, 2.0, 1.5	1.5, 1.0, 0.5
May 20th (141)	2.5, 2.0, 1.5	2.5, 2.0, 1.5	1.5, 1.0, 0.5
May 31st (152)	2.0, 1.5, 1.0	2.0, 1.5, 1.0	1.0, 0.5, 0.0
June 10th (162)	2.0, 1.5, 1.0	2.0, 1.5, 1.0	1.0, 0.5, 0.0
June 20th (172)	1.5, 1.0, 0.5	1.5, 1.0, 0.5	0.5, 0.0, 00.5

Data Collection: The center two rows of each plot were mechanically harvested at maturity (R8) for grain weight and moisture. Yields were calculated and adjusted to a moisture content of 130 g kg^{-1}.

Statistical Analysis was performed in SAS Version 9.3 (SAS Institute., Cary, NC.) where seed yield was subjected to a mixed-model analysis using the PROC MIXED procedure for the effect of variety MG on yield within each location (3) and planting date (5) pooled over years. This resulted in 15 combinations. MG was treated as a fixed effects, while rep, rep*variety, variety within MG, and the overall error term were treated as random effects. In addition, seed yield was subjected to a regression analysis using the PROC REG and PROC MIXED procedures to quantify the yield loss associated with delayed planting across and within each location and year.

Results & Discussion

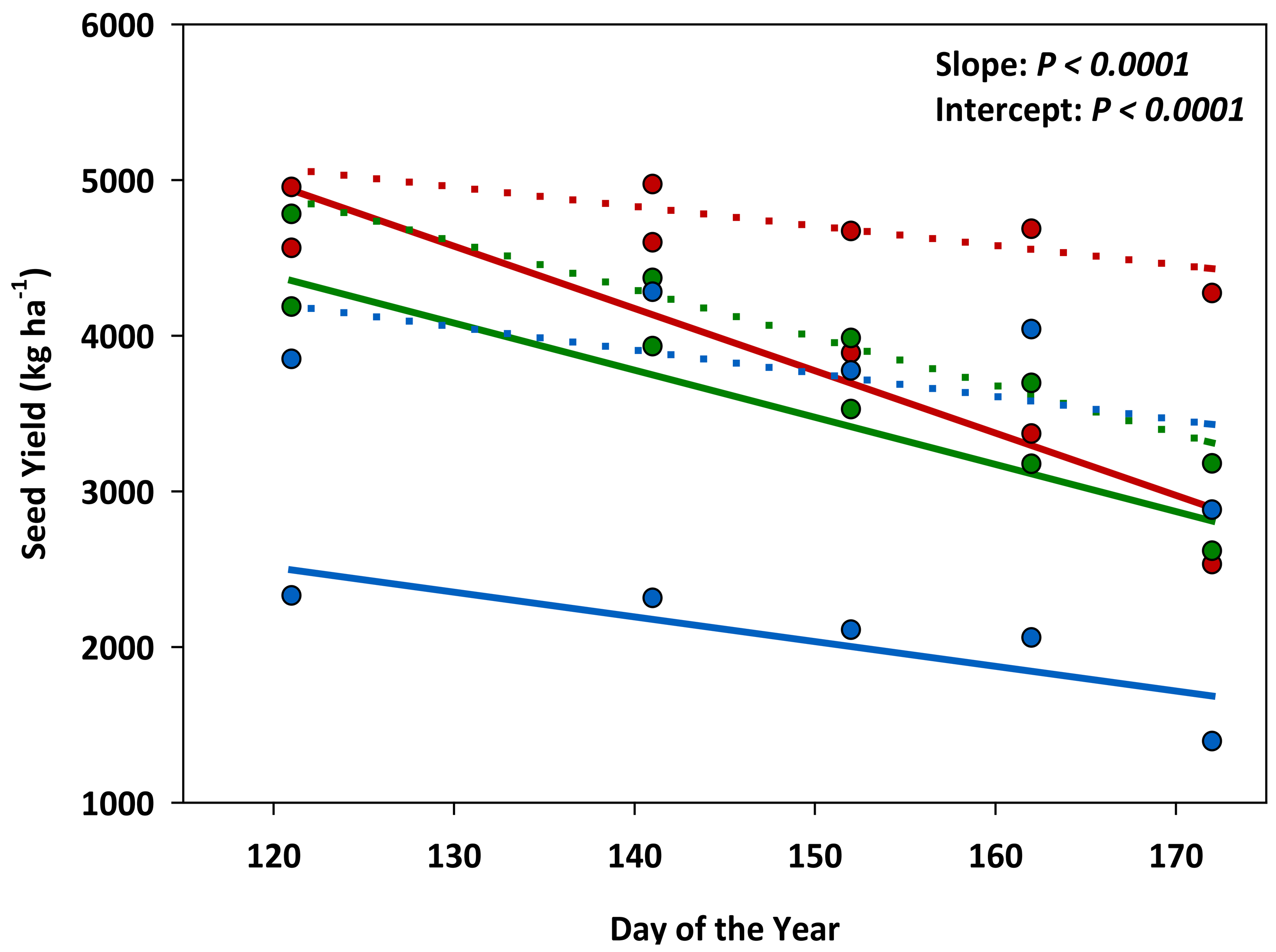

***Figure 1.* Effect of planting date on seed yield for Arlington (Red), Hancock (Green), and Spooner (Blue), WI in 2014 (solid) and 2015 (dashed).**

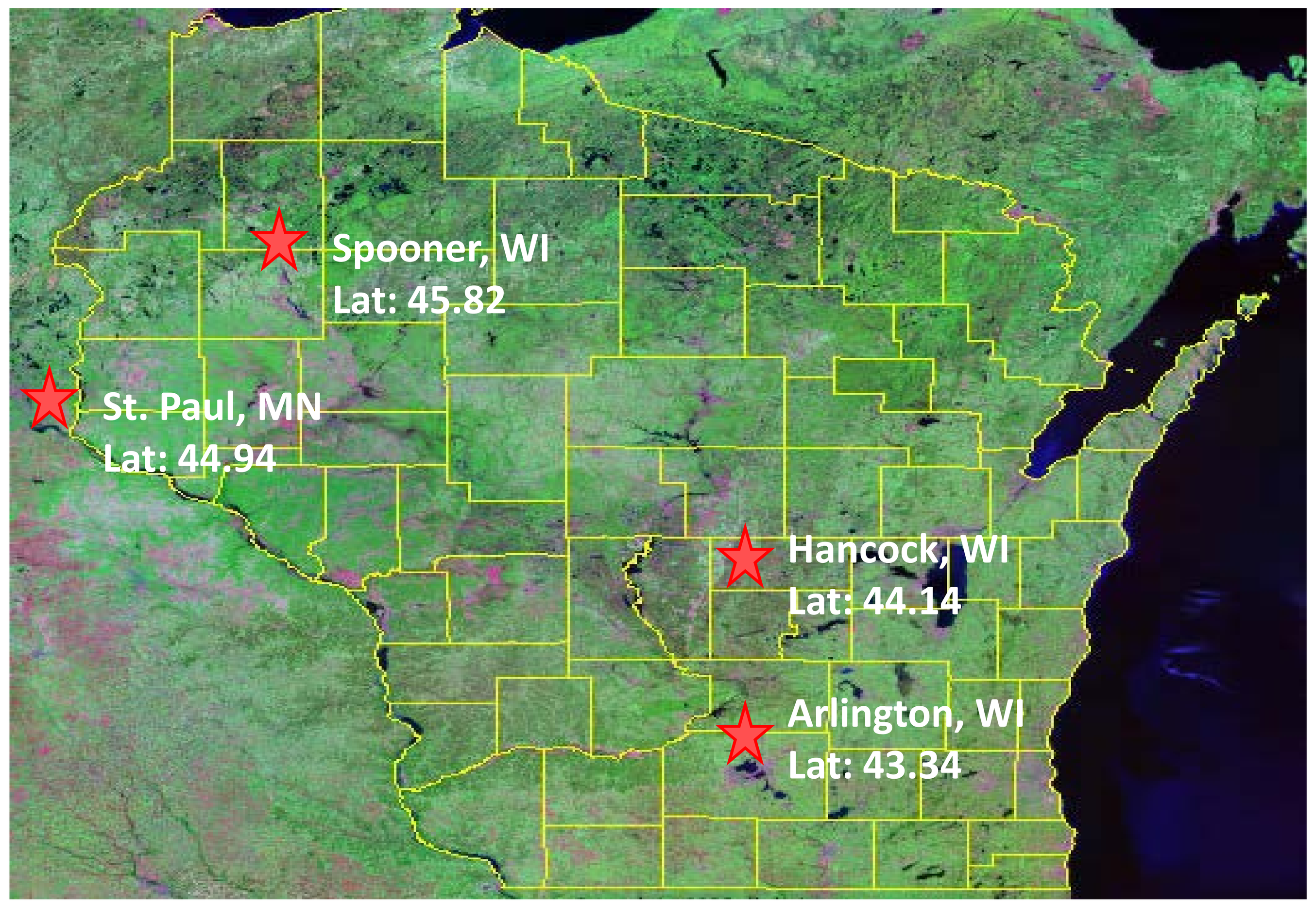

***Figure 2.* Experiment locations and latitude for 2014 and 2015.**

Planting Date

- Across all locations and years, planting date showed a significant effect on yield (p-value < 0.0001) where maximum yields were obtained by planting the first week in May and then declined by 24.1 kg ha^{-1} d^{-1} (Figure 1).
- The rate of yield loss was greater during 2014 than 2015 (p-value < 0.0001), but this was heavily influenced by Arlington (Table 2).
- The rate of yield loss differed between years for Arlington (p-value < 0.0001) but not for Hancock (p-value = 0.66) and Spooner (p-value = 0.69), which averaged 30.6 and 15.4 kg ha^{-1} d^{-1}, respectively (Table 2).

***Table 2.* Slope of each regression line from Figure 1. quantifying the yield loss for each day planting as delayed past May 1st.**

Location	Year 2014	Year 2015	*P*-value†
	——— kg ha^{-1} day^{-1} ———		*P > F*
Arlington	-40.1	-12.5	< 0.0001
Hancock	-30.3	-30.8	0.66
Spooner	-15.9	-14.9	0.69
Mean‡	-28.8	-19.4	< 0.0001

†Comparison of slopes between 2014 and 2015 within each location.

‡Comparison of slopes between 2014 and 2015 across all locations.

***Table 3. P*-value for MG effect on yield within each location by planting date combination for 2014 and 2015.**

Planting Date	Arlington	Hancock	Spooner
	——— *P < F* ———		
May 1st	**0.097 (2.5)†**	**0.008 (2.5)**	0.562 (1.0)
May 20th	**0.035 (2.5)**	**0.001 (2.5)**	0.841 (1.0)
May 31st	**0.021 (2.0)**	**0.099 (2.0)**	0.747 (0.5)
June 10th	0.678 (2.0)	**0.041 (2.0)**	0.587 (0.5)
June 20th	0.990 (0.5)	0.86 (0.5)	**0.010 (0.5)**

† Numerically highest yielding MG within each location by planting date combination is displayed within ().

Maturity Group x Planting Date Selection

- 8 of 15 location x planting date combinations (environments) displayed a significant (p-value < 0.10) MG effect on yield (Table 3).
- The first three planting dates within Arlington and first four planting dates within Hancock displayed significant yield increases for the longest MG.
- The middle MG within the first four planting dates at Spooner resulted in the highest yield numerically but was not significant.
- Within the fifth planting date at Arlington and Hancock the shortest MG yielded the highest numerically but not significantly, while the longest MG within the fifth planting at Spooner displayed a significant yield increase.

Conclusions

- Planting in early May maximized yield across all locations and years which then declined by 24.1 kg ha^{-1} d^{-1} on average when planting was delayed.
- The yield decline from delayed planting was similar between years at Hancock and Spooner but differed at Arlington. This was possibly due to a more advantageous and extended growing season in 2015 compared to 2014 at Arlington.
- Multiple planting dates (7/10) within Arlington and Hancock showed significant yield increases for the longest MG, but Spooner did not.
- Early planting is a proven management practice to increase yield and is potentially more specific to the location, than year; while planting the longest possible MG is a cost effect method to more often increase yields with early and delayed planting up to June 10th. This was not the case at the most northern latitude, however.

Literature Cited

- De Bruin, J.L. and P. Pedersen. 2008. Soybean seed yield response to planting date and seeding rate in the upper Midwest. Agron. J. 100: 696-703.
- Gaspar, A.P and S.P. Conley. 2015. Responses of canopy reflectance, light interception, and soybean yield to replanting suboptimal stands. Crop Sci: 55:377-385.