RESPONSES OF CANOPY REFLECTANCE, LIGHT INTERCEPTION, & SOYBEAN SEED YIELD TO REPLANTING SUBOPTIMAL STANDS

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Introduction

Soybean [*Glycine max* (L.) Merr.] planting date trends have steadily shifted earlier within the northern Corn Belt (De Bruin and Pedersen, 2008), while inclement weather, insect pressure, and disease pressure associated with spring planting can result in diminished plant stands. In these situations, producers are faced with the decision to fill in suboptimal stands, till and replant the entire stand, or leave the initial stand as is. However, limited published literature exists concerning this decision.

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

1. Determine the threshold for replanting suboptimal stands to maximize seed yield at different planting dates
2. Quantify the relationship of cumulative intercepted photosynthetically active radiation (CIPAR) and cumulative normalized difference vegetative index (CumNDVI) on seed yield
3. Quantify the effects of fungicide and insecticide seed treatments on replant thresholds.

**This poster will highlight results from objectives 1 and 2.*

Material & Methods

Research was conducted at the Arlington Ag Research Station in southern Wisconsin during the 2012 and 2013 growing seasons using the Syngenta Brand soybean, S20-Y2. The trials were a RCBD in a split-plot arrangement with four reps. The whole-plot factor was three planting dates and the sub-plot was a factorial of three seed treatments and twelve seeding rate-replant combinations, of which three simulated a tillage operation.

Treatment Components:

Seed treatment		Planting date		Seeding rate	
Initial	Replant	Initial	Replant	Initial	Replant
		2012		Seeds ha^{-1}	
UTC	CruiserMaxx	11-May	25-May	98,800	0
ApronMaxx		30-May	13-Jun	98,800	247,000
CruiserMaxx		15-Jun	25-Jun	148,200	0
		2013		148,200	197,600
		7-May	3-Jun	197,600	0
		3-Jun	19-Jun	197,600	148,200
		17-Jun	1-Jul	247,000	0
				296,400	0
				345,800	0
				0	345,800
				0	444,600
				0	543,400

Yield (kg ha^{-1}) was determined by mechanically harvesting the initial planting and replanted middle rows of each plot (9.75 m^2) at maturity (R8) for grain weight and moisture. Yields were adjusted to a moisture content of 130 g kg^{-1}.

CIPAR (MJ m^{-2}) was calculated from the summation of daily canopy light interception times the daily avg. photosynthetically active radiation from the V2-R6 growth stage based upon methods similar to Edwards et al. (2005).

CumNDVI was calculated as the summation of daily NDVI values from the V2-R4 growth stages. CumNDVI is a relative number and therefore has no units. Measurements stopped at R4 due to the replant rows making it unmanageable to enter the plots

Statistical Analysis was performed in SAS Version 9.3 (SAS Institute., Cary, NC.) where yield, CIPAR, and CumNDVI were subjected to a mixed-model analysis using the PROC MIXED procedure. Planting date, seeding rate (includes the replant decision), and their interaction were treated as fixed effects, while year, replicate x planting date within year, and the overall error term were treated as a random effect.

Results & Discussion

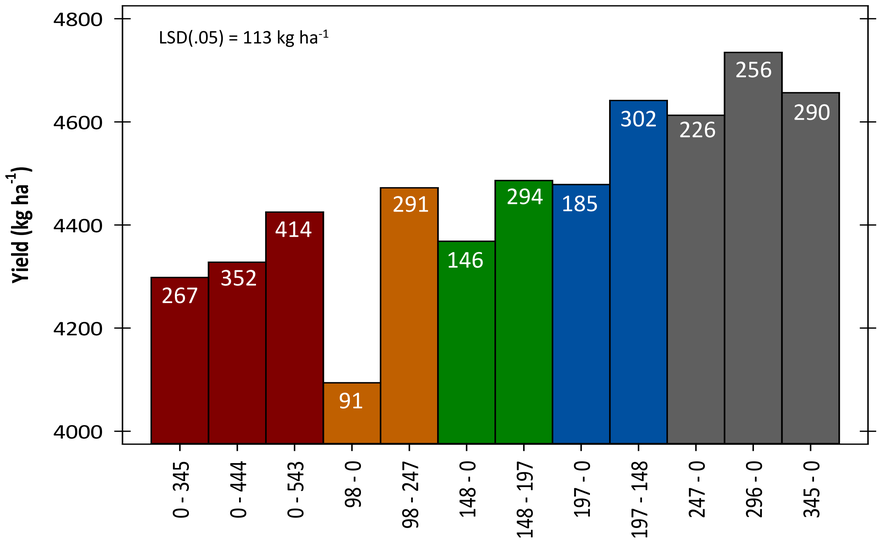

Figure 1. **Yield of twelve different seeding rate – replant scenarios. Final plant stands are reported at the top of each bar as 1000 plants ha^{-1}.**

Replant Decision

- The twelve scenarios showed a significant effect on yield (p-value <0.0001).
- Maximum yields were obtained with >296,400 seeds ha^{-1} and no replanting, which produced plant stands above 247,000 plants ha^{-1}.
- Initial plant stands <247,000 plants ha^{-1} filled in with enough seed to raise the final plant stand >247,000 plants ha^{-1} saw yield increases.
- Replanting the entire stand only increased yield over an initial plant stand of 91,000 plants ha^{-1}.

Table 1. **CIPAR and Cum NDVI values for each seeding rate, planting date, and their interaction. LSD values are presented in italicized bold.**

Variable		Planting date Early	Mid	Late	Mean
CIPAR, MJ m^{-2}					
Initial	Replant				
Seeds ha^{-1}					
98,800	0	594	570	518	561
98,800	247,000	618	587	531	579
148,200	0	620	584	535	580
148,200	197,600	630	605	542	592
197,600	0	634	600	543	592
197,600	148,200	640	609	547	599
247,000	0	653	613	554	607
296,400	0	661	622	556	613
345,800	0	670	630	554	618
LSD (0.05)			***13***		***4***
Mean		635	602	542	
			14		
CumNDVI					
98,800	0	30.9	28.1	25.7	28.2
98,800	247,000	33.3	29.9	26.7	30.0
148,200	0	33.1	29.4	27.5	30.0
148,200	197,600	33.5	31.3	27.6	30.8
197,600	0	34.5	31.0	28.3	31.2
197,600	148,200	34.8	31.8	28.5	31.7
247,000	0	36.0	32	29.1	32.4
296,400	0	36.4	32.6	30.2	33.1
345,800	0	36.8	32.6	30.0	33.2
LSD (0.05)			***0.9***		***0.4***
Mean		34.4	31.0	28.2	
			0.9		

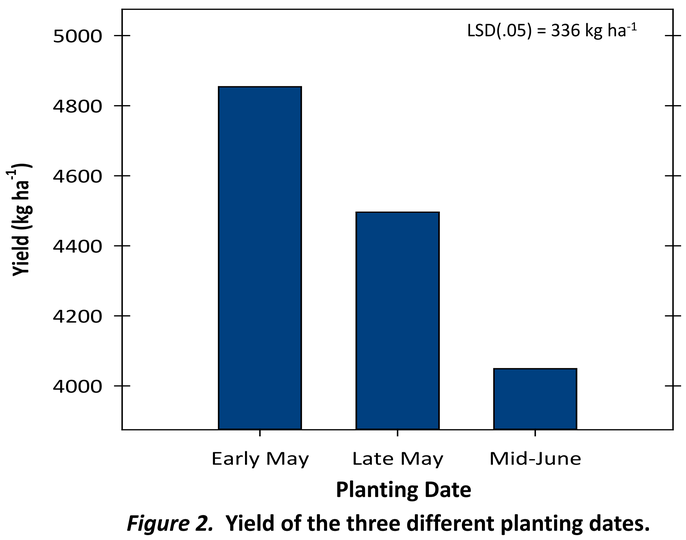

Figure 2. **Yield of the three different planting dates.**

CIPAR & CumNDVI

- Planting date, seeding rate, and their interaction influenced CIPAR and CumNDVI levels (p-value < 0.0002).
- CIPAR (R^2 = 0.54) and CumNDVI (R^2 = 0.49) were positively related to yield .
- CIPAR and CumNDVI declined as planting was delayed and displayed the largest values with seeding rates >296,400 seeds ha^{-1}.
- Both displayed larger values for 98,000 seeds ha^{-1} planted early compared to 345,000 seeds ha^{-1} planted late.

Planting Date

- Planting date showed a significant effect on yield (p-value = 0.0003) where maximum yields were obtained by planting before May 10th.
- Yield declined by 15.4 kg ha^{-1} d^{-1} between the early and late May planting dates and by 30 kg ha^{-1} d^{-1} between the late May and mid June planting dates.
- Yield declined by an average of 21.2 kg ha^{-1} d^{-1} over the whole planting season.

Conclusions

- Planting in early May maximized yield, which then declined by an average of 21.2 kg ha^{-1} d^{-1} when planting was delayed after May 10th.
- Filling in suboptimal plant stands (<247,000 plants ha^{-1}) with enough seed to bring the final plant stand above 247,000 plants ha^{-1} increased yield regardless of the planting date. Using tillage and replanting the entire stand was not advantageous compared to filling in the existing stand.
- CIPAR and CumNDVI were both positively related to yield and can help explain yield declines from delayed planting and yield increase s from filling in suboptimal (<247,000 plants ha^{-1})stands.

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.
- Edwards, J.T., L.C. Purcell, and D.E. Karcher. 2005. Soybean yield and biomass responses to increasing plant populations among diverse maturity groups. Crop Sci: 45:1778-1785.

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