ECONOMIC RISK & PROFITABILITY OF SOYBEAN SEED TREATMENTS AT REDUCED SEEDING RATES

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Introduction

Earlier soybean [*Glycine max* (L.) Merr.] planting coupled with increasing seed cost and higher commodity prices has led to a surge in the number of hectares planted with seed treatments (Esker and Conley, 2012). Furthermore, recent studies have suggested that growers should consider lowering seeding rates to increase their return on investment (De Bruin and Pedersen, 2008; Epler and Staggenborg, 2008). Ultimately, growers would like to know the value proposition of combining seed treatments with lowered seeding rates.

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

1. Quantify the effects of seed treatments and seeding rates on soybean seed yield
2. Assess the economic risk and profitability of seed treatments and seeding rates, including the calculated economically optimal seeding rate (*EOSR*) and sub-optimal seeding rates (<247,000 seeds ha^{-1}) for each seed treatment.

Materials & Methods

Research was conducted at nine locations throughout Wisconsin during the 2012 growing season.

Variety: Syngenta Brand S20-Y2
Seeding Rates:
- 98800, 148200, 197600, 247000, 296400, and 345800 seeds ha^{-1}

Seed Treatments: applied at labeled rates
- Untreated Control (UTC) $0 unit^{-1}
- ApronMaxx RTA® (AM) $5 unit^{-1}
- CruiserMaxx® (CM) $12 unit^{-1}

Plot Dimensions: 2.3 m wide (six, 38cm rows) by 6.4m long
Data Collection: The center four 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}.
Seed Cost: $50 unit^{-1}
Grain Sale Price: $0.44 kg^{-1}

Statistical Analysis: Yield was subjected to a mixed-model analysis using the PROC MIXED procedure in SAS Version 9.3 (SAS Institute Inc., Cary, NC). Seeding rate, seed treatment, and their interaction were treated as fixed effects, while location and replicate were treated as random effects. Yield modeling (Figure 1) and a partial budget profit analysis (Figure 2) was performed using a negative exponential model. The *EOSR* for each seed treatment was calculated from the first derivative of the yield model equations.

Economic Risk Analysis: The analysis was performed in RStudio (RStudio Inc., Boston, MA) using the MU, VCOV, and RMULTNORM functions on the negative exponential yield models (Figure 1) and applying these results to Monte Carlo Simulation from a bivariate normal distribution using a variance-covariance matrix of the estimated model parameters for the means. These random draw parameters were used in determining the probability of increasing profit ha^{-1} or breaking-even at the pre-set seeding rates and *EOSR*, for each seed treatment (ex. CM-98,800 seeds ha^{-1}), over a pre-determined "base case". In addition, the average profit ha^{-1} increase was determined for positive, negative, and all outcomes. The base case is untreated seed at 345,800 seeds ha^{-1}, resulting in 20 comparison to the "base case" (Table 1).

Preliminary Results

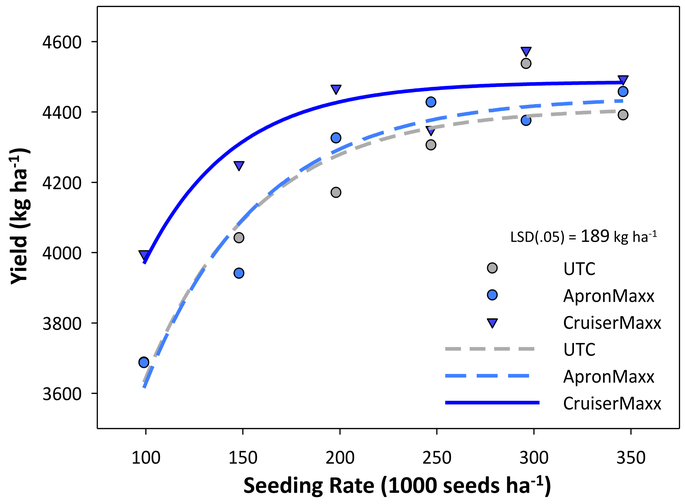

Figure 1. Yield Modeled for Seeding Rate by Seed Treatment Interaction.
- UTC = 4413.17(1-e$^{-0.0175*\text{Seeding Rate}}$) R^2 = 0.91
- ApronMaxx = 4444.27(1-e$^{-0.017*\text{Seeding Rate}}$) R^2 = 0.94
- CruiserMaxx = 4486.18(1-e$^{-0.0218*\text{Seeding Rate}}$) R^2 = 0.87

Yield Analysis

- There was a significant seed treatment by seeding rate interaction (p = 0.037)
- CruiserMaxx yield was greater that ApronMaxx and UTC at 98,800 and 148,200 seeds ha^{-1}
- CruiserMaxx yield was greater than UTC at 197,600 seeds ha^{-1}
- CruiserMaxx yield was greater than ApronMaxx at 296,400 seeds ha^{-1}
- No seed treatments difference were noted at 247,000 and 345,800 seeds ha^{-1}

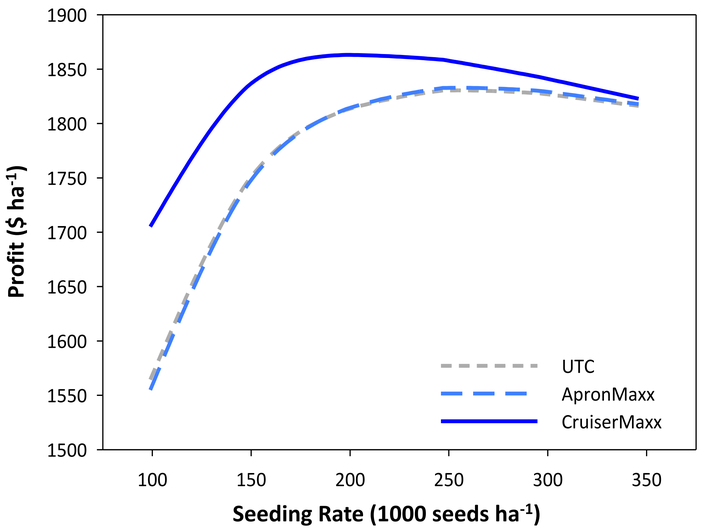

Figure 2. Seed Treatment by Seeding Rate Profit Analysis.

Profit Analysis

- Profitability did not differ between ApronMaxx and UTC at any seeding rate
- Economically Optimal Seeding Rates (*EOSR*):
  - UTC = 260,000 seeds ha^{-1}
  - ApronMaxx = 261,000 seeds ha^{-1}
  - CruiserMaxx = 210,000 seeds ha^{-1}

	Break-Even Probability	Positive Outcomes	All Outcomes	Negative Outcomes
		Avg. Profit Increase ($ ha^{-1}) Over "Base Case"		
UTC-296,400	0.89	11	9	-9
UTC-247,000	0.76	18	8	-21
UTC-197,600	0.46	18	-14	-41
UTC-148,200	0.08	13	-84	-93
UTC-98,800	0.00	18	-267	-267
AM-345,800	0.50	61	1	-59
AM-296,400	0.55	62	10	-54
AM-247,000	0.55	60	10	-52
AM-197,600	0.42	51	-14	-61
AM-148,200	0.13	37	-88	-106
AM-98,800	0.00	31	-277	-277
CM-345,800	0.54	62	8	-56
CM-296,400	0.63	68	25	-49
CM-247,000	0.70	72	37	-46
CM-197,600	0.70	72	36	-48
CM-148,200	0.52	60	0	-69
CM-98,800	0.09	37	-136	-154
UTC-*EOSR*	0.81	17	10	-18
AM-*EOSR*	0.56	61	12	-52
CM-*EOSR*	0.71	73	38	-47

Table 1. Economic Risk Analysis. Break-Even Probabilities for various Seed Treatment by Seeding Rate Combinations.

Economic Risk Analysis

- CruiserMaxx showed break-even probabilities >0.50 for all seeding rates except at 98,800 seeds ha^{-1}.
- CruiserMaxx at 345,000 seeds ha^{-1} had a break-even probability of 0.54 and averaged a $8 ha^{-1} profit increase over the base case.
- CruiserMaxx and ApronMaxx achieved the highest break-even probability and profit ha^{-1} increase at their *EOSR.*
- UTC showed the largest profit ha^{-1} increase at it's *EOSR*, but the highest break-even probability was at 296,400 seeds ha^{-1}.

Preliminary Conclusions

- Lower seeding rates (<247,000 seeds ha^{-1}) showed increased yields and profitability with CruiserMaxx.
- ApronMaxx and UTC showed no difference's in yield or profitability at any seeding rate.
- At higher seeding rates (>247,000 seeds ha^{-1}) yield and profitability was not significantly affected by seed treatment use.
- ApronMaxx and UTC required higher seeding rates (>247,000 seeds ha^{-1}) to achieve break-even probabilities >0.50 and their *EOSR* showed the largest average profit ha^{-1} increase over the base case.
- CruiserMaxx showed break-even probabilities >0.50 for all seeding rates except at 98,800 seeds ha^{-1}, but the lowest risk (0.71) and highest average profit ha^{-1} increase ($38 ha^{-1}) was achieved at its *EOSR,* which was 50,000 seeds ha^{-1} less than ApronMaxx and UTC.

Literature cited

- Esker, P. and S.P. Conley. 2012. Probability of yield response and breaking-even for soybean seed treatments. Crop Sci: 52:351-359.
- 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.
- Epler, M. and S. Staggenborg. 2008. Soybean yield and yield component response to plant density in narrow row systems. Online. Crop Management doi:10.1094/CM-2008-0925-01-RS.