Development of a Yield Loss Prediction Model for Asian Soybean Rust

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INTRODUCTION

The aim of the Soybean Rust (SBR) Yield Loss Model Project is to develop an interactive software tool to calculate potential yield loss due to SBR. This is a collaborative project and involves University of Kentucky (UK), Louisiana State University (LSU), and Embrapa-Soja in Brazil.

We know that soybean rust causes accelerated defoliation, therefore the impact on yield will likely depend on the extent of the defoliation and the growth stage when it occurs.

There are models available that predict yield loss based on % leaf loss. However, remaining leaf area index (LAI), and canopy light interception, provides the most accurate estimates of yield loss due to defoliation (Board et al., 1994, 1997; Board, 2004).

Development of a yield loss prediction model: Steps and progress to date

Step 1: Test the hypothesis that yield loss due to SBR was largely due to defoliation.

- 2005-06 trial Londrina, Brazil.
- Disease and early defoliation reduced seed size (Table 1).
- Relationship between healthy leaf area index and yield.

Step 2. To develop and validate a mechanistic yield loss model specific for maturity groups (MG) and growth stage.

Trials were planted at LSU and UK this season. Details and preliminary data from the UK trial follow.

OBJECTIVE

To develop a mechanistic SBR yield loss prediction model based on remaining LAI.

METHODOLOGY

Experimental Design: RCBD, 4 replications, treatments in a split-split plot design.

- Two varieties (Asgrow 3905 (MG III) and DP 4331RR (MG IV)).
- Five weekly defoliations at R5.5, R5.8, R6, R6.3, and R6.6.
- Four levels of defoliation (control, 33%, 66%, and 100% defoliation).

Leaf Area Index: LAIs of the control plots were measured by destructive sampling at R5. For subsequent defoliations the LAIs were adjusted based on the number of leaves which had dropped from the plants within 1 m^2 chicken wire enclosures in each of the control plots.

Figure 1: Aerial view of a set of defoliated plots.

Figure 2: A 100% defoliation plot showing earlier maturity.

Figure 1 shows a set of defoliation plots. Note the 100% defoliation plot and the similar appearance of the remaining plots from above. The defoliation treatments started with the lower canopy. One of the effects of defoliation is earlier maturity (Fig. 2).

RESULTS

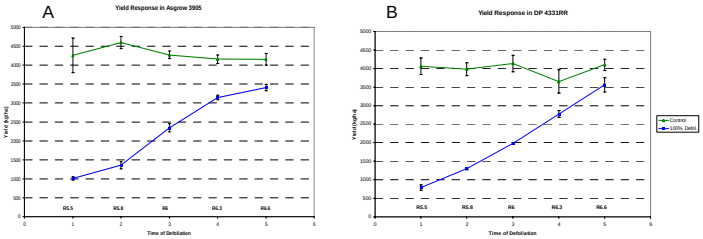

Figure 3: Yield response to 100% defoliation with Asgrow 3905 (A) and DP 4331RR (B)

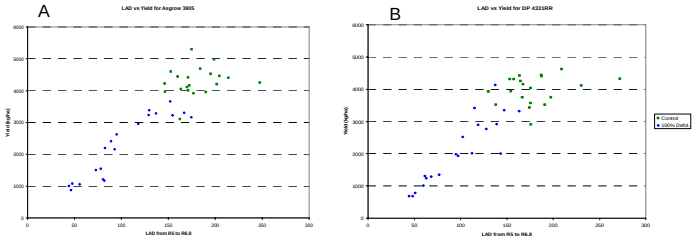

Figure 4: Leaf Area Duration from R5 to R6.8 vs. Yield for the control and 100% defoliation treatments with Asgrow 3905 (A) and DP 4331RR (B).

Treatment	100 Seed Wt. grams	
A (SBR start R1) (no fung.)	7.0	*c*
B (SBR start R5) (fung. R2)	7.5	*c*
C (Manual Defol. To mimic A)	8.7	*b*
D (Manual Defol. To mimic B)	9.4	*ab*
E (Control, no defol., fung.)	10.0	*a*
C.V. (%)	10.4	
LSD (0.05)	1.1	
Pr > F	<0.0001	

Table 1: 100 seed weights from SBR & defoliation trial in Brazil.

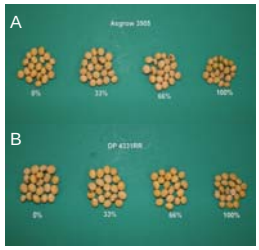

Figure 5: Seed samples (20 each) from control, 33%, 66%, and 100% defoliation treatments with Asgrow 3905 (A) and DP 4331RR (B). The defoliations were at R5.5.

SUMMARY

Impact of defoliation on yield was dependent on growth stage (Fig. 3). Yield is related to Healthy Leaf Area Duration (Fig. 4). The defoliation treatments had an impact on seed size (Fig. 5). Both varieties responded similarly (Fig. 3 – Fig 5). Similar results in Brazil and Kentucky.

What's Next?

The Project has generated considerable interest and the number of partners may increase. Preliminary results from Brazil and the U.S. are promising and support the utility of a yield loss prediction model based on remaining LAI. Stay tuned for updates on model development and validation!

http://www.uky.edu/Ag/Agronomy/Department/sbr/

References

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