Yield Response of Soybean to Partial and Total Defoliation during the Seed Filling Period

J.E. Board1, S. Kumudini2, J. Omielan2, E. Prior2, and C.S. Kahlon1

1School of Plant, Environment, and Soil Sciences, Louisiana State University Agricultural Center, Baton Rouge, LA, 70803.
2Dept. of Plant and Soil Sciences, Univ. of Kentucky, Lexington, KY, 40546.

ABSTRACT
Understanding how defoliation affects soybean [Glycine max (L.) Merr] yield during the seed filling period is essential in making management recommendations for contour leaf removal systems. The objective of this study was to gain a greater understanding of the mechanisms for yield reduction with defoliation at various stages across the seed filling period. Defoliations were conducted from the bottom of the canopy up to mimic the progress of soybean rust. Two defoliation levels: 0% defoliation (control), 33% defoliation, 66% defoliation, and 100% defoliation. Throughout the seed filling period, data were taken on yield, harvest index, dry matter, seed number per area, and seed size. Data were analyzed by SAS PROC MIXED with mean separation by SAS LSMEANS using Tukey’s test. Regression analyses for determination of linear, quadratic, and cubic relationships were also analyzed with PROC MIXED.

INTRODUCTION
Several biotic and abiotic stresses of soybean affect yield through defoliation occurring during the seed filling period. Previous studies have focused on either a single defoliation level or a combination of defoliation and a single cultivar. These previous studies have not focused on delineating the effects of defoliation on yield across multiple defoliation levels and cultivars. In addition, these studies have not encompassed a comprehensive picture of how partial and total defoliations affect yield at different locations. Although defoliation influence includes effects on canopy photosynthesis, leaf area index reduction, altered partitioning of dry matter to plant parts, leaf abscission, delayed leaf senescence, and even biomass change, defoliation yield was shown to be an important contributor to yield loss. Light interception has been shown to be a contributor to yield loss due to defoliation injury (Browde et al., 1994; Hinson et al., 1978; Ingram et al., 1981; Higley, 1992). Previous studies have suggested that either leaf area index or light interception have potential use as criteria for significant yield loss at certain stages of seed filling (Board et al., 1997).

OBJECTIVE
The first objective of this study was to determine yield response of soybean to partial and total defoliation during the seed filling period that simulated the defoliation pattern of soybean rust, that is, defoliation from the bottom of the canopy up. This was warranted because no previous study has examined canopy defoliation patterns to determine the effects on yield. The second objective was to determine defoliation effects on percent defoliation and leaf area index remaining after defoliation, and leaf area remaining after defoliation. Within each site, yield loss (%) yield loss vs. control, relative light interception reduction, percent defoliation, and leaf area index remaining after defoliation were averaged across the R5-R6 period (the period during which most yield loss occurs). Across sites, defoliation effects were consistently identified and were similar across multiple defoliation levels. These results provide general guidelines for management of defoliation pests at various stages of seed filling. Across sites, defoliation was identified and was similar across multiple defoliation levels. These results provide guidelines for management of defoliation pests at various stages of seed filling. Across sites, defoliation was identified and was similar across multiple defoliation levels. These results provide guidelines for management of defoliation pests at various stages of seed filling. Across sites, defoliation was identified and was similar across multiple defoliation levels. These results provide guidelines for management of defoliation pests at various stages of seed filling. Across sites, defoliation was identified and was similar across multiple defoliation levels.