MISSISSIPPI SOYBEAN PROMOTION BOARD
PROJECT NO. 77-2015 (HESTER FELLOWSHIP—YEAR 1)
2015 Annual Report

TITLE: Effects of Defoliation on Mississippi Soybean Yields

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EXECUTIVE SUMMARY

The first year of this project's research provided the following results.

- 33% and 66% defoliation at either V3 or V6 alone did not significantly reduce soybean yield below that from the non-defoliated check (Figure 1).
- Multiple defoliation events during soybean vegetative development (V3 and V6) did not exhibit a significant compounded or cumulative effect on soybean yield (Figure 1).
- Defoliation levels of 33% and 66% all season reduced yields below that from the non-defoliated check, as did 33% and 66% defoliation at R3 (Figure 2). 100% defoliation at R3 resulted in a yield that was only 21% of that from the non-defoliated check.
- Results from this preliminary study gave no indication that yield losses from defoliation are affected by planting date that ranged from early April through mid-June (Figures 3 & 4).
- Overall, these preliminary results indicate that multiple defoliation events during soybean vegetative development do not significantly affect soybean yield beyond that from singular defoliation events, and that yield losses from defoliation may not be affected by early vs. late planting.

BACKGROUND

Injury from defoliating insects is responsible for more yield loss to Mississippi soybean producers than any other feeding guild of insects. In 2014, defoliating insects alone cost Mississippi producers $37,081,635 (Musser, Catchot et al. 2015). Insects contributing to defoliation include bean leaf beetles, soybean loopers, velvetbean caterpillars, green cloverworms, armyworms, grape colaspis, flea beetles, and grasshoppers.

Previous research conducted by Owen (2012) has shown that, while soybeans in the vegetative growth stages can tolerate a relatively large amount of defoliation, excessive foliage loss that occurs during the R3-R5 growth stages can have devastating effects on yield.

Current Mississippi recommendations put treatment thresholds for defoliation at 35% pre-bloom and 20% during and after bloom (Catchot, Allen et al. 2016). However, a producer may be required to treat for defoliating pests multiple times during a single growing season. In these situations it isn't known if multiple defoliation events compound to further increase yield loss.

For instance, if a pest defoliates a soybean crop 30% during the vegetative stage then another pest defoliates the crop an additional 20% during the reproductive stage, is the effect additive? These two events could have a great or no effect at all on each other. The question is whether or not the latter of the two defoliation events needs to have a lower treatment threshold due to the damage that occurred earlier in the season.

Soybeans are planted over a relatively lengthy amount of time. Planting dates generally range from mid-March to mid-July, with around April 20th typically being the optimum planting date for maximum yield (MSU Ext 2014). Earlier planted soybeans that have defoliation occur during their vegetative growth stages should have more time to recover lost leaf area before reaching the more sensitive reproductive stages vs. later-planted soybeans that only have a short time to recover. These differences in recovery time could be an important factor with respect to treatment timing.

The objective of these tests is to refine treatment recommendations by evaluating the effects of compounding defoliation and how planting dates can affect yield loss associated with defoliation on Mississippi soybeans.

MATERIALS AND METHODS

Tests were conducted during the 2015 growing season at the R.R. Foil Plant Science Research Center at Starkville, MS and the Delta Research and Extension Center in Stoneville, MS. Trials were planted at 110,000 seeds per acre in 38-inch-wide rows using Asgrow 5335. Plot sizes were 4 rows wide by 10 feet long with treatments arranged in a randomized complete block design. All plots were periodically treated with insecticide/fungicide to eliminate effects of various pests.

The middle two rows of each plot were hand-defoliated at the specified growth stages and levels for each test. Leaf area index and plant heights were measured periodically during the growing season. Stand density and yields were recorded for all plots. All data were analyzed using JMP 12 (1989-2007) with an ANOVA model. Means were separated using Tukey's HSD ($P > 0.05$).

Effects of Compounding Defoliation on Soybeans

Two tests were conducted in 2015 to evaluate the effects of compounding defoliation on soybeans. For both tests, soybeans were planted on April 30th and June 2nd at Starkville and Stoneville, respectively. All treatments were replicated 4 times.

Objective 1 evaluated the effects of compounding defoliation in vegetative soybeans. Tests were set up as a full factorial with factors being defoliation (0, 33, 67 or 100%) and soybean growth stages (V3 and/or V6), thus resulting in 16 treatments (4 defoliation levels at 2 stages in 2 planting dates).

Objective 2 evaluated compounding defoliation on vegetative and reproductive stage soybeans. Plants were defoliated weekly, maintaining a constant 17, 33, or 67 percent reduction in leaflet

number throughout the vegetative growth stage and during the entire growing season, or 17, 33, 67, or 100 percent once at the R3 growth stage. An undefoliated control was also included.

Effects of Planting Date on Defoliation

Objective 3 evaluated the effects of planting date on effect of defoliation. Soybeans were planted every other week beginning in early April and ending in Mid-June, for a total of 6 planting dates. Only the first 5 planting dates were harvested for the Stoneville test due to poor stand on the last planting date. Each planting date contained a non-defoliated and 100 percent defoliated effect for a total of 12 treatments with 6 replications. All defoliations occurred when plants reached the V4 growth stage.

RESULTS AND DISCUSSION

Objectives 1 and 2—Effects of Compounding Defoliation on Soybeans

Objective 1. Plots that received 100% defoliation at V3 yielded lower than those that received 33 or 66%, but not lower than the untreated check (Figure 1). Plots defoliated 100% during the V6 growth stage reduced yields below the untreated but no other treatment. No interaction between treatments was observed. Losses from single defoliation events in vegetative stage soybeans were consistent with studies conducted by Owen (2012). Preliminary results suggest that multiple defoliation events in vegetative stage soybeans do not compound to further impact yields.

Objective 2. Continuous defoliation at any level throughout the vegetative stage did not reduce yields significantly below the untreated (Figure 2). Defoliation levels of 33, 66, and 100% at R3 reduced yields below the untreated check. Defoliation rates of 33 and 66% occurring season-long reduced yields below the untreated check as well. No season-long defoliation treatment reduced yield significantly below its respective R3 treatment. These results, while only preliminary, indicate that defoliation occurring during vegetative growth stages has very little, if any, additional impact on yield losses that occurr as a result of reproductive defoliation.

Objective 3—Effects of Planting Date on Defoliation

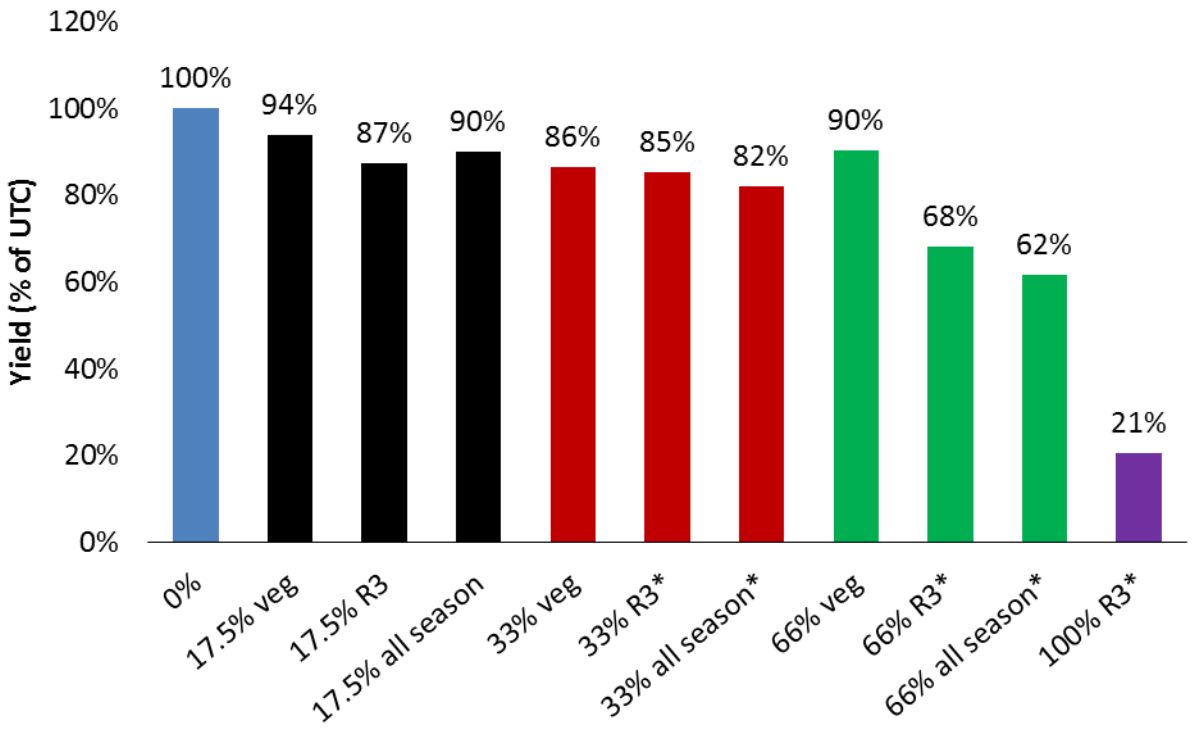
The Starkville, MS location results displayed trends that later-planted soybeans were more susceptible to yield loss from defoliation than earlier-planted beans; however, these trends were not significant (Figure 3). Values ranged from 1% yield loss for the earliest (8 April) planting date to 30% yield loss for the latest planting date (4 June). Results from the same test at Stoneville, MS were not consistent with those found at Starkville. Stoneville results did not provide any indication that yield losses from defoliation would be affected by planting date (Figure 4).

Inconsistencies between locations are likely due to differences in weather and irrigation frequency. Weather data from the Hills and Delta regions are currently being evaluated for the two trial locations. Studies will be conducted in subsequent summers to further evaluate this effect and could potentially lead to a threshold that can be adjusted for planting date.

Figure 1. Percentage yield of defoliation treatments during vegetative development compared to yield of untreated check (Objective 1)

		V6 Defoliation			
		0	33%	66%	100%
V3 Defoliation	0	100%	97%	96%	77%
	33%	105%	93%	88%	83%
	66%	100%	95%	101%	92%
	100%	86%	75%	79%	75%

Figure 2. Percentage yield of defoliation treatments compared to untreated check (Objective 2)



* Significantly lower than the untreated check (P > 0.05)

Figure 3. Yields and percentage yield reduction from defoliation at each planting date at Starkville, MS (Objective 3)

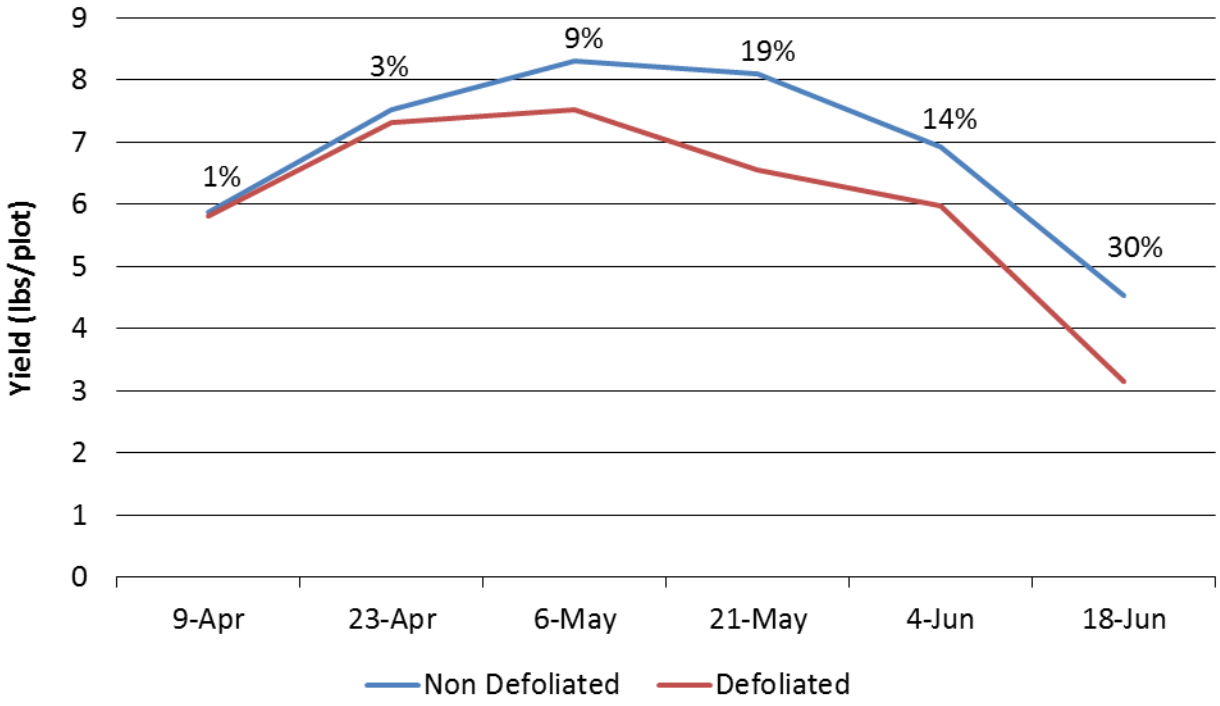
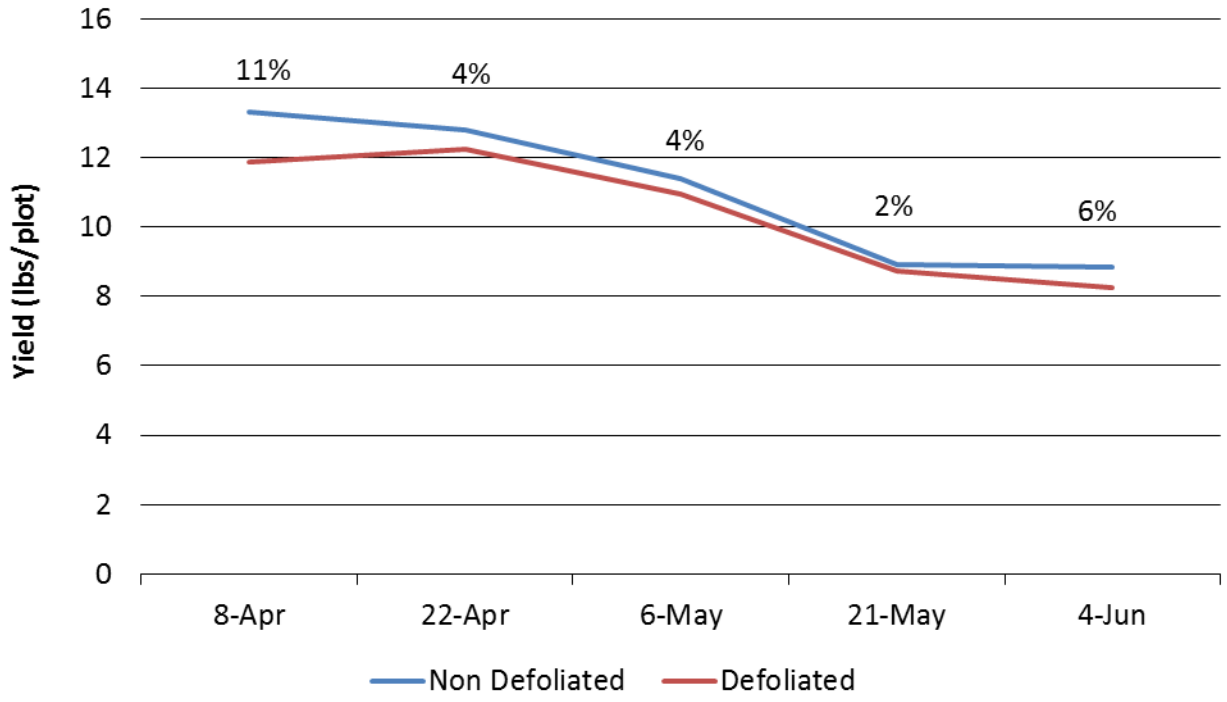


Figure 4. Yields and percentage yield reduction from defoliation at each planting date at Stoneville, MS (Objective 3)



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