

# **CONTINUED EVALUATIONS OF INTERNAL BOLL-INJURY THRESHOLDS FOR STINK BUGS IN THE SOUTHEAST**

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## **Abstract**

Because the importance of controlling stink bugs in cotton will continue to be an important concern for producers growing cotton in the southeastern USA, we continued research into refinement of current boll-injury thresholds. A summary of 49 threshold trials conducted from 2005 through 2008 in NC, SC, and GA indicated that stink bugs caused significant reductions in yield when present at moderate-to-high levels. A static threshold of 20% boll injury performed well in these trials in terms of yield and economic return but left some cotton unprotected. Under conditions of lower pressure from stink bugs, the 20% static threshold protected cotton and prevented over treatment for stink bugs in many trials but was not protective enough during a critical period of boll development defined as the 3<sup>rd</sup> through 5<sup>th</sup> week of bloom. Although the static 20% threshold resulted in positive economic returns across the majority of these tests, a dynamic threshold resulted in higher profits across all levels of pressure from stink bugs. The dynamic action threshold, based on varying injury levels by week of bloom (8 weeks: 50, 30, 10, 10, 10, 30, 30, and 50%), demonstrated the importance of aggressive protection from stink bugs during weeks 3-5 of bloom.

### **Introduction**

As cotton varieties with single-protein (i.e. Bollgard) protection from caterpillar pests, provided by genetic insertions from *Bacillus thuringiensis* (Bt) var. *kurstaki*, are phased out after 2010 and dual-protein (i.e. Bollgard II, WideStrike, VipCot) transgenic Bt varieties become the only option, the bollworm, *Helicoverpa zea* (Boddie), will no longer be the most damaging insect pest of cotton in the USA. True bugs (Miridae – plant bugs and Pentatomidae – stink bugs) will take over the number one spot, depending on region of the country (Southeast, Mid-South, West). The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), will be the most important insect pest of cotton in the Mid-South, the western tarnished plant bug, *Lygus hesperus* Knight, will remain predominant in western areas, and species of stink bugs, such as the green stink bug, *Acrosternum hilare* (Say), the southern green stink bug, *Nezara viridula* (L.), and the brown stink bug, *Euschistus servus* (Say), will be the most important group of insect pests of cotton in the Southeast.

Although thresholds for stink bugs based on bug density have been researched (Greene et al. 2001), the most useful threshold in the last 10 years has been the boll-injury threshold first investigated in 1998 (Greene and Herzog 1999). A static boll-injury threshold of 20% (or some modification, i.e. 10-20%) has been adopted and used for managing stink bugs in most cotton-producing states since the initial research. Refinement of that economic threshold for stink bugs has been explored extensively (Bacheler and Mott 2005, Roberts and Bednarz 2005, Bacheler et al. 2006, Roberts et al. 2006, Greene et al. 2008) since the initial trials. Because of further reductions in insecticide use for bollworm eminent with the upcoming unavailability of Bollgard, further development and validation of thresholds for the sucking bug complex in cotton are needed to maximize yields and preserve high fiber quality. In 2008, we continued investigations on treatment thresholds and application timings for stink bugs in cotton in North Carolina, South Carolina, and Georgia. Summarized data from multiple years (2005-2008) are presented.

### **Materials and Methods**

Cotton (Bollgard II / Roundup Ready Flex) was planted during late April and May in North Carolina, South Carolina, and Georgia during 2008 and previous years (2005-2007). Percent boll damage was determined by randomly selecting quarter-sized bolls (10 or 25) from each plot. Each boll was evaluated for internal feeding injury and lint stain damage. Foliar applications of lambda-cyhalothrin (Karate 2.08CS) or cyfluthrin (Baythroid 1 or 2EC) at 0.033 lb (AI)/acre plus dicofol (Bidrin 8E) at 0.25 lb (AI)/acre were made based on percent internal boll injury (static at 10, 20 or 30%; or dynamic at 50, 30, 10, 10, 10, 30, 30, and 50% for weeks 1-8 of bloom, respectively) or on schedule (weekly; 3<sup>rd</sup>, 5<sup>th</sup>, and 7<sup>th</sup> week of bloom). Samples of insect density were taken regularly with a drop cloth to determine abundance and species present in plots. Net returns of treatments were calculated by subtracting insecticide application costs (pyrethroid + organophosphate + application cost) of \$9.00 per acre per application from lint yield (lb/acre) in excess of the UTC valued at \$0.65/lb. Calculated returns presented are relative and designed only for comparisons; they do not represent comprehensive economic analyses. Data were processed using Agriculture Research Manager (ARM) (Gylling Data Management, Inc., Brookings, SD), and means were separated using Least Significant Difference (LSD) procedures following significant F tests using Analysis of Variance (ANOVA).

### **Results and Discussion**

We evaluated treatment thresholds for stink bugs in 49 trials during 2005-2008 in North Carolina, South Carolina, and Georgia. In 23 of those trials with 6 core treatments, we saw minor differences in treatment yields in terms of percent difference from yields in the untreated controls (Figure 1). As a result, yield data (Figure 2) were not statistically different but demonstrated that the 20% static and dynamic boll-injury thresholds were the only profitable treatments across years, states, trials, and broad conditions of pressure from bugs. Use of the dynamic threshold resulted in the highest net return (\$6.25/acre). When pressure from stink bugs was defined as “moderate/high”, “low/moderate”, or “low” at 2 or more sprays, 1 spray, and no sprays, respectively, at the 20% threshold, it allowed a closer examination of performance of varying thresholds under similar conditions. Under moderate/high pressure from bugs at 14 trials, differences in treatment yields (Figure 3) in terms of percent difference from yields in the untreated controls was high (30-45%). As a result, significant differences in yield (Figure 4) were detected, with highest yields and net returns in plots sprayed weekly for stink bugs. Under moderate/high pressure from stink bugs, the 20% threshold statistically protected most cotton at these 14 sites but left some cotton unprotected. Under the same defined moderate/high pressure from stink bugs at 5 trials with the

dynamic threshold in common, differences in treatment yields (Figure 5) in terms of percent difference from yields in the untreated controls remained high (20-30%). As a result, yields (Figure 6) were again statistically higher in all treatments sprayed for stink bugs; however, the highest net return (\$137.61) was realized in the dynamic threshold treatment. When pressure from stink bugs was categorized as low/moderate, differences in treatment yields (Figure 7) in terms of percent difference from yields in the untreated controls were dramatically reduced (0-5%). Significant differences in yield (Figure 8) were not detected at low/moderate levels of stink bug pressure, yet the dynamic threshold again returned the highest economic advantage (\$8.82/acre). When an automatic (calendar-spray) treatment (wk 3, 5, 7 of bloom) was added to the analysis under low/moderate levels of pressure from stink bugs (Figure 9), differences in treatment yields in terms of percent difference from yields in the untreated controls remained low (1-6%), but statistical differences in yield (Figure 10) were detected. Both the weekly-sprayed and the dynamic threshold treatments yielded statistically more lint than the UTC, but only the dynamic threshold had a positive net return (\$21.52/acre). Under low pressure from stink bugs (0 sprays at 20% threshold), differences in treatment yields in terms of percent difference from yields in the untreated controls were either negative or < 3% (Figure 11). As a result, yield data (Figure 12) were not significantly different but demonstrated that the dynamic boll-injury threshold was the only profitable treatment (\$7.42/acre).

The static boll-injury threshold (20% or a minor variation) has served as the most reliable threshold for stink bugs for almost a decade, but, after careful review of numerous yield data covering the last 4 years, a modification seems necessary. Our data and complementary research information (Bacheler and Mott 2005, Bacheler et al. 2006, 2007) indicated that when cotton was more aggressively sprayed with insecticide during the 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> week of bloom, lint yield was protected, and relative economic returns were above that provided by the static threshold. The importance of controlling stink bugs during that critical portion of the blooming period should be stressed. Crop phenology, changing susceptible boll load, population development of stink bugs during weeks of rapid blooming, and timing of insecticide applications are all critical factors that explain why a dynamic threshold should provide increased protection from stink bugs. The most concise reason why a dynamic threshold is effective is that the impact of stink bugs early and late in the season is inherently reduced. In most fields, the first two weeks of bloom are relatively unimportant in terms of protection from stink bugs because bolls are neither large enough nor available in large quantities and because populations of stink bugs are still low. The last two weeks of bloom (7<sup>th</sup> and 8<sup>th</sup>) are also relatively unimportant in most cases primarily because susceptible bolls are declining in number. The 6<sup>th</sup> week of bloom can be important, depending on the level of pressure from stink bugs, crop status, etc, but the 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> weeks of bloom are clearly important. Recommendations concerning control of stink bugs in cotton will be modified or appended to include the importance of protecting cotton during this critical window.

### **Acknowledgments**

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### **Disclaimer**

The mention of trade names in this report is for informational purposes only and does not imply an endorsement.

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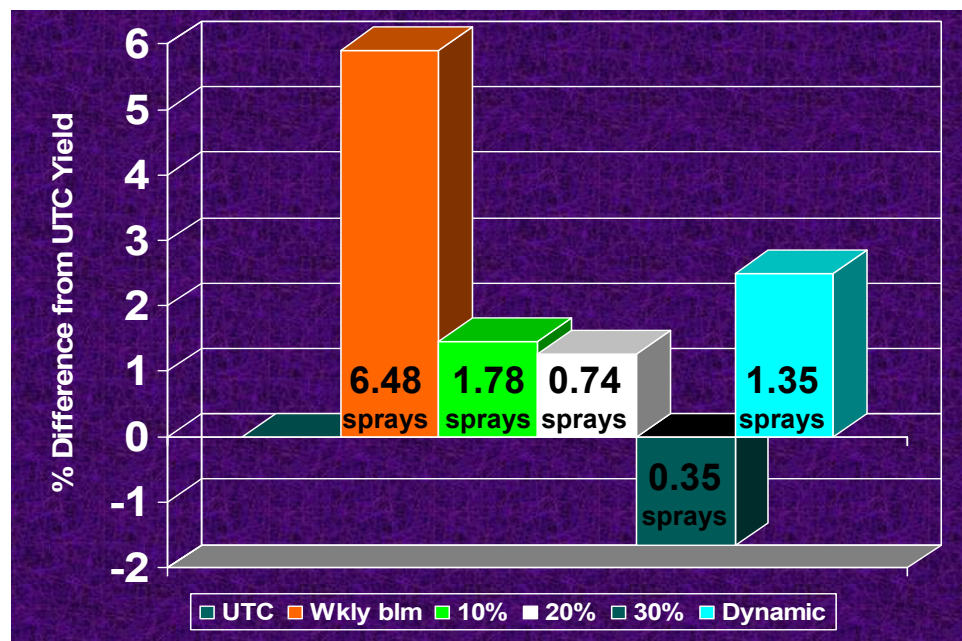


Figure 1. Percentage difference in lint yield from the untreated control and average number of insecticide applications following treatment regimens at various threshold levels for stink bugs in cotton at 23 sites across North Carolina, South Carolina, and Georgia during 2006-2008.

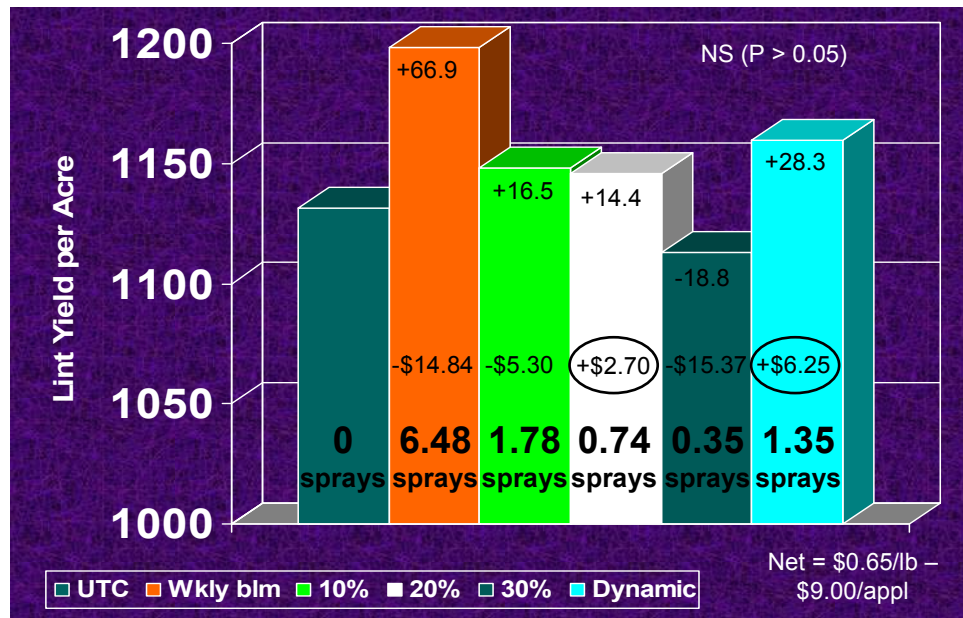


Figure 2. Yields, average number of insecticide applications, and net economic return following treatment regimens at various threshold levels for stink bugs in cotton at 23 sites across North Carolina, South Carolina, and Georgia during 2006-2008. Insecticide application (pyrethroid + organophosphate + application costs) was \$9.00 per acre. Cotton was priced at \$0.65/lb.

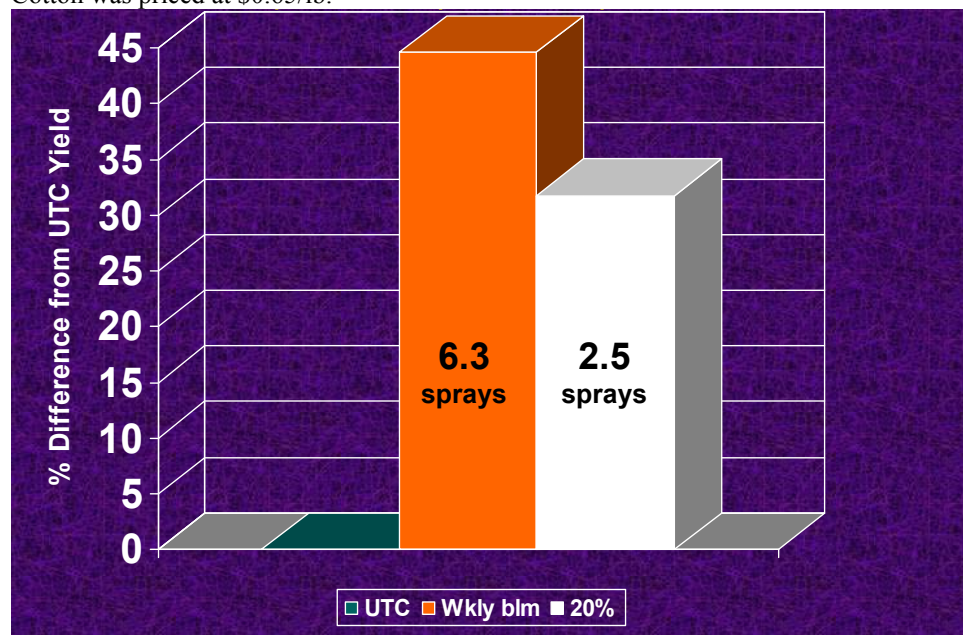


Figure 3. Percentage difference in lint yield from the untreated control and average number of insecticide applications following treatment regimens at various threshold levels for stink bugs in cotton at 14 sites across North Carolina, South Carolina, and Georgia during 2005-2008 with moderate-to-high pressure (2 or more sprays to 20% threshold) from stink bugs.

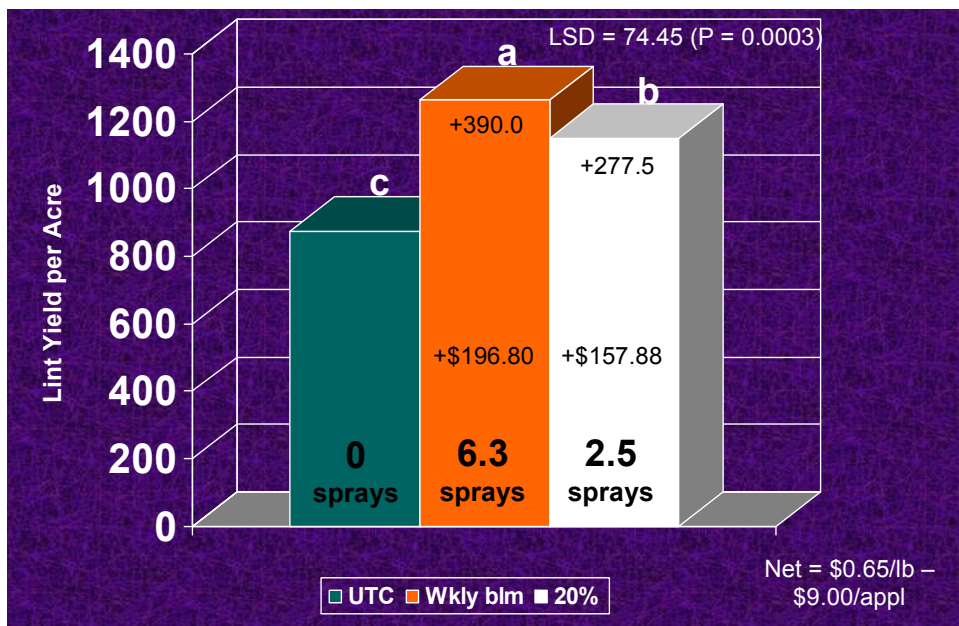


Figure 4. Yields, average number of insecticide applications, and net economic return following treatment regimens at various threshold levels for stink bugs in cotton at 14 sites across North Carolina, South Carolina, and Georgia during 2005-2008 with moderate-to-high pressure (2 or more sprays to 20% threshold) from stink bugs. Insecticide application (pyrethroid + organophosphate + application costs) was \$9.00 per acre. Cotton was priced at \$0.65/lb.

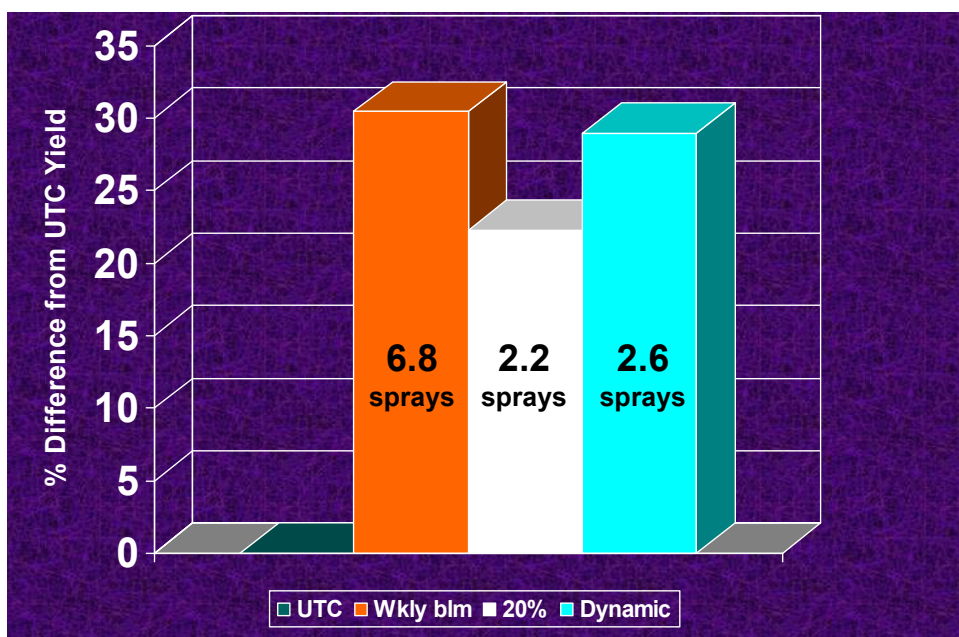


Figure 5. Percentage difference in lint yield from the untreated control and average number of insecticide applications following treatment regimens at various threshold levels for stink bugs in cotton at 5 sites across North Carolina, South Carolina, and Georgia during 2006-2008 with moderate-to-high pressure (2 or more sprays to 20% threshold) from stink bugs.



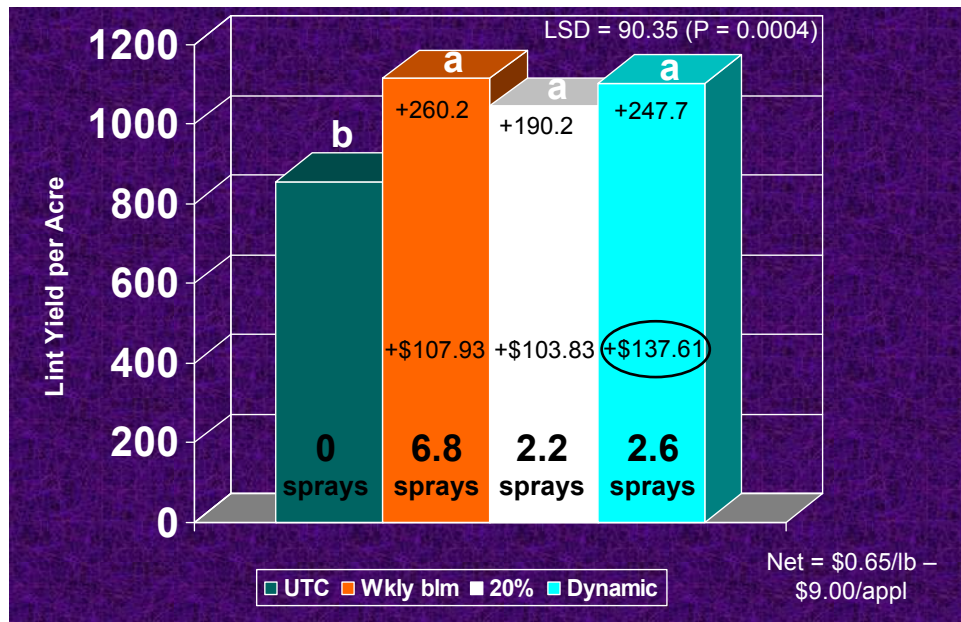


Figure 6. Yields, average number of insecticide applications, and net economic return following treatment regimens at various threshold levels for stink bugs in cotton at 5 sites across North Carolina, South Carolina, and Georgia during 2006-2008 with moderate-to-high pressure (2 or more sprays to 20% threshold) from stink bugs. Insecticide application (pyrethroid + organophosphate + application costs) was \$9.00 per acre. Cotton was priced at \$0.65/lb.

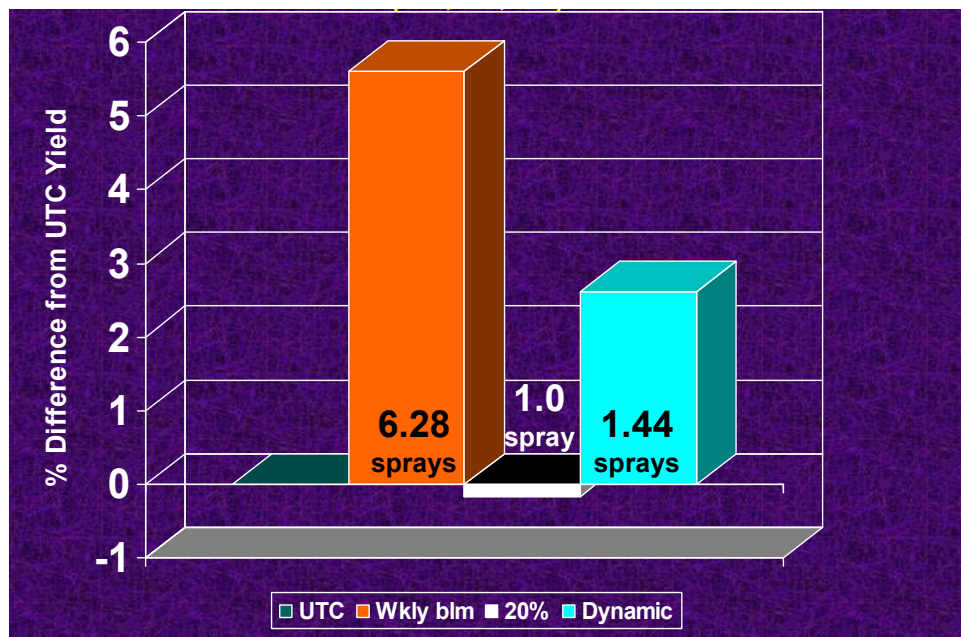


Figure 7. Percentage difference in lint yield from the untreated control and average number of insecticide applications following treatment regimens at various threshold levels for stink bugs in cotton at 18 sites across North Carolina, South Carolina, and Georgia during 2006-2008 with low-to-moderate pressure (1 spray at 20% threshold) from stink bugs.

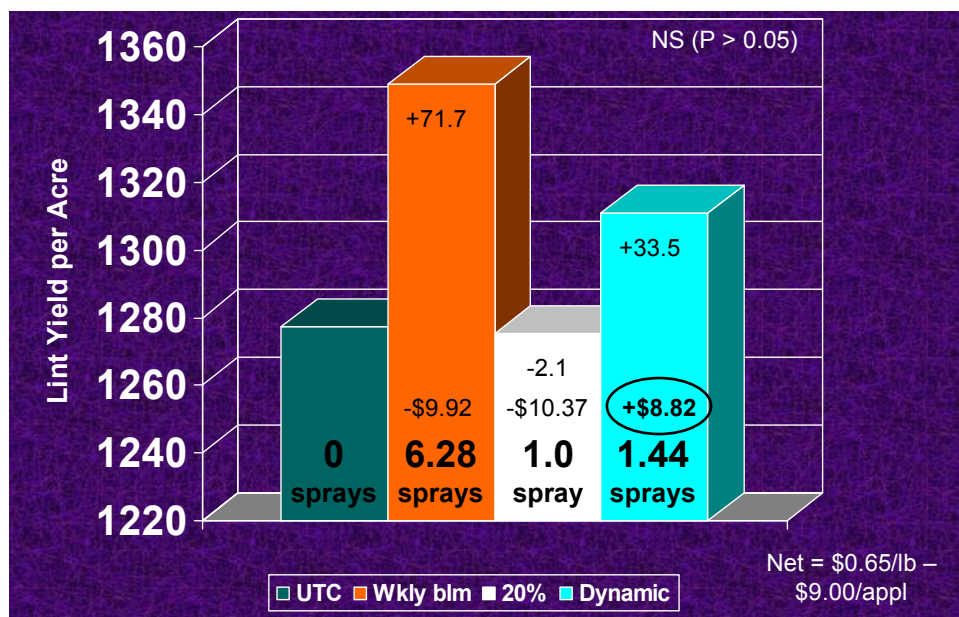


Figure 8. Yields, average number of insecticide applications, and net economic return following treatment regimens at various threshold levels for stink bugs in cotton at 18 sites across North Carolina, South Carolina, and Georgia during 2006-2008 with low-to-moderate pressure (1 spray at 20% threshold) from stink bugs. Insecticide application (pyrethroid + organophosphate + application costs) was \$9.00 per acre. Cotton was priced at \$0.65/lb.

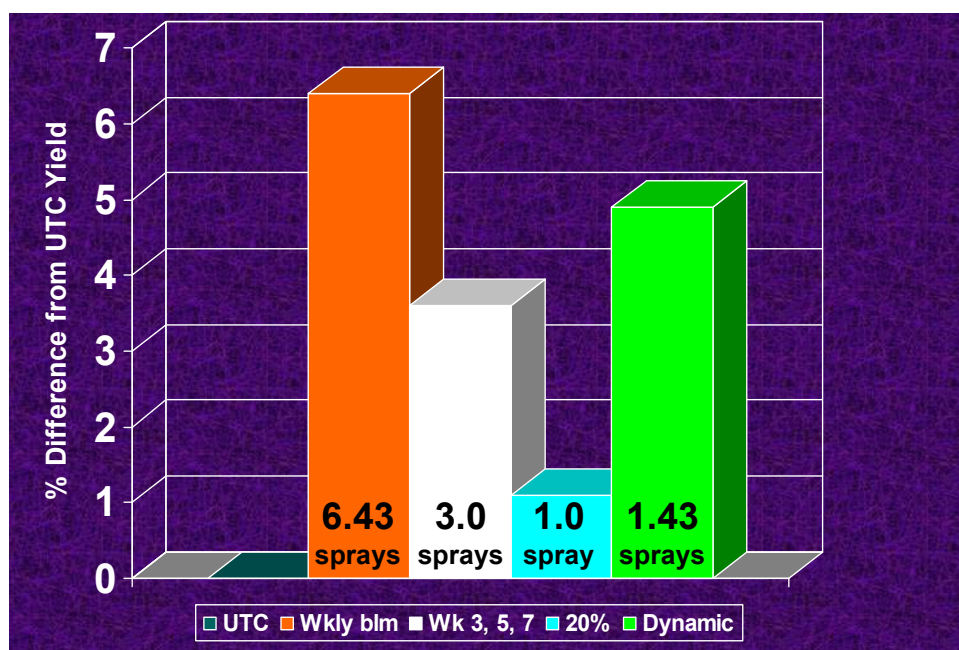


Figure 9. Percentage difference in lint yield from the untreated control and average number of insecticide applications following treatment regimens at various threshold levels for stink bugs in cotton at 7 sites across South Carolina and Georgia during 2006-2008 with low-to-moderate pressure (1 spray at 20% threshold) from stink bugs.



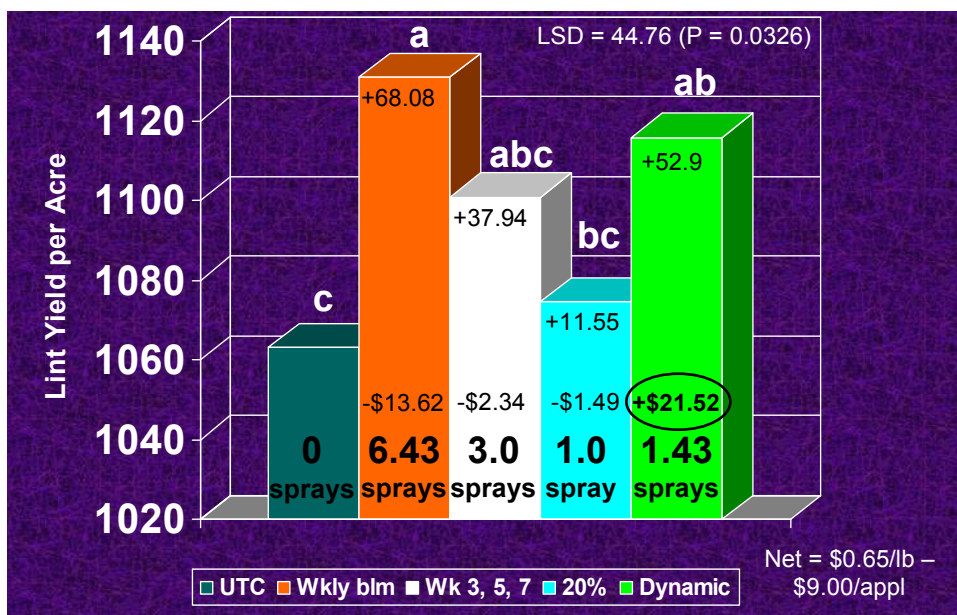


Figure 10. Yields, average number of insecticide applications, and net economic return following treatment regimens at various threshold levels for stink bugs in cotton at 7 sites across South Carolina and Georgia during 2006-2008 with low-to-moderate pressure (1 spray at 20% threshold) from stink bugs. Insecticide application (pyrethroid + organophosphate + application costs) was \$9.00 per acre. Cotton was priced at \$0.65/lb.

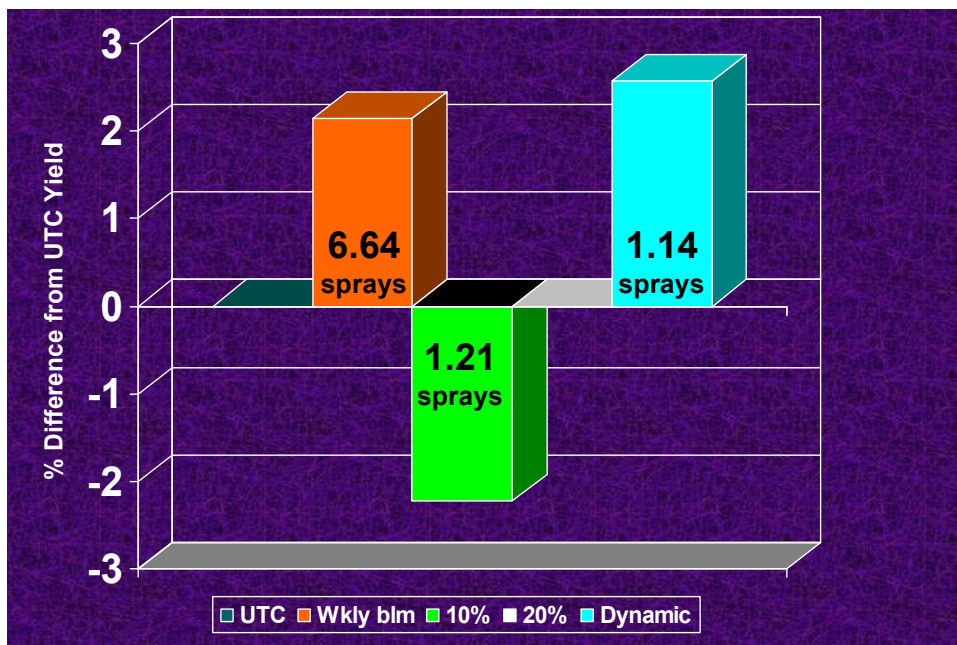


Figure 11. Percentage difference in lint yield from the untreated control and average number of insecticide applications following treatment regimens at various threshold levels for stink bugs in cotton at 14 sites across North Carolina, South Carolina and Georgia during 2006-2008 with low pressure (no sprays at 20% threshold) from stink bugs.

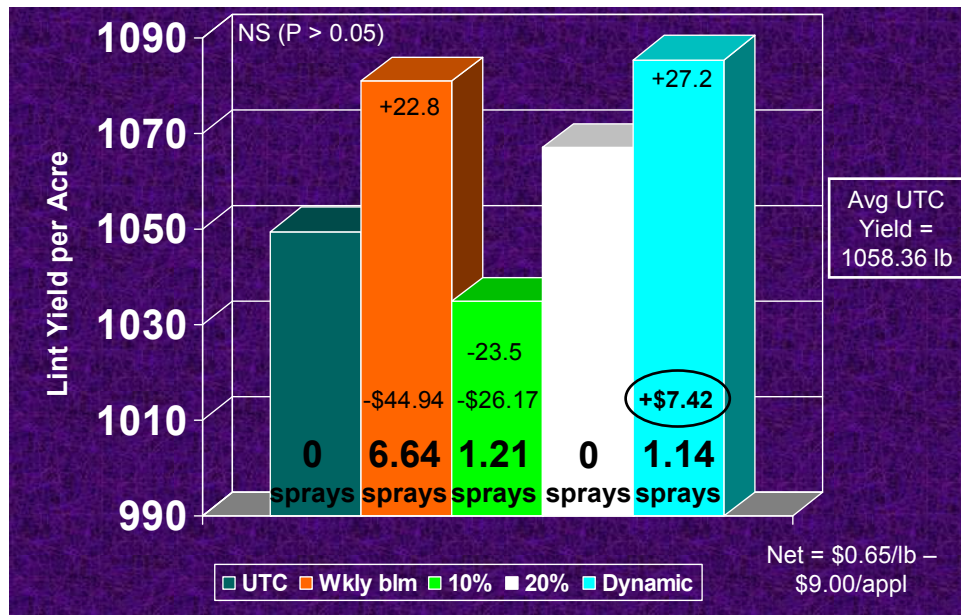


Figure 12. Yields, average number of insecticide applications, and net economic return following treatment regimens at various threshold levels for stink bugs in cotton at 14 sites across North Carolina, South Carolina, and Georgia during 2006-2008 with low pressure (no sprays at 20% threshold) from stink bugs. Insecticide application (pyrethroid + organophosphate + application costs) was \$9.00 per acre. Cotton was priced at \$0.65/lb.