APPLICATION OF BORDER SPRAYS TO MITIGATE STINK BUGS IN COTTON

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Introduction

Southeastern cotton producers have effectively transitioned from an insecticide intensive management system to a low spray (non-disruptive) system. This dramatic change was made possible by key developments including: boll weevil eradication, changing cultural land management practices, transgenic cotton cultivars, and selective insecticide chemistries. For example, Georgia growers averaged 14.3 insecticide applications per cotton field in 1986. Currently, the boll weevil has been eradicated from this region and the bollworm/budworm complex is generally managed below economic injury levels using transgenic *Bacillus thuringiensis* (*Bt*) cotton cultivars. Selective insecticides are used judiciously to mitigate pest outbreaks without disrupting natural enemies or flaring secondary pests. As a result of these changes, southeastern region cotton producing states averaged 2.0 and 2.3 insecticide sprays per year during 2006 and 2007, respectively. However, the substantial decline in insecticide usage has left an ecological niche for stink bugs in southeastern cotton production. The stink bug complex has become a serious production challenge that could compromise the delicate balance between not spraying and depending on natural control to regulate the remaining pests. Particularly troublesome in this trend is the fact that populations of brown stink bugs are tolerant of pyrethroid insecticides. Growers must use more disruptive organophosphate insecticides like dicrotophos, methyl parathion, and acephate to control these pests. Alternative approaches to stink bug management are needed to prevent widespread secondary pest outbreaks.

We previously conducted research on the process of stink bug invasion in a cotton field. Results showed that stink bug captures spiked sharply with the onset of bloom. In addition, we noted that populations were strongly clumped and tended to be more common on the edges of fields. We also noted that adults were captured at the periphery of the fields a week before we observed populations in the center of the field. Last year, we initiated a study to try to decrease stink bug population density and observed boll damage by spraying the borders of cotton fields starting as soon as stink bugs were observed. Unfortunately, data show that strategy did not work. We hypothesized that we waited too long before spraying and this prevented us from actually stopping the bugs before they dispersed into the field. This year we planned to automatically make border applications during the first and second weeks of bloom in hopes of targeting stink bugs as they moved in the fields. This strategy could be considered risky because there is the potential for applying insecticides in the absence of stink bugs. However, if this strategy would prevent the need for one or more field wide insecticide applications, there would be tangible benefits to growers including preservation of natural enemies, reduced incidence of secondary pest outbreaks, and significant savings in insecticide and application costs. The objective of this study was to evaluate in-field border sprays to mitigate whole field stink bug infestations in commercial cotton.

Materials and Methods

Three commercial cotton fields in Georgia were selected for inclusion in the border spray trial in 2010. Two of these fields were assigned border spray applications as soon as the fields reached first bloom and the third field was left untreated during the entire study. Fields were spatially mapped using GIS mapping software and then overlaid with a grid of sampling points at approximately 1-acre intervals. Additional sampling points around the perimeter of the entire field were used to get complete coverage of fields (Table 1). Each sampling point was marked using an 8-foot tall flag on a fiberglass pole. Starting at first bloom, weekly sampling at each sampling point included 20 sweeps with a 15-inch sweep net collection of 10 soft quarter-sized bolls. Sampling was conducted on opposite sides of the flag each consecutive week to prevent sampling the exact same plants or removing too many bolls from the any one plant. Bolls were pooled by sampling location in each field and placed in labeled plastic bags. At the laboratory, each boll was internally examined for evidence of stink bug feeding such as internal warts or stained lint.

Table 1. Acreage and border crops of cotton fields selected for study

Location	Treatment	Acres	Number of Sample Locations	Field Perimeter (feet)	Adjacent crops
Nashville	Border spray	61	77	7075	Peanut
Rebecca	Border spray	55	64	6587	Peanut, woods
Tifton	Untreated	17	24	3516	Peanut


Figure 1. Mist blower being pulled around the perimeter of a cotton field.

In the border sprayed fields, the outer perimeter of the field was treated using a trailer mounted mist or blast sprayer pulled behind a pickup (Figure 1). The blower delivered the pesticide about 20 rows into the interior of each field and was calibrated to deliver a tank mix of dicrotophos (Bidrin 8) at 4 oz per acre + beta-cyfluthrin (Baythroid XL) at 2 oz per acre. One week after the first application, we planned to make a second automatic application. Each sampling point was classified as being on the edge of the field or in the center, defined as flags that were generally about 200 feet from a field border.

Data analyses were conducted at the end of the year. By week, the mean percent boll damage was calculated for edge sampling locations, center sampling locations, and a field wide average. Second, the mean number of stink bug captures (all species combined) was calculated for the same sampling locations. Finally, the mean percent boll damage at each sampling location was plotted using spatial maps to visualize damage.

Results and Discussion

There were a total of 8770 bolls collected 142 adult stink bugs captured during the study. The majority (75%) of the captured stink bugs were *Euschistus* spp., primarily the brown stink bug. Green stink bugs comprised 18% of the captures and finally southern green stink bug comprised 7% of the captures. The total amount of insecticide sprayed per treatment was approximately 10% of the active ingredient that would have been sprayed in a whole field application. Border applications required 21 to 23 minutes each.

Sampling commenced during the first week of bloom as determined by white flowers on at least one-half of the plants across the entire field. Treated fields were sampled and then immediately sprayed so that we had data from the same day the spray was made. While the field at Nashville received planned applications on July 19 and July 26, the field at Rebecca received a scheduled treatment on July 15, and then delayed application on July 24, due to heavy rains during the previous week. Environmental stress including extreme heat and drought precluded production of sufficient quarter sized bolls during the sixth week of bloom at Rebecca.

Extension based thresholds for application of foliar insecticides for stink bugs were reached on each field. Those thresholds are 20, 15, 15, 15, 20, and 30% for the 2nd, 3rd, 4th, 5th, 6th, and 7th weeks of bloom, respectively. The untreated field exceeded the treatment threshold during four of the six possible weeks (Table 2). Moreover, during those four weeks, the average percent damage above the threshold was greater than 16%. Conversely, the border sprayed field at Rebecca only exceeded threshold by less than 2% during the 7th week of bloom. The border sprayed field at Nashville exceeded the threshold during the final two weeks of bloom only, and by an average of 4 percent weekly. There were nearly twice as many stink bugs captured per sample in the untreated field compared to the border treated fields (Table 3). For example, the average number of stink bugs per sample across the entire year at Rebecca was 0.08 stink bugs per sample, 0.17 stink bugs per sample at Nashville, and 0.30 stink bugs per sample at Tifton.

Table 2. Mean percent boll damage observed by treatment strategy, week of bloom, and field location. Whole field means followed by an asterisk (*) indicate that the field exceeded the Extension recommended threshold for triggering an insecticide application

Week of Bloom	Rebecca (Border Treated)			Nashville (Border Treated)			Tifton (Untreated)		
	Edge	Center	Whole Field	Edge	Center	Whole Field	Edge	Center	Whole Field
2	6.9	10.6	9.03	3.6	4.2	3.4	15.4	13.8	14.8
3	13.3	15.8	14.8	12.7	11.9	12.2	30.62	20.0	27.1*
4	15.5	13.5	14.4	12.5	16.3	14.9	16.87	17.5	17.1*
5	14.3	11.1	12.5	37.7	13.2	22.7*	22.5	2.0	14.6
6	-	-	-	31.2	15.0	20.7*	59.4	38.8	53.1*
7	37.6	27.6	31.9*	-	-	-	49.7	26.3	41.9*

Table 3. Mean number of adult stink bugs (all species) per 20 sweeps by treatment strategy, week of bloom, and field location

Week of Bloom	Rebecca (Border Treated)			Nashville (Border Treated)			Tifton (Untreated)		
	Edge	Center	Whole Field	Edge	Center	Whole Field	Edge	Center	Whole Field
2	0.04	0.03	0.03	0.00	0.04	0.03	0.00	0.38	0.13
3	0.07	0.08	0.08	0.00	0.00	0.00	0.44	0.13	0.33
4	0.12	0.11	0.11	0.30	0.04	0.14	0.19	0.13	0.17
5	0.04	0.03	0.03	0.80	0.00	0.33	0.56	0.13	0.41
6	-	-	-	0.87	0.06	0.37	0.44	0.13	0.34
7	0.31	0.05	0.16	-	-	-	0.62	0.00	0.41

Spatial mapping of each field by week was conducted to show how boll damage changed in a spatial context. At Nashville, the most significant damage occurred on the northern edge of the field, which bordered a similar sized peanut field (Figure 3). The two border sprays appeared to keep the infestations at relatively low levels until the 5th week of bloom when extremely heavy stink bug damage was detected on the border with the peanut field. Regardless of week of bloom, the percent damage in the center of the field never exceeded 16.3%. At Rebecca, border sprays also appeared to do a good job suppressing early and midseason stink bug damage (Figure 4). The percent damage in the center of the field did not exceed threshold until the 7th week of bloom when most of the crop would have been made. The most serious damage at Rebecca was along the west and northwest sides of the field, which also bordered large peanut fields. Late season damage was apparent on the eastern edge of this field, which matured slightly slower than the rest of the field. Finally, the untreated field at Tifton had the heaviest stink bug infestations (Figure 5). This field was bordered by peanut on the north and east sides. Damage exceeded threshold in the center of the field nearly as often as on the edges.

Data collected in 2010 suggest that the border sprays provided measureable stink bug and damage suppression compared to the untreated field. Admittedly, the unsprayed field was considerably smaller than the two treated fields and there could be inherent differences in stink bug movement between the two field sizes, but the smaller field was necessitated because growers were unwilling to maintain a large unsprayed field. This study suggested that the two border applications may prevent the need for whole field application during weeks three through five of bloom, which are the most important weeks to "make the crop." The Nashville field nearly made it through the first 6 wk of bloom without exceeding the threshold. In fact, the boll damage in the center of the treated field did not exceed 16.3 % in the first 6 wk of bloom, whereas the center of the unsprayed field nearly reached 40% damage in the same amount of time. Although stink bug population density and boll damage increased sharply in the 7^{th} week of bloom, there is comparatively little cotton being produced at this time relative to weeks 3 though 5.

This study is currently incomplete because it requires more replications for statistical comparison between treatments. To address this situation we are continuing the study in 2011 and collaborating with researchers at Clemson University who followed the same protocol. In the future we will likely be comparing the number of whole field insecticide applications required for a border sprayed field managed field to a field simply managed without border sprays. Even savings of one whole field spray per year could be economically valuable from a cost savings perspective.

Acknowledgments

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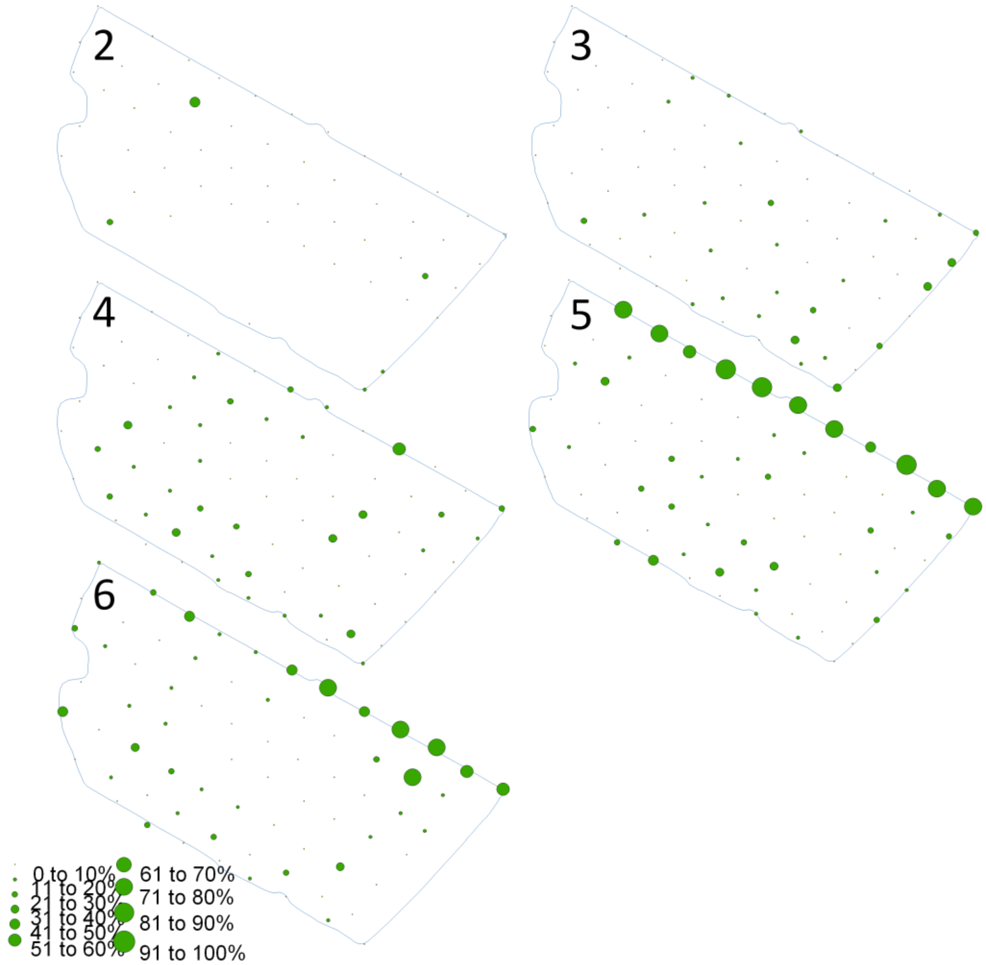

Figure 2. Percent damaged bolls during 5 weeks of bloom in a 61 acre border treated field located at Nashville, GA. Increasing circle diameter indicates increased boll damage.

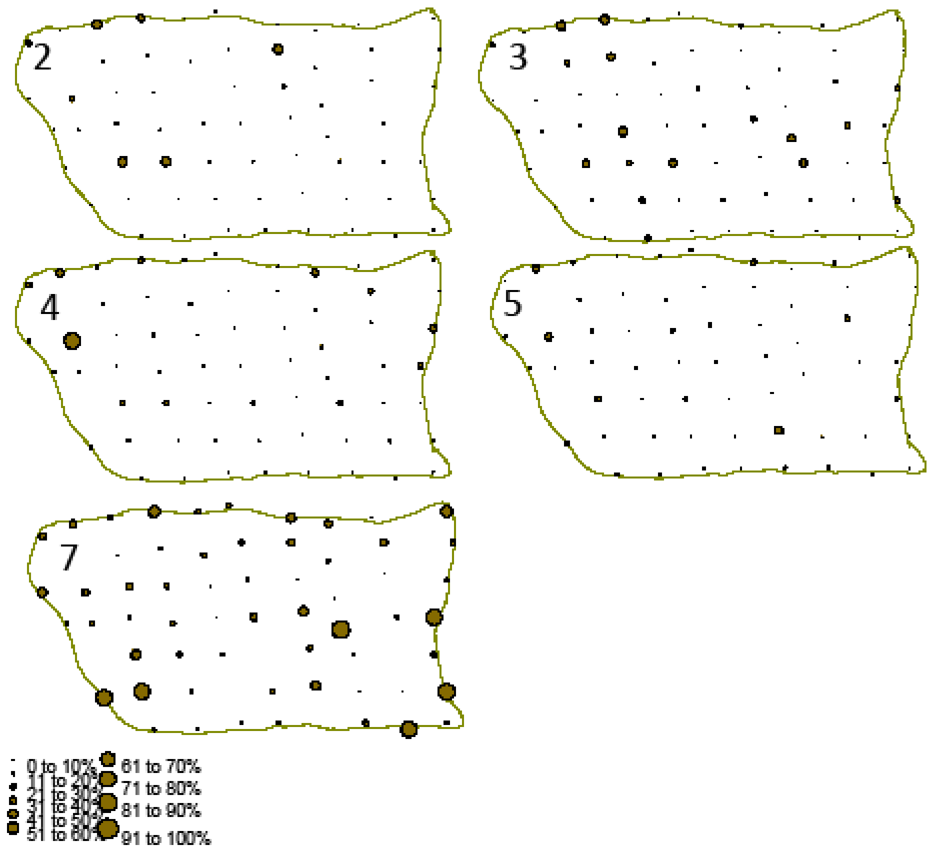

Figure 3. Percent damaged bolls during weeks 2 through 7 of bloom (no correctly sized bolls available during 6th week) in a 55 acre border treated field located at Rebecca, GA. Increasing circle diameter indicates increased boll damage.

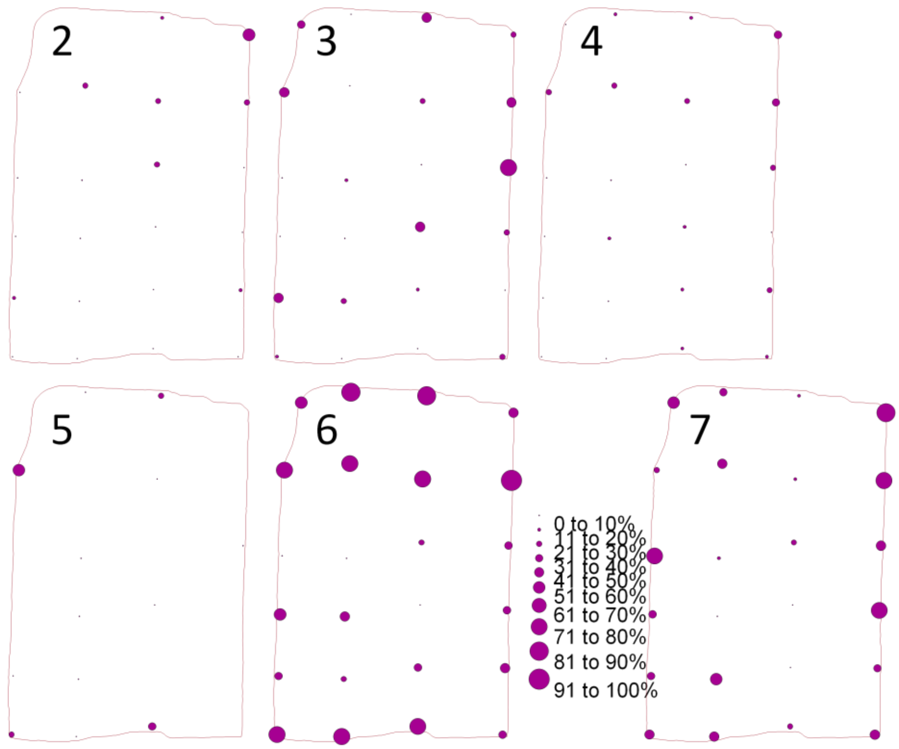

Figure 4. Percent damaged bolls during weeks 2 to 7 of bloom in a 17 acre untreated field located at Tifton, GA. Increasing circle diameter indicates increased boll damage.