A NOVEL PESTICIDE USE STRATEGY TO MANAGE PHYTOPHAGOUS STINK BUGS IN SOUTHEASTERN COTTON

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Abstract

The feasibility of using alternating strips of insecticide was compared to a conventional whole field application for managing the stink bug complex in southeastern cotton production. Trials were conducted on commercial farms at multiple locations in Georgia, North Carolina and South Carolina. Stink bug density and internal boll damage were monitored weekly until the internal boll damage exceeded the Extension recommended threshold to initiate insecticide applications. Unfortunately, stink bug pressure was generally light during 2011 and additional replication under heavier insect pressure is required to fully evaluate the hypothesis. Preliminary data analysis from two states suggests that both application methods reduced internal boll damage below the treatment threshold.

Introduction

Phytophagous stink bugs are economic pests of cotton in southeastern states (Green et al. 2001, Reay-Jones 2009). The stink bug complex includes three principle species: green stink bug, *Chinavia hilaris*; southern green stink bug, *Nezara viridula;* and brown stink bug, *Euschistus servus* (Green et al. 2009). Based on crop loss estimates throughout Cotton Belt, stink bugs ranked as the second most damaging insect pest in 2010, causing 0.724% reduction in cotton yields in 2010 (Williams 2011). Approximately 1.8 million acres were infested by stink bugs in 2010, resulting in an estimated yield loss of 70,000 bales in Georgia and Carolinas (Williams 2011). In addition, farm profitability can be affected by the management costs at the rate of $12 -15 per treated acre with most fields being treated multiple times. Stink bug feeding causes abscission of immature bolls, lint staining and associated fiber quality loss, and reduced yield (Barbour et al. 1990, Willrich et al. 2004). Both brown stink bugs and southern green stink bugs transmit a boll rotting bacterium, *Pantoea agglomerans*. Infections by the strain Sc 1-R of *P. agglomerans* can cause rotting of the entire locule or boll that was damaged by stink bug feeding (Medrano 2007). Reduction in broad spectrum insecticide applications, formerly used to control the boll weevil (*Anthonomus grandis* Boheman), and widespread adoption of Bt cotton varieties to manage the bollworm complex are believed to be major reasons for increased incidence of stink bugs in southeastern farmscapes (Bundy and McPherson 2000, Green et al. 2001)

Current Extension guidelines for stink bug treatment stipulate that growers adopt a dynamic treatment threshold based on the number of susceptible bolls present during a given week of bloom (Green et al. 2008). During weeks 3-5, when there are numerous quarter- sized soft bolls, the threshold is 10-15% injured bolls. On weeks 2 and 6, treatment is recommended only if 20% of bolls are damaged (Green et al. 2008). Alternatively, insecticide application can be initiated if one stink bug is present per 6 row feet. When the threshold is exceeded, growers typically apply whole field applications of organophosphate or pyrethroid insecticides. Recent studies show that stink bugs move into cotton fields from adjacent fields and hosts. Infestation near the edges of cotton fields can have a negative influence on the fiber color and quality (Toews and Shurley 2009). The use of whole field applications of organophosphate or pyrethroid insecticides can severely reduce the predator and parasitoid populations thereby leading to secondary pest outbreaks such as aphids, whiteflies, and spider mites.

The objective of this study was to compare the efficacy of a strip application, spraying the field every other pass by ground rig, to the conventional method of spraying the whole field (whole field application). If successful, the strip application method would decrease application time, insecticide active ingredient, risk of secondary pest outbreak, and potential for insecticide resistance to develop.

Materials and Methods

The study was conducted in commercial scale farms with fields greater than 30 acres in three southeastern states: Georgia, South Carolina and North Carolina. In Georgia, strip applications were made at Midville (Burke County, 32.872793N, 82.215307W) and Plains (Summer County 32.828719 N, 82.225242W). A field located near Tifton (Tift County, 31.531406 N, 83.562559 W) received whole field applications. In North Carolina, a single large field located at Plymouth (Washington County 35.619201N, 76.735496W) was subdivided into two fields, Plymouth-1 and Plymouth-2, for strip and whole application, respectively. All fields in the study had at least one shared border with agronomic crops such as peanut or corn.

Prior to first flowering, fields were spatially mapped using a GPS receiver and mapping software (Arcmap10, ESRI 2010). Uniformly spaced sampling points were assigned using an approximate 60-meter grid in a hexagonal/rectangular pattern. Sample points in each field were marked using a 2.4-m tall bicycle flags labeled with a unique number. This density of sample points provided an approximate density of 1 sample per 0.4 ha. Weekly sampling, including both sweep net and internal boll damage estimates, commenced during the second week of bloom. At each sample point, technicians sampled for stink bugs using two set of 25 sweeps with a 38.1-cm sweep net. For estimating internal boll damage, 10 quarter-sized soft bolls were collected from each sample point and pooled into 3.79 liter produce bags labeled with respective flag number. The selection of correct boll size was aided by the scouting tool developed by North Carolina State University/Clemson University/University of Georgia Extension, which consists of a stiff plastic card with holes of size 2.4 cm and 2.7 cm respectively (Bacheler et al. 2010). Only those bolls which could pass through the large hole but not through the small holes were collected. Actual sample locations relative to the sample flag varied each week to avoid sampling the same plants in consecutive weeks. Sampled bolls were transported into the lab in a cooler and then dissected to assess boll damage. Percentage boll damage was calculated each week and insecticide application was initiated when the percentage boll damage exceeded the threshold. Both application methods utilized a full rate (6-8 oz per acre) of dicrotophos (Bidrin 8) applied using a 22-row ground rig. Weekly sampling for damaged bolls and stink bugs continued until cutout. In 2011, subsequent insecticidal applications were not required in the majority of the fields due to low stink bug pressure.

For statistical analysis, the square root of percentage boll damage data from each flag point was arcsine transformed to get a nearly normal distribution (Zar 1999). For analyses, we considered each sampling point as an individual experimental unit and compared the strip application to the whole field application. In addition, we contrasted the week prior to insecticide application and immediately following application by treatment strategy. The PROC GLIMMIX procedure with means separations following the LSMEANS option in SAS 9.2 (SAS Institute Inc. Cary, NC, USA) was used for statistical comparison. In addition, weekly percentage boll damage data were used to create spatial maps for visualizing stink bug dynamics. Spatially interpolated spatial maps based on the inverse distance weighted (IDW) method and were created using ArcMap (ESRI software, Redlands, CA).

Results and Discussion

Cotton boll damage increased gradually by week of bloom and the all five fields exceeded the treatment threshold by 4th or 5th week of bloom. Mean percentage boll damage exceeded the threshold in the fifth week of bloom at Midville (12.7%) and Plains (11.6%) and by fourth week at Plymouth-1 (13.7%) and Plymouth-2 (15%). With the exception of the Tifton field, all other fields had statistically similar boll injury levels the week before the insecticide application (F=2.16; df= 4, 176; P=0.07). At Tifton, a commercial scout recommended that the grower apply insecticide during 4th week of bloom when the boll damage reached 7%. That application dropped the boll damage to 4.7% in the next week. Estimates of boll damage following the week after insecticide application differed significantly based on the method of application (F=6.23; df =1, 175 P=0.01). The whole field application suffered lesser boll injury (6.89 ± 1.1) compared to strip application (10.81 ± 1.2) after the insecticide treatment. Overall, there was no significant difference in boll damage between the weeks before and after the insecticide (F=0.52; df=1, 287; P=0.47). Comparison between boll damage from treated (mean=9.47 ± 1.3, n = 50) and untreated (mean =

12.07 ± 2.0, n = 53) areas in strip-applied fields yielded no significant differences (F=0.44; df= 1, 208; *P*= 0.50).

At Plains and Midville, where the insecticide was applied using the strip method, the percentage boll damage was brought down to below threshold levels immediately after treatment. The recommended threshold level during 6th week of bloom is 20%. By strip application, the damage was down to 8% from 11.6% in Plains and to 10.6% from 12.6% in Midville. Further, the percentage boll damage in Plains was kept under check up to three week after the insecticide treatment. At the Plymouth-1 field, noticeable decline in percentage damage was not observed. Data were not collected in Midville and Plymouth after 6th week because cotton reached cutout.

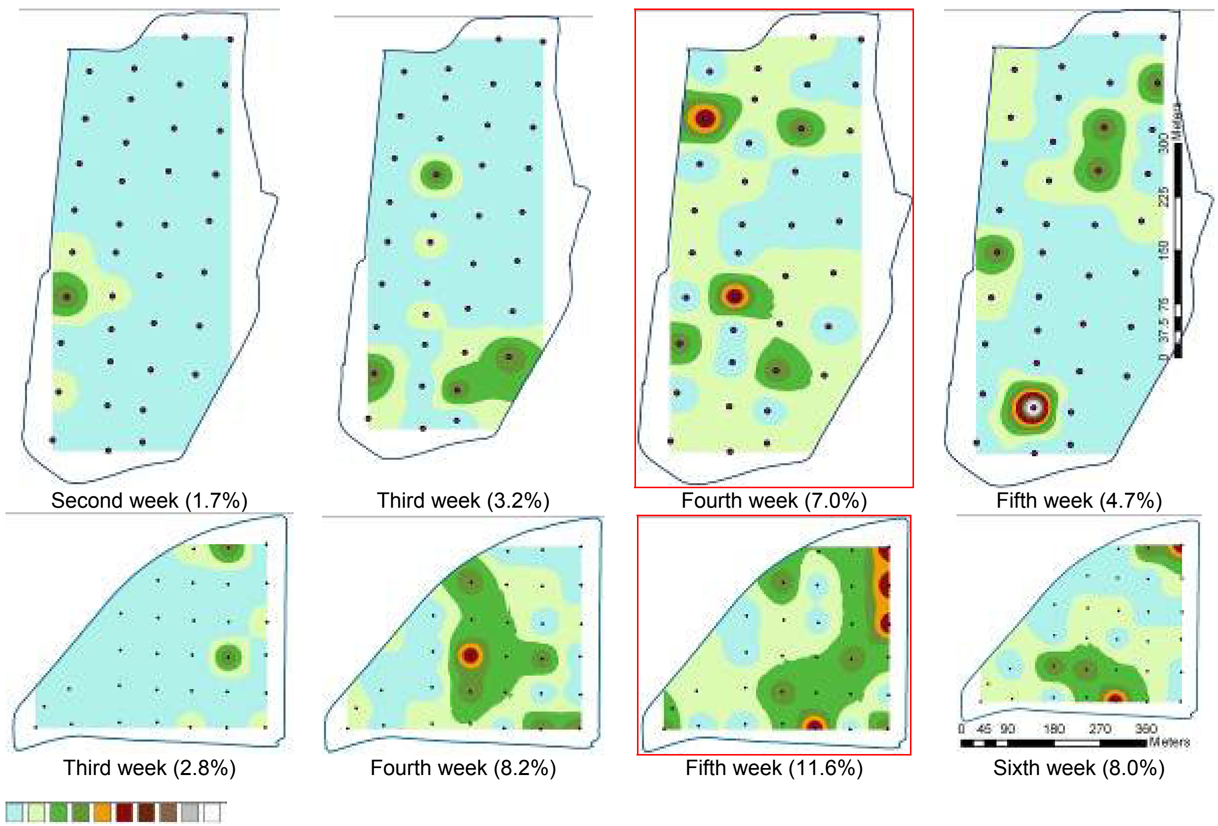

Figure 1. Increase in percentage boll damage by weeks of bloom at Tifton (top row-whole field application) and Plains (bottom row-strip application). Color change indicates 5% differences in percent boll injury ranging from < 5% (light blue) to 50% (white). Maps within red rectangle indicate week after which insecticide was applied.

Spatially interpolated maps of percentage boll damage by week of bloom at Tifton (whole) and Plains (Strip) indicate possible clustering of stink bug activity towards shared borders with other crops (Figure 1). Though not statistically tested, both treatments tended to disperse the clustering pattern of boll damage after the insecticide applications.

Stink bug populations were generally low in all fields. The highest number of stink bugs per field (inclusive of all species and life stages) in a given field per week was 10 individuals ((4th week at Plymouth-2 field (N=36)). No more than one stink bug was caught in any field during the week following insecticide application, irrespective of the method of spray.

Summary

Analysis of data from two states indicates that the project could be promising during seasons with low stink bug activity. The study under a high stink bug pressure during early weeks of bloom (3rd, 4th and 5th) would reveal its actual potential as an alternate method. This method if found successful in critical weeks of bloom, growers could substantially reduce the cost and labor towards management of stink bugs added with benefits such as being friendly towards natural enemies and environment.

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