BORDER APPLICATIONS OF INSECTICIDE TO MANAGE STINK BUGS IN SOUTH CAROLINA AND GEORGIA COTTON

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Abstract

Because our previous work has shown that stink bug densities and associated boll injury are typically greatest along the edge of cotton fields, in-field border applications of insecticide were evaluated in cotton to manage stink bug infestations in South Carolina and Georgia in 2009. Rather than applying insecticides over the entire field, applications were made using a mist sprayer only for border infestations (~80 feet) upon first signs of damage. Stink bug densities and associated injury to cotton bolls (10 soft quarter-sized bolls per location) were recorded throughout the season using a grid sampling plan and transects from field borders. A yield monitor provided information on spatial variability of yield and potential associations with stink bug injury. Fields were spatially mapped using GIS software (ArcView 9.2). While border applications reduced stink bug densities and boll injury along the edge of cotton fields, more research is needed to improve the efficacy of application in managing infestations throughout the field, possibly by better timing initial applications. The potential pesticide savings would be important from the perspective of reducing active ingredient applications, reduced time to make applications, and finally conserving natural enemies by not treating the entire field.

Introduction

Once considered secondary pests in cotton, stink bug damage and abundance on cotton in the Southeast United States have greatly increased in recent years (Greene et al. 1999, 2001). Crop losses caused by stink bug damage in cotton were estimated at $60 million in the United States in 2002 (Williams 2002). The frequency of broad spectrum insecticide applications to manage sucking bugs has increased from 1/ha in 1992 to 3/ha in 2005. Stink bugs infested 6.5 million acres of cotton in 2006 and destroyed 151,347 bales across the United States. Damage was particularly severe in the Southeast, with losses of 51,607 bales, 25,000 bales, and 20,488 bales in North Carolina, South Carolina, and Georgia, respectively (Williams 2007). The management of stink bug infestations in cotton currently relies on scouting and the use of insecticides when thresholds are met. Scouting for these insects involves either the collection of bolls (~2.5 cm in diameter) for internal injury assessment or direct sampling (i.e. beat cloths or sweep nets) for estimates of bug density (Greene et al. 2001, Reay-Jones et al. 2009, 2010).

Recent work in South Carolina and Georgia has shown that densities of stink bugs and boll injury were greatest in cotton immediately adjacent to bordering crops, and decreased as distance from the margin increased (Reeves 2009). The border spray concept was suggested following analyses of boll damage to individual fields in which damage generally started along field edges. Within a week or two of initial infestation, additional damage was evident in interior portions of the field, but we hypothesized that these colonization areas likely originated from the edges. Therefore, if we could treat the border populations upon first signs of damage, we could prevent needing to treat the entire field. The pesticide savings would be important from the perspective of reducing active ingredient applications, reduced time to make applications, and finally conserving natural enemies by not treating the entire field. For example, treatment of a 50-foot border around a square 25-acre field would require only treating 3.8 acres total (an 85% reduction). Research began in 2009 to scientifically investigate border applications of insecticide in South Carolina and Georgia. Preliminary data are presented.

Methods

Seven cotton fields (one field at the Clemson University Pee Dee Research and Education Center, Florence SC; two commercial fields in SC and four in GA) were selected to evaluate border applications of insecticide. Field size ranged from 5.6 ha (14 ac) to 17.8 ha (44 acres). In each field, a sampling grid consisted of one sampling location (marked with a 1.8-m fiber glass pole) for every 0.404 ha (1 acre), with each pole being separated by 63.7 m (208 feet). Grids were classified as exterior if one boundary of the grid was along the periphery of the field and interior if the grid was bordered by cotton on all four sides.

After the majority of plants had initiated blooming, stink bugs were sampled weekly using a 0.91×0.91-m white beat cloth. After placing the beat cloth on the ground between two rows, both rows were vigorously shaken over the cloth to dislodge stink bugs from the plants. Samplers enumerated both adults and immatures in each of two subsamples taken at each location, corresponding to sampling a 3.7-m row, with at least 2 m between each subsample. Bugs were summed from both subsamples at each location before analyses. Stink bug injury to bolls was monitored because previous research showed that this method was 10-fold more sensitive than detecting insects with common beat cloth or sweep net sampling techniques (Toews et al. 2008). Boll damage was assessed by taking 10 bolls (~2.5 cm diameter) weekly from each sampling location and then examining them in the laboratory for internal symptoms of stink bug feeding injury (warts and stained lint) caused by stink bugs as described by Bundy et al. (2000). Sampling ended when no more soft bolls (2.5 cm sized) were observed.

Additional edge sampling was used in selected fields to get complete coverage of fields with odd shapes and to better quantify 'edge effects'. Stink bugs and boll injury were sampled as described above along transects at 0, 5, 10 and 25 meters from the edge of cotton fields.

Tank-mixed applications of dicrotophos (Bidrin 8) at 0.28 kg [AI]/ha + *lambda*-cyhalothrin (Karate 2.08) at 0.033 kg [AI]/ha were made using a mist sprayer pulled behind a pickup from outside the field. This technique allowed the deposition of relatively more insecticide near the field margin (where infestations likely originate) compared with farther into the field where the mist stopped. Preliminary data (Reeves 2009) suggest that we need to treat 20 rows (~60 ft) from the edge of the field to cover the initial infestations. The mist sprayer treated up to from 40 to 80 ft depending on prevailing wind.

Border applications were made for field 1 (3, 10 and 17 August), field 2 (21 July, 27 July and 3 August), field 3 (10 and 17 August), field 4 (28 August, 12 September), field 5 (19 August), field 6 (19 August), and field 7 (25 August). In the six commercial fields used in our study, growers applied cyfluthrin (Baythroid) in fields 2 and 3 (18 August), field 4 (2 September), field 5 (27 July), field 6 (28 July) and in field 7 (10 September) across whole fields. Yield data were collected in field 1 with yield monitor equipment. The inverted distance weighted method was used to create interpolation maps of boll injury and yield (ArcView 9.2, ESRI 2006). Stink bug densities and boll injury are presented for exterior and interior locations of each field.

Results and Discussion

Only field 1, which was at the Pee Dee REC in Florence, SC, did not receive applications of insecticide across the entire field. The other seven fields were located on farm, and were therefore managed according to cooperating growers. Results will therefore focus more on field 1. Boll injury and stink bug densities for this field are presented in Figs. 1 and 2. Densities were low and below the threshold of one bug per 6 row foot on all sampling dates. Densities shown in Figure 2 did not reveal a clear pattern of control by border applications, although infestations were absent on 25 August, one week after the final application. However, boll injury averaged 19.7% on 30 July, the date of the first border application of insecticide. Average boll injury did not drop below 20% at any subsequent date, despite the three border applications of insecticide. Clear patterns were not apparent from boll injury at the grid sampling locations in Figure 1.

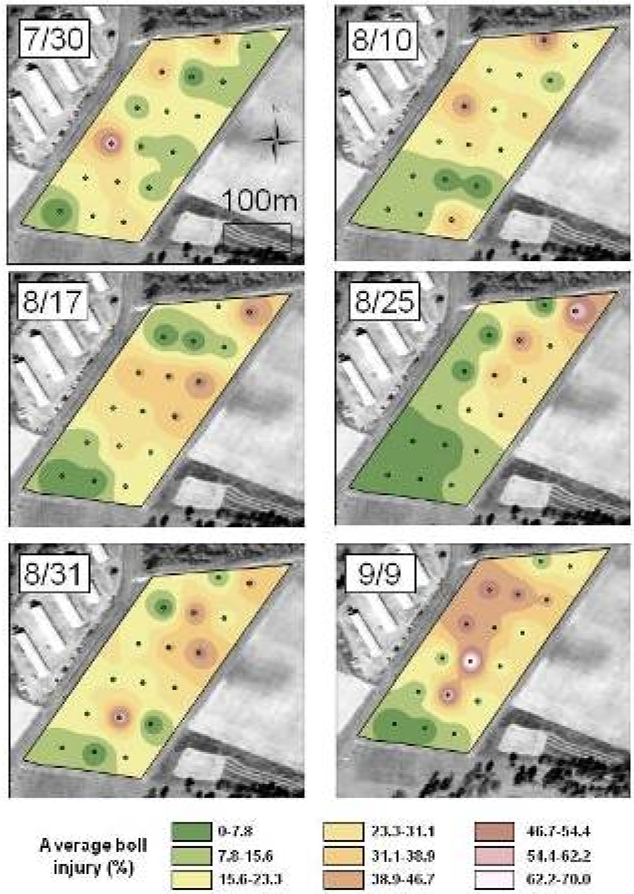

Figure 1. Inverted distance weighted interpolation maps of boll injury in cotton field 1 at Pee Dee REC in Florence, SC, 2009. Border applications of insecticide made on 8/3, 8/10 and 8/17.

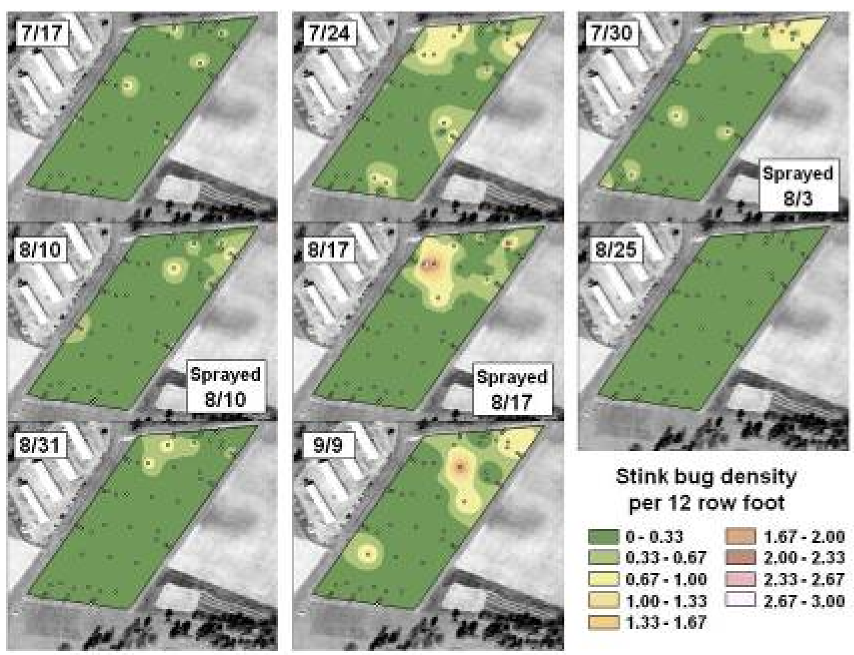

Figure 2. Inverted distance weighted interpolation maps of stink bug densities (all species) sampled with a beat cloth on 12 foot of row in cotton field 1 at Pee Dee REC in Florence, SC, 2009.

Densities of adult stink bugs in exterior sampling locations decreased with each application of insecticide in field 1, but increased rapidly after the last application (Figure 3). However, densities at interior sampling locations did not appear to be affected by applications. Interestingly, boll injury remained relatively constant around 20% across sampling dates at exterior sampling locations, whereas, boll injury at interior sampling locations increased. This may indicate that applications of insecticide did not provide a sufficient level of control to prevent injury from occurring in interior portions of the field. Cotton lint yield did not show a clear pattern in field 1 (Figure 4). Yield was averaged from 50 locations recorded by the monitor around each grid sampling location; average yields from interior and exterior locations were 763 and 830 lb/ac, respectively. Border applications may therefore have provided some control of stink bugs along the edge of field 1, thus leading to an increase in yield.

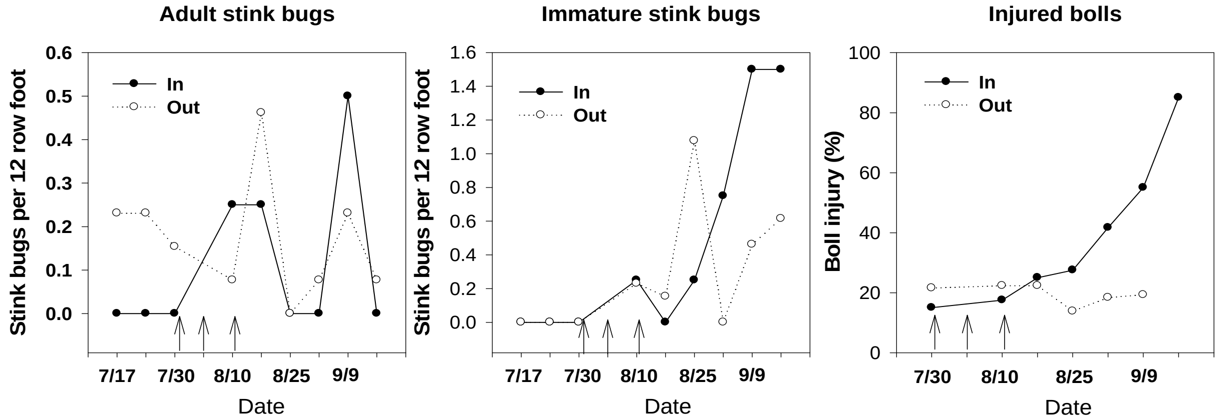

Figure 3. Densities of adult and immature stink bugs (all species) and associated boll injury in interior (In) and exterior (Out) locations of cotton field 1 at Pee Dee REC in Florence, SC, 2009. Arrows indicate border applications of insecticides.

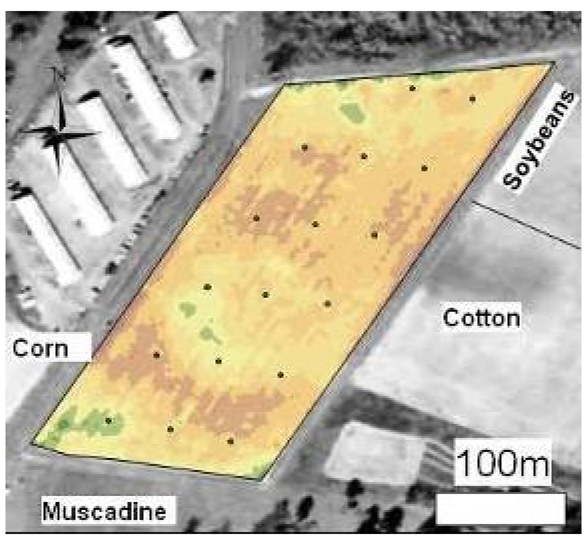

Figure 4. Inverted distance weighted interpolation maps of yield in cotton field 1 at Pee Dee REC in Florence, SC, 2009. Yield categories range from green (46-235 lb lint/ac) to light pink (1,564-1754 lb lint/ac).

Fields 2-7 all received at least one application of insecticide across the whole field, as indicated in Figures 5-9. This limited our ability to evaluate the efficacy of border applications of insecticide for stink bug control. However, in several cases, border applications of insecticide reduced densities of stink bugs to a greater extent in exterior locations than in interior locations (e.g. boll injury in field 7 after first application). These results suggest that border applications did not provide field-wide control of stink bugs and boll injury. A possible reason for the lack of efficacy could be that initial applications were made after stink bugs had already infested cotton fields. Future work will aim to impact infestations earlier in the growing season.

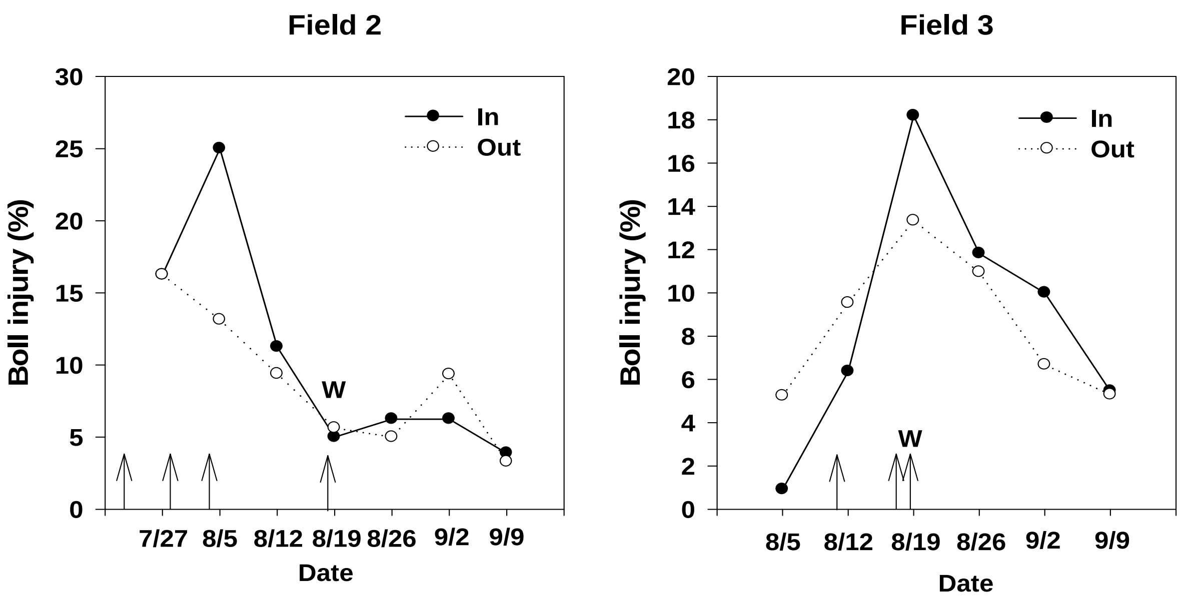

Figure 5. Boll injury in fields 2 and 3 in interior (In) and exterior (Out) locations of cotton fields in Cameron Co., SC, 2009. Arrows indicate border applications of insecticides or whole field applications (W).

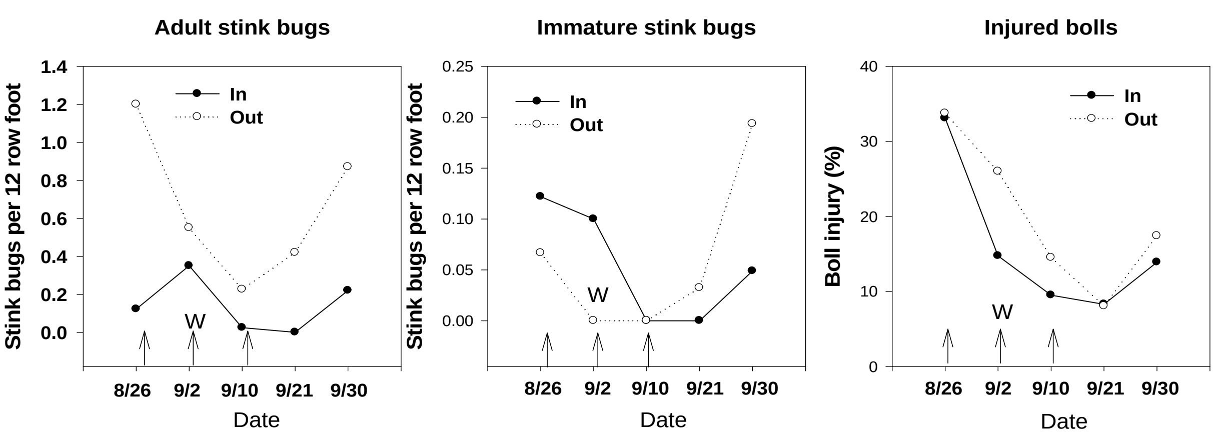

Figure 6. Densities of adult and immature stink bugs (all species) and associated boll injury in interior (In) and exterior (Out) locations of cotton field 4 in Coffee, GA, 2009. Arrows indicate border applications of insecticides or whole field applications (W).

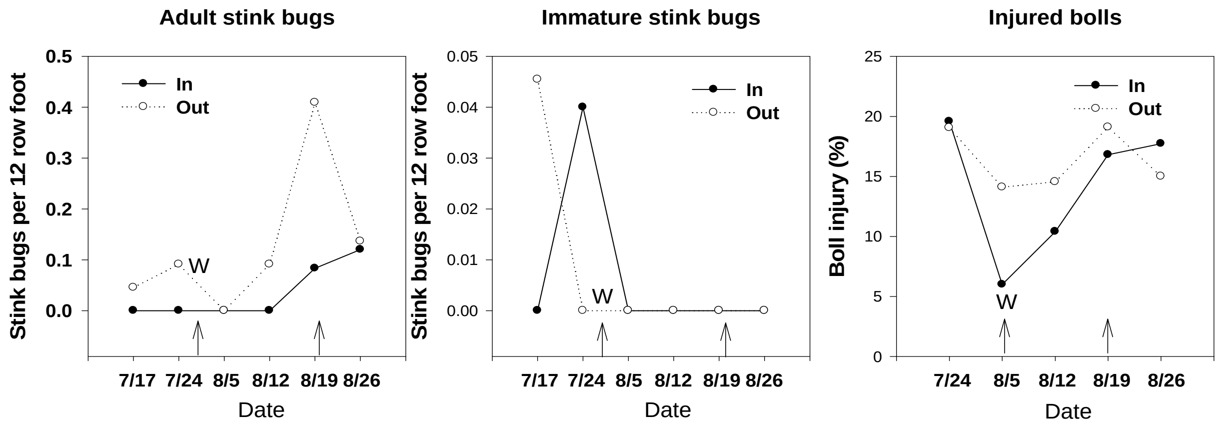

Figure 7. Densities of adult and immature stink bugs (all species) and associated boll injury in interior (In) and exterior (Out) locations of cotton field 5 in Forks, GA, 2009. Arrows indicate border applications of insecticides or whole field applications (W).

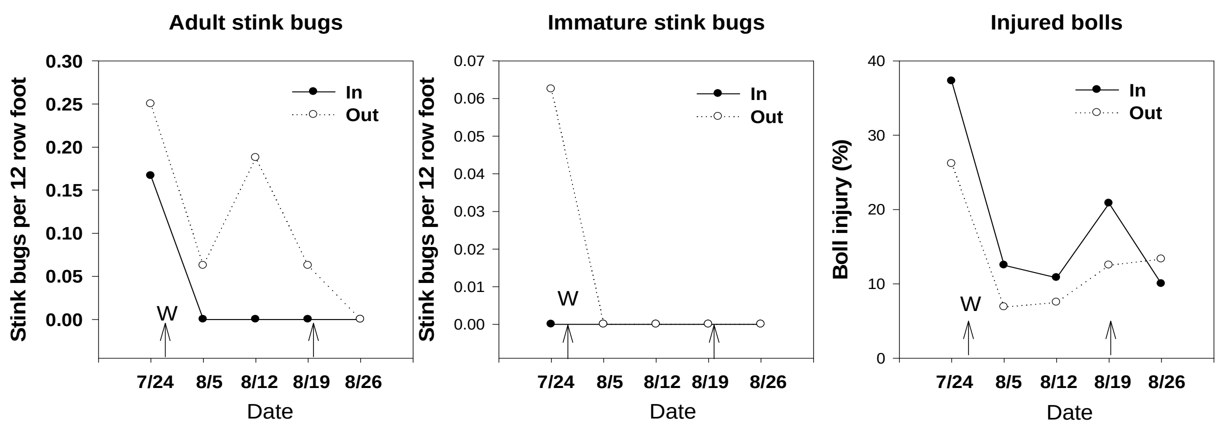

Figure 8. Densities of adult and immature stink bugs (all species) and associated boll injury in interior (In) and exterior (Out) locations of cotton field 6 (MM), GA, 2009. Arrows indicate border applications of insecticides or whole field applications (W).

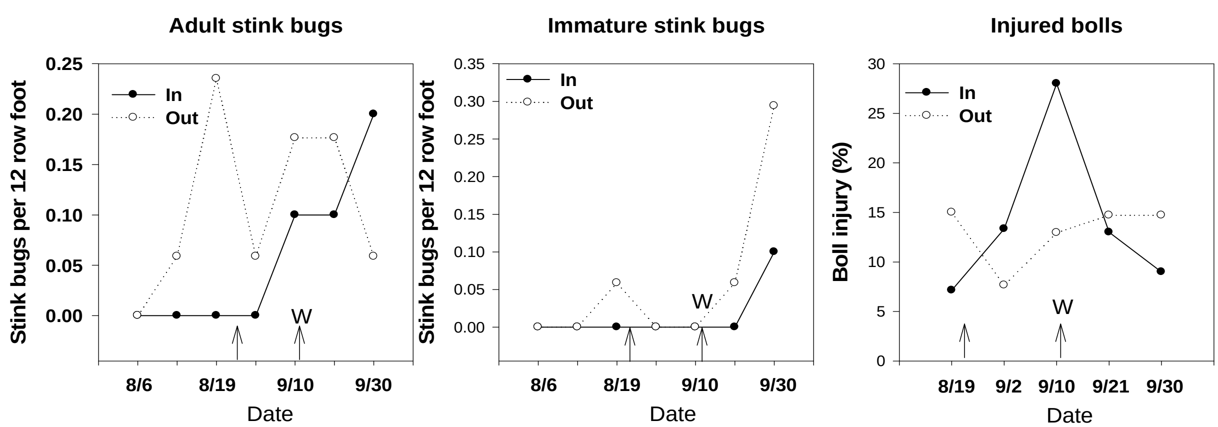

Figure 9. Densities of adult and immature stink bugs (all species) and associated boll injury in interior (In) and exterior (Out) locations of cotton field 7 (SR), GA, 2009. Arrows indicate border applications of insecticides or whole field applications (W).

Acknowledgments

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