2005 Beltwide Cotton Conferences, New Orleans, Louisiana - January 4 - 7, 2005

MANAGING STINK BUG POPULATIONS IN COTTON-SOYBEAN PRODUCTION SYSTEMS IN ARKANSAS

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Abstract

From 2002 through 2004, densities of stink bugs were monitored in six crops located in replicated small plots and commercial production fields in Southeast Arkansas. Small cotton plots were embedded into commercial soybean, corn, and cotton fields in Southwest and Northeast Arkansas during 2003. Stink bug densities remained low in commercial cotton fields throughout the three-year study in Southeast Arkansas, however damaging populations were commonly observed in both early- and late-maturing soybean during reproductive growth stages. Damaging densities occurred only twice in small plots in Southeast Arkansas. Cotton plots embedded in commercial soybean fields in Southwest Arkansas developed stink bug densities up to eight times the current treatment level and received significantly more damage than plots embedded in cotton fields in Northeast Arkansas.

Introduction

Stink bugs have been documented as occasional pests in cotton since the early twentieth century (Bundy et al. 1998). However, in most situations stink bugs have been considered secondary pests in cotton because of incidental control from broad spectrum pesticide use. For decades broad-spectrum insecticides targeting bollworm, *Helicoverpa zea* Boddie, tobacco budworm, *Heliothis virescens* (L.), and tarnished plant bug, *Lygus lineolaris* (Palisot de Beauois), have suppressed stink bug densities to levels that rarely reach injurious levels (Greene and Herzog 1999). However, with the expansion of boll weevil eradication programs, transgenic *Bacillus thuringiensis* (Bt) cotton cultivars, and new chemistries with selective modes of action, many areas of the Cotton Belt have reported stink bugs becoming prominent pests (Greene and Herzog 1999). Increased presence of early season soybean production systems may also contribute to higher densities in cotton by providing an early host, from which populations can build, and upon maturity, migrate into other crops.

The three major phytophagous pentatomids that attack cotton in Arkansas are, brown stink bug, *Euschistus servus (Say)*, green stink bug, *Acrosternum hilare (Say*), and southern green stink bug, *Nezara viridula (L.)*. These three species commonly feed on cotton (Sullivan et. al. 1996) causing yellowing of lint, shedding of young bolls, and a reduction of harvestable locks (Roach 1988, Wene and Sheets 1964). In addition, stink bugs attack corn and are a major pest of soybeans. Until recently, controlling these pests has been of minor concern, but increased densities and damage are encouraging more attention to stink bug management in U.S. cotton.

In 1998, stink bugs were ranked as the ninth most destructive pest in U.S. cotton. Approximately 24% of U.S. cotton was infested with stink bugs leading to reduced yields of 0.15% (Williams 1999). By 2002, stink bugs had increased in rank to the fourth most destructive pest in U.S. cotton, trailing only heliothines, plant bugs, and thrips. Approximately 42% of U.S. cotton was infested, resulting in 0.45% reduction in yields (Williams 2003). Trends of increased stink bug infestations in U.S. cotton are evident in Arkansas as well. From 1998 to 1999, no stink bug infestations were reported in Arkansas cotton (Williams 1999 and 2000). In 2000, 50% of Arkansas cotton was infested by stink bugs, resulting in 0.03% yield reductions (Williams 2001). Stink bug infestations of Arkansas cotton reached 100% in 2001, reducing yield by 0.56% (Williams 2002). Stink bug infestations of Arkansas cotton continued to be 100% once again in 2002, but yield reductions dropped slightly to 0.5% (Williams 2003). Although, yield loss from 2001 to 2002 declined, approximately 39% of Arkansas's cotton was treated in 2002, as compared to 25% in 2001. As of 2002 stink bugs were ranked as the fourth most destructive pest in Arkansas (Williams 2003).

In 2002, we began surveying South Arkansas crops to better understand the relative contributions of these crops to comparative densities of major polyphagous pests, especially pentatomids, mirids, and heliothines. From 2002 through 2004, a large database was assembled from observations made in both small plot and production environments. The purpose of this paper is to report preliminary results of these initial studies.

Materials and methods

This research was initially conducted in conjunction with large-scale heliothine research in Drew and Desha Counties in Southeast Arkansas during 2002 and 2003. Densities of various pests, including stink bugs, were monitored throughout the season in six crops located in replicated small plots and commercial fields. During 2004, both replicated small plots and commercial fields were once again utilized although our research efforts were more focused on monitoring stink bug movement across the landscape.

In 2003, a total of 24 locations in Drew and Desha Counties in Southeast Arkansas were sampled. Each location consisted of an interface of transgenic Bt cotton and one of six adjacent crops. The crop interfaces included Bt cotton-Bt cotton, Bt cotton-conventional cotton, Bt cotton-corn, Bt cotton-grain sorghum, Bt cotton-late soybean, and Bt cotton-early soybean. Early soybean production was with indeterminate varieties planted April through May, and late soybean production was with determinate varieties planted in May and June. Each crop interface was replicated four times. Sampling began in early June and continued weekly through the first week of September. Stink bug densities were measured on the border (first 50 rows) and near the center in Bt cotton fields and on the border of adjacent fields with 100 row feet of drop cloth samples taken at each location. All densities are expressed as number per acre in 2003 interface data. Stink bugs were separated into nymph and adult stages of green stink bug and brown stink bug. Green stink bug category included green and southern green stink bugs.

During 2002 and 2003, a series of experimental plots of Bt cotton, conventional cotton, corn, maturity group (MG) IV, MG V, and MG VI soybean were planted in Drew County in Southeast Arkansas. Plots were replicated 4 times in a randomized complete block, each ca. 0.25 acre in size. Plots were sampled weekly from May through mid-September using a 5-foot drop cloth. A total of 100 row feet was sampled in the center rows of each plot. Due to high densities, only total stink bugs were recorded. Results are given as total number of stink bugs per acre.

In 2003, small plots of cotton (ca. 0.03 acre) were embedded into MG V soybean and corn production fields in the Red River Bottoms of Little River County in Southwest Arkansas. Identical plots were also embedded in cotton production fields in Northeast Arkansas in Mississippi County. Visual samples were taken every other week from mid-July through the second week of September. At each sampling date, five plants were mapped, recording presence or absence of fruit at each position along with stink bug damaged squares and bolls. Densities of nymphs and adults were recorded as green or brown stink bug categories and expressed as number per acre.

During 2004, replicated small plots and interfaces of cotton and early soybean were again monitored in Drew and Lincoln Counties in Southeast Arkansas. Small plots (ca. 0.03 acre) of cotton, corn, MG III, MG IV, MG V, and MG VI soybean were placed inside production fields at three locations. Plots were paired into sprayed and unsprayed treatments and replicated three times. Stink bug densities were measured weekly using a 15-inch sweep net with four sets of 25 sweeps taken at each location. Densities are expressed as number per 25 sweeps.

Results

Stink bug densities were very low in the 32 production cotton fields in Southeast Arkansas during 2003. There were no differences in stink bug populations in Bt-cotton at any of the crop interfaces. Highest average densities occurred during the first week of August, although the highest level reached only 300 stink bugs per acre. Current recommended treatment thresholds are 2,300 stink bugs per acre (Greene et al. 2004). Stink bug populations in the six crops adjacent to Bt-cotton were also low throughout the year. Brown stink bugs were the most abundant species in conventional- and Bt-cotton (Figure 1).

Replicated small plots in Drew County produced extremely high populations of stink bugs during 2002. A peak density of 94,000 stink bugs per acre was reached in the MG IV soybean in late-July. Stink bug densities in cotton reached peak levels of 4,000 and 9,000 stink bugs per acre during the first week of July and the second week of August, respectively. Both peak densities in cotton corresponded to the two lowest recorded densities in the early soybean (Figure 2).

Densities were lower in the small plots during 2003, with a peak density of 40,000 stink bugs per acre in MG IV soybean. Overall population trends were similar to the previous year except densities in cotton remained low throughout the season (Figure 3).

Small plots of cotton embedded in late soybean fields in Southwest Arkansas developed densities of 17,000 and 18,000 stink bugs per acre in 2003 (Figure 4). Identical plots on the same farm, embedded in corn, as well as embedded plots in production cotton fields of Northwest Arkansas never produced detectible stink bug populations.

Cotton plots embedded in late soybean production fields received greater stink bug damage than plots embedded in cotton production fields. During August, there was an average of ten bolls per plant on plots in both late soybean and cotton (Figure 5). At harvest, only 0.89 bolls per plant remained on plots in late soybean, while plants in cotton retained 4.81 bolls.

Multiple crop small plots in Southeast Arkansas during 2004 had similar population trends to 2002 and 2003 small plots. Stink bugs infested MG III and MG IV soybean during early July and remained until maturity in late-August. Subsequent populations developed in MG V and VI soybean plots, reaching a density five times threshold levels. Corn and cotton plots were never infested (Figure 6).

Discussion

Many areas of the U.S. have seen stink bugs become a more injurious pest to cotton. Over the past three years, stink bug numbers were low in commercial cotton fields in Southeast Arkansas. Many factors could be involved in suppressing stink bugs in cotton, but two major reasons appear to be greater acreages of attractive, more preferred soybean and frequent insecticide applications for other pests, especially the tarnished plant bug.

Stink bugs are highly attracted to both early and late soybean in reproductive growth stages. Over the three years of study in Southeast Arkansas, stink bugs repeatedly colonized soybean at high densities, while neighboring cotton received only minor infestations. An exception occurred during 2002 in the multicrop small plots when damaging densities of stink bugs were present during the first week of July and second week of August. Both infestations lasted only briefly, and the following week populations in cotton decreased to original levels. Observations indicate that when reproductive stage soybean are in close proximity, stink bugs rarely infest cotton. However, the small plot experiments in Southwest Arkansas, an area with relatively large acreage of soybean and high densities of stink bugs, showed that stink bugs will infest cotton when nearby soybean mature.

Stink bug densities in cotton in Southeast Arkansas seemed to be suppressed by multiple insecticide treatments. Most cotton receives up to ca. 4 sprays for tarnished plant bug and ca. 2 sprays for heliothines per season, leaving little opportunity for stink bug populations to build. Although most cotton in the study was infested by stink bugs, damaging densities developed only in unsprayed environments.

Further reductions in the routine use of insecticides in cotton could result in more problems with stink bugs. The preference of stink bugs for other crops, especially reproductive stage soybeans, appears to be a key to managing population growth over large-scale environments. We are currently investigating a trap crop system to manage late-season stink bug population growth.

Acknowledgements

The Arkansas Soybean Promotion Board and the Arkansas Agricultural Experiment Station provided financial support for this study. We would like to thank Thad Freeland (Tillar and Company), Worth Matteson (Matteson Farms), Dick Goodgame, and Mar Miles for their cooperation and assistance.

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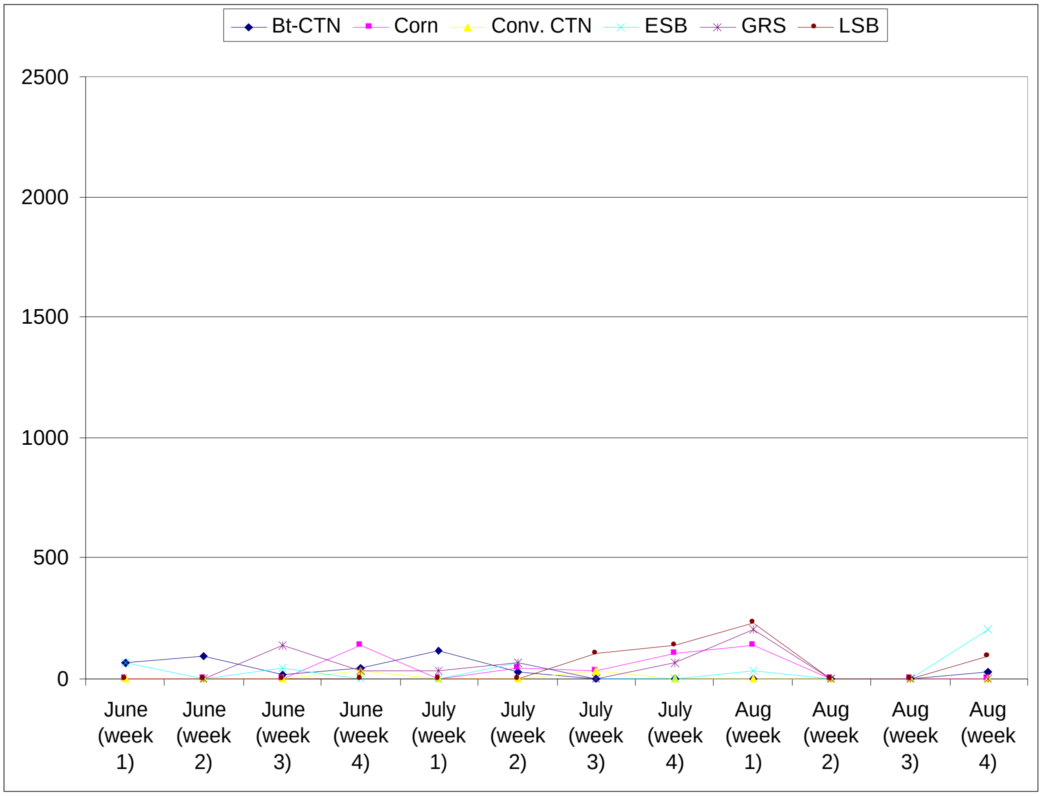

Figure 1. Stink bugs per acre in 2003 commercial Bt-cotton fields adjacent to six other crops in Southeast Arkansas

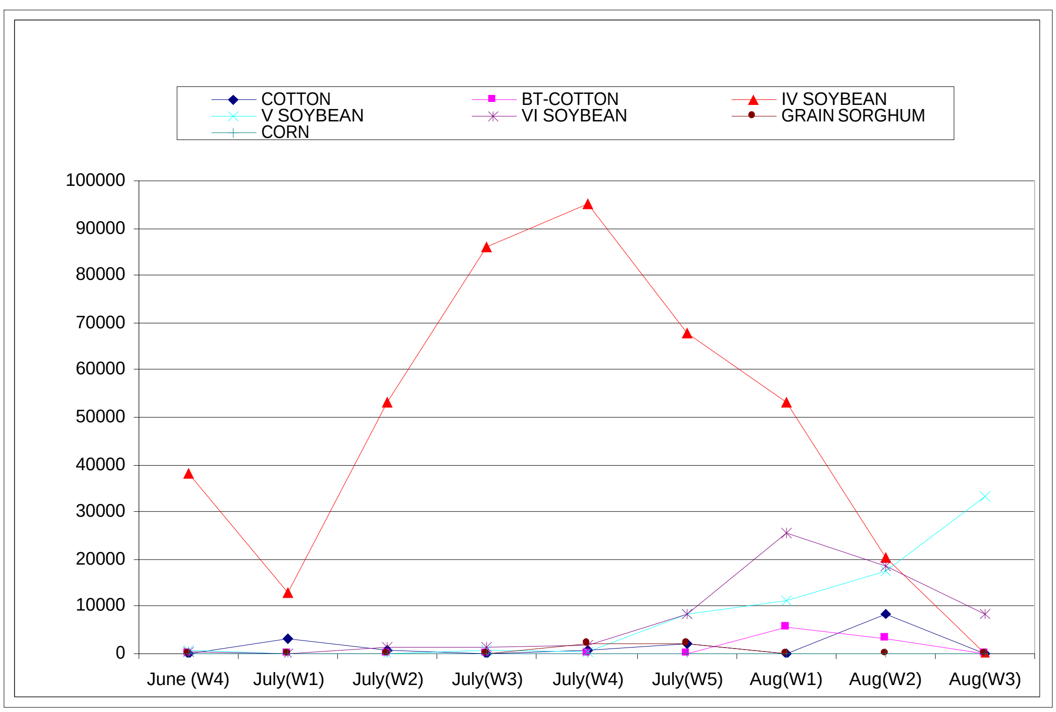

Figure 2. Stink bugs per acre in 2002 replicated small plots in Southeast Arkansas.

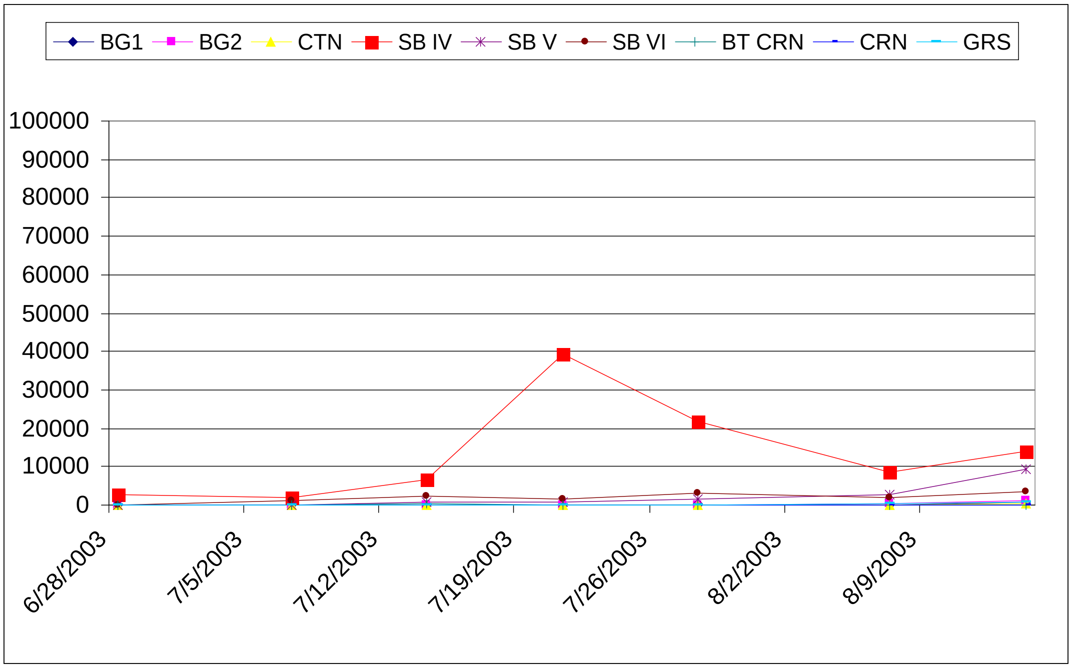

Figure 3. Stink bugs per acre in 2003 replicated small plots in Southeast Arkansas.

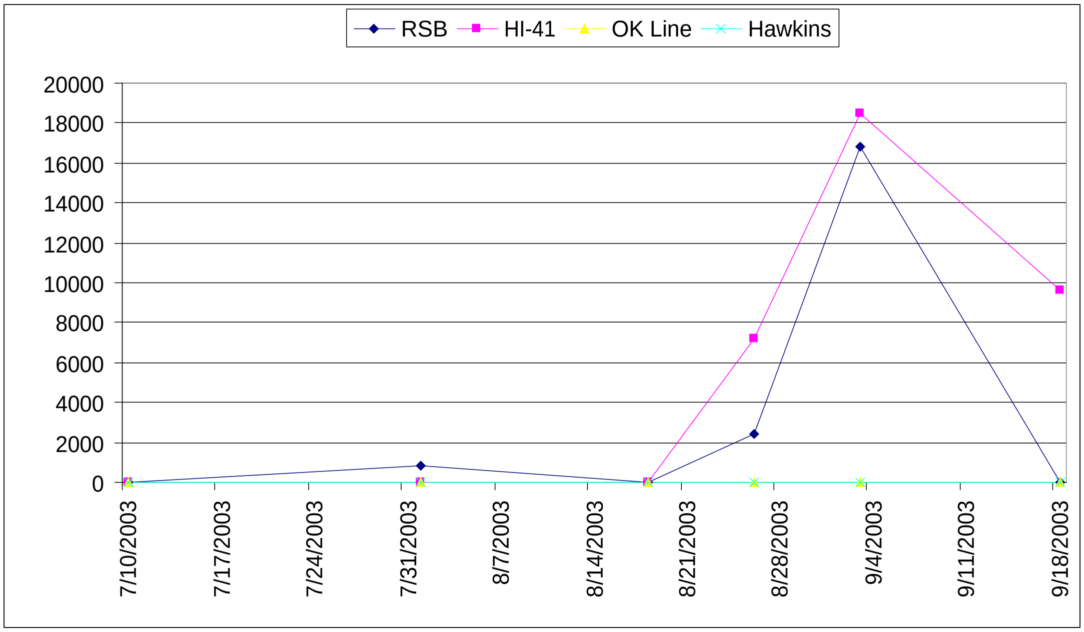

Figure 4. Stink bugs per acre in embedded plots in Southwest Arkansas. RSB and HI-41 plots were embedded in soybean; OK Line and Hawkins were embedded in corn.

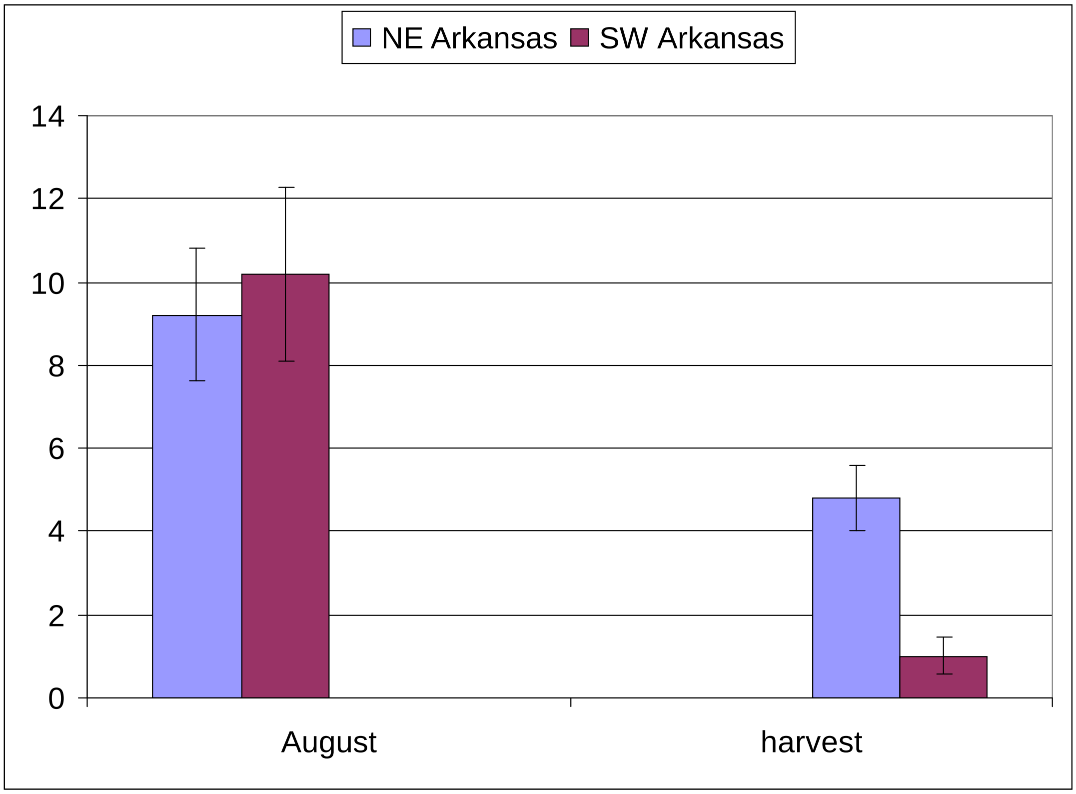

Figure 5. Average bolls per plant (±SEM) in cotton plots embedded in soybean fields in Southwest Arkansas and cotton fields in Northeast Arkansas.

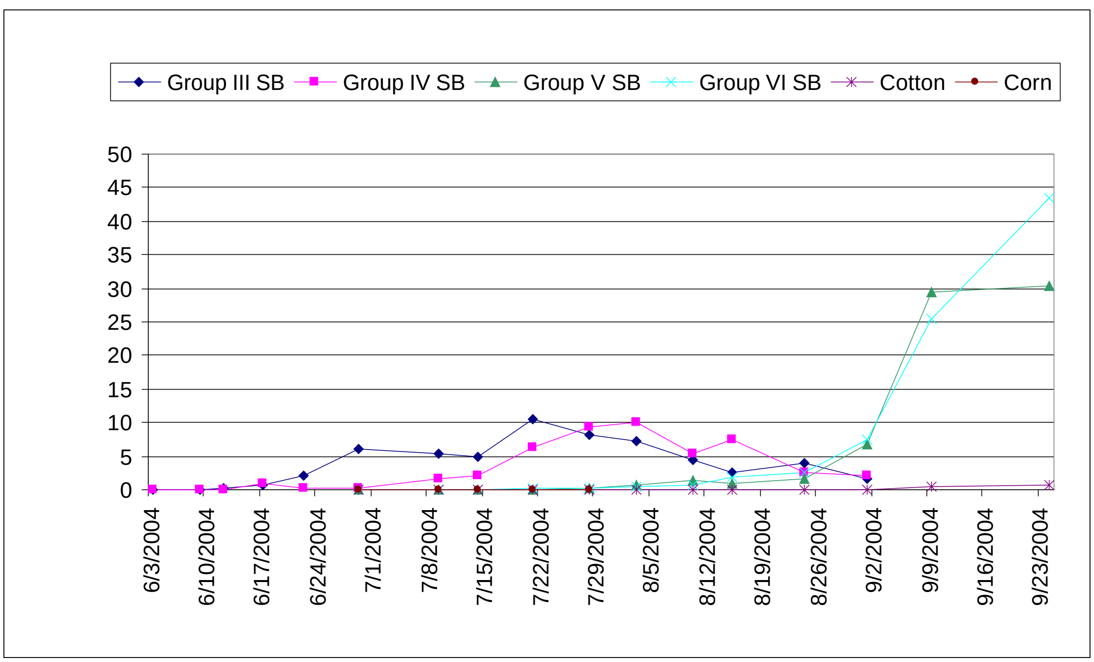

Figure 6. Stink bugs per 25 sweeps in 2004 replicated small plots in Southeast Arkansas.