FARMER FRIENDLY SUMMARY

COTTON INSECT PEST MANAGEMENT
Agreement 07-961TN
Scott Stewart, The University of Tennessee

Funding is used to partially support general extension activities such as scout training, moth trapping, resistance monitoring, insecticide testing and on-farm evaluations of various insect control technologies and treatment thresholds. Funding is also used to help support regional projects, several of which are also minimally supported by core grants from Cotton Incorporated. Pheromone moth trapping for bollworm, tobacco budworm, and beet armyworm are improving the decision making of crop managers. In 2009, moth catches for each county were reported weekly in the Tennessee IPM newsletter. This information was posted on the internet at www.utcrops.com and was distributed to agents, producers, consultants and other agricultural professionals via the *IPM Newsletter*. Only bollworm moths were caught in substantial numbers during 2009, but bollworm flights were still relatively small with the greatest activity occurring in mid August. This was consistent with the generally low populations observed in most fields. Corresponding data from an annual boll damage survey also confirmed a relatively low incidence of caterpillar infestations in West Tennessee. Assays using bollworm (i.e., corn earworm) moths indicated low to moderate resistance to pyrethroid insecticides that would probably not result in noticeable field control failures unless larval populations were unusually high. Analyses show that across a large area 70 to 100% of moths in the landscape during late July and early August are originating from grass hosts, likely corn in Tennessee. The boll damage survey recorded the highest ever level of injury from hemipteran pests.

As part of several multi-state projects, several experiments were done in Tennessee including the evaluation of 1) in-season use of Temik for insect management in cotton and efficacy of selected insecticides for control of the tarnished plant bug, 2) automatic insecticide applications following preventative insecticides for thrips, and 3) cotton yield loss caused by two-spotted spider mite and efficacy of selected miticides. Comprehensive reports for these efforts have been submitted by the appropriate project leaders. Excessive rainfall during both the planting and harvest windows negatively affected the above efforts in Tennessee. Nevertheless, we successfully identified the best pesticides for control of spider mites and plant bugs. For the second year, data indicated that side-dressing Temik significantly reduced plant bug infestations and improved cotton yields, although results were more variable in 2009. Across 20 locations, at-planting insecticides for thrips control often improved yields. Supplemental foliar insecticides in addition to at-planting treatments did not usually improve yields, but applications made at the 1-2 leaf stage provided the most yield response when a response from foliar insecticide was observed.

About 30 additional experiments related to insect pest management in cotton were successfully completed in 2009. These evaluations included the impact of insecticide and fungicide applications on boll rot and insecticide efficacy trials for thrips, spider mites, plant bugs, stink bugs and bollworm. The data generated from these above experiments are used to validate and modify extension insect control recommendations in Tennessee. The results of most experiments have been individually summarized and published on the www.utcrops.com website.

ANNUAL REPORT

COTTON INSECT PEST MANAGEMENT
Agreements 07-961TN
Scott Stewart, The University of Tennessee

Funding for this project was used to partially support general extension activities such as scout training, moth trapping, insect damage surveys, resistance monitoring, and insecticide testing and on-farm evaluations of various insect control technologies and treatment thresholds. In addition, funds were also used to help support several regional projects as described herein.

1) Moth Trapping. Despite the use of Bt-transgenic cotton on over 95% of the acreage in Tennessee, bollworm and tobacco budworm still compose an important pest complex. Bollworms may cause significant economic damage to Bt cotton fields, and the bollworm/budworm can be even more damaging to non-Bt cotton. More importantly, the threat of tobacco budworm infestations results in high adoption of Bt cotton. Resistance to pyrethroid insecticides in tobacco budworm populations makes distinguishing between budworm and bollworm infestations very critical in non-Bt cotton. Using a pyrethroid insecticide on a “worm” infestation which contains a significant percentage of tobacco budworms often results in serious economic losses.

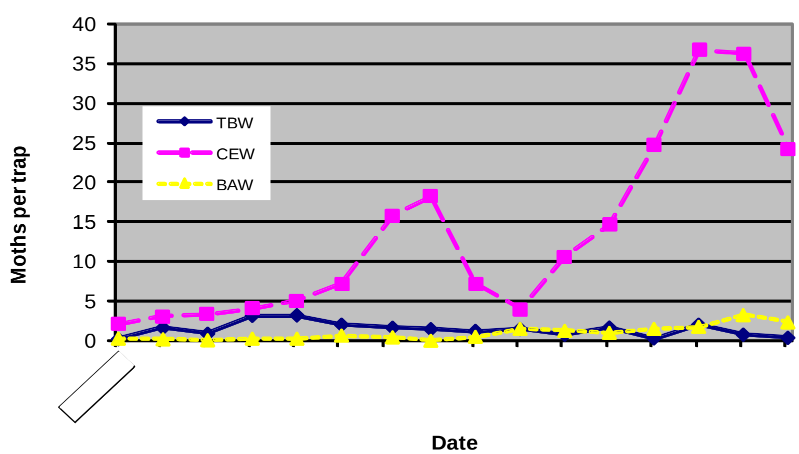
Area-wide monitoring remains a valuable tool in predicting the occurrence and size of pest populations. Pheromone trapping programs for bollworm, tobacco budworm, and beet armyworm provide insight into the timing and intensity of moth flights. For example, unusually high trap catches for a particular species can alert consultants and producers to the potential for impending outbreaks. When performed on a regional level and over a number of years, moth trapping can indicate historical and geographical patterns in the distribution of pest populations. Moth monitoring improves the decision making process, helping crop managers in the selection of insecticides and to indicate the need for intensified sampling efforts. This ultimately helps to minimize control costs and/or yield losses incurred by producers. Traps can also be used to collect moths used in assays for resistance to pyrethroid insecticides.

Pheromone moth traps for corn earworm (CEW or bollworm), tobacco budworm (TBW), and beet armyworm (BAW) were run on a weekly basis from early May through August. Traps were located in cotton growing areas of each county and were usually placed on the borders of cotton fields. All pheromone lures were obtained from Great Lakes IPM (Vestaburg, MI) and were changed at two week intervals. At least one, and usually two, sets of bollworm and tobacco budworm traps were run in each of the following 12 counties in West Tennessee: Carroll, Crockett, Dyer, Fayette, Gibson, Hardeman, Haywood, Shelby, Tipton, Lake, Lauderdale, and Madison. One beet armyworm trap was located in each of the above counties.

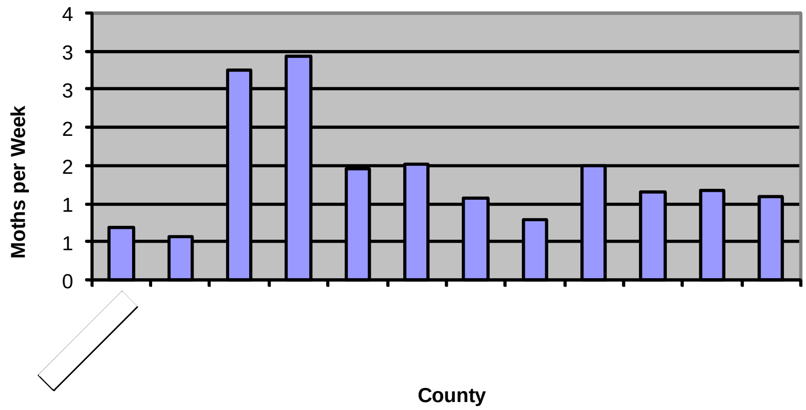
Outcomes: Moth catches for each trap were reported weekly in the Tennessee IPM Newsletter. The newsletter is distributed to agents, cotton producers, consultants and other agricultural professionals and is also posted on the internet at www.utcrops.com.

Tobacco budworm moth catches were low and similar to previous years with a small, early June peak reflecting emergence from alternate hosts. Most tobacco budworm moths were caught in Tipton, Shelby, Haywood, Madison and Gibson Counties. It is not surprising that few if any fields of cotton were treated for tobacco budworm considering the low acreage of non-Bt cotton and the low populations of tobacco budworm. The highest single-trap capture was recorded in west Haywood County where 17 moths were caught the week preceding May 27.

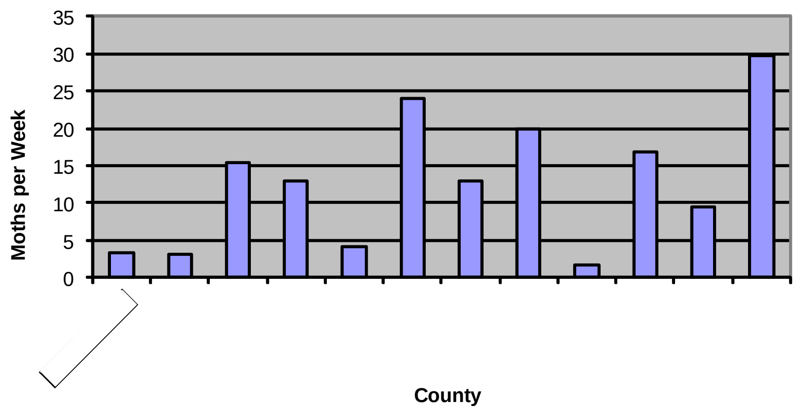
Catches of corn earworm (i.e., bollworm) moths in pheromone traps were relatively low and remarkably similar to 2008, although they were about twice as high as those observed in 2007. The bollworm is Tennessee's most significant caterpillar pest in cotton because this species is able to cause economic injury to Bt cotton which composes the vast majority of the acreage. Peak trap catches during 2009 occurred in mid to late August, about two weeks later than usual and when most fields were too mature to be at significant risk. The unusually late corn crop caused by heavy spring rains also resulted in a delayed emergence of corn earworm from corn. More corn earworm moths were caught in Madison, Dyer, Lake and Carroll Counties than other areas. The highest single trap catches were observed in Gibson County (151, Kenton area, July 29) and Madison County (152, WTREC, August 8). Few beet armyworm moths were caught in 2009 with an average peak in trap catches in August of less than five moths per trap per week. Trapping did not necessarily reflect all local variations in pest densities observed in cotton fields, in part because trap density was not high and because other factors influence oviposition and survival of these pests in cotton. However, the pheromone trapping program did an excellent job of predicting the relatively late occurrence of corn earworm populations observed in 2009. This correlated well with relatively low boll damage observed in many areas (see below).



Average number of tobacco budworm (TBW), corn earworm (CEW), and beet armyworm (BAW) moths caught per trap in pheromone traps across West Tennessee (2009).



Seasonal average number of tobacco budworm moths caught per trap per week in 2009.



Seasonal average number of corn earworm moths caught per trap per week in 2009.

2) Boll Damage Survey in Non-Bt, WideStrike, Bollgard and Bollgard II Cotton. A survey has been conducted in late season annually beginning in 2002. In recent years, we have been doing this survey for selected varieties in the UT County Standardized Variety Trial. These data are used to identify major insect pests, changes in pest trends, and to estimate crop losses. This information provides a historical database and also helps determine the relatively efficacy of various transgenic traits (e.g., Bollgard, Bollgard II and WideStrike). From 2002 – 2008, boll damage attributed to caterpillar pests in non-Bt cotton has ranged from 0.7 to 9.4 %. In recent years, Bollgard II and WideStrike cottons have reduced this damage by about 90% with Bollgard II being slightly more effective (see table below). Boll damage attributed to hemipteran pests such as plant bugs and stink bugs has ranged from 3 to 6.2% during this same time period.

Summary of boll damag[redacted]
caterpillar pests in Wes[redacted]

Trait			[redacted]03	2004	2005	2006	2007	2008	Average	
Non Bt	9.39	8.29	2.04	1.50	5.13	0.72	1.48	4.1	2.2
Bollgard	2.41	3.21	0.31	0.08	1.25	0.18	0.33	1.1	0.5
Bollgard II	---	1.05	0.13	0.08	0.15	0.08	0.05	0.3	0.1
WideStrike	---	---	---	0.12	0.35	0.13	0.10	---	0.2

Note: total bolls sampled ≈[redacted]

In 2009, as part of the [redacted] cotton varieties were pl[redacted] these tests were survey[redacted] 375 WRF) and Bollga[redacted] original Bollgard techn[redacted] 2010. Damage surveys [redacted] samples of 100 conse[redacted] locations was fewer th[redacted] locations. County tests [redacted] Lake, Tipton, and Mad[redacted] primarily caused by bol[redacted] injury (stained lint, etc[redacted] number of bolls with [redacted] potentially could contri[redacted] across varieties within [redacted]

Outcomes: Boll damag[redacted] locations in 2009 (see [redacted] Dyer, Tipton and She[redacted] locations had < 3% b[redacted] averaged 0.41%, and 0.[redacted] consistent with moth tr[redacted] caused by hemipteran [redacted] survey began, averagin[redacted] observed in 2008 (6.16[redacted] observed in many areas[redacted] County location where [redacted] first time, significant boll rot was observed in the survey at some locations. In particular, the same Shelby County location as above averaged about 18% boll rot. Our survey is timed to occur when the first bolls open, so it tends to underestimate the ultimate amount of boll lock and hard lock that will occur.

2009 Boll damage survey. Average percent boll damage by variety across 9 locations.

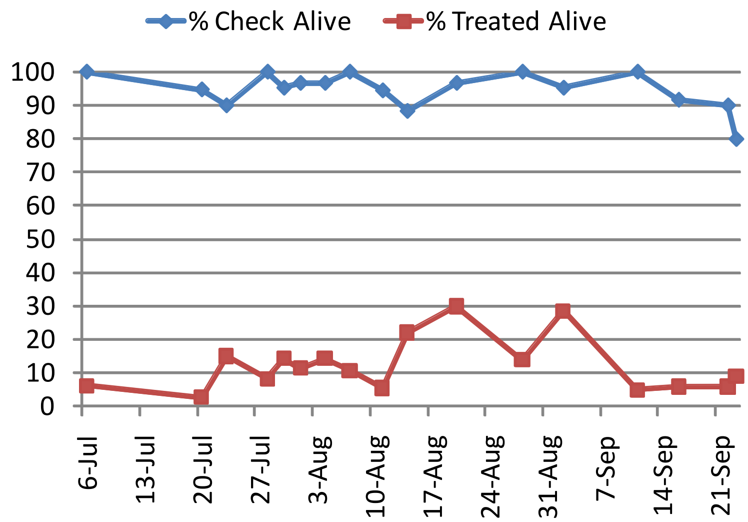
Variety	Worm Damage	Bug Damage	Boll Rot	Total Damage
PHY 375 WR	0.41	9.00	2.26	11.67
DP 0920 BGII/RF	0.33	9.22	2.00	11.56
PHY 315 RF	2.85	9.26	1.89	14.00

Damage = penetration of boll wall.
Each location = 3 samples of 100 consecutive, harvestable bolls per variety.

3) Resistance Monitoring. Insects are well known to develop resistance to insecticides. There is increasing documentation of bollworm resistance to pyrethroid insecticides in parts of the lower Midsouth. Although pyrethroid and acephate resistance in some tarnished plant bug populations has also been documented in at least part of the Midsouth, until recently there have been no monitoring efforts in Tennessee. Therefore, an insecticide resistance monitoring program was instigated in 2006 for both bollworm and tarnished plant bug populations collected in West Tennessee. Monitoring resistance of key insect pests helps to document resistance and implement insect resistance management plans. Vial assays of adults are used in both cases.

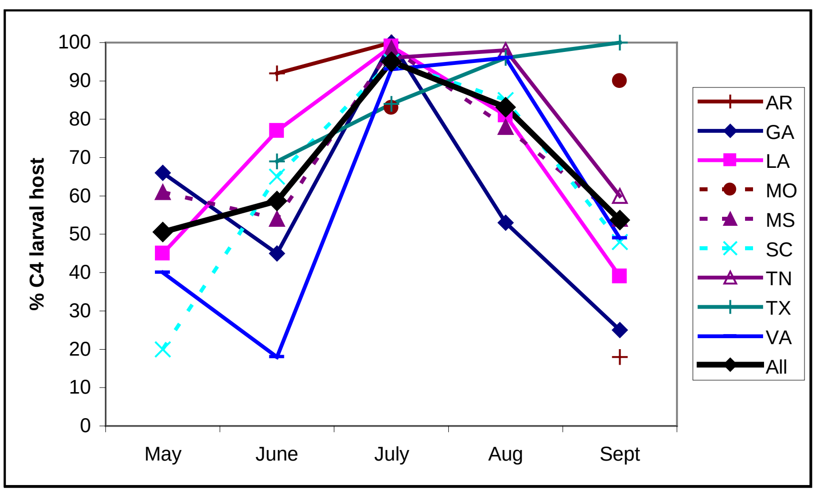
Populations of tarnished plant bugs were <u>not</u> tested in 2009, in part because excessive rainfall in September prevented their timely collection. Vial assays using 5 ug/vial cypermethrin, a synthetic pyrethroid, were again performed on bollworm moths in 2009. This represents a discriminating dose where 90% or higher of susceptible moths are expected to die after 24 h exposure. Fresh bollworm (i.e., corn earworm) moths were collected from traps that were baited with pheromone lure on the previous night. All moths were collected in Madison County at the West Tennessee Research and Education Center. For several years and as part of a cooperative effort, moths from the above tests have been submitted to scientists in Mississippi (F. Musser, R. Jackson) who are assaying moths using a technique that determines if the larval host was a C_3 or C_4 plant. These data are being collected to better understand the population dynamics of bollworm and determine the impact of host origin on resistance levels. C_3 plants are broadleaves such as cotton and soybean. C_4 plants are usually grasses, and presumably any bollworms testing positive for C_4 plants developed on corn or sorghum because these are primary hosts during the time frame of moth trapping.

<u>Outcomes:</u> 1277 moths were used in the vial tests that were done between 6 July and 21 September, 2009. Percent survival after 24 h was recorded for moths in treated and untreated vials (see figure below). The average, corrected percent survival of moths to the 5 ug/vial dose of cypermethrin was about 10%, similar to 2008 and less than observed in 2006 (16%) and 2007 (21%). These data indicate some level of resistance but not to the levels that result in field control insecticide failures when spraying pyrethroid insecticides for the control of bollworm infestations. In perspective, 30-45% of bollworm moths collected in Louisiana during July of recent years have survived when exposed to this same discriminating dose.



Percent survival of bollworm moths to cypermethrin in vial assays (24 h exposure).

C_3 and C_4 analyses indicate that, across a large area, 70 – 100% of moths in the landscape during late July and August are originating from grass hosts, likely corn (see figure below). Increased survival to vial assays was observed in Tennessee during mid to late August. This is consistent with observations in other states and is partially because moths emerging from corn are generally fitter than those from other hosts.



Percent of bollworm (corn earworm) moths whose larvae host was a C_4 plant, typically a grass and likely corn or sorghum during late July and August.

4) Regional Projects. In 2009, about $10,000 in core Cotton Incorporated funding was received to support several regional projects. Full reports on these efforts have been submitted separately by project leaders. However, shortened summaries are included here because state-support funding is substantially used to complete these efforts.

a) In-season use of Temik for insect management in cotton and efficacy of selected insecticides for control of the tarnished plant bug (PI: Don Cook). The cotton-corn interface has proven to be a hot spot for tarnished plant bug. In this study, scientists from five states are evaluating the value of side-dressing Temik in cotton rows adjacent to corn as a means to control tarnished plant bug populations both in this interface and in the remainder of the cotton field. In 2009, two tests were completed in Lauderdale County, TN as part of this effort. Another component of this regional project was the standardized evaluation of insecticides for the control of tarnished plant bug, including their impact on square retention and yield.

Outcomes: Across LA, AR, MS, TN, and MO trials were conducted during 2008 (nine trials) and 2009 (ten trials) to evaluate the impact of in-season application of aldicarb on tarnished plant bug infestations and yield. Selected sites were fields with a corn-cotton interface with cotton rows running parallel to the corn. Corn and cotton fields were not separated by more than 40 feet of uncultivated land (turn-row, ditch, etc.). The trials included 2 treatments (Temik 15G and a non-treated control) that were applied in addition to all normal production practices. Temik was applied to the first 32 rows from the edge of the field next to corn at 10 lb form./acre as a side-band when plants in the adjacent corn field were at the green silk stage or the cotton had reached the match-head square stage. When the Temik was applied, the applicator was passed through the non-treated plots so that any root pruning that occurred during application would be uniform across plots for both treatments. Plots were at least 100 ft. long, with a minimum of three replications. All of the plots within a trial were ordered along the corn–cotton interface using a randomized complete block design. With the exception of the Temik applications, the fields were managed according to the growers' standard production practices, including insecticide applications over the entire field.

Sampling for tarnished plant bugs was initiated at the time of Temik application and collected weekly for 4-6 weeks. Sweep net sampling was used throughout the trial to monitor plant bug densities. Drop cloth sampling was also conducted to monitor the level of reproduction in the trial area. Four samples were collected within each plot at regular distances from the edge of the field. Plots were divided into 8 row sections (rows 1-8, 9-16, 17-24, and 25-32) and the center two rows of each section was sampled. Sampled areas were marked so that the same areas could be re-sampled each week. In addition, at least two samples per plot were collected; one was within 4 rows of the plot (35-36 rows from the edge of the field) and the other was at least 150 ft (ca. row 80) out from the edge of the plots to evaluate the width of the elevated TPB density edge. Each sample consisted of 2 sets of 25 sweeps and 2 drop cloth samples (10 row ft). Yield was estimated by harvesting at-least two rows from each set of 8 rows of each plot (4 yield measurements per plot). Also, yield was estimated within the first six rows adjacent to each plot and at 150 ft from the edge of each plot. Data were combined across locations and subjected to ANOVA procedures using the SAS mixed procedure, with means separated according to Fisher's Protected LSD.

During 2008, trends for lower total tarnished plant bug densities using sweep net sampling were observed in the Temik treated plots at all sample locations during the first three weeks after application. Significantly more plant bugs were captured in the non-treated plots compared to the Temik plots at rows 1-8 during week 3, rows 17-24 and rows 25-32 during week 2, and rows

9-16 during week 5. Across all rows, the Temik treated plots had significantly fewer plant bugs than the non-treated plots during weeks 2, 3, and 5.

Trends for lower numbers of total tarnished plant bugs were observed in the Temik treated plots at all sampling locations during the first three weeks after application using drop cloth sampling. Plots treated with Temik had significantly fewer plant bugs than the non-treated plots at rows 1-8 during weeks 2 and 5, rows 9-16 and rows 17-24 during week 3, and rows 25-32 during week 2 (Table 3). Across all rows, the Temik treated plots had significantly fewer plant bugs than the non-treated plots during weeks 2, 3, and 5.

At all sample locations, trends for higher yields were observed in the Temik treated plots compared to the non-treated plots. The sample locations, rows 9-16 and 17-24, in the Temik treated plots produced significantly more yield compared to the same locations in the non-treated plots. Also, the sample locations 150 ft outside of the Temik plots yielded significantly more than the same sample locations adjacent to the non-treated plots. Across all rows the Temik treated plots produced significantly more yield compared to the non-treated plots.

Impact of side dress application of Temik 15G on tarnished plant bug densities across rows sampled by sweep net during 2009.

	Total Tarnished Plant Bugs[1]/25 Sweeps				
Rows/Treatment	Week 1[2]	Week 2[2]	Week 3[2]	Week 4[2]	Week 5[2]
Temik	0.8	1.5b	2.0	1.9	1.1b
Non-Treated	0.9	2.0a	2.4	2.0	2.2a
P>F	0.19	<0.01	0.6	0.41	<0.01

Means with a common letter are not significantly different (FPLSD, *P*=0.05).
[1]Adults plus nymphs; [2]Weeks after application.

Impact of side dress application of Temik 15G on tarnished plant bug densities across rows sampled by drop cloth during 2009.

	Total Tarnished Plant Bugs[1]/5 row ft				
Rows/Treatment	Week 1[2]	Week 2[2]	Week 3[2]	Week 4[2]	Week 5[2]
Temik	0.5	1.1	1.2	2.0	2.3
Non-Treated	0.9	1.3	1.3	2.3	2.8
P>F	0.10	0.37	0.75	0.23	0.13

Means with a common letter are not significantly different (FPLSD, *P*=0.05).
[1]Adults plus nymphs; [2]Weeks after application.

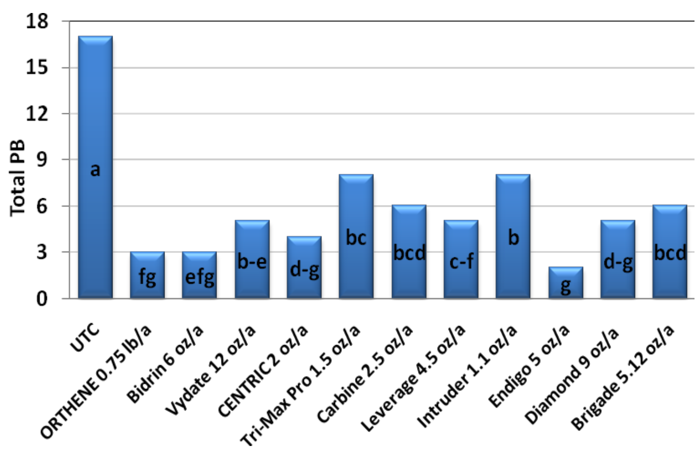
Impact of side dress application of Temik 15G on lint yield during 2009.

	Yield (lb lint/acre)					
Treatment	Rows 1-8[1]	Rows 9-16[2]	Rows 17-24[3]	Rows 25-32[4]	6 Rows Outside[5]	150 ft Outside[6]
Temik	875.6	828.6	953.4a	863.4	802.4	856.7
Non-Treated	855.8	771.1	835.0b	799.2	789.7	877.2
P>F	0.56	0.12	0.03	0.17	0.66	0.68

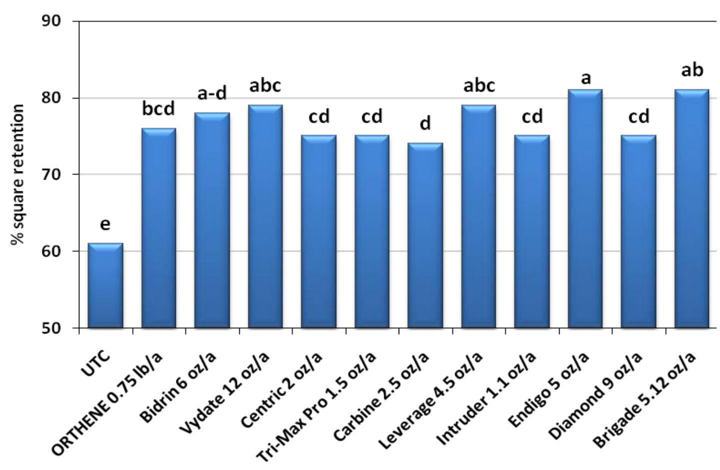
Means with a common letter are not significantly different (FPLSD, *P*=0.05).

[1]Rows 1-8 from interface with corn;[2]Rows 9-16 from interface with corn; [3]Rows 17-24 from interface with corn; [4]Rows 25-32 from interface with corn; [5]6 rows outside of and adjacent to the treated and non-treated plots; [6]150 feet outside of and adjacent to the treated and non-treated plots.

The results of the standardized efficacy trial indicated that several insecticides or insecticide pre-mixes provide better control than alternative compounds, but all treatments reduced tarnished plant bug numbers and increased square retention (see graphs below). Orthene 90 (0.75 la/a), Bidrin (6 oz/a), Centric (2 oz/a), Endigo (5 oz/a) and Diamond (9 oz/a) reduced tarnished plant bug populations the most. Yield data were highly variable (not shown), but only was the Endigo treatment yielded more than untreated plots.



Total Plant Bugs Across Trials. Assessment Timing: 0-5 Days After Treatment 2.
Locations: AR-(Studebaker), AR-(Akin), AR-(Lorenz), MS-(Catchot) and TN 9Stewart).
Bars not followed by a common letter are significantly different (*P* < 0.05).



Percent Square Retention Across Trials. Assessment Timing: 0-5 Days After Treatment 2
Locations: AR-(Studebaker), AR-(Akin), AR-(Lorenz) and TN (Stewart).
Bars not followed by a common letter are significantly different (*P* < 0.05).

b) Evaluation of automatic insecticide applications following preventative insecticides for thrips (PI: Scott Akin). A standardized experiment was implemented at 20 locations across the

Cotton Belt including a location in Madison Co., Tennessee. The main intent of this study is to determine in which conditions do scheduled, foliar applications of insecticide for the control of thrips on seedling cotton result in improved yield. Another component of this project was the survey of thrips species that are present across a wide geography.

Plot size was 4 rows x 50 feet and arranged in a randomized complete block design with factorial arrangement of treatments (3 x 4, 4 replications). Treatments consisted of two factors including 'Factor A' (at-plant insecticide) and 'Factor B' (automatic application timing of foliar insecticide). 'Factor A' consisted of no seed preventative insecticide, Aeris® seed treatment, or Temik® 15G (5.0 lbs/A) applied in-furrow. 'Factor B' consisted of no foliar application, an automatic application at 1-2 true leaves, an automatic application at 3-4 true leaves, or automatic applications at 1-2 and 3-4 true leaves. Varieties were chosen based on optimal agronomics/insect protection (e.g., Bollgard II or WideStrike) for each location. Seed-cotton yield was recorded from the middle two rows and analyzed with various secondary data such as thrips numbers, weather data, nematode samples, days to emergence, plant stage at each sampling, and a maturity rating of the approximate date when the plots reached NAWF5.

Outcomes: Data from this test are not fully analyzed. Excessive rainfall affected many locations in the Midsouth, resulting in low thrips numbers and confounding yield data. Tobacco thrips were by far the most common species observed across the Cotton Belt. Western flower thrips were the dominate species at a few locations (e.g., Texas). In Tennessee, soybean thrips and onion thrips were common in 2009. Overall, the data showed that at-planting insecticide treatments improved yields at multiple but not all locations (data not shown). This research will be repeated to further evaluate these automatic applications. Results from Virginia are expected to be representative and suggest that a foliar application at 1-2 leaf stage can improve yields in environments where thrips are causing extensive damage; whereas applications at the 3-4 leaf stage were not needed if an application was made at the 1-2 leaf stage (see tables below).

Effect of automatic foliar insecticide timing on yield across all at-plant treatments (VA, 2009).

Foliar Timing	Seed cotton yield
UTC	1210 c
1-2 leaf	1409 a
3-4 leaf	1312 b
1-2 & 3-4 leaf	1413 a

Means in the same column followed by the same letter are not significantly different (Duncan's New MRT $P<0.0001$, P[AB] = 0.2002).

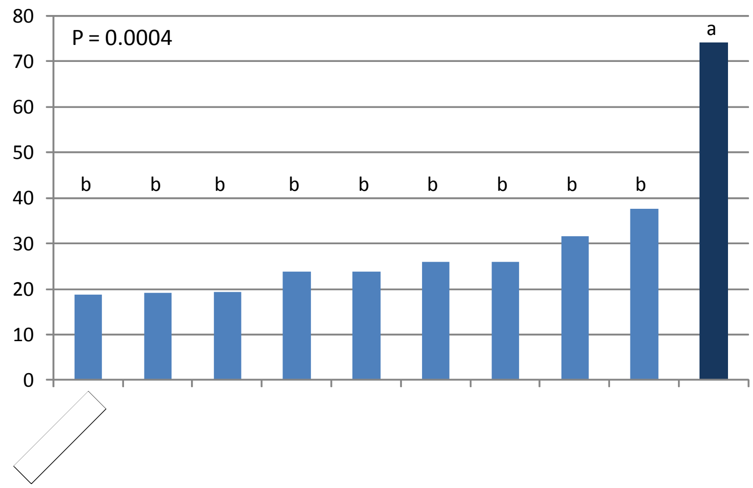
Effect of at-plant insecticide on yield across all automatic foliar insecticide timings (VA, 2009).

Preventative	Seed cotton Yield
UTC	1180 c
Aeris	1494 a
Temik 5 lbs/A	1333 b

Means in the same column followed by the same letter are not significantly different (Duncan's New MRT $P<0.0001$, P[AB] = 0.2002).

c) Evaluation of cotton yield loss caused by two-spotted spider mite and efficacy of selected miticides (PI: Jeff Gore). One component of this test is investigating how the timing and intensity of spider mite infestations impact yield. Five states were involved in this test, including Tennessee. In each state, spider mites were infested onto cotton at different growth stages, and the intensity and duration of infestations were noted as well as the impact on the plant and yield. One possible outcome of this experiment is to determine a point in which applications to control infestations can be terminated based on crop maturity. A second component of this project is the standardized evaluation of miticides across the Midsouth, including determining treatment effects on yield.

Outcomes: Excessive rainfall and adverse environmental conditions significantly impacted the results of experiments in 2009. In general, spider mites significantly impacted yields where data was able to be generated (data not shown). Infestations initiated at the 3-leaf stage resulted in significantly lower yields compared to the non-infested in all three of the trials that reported a yield loss. Infestations beginning at first bloom significantly reduced yields in 2 of the 3 trials reported. Additionally, infestations beginning at 200 heat units and 400 heat units beyond first bloom resulted in significant yield reductions in one of the 3 trials reported. In general, all of the treatments evaluated in the standardized efficacy trial significantly reduced mite populations compared to the non-treated (e.g., example graph below). There were no significant differences in yields among the treatments.



Treatment effects on spider mite numbers (per 10 IN^2) at 7-9 DAT when averaged across five locations. Bars without common letter are significantly different ($P < 0.05$, Proc Mixed, pdiff). Rates (oz/a) are shown behind the product names.

5) Other Activities. Funding for this project is used to support general IPM Extension activities in Tennessee and an insecticide screening program. This includes the delivery of the annual Cotton Scout School held at the West Tennessee Research and Education Center. Scouts are delivered classroom-style and in-field training related to cotton plant development, insect management (identification, sampling, etc.) and disease and weed identification. A scouting notebook was prepared for each attendee. This project also supports the preparation and publication of *Insect Control Recommendations for Field Crops* (UT Publication, PB1768) which contains IPM information for cotton. This publication is also available on the web at www.utcrops.com. In addition, numerous insecticide trials and other experiments were established in 2009 to investigate various insect control practices and strategies for cotton pests. In all cases, replicated trials were established in an RCB design, usually with four replicates, and analyzed using appropriate statistical methods.

Outcomes: Because of decreased cotton acres in the state, only 45 scouts participated in the Cotton Scout School during 2009. A scouting notebook was prepared for each attendee. About 1,500 copies of the *Insect Control Recommendations for Field Crops* (PB1768) were distributed to clientele groups. Demand for this publication has nearly doubled since insect control recommendations for cotton, corn, soybean, wheat, sorghum and pasture were included in one publication.

Approximately 30 other experiments were successfully established in cotton to investigate various insect control practices and strategies. The data generated from these activities are used to validate and modify extension insect control recommendations for Tennessee. These evaluations included insecticide efficacy trials for thrips, spider mites, plant bugs, stink bugs and bollworm. They also included the testing of several new insecticides and insecticide formulations. We continue to investigate new Bt corn traits which promise to significantly reduce corn earworm (bollworm) populations developing in corn, thus impacting populations seen in cotton. One experiment evaluated the effects of foliarly applied fungicide and insecticide applications on boll rot and hard lock. These data indicated that insecticides had a greater impact on reducing hard lock than did fungicide application (data not shown). Results of most experiments have been individually summarized and will be published on the utcrops.com website at http://www.utextension.utk.edu/fieldCrops/MultiState/MultiState.htm. The same website also serves as a data warehouse for some experiments done by other universities in the Midsouth.