64th ANNUAL CONFERENCE REPORT ON COTTON INSECT RESEARCH AND CONTROL

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Abstract

There were 10,706,700 acres of U.S. Cotton (Upland and Pima) harvested with an average of 821 pounds of lint per acre (USDA –January 2011 report) in 2010.

Arthropod pests of cotton reduced yield by 3.91% in 2010. Heliothines (bollworm/budworm) reduced yields by 1.186% attaining losses greater than all other pests. The bollworm was the predominant heliothine species to attack cotton in 2010. Bollworms were estimated to make up 95% of the population. The stink bug complex was second at 0.724%. *Lygus* (0.677%) were 3rd and cotton fleahoppers (0.362%) were 4th. Aphids (0.286%) rounded out the top five cotton arthropod pests for the year. Beltwide, direct insect management costs amounted to $56.05 per acre. Cost plus loss is estimated at $974 million. **(see M.R. Williams, this proceedings)**.

Crop and Arthropod Pest Conditions:

Alabama

Cotton was planted on 345,000 acres in 2010, an increase of about 25% over the previous year. Over 96% of the acreage contained the Roundup genes and approximately 90% contain genes for lepidopteran control. Due to the phase out of DP555, market share was gained by Phytogen, FiberMax and Stoneville varieties.

Early season insect pressure (thrips, aphids, cutworms, grasshoppers and plant bugs) was below historical levels for the second year in a row and very limited foliar applications were necessary. More than 80% of the acres were planted with insecticide treated seed, with the remainder planted with Temik in-furrow. Midseason pests included bollworms at below normal numbers which dictated fewer oversprays over the varieties with stacked lep genes. Very few lep sprays were made statewide, even in fields planted to conventional varieties. 2010 was one of the lowest pressure years in history for all lepidopteran species.

Stink bugs were by far the most economic of all cotton insects. Two to four foliar sprays were needed over most of the state to hold damage below threshold level. The dominant species in 2010 was the brown stink bug, *Euschistus servus*. The stink bug complex remains a complex issue to many growers and field-men, especially as it relates to scouting techniques and thresholds.

Weather during the production season was good until about July 15-20 at which time rainfall ceased and temperatures increased to 96-102° F (days) and 78-82° F (nights) for the following two months. This combination of heat and drought took its' toll on yields since only 10% of the state acreage is irrigated. Therefore, an 800-1000 lb potential yield deteriorated to about 500 lbs. Certain fields in several regions of the state yielded as low as 200-250 lbs of lint/acre.

Research continues with the newer chemistries against the bug complex, sucking pests, and leps. Also, the newer genetic technologies are being evaluated both agronomically and entomologically within the state. **(Ron Smith)**.

Arkansas

Cotton was planted on about 545,000 acres in 2010 which was up from 520,000 planted acres in 2009. Approximately 540,000 acres were harvested with an average yield of 1049 lbs lint/acre in 2010. Over 95% of the cotton in the state was planted to WideStrike and Bollgard II varieties. A small percentage of conventional cotton was planted (>1%) this year. Growers have shown an increasing interest in conventional varieties. Growing conditions were extremely hot and dry. Temperatures hit over 100 degrees F during late June. Weed resistance to glyphosate continues to be an increasing problem across the state. Weather was unusually dry throughout September and October and cotton was harvested in record time in 2010. Yields were above average.

Thrips pressure was light to moderate across the state. A foliar application for thrips was made on a small percentage of the crop. Spider mites were higher than last year due to the hot, dry conditions in 2010. Mite populations were higher in the northern part of the state. Approximately 20% of the cotton in the state was treated for spider mites and requiring 1 to 2 applications of a miticide.

Tarnished plant bugs were at moderate to high levels and were the number one pest again this year. High populations were in the typical areas near corn fields. Pockets of clouded plant bugs were seen in northeast Arkansas. Growers made approximately 3 applications for plant bugs in 2010.

Bollworms were extremely heavy, particularly in the southern part of the state. Bollworm was the number 2 pest in cotton in 2010. Approximately 60% of the cotton acreage required at least one application of a pyrethroid for bollworms. Widestrike cotton averaged 2 oversprays in some areas of the state. The stink bug complex did cause some yield loss on a small acreage, more so in the northern portion of the state. **(Glenn Studebaker)**.

California

There were 307,000 acres of cotton planted in CA in 2010, an increase of 200,000 acres from 2009. The San Joaquin Valley planted 95% of the total acres with the remainder being cultivated in the Southern Desert Valleys (11,205 acres, a 57% increase) and Sacramento Valley (4,685 acres, 51% increase). There were 184,000 acres planted to Pima cotton and 123,000 acres planted to upland cottons. Almost all the upland Bt cotton was planted primarily in the Southern Desert Valleys.

Yield is estimated to be 1,483 lbs/acre for upland and 1,174 lbs/acre for Pima. In the SJV, planting was split between lat March/early April and mid to late May, due to cold, wet conditions through April/May. Between March 5^{th} and April 31^{st} planting conditions based on DD>60, five days post planting were unfavorable or marginal for planting cotton 42% of the days and 58% of the days were adequate to ideal for cotton emergence at the Westside REC. The warm temperatures in September and October allowed for an extended growing season and provided the opportunity to develop additional yield.

The cool and very late start to the season created scattered areas that required thrips treatments. Spider mites were generally low although miticides were tanks mixed as a precaution when Lygus were treated. Due to the influence of the El Niño conditions and extended rainy periods into spring, Lygus was the key issue in the San Joaquin Valley (SJV). Multiple applications were made in many areas, resulting in shortages of some insecticide products. Because of the delayed season, treatment decisions were very conservative. However, the pressure and treatment response varied widely through the SJV from none to 4-5 applications. Aphid and whitefly populations were not severe. Pink bollworm eradication efforts continued in the southern deserts with good progress being reported. **(Peter Goodell)**.

Georgia

Approximately 1.325million acres of cotton were harvested in Georgia during 2010. Production was variable depending primarily on available moisture. However, excessive heat, both daytime and nighttime temperatures, occurred during summer months and negatively impacted yield potential on most acres. Harvest conditions were generally good and average yield is estimated at 779 lbs. lint per acre.

Thrips populations were variable depending on location and planting date. Early planted cotton experienced heavy thrips infestations whereas low to moderate infestations were observed on later plantings. Other seedling pests such as grasshoppers and cutworms were rarely observed. Aphid populations were light to moderate and crashed due to the naturally occurring fungus during early summer; only a small percentage of the acreage was treated with insecticide for aphids. Tarnished plant bug infestations were relatively high for about two weeks in localized areas. Damage occurred in some fields which were not managed appropriately. Spider mite problems developed in some fields which were treated multiple times for tarnished plant bugs, but these were in isolated areas. Spider mites continue to be a pest of concern in that this pest is present at detectable levels in many areas. Additionally, we have consistently created economic infestations in research trials with multiple applications of some broad spectrum insecticides. Spider mites are a pest which requires careful management.

Corn earworm and tobacco budworm populations were generally low. However some areas of moderate to high pressure were observed in east Georgia. Most cotton planted in Georgia is transgenic Bt cotton and only a small percentage of acres need a supplemental insecticide application for corn earworm. We continued to monitor pyrethroid susceptibility of corn earworm using cypermethrin treated vials; 2010 results were similar to previous years in terms of susceptibility. Fall armyworm and beet armyworm populations were low statewide. However, we observed high numbers of beet armyworm infesting Palmer amaranth in some fields. Soybean looper populations were also very low.

Stink bugs were the most common insect treated with insecticide during mid and late season. Populations were near normal; however the majority of fields exceeded threshold levels for stink bugs at some point during the year. As in years past, brown stink bugs were the predominant species during June and early July. During August we observed a mix of both brown and southern green stink bugs that eventually became mostly southern green during September.

Silverleaf whiteflies were present in very localized areas but generally did not build to high populations. No boll weevils were captured by boll weevil eradication personnel during 2010. **(Phillip Roberts)**.

Louisiana

Cotton was planted on about 254,000 acres in Louisiana during 2010, which was slightly higher than that planted in 2009. Nearly 251,000 acres were harvested with an average lint yield of 905 lb/acre in 2010. The overall crop condition from excessive heat and drought during most of the season suggested poor yields. Several varieties responded favorably to a longer-than-normal growing season and allowed many producers harvest to a high (>1250 lb) yielding crop. The persistent rainfall events during August, September, and October of 2009 that caused significant lint yield and seed quality losses did not occur in 2010. Much of the crop was harvested with little to no rainfall on open seedcotton and lint quality was better in 2010 than that observed in previous years. However, weather-induced yield losses remain the primary limiting factor for cotton production in Louisiana.

Greater than 93% of the cotton acreage was planted with varieties containing Bollgard, Bollgard 2, or WideStrike technologies. In addition, most of the cotton seed planted in Louisiana was treated with an insecticide and fewer than 8% of the acres received an application of Temik 15G as an infurrow granule at-planting. Even though winter wheat acreage was lower than in previous years, relatively high numbers of thrips migrated to adjacent cotton fields from wheat, corn, and native vegetation adjacent to cotton fields. Early season thrips problems on cotton seedlings were low-to-moderate in many areas. The insecticide seed treatments (primarily imidacloprid and thiamethoxam) used by many producers provided initial control of infestations, many fields were over-sprayed with a single insecticide application for thrips. Cotton aphid was a minor problem during 2010 and very few fields experienced less than satisfactory control with recommended products. Two Louisiana populations of cotton aphid tested by Mississippi State exhibited reduced susceptibility to thiamethoxam. Tarnished plant bugs remained the most significant and widespread cotton pest, but infestations were generally not as high or persistent as that experienced in 2009. Unsatisfactory control was observed with single applications of numerous products during late July and August. Insecticide susceptibility surveys continue to show that acephate and pyrethroid resistance is widespread in Louisiana populations of tarnished plant bug. Bollworm was a major pest in Bollgard, Bollgard 2, and WideStrike fields, but co-applications of pyrethroids with insecticides used for tarnished plant bug reduced the overall significance of the problem. During 2010, oversprays actually targeted bollworm as a single target in Bollgard 2 and WideStrike fields. This was the first year that sufficient numbers of bollworm as late instars could be collected and used to establish laboratory colonies in more than isolated fields. Although significant yield losses from bollworm were not common, supplemental pyrethroid sprays were used to mitigate fruiting form injury. Other caterpillar pests such as fall armyworm, beet armyworm, and soybean/cabbage looper were isolated problems on limited acreage and generally were effectively managed with timely insecticide sprays. The rice-grass strain infested some fields, but were generally restricted feeding on annual grasses which escaped control with herbicides. This strain did not cause significant injury to cotton plants but should not be confused with later infestations of the corn-cotton fall armyworm strain which did damage bolls in a few fields. Southern green and brown stink bugs were common in some fields during the boll maturation periods of plant development and likely migrated from senescing fields of soybean. Levels of stink bug-damaged bolls were recorded above the action threshold in those fields, but in general, overall stink bug infestations were lower in all crops during 2010. Extended periods of drought and high temperatures caused spider mites to infest significant acreage for the entire season. Many of these initial infestations were detected on the borders of cotton fields that were adjacent to field corn. Surveys of corn fields showed high infestations of two-spotted spider mite after planted entered the tassel stage, and those populations appeared to disperse by wind into adjacent cotton fields. Multiple applications of acaricides were necessary to maintain satisfactory control. Occasional reports of grasshoppers and slugs injuring cotton seedlings were again common during the early season. Slug infestations were heaviest in reduced-tillage cotton production systems of grain sorghum or field corn residue from the previous year. Grasshoppers migrated along field borders as the drought caused premature senescence of native hosts along field margins. The nut curculio, *Conotrachelus hicoriae* Schoof, was identified as a new cotton pest and was found in a few fields damaging cotton bolls. This species is a common pest of pecans in the Louisiana and its occurrence in cotton was likely accidental. Based upon an 1899 reference from Georgia, acorn weevils and other nut-feeding weevils are occasionally observed in cotton fields. Boll injury from this pest during 2010 was severe (>20%), but infestations were restricted to field borders adjacent to oak trees. **(B. Rogers Leonard)**

Mississippi

Cotton producers in Mississippi planted approximately 425,000 acres of cotton in 2009. This was a 33% increase in acres compared to 2009. Approximately 5% of cotton in MS was planted to transgenic single gene Bt varieties and 90% of cotton acres was planted to dual toxin transgenic Bt varieties. The most popular varieties planted in 2010 were Stoneville 5288 BGII/F, 4288BGII/F, Stoneville 4427BGII/F, PHY375WRF, and DeltaPine 0912BG/RR. These five varieties made up approximately 50% of the total acres planted in 2010. The most widely planted dual toxin Bt variety planted was Stoneville 5288BGII/F, making up 11.2% of cotton acres.

Total insect losses in MS were higher in 2010 than in 2009. Overall losses from insect pests in 2010 were 8.94% compared to 5.94% in 2009. Mississippi averaged 8.6foliar applications to control pests in 2010 for an average foliar insect control cost of $90.62 per acre. Final cotton yield estimates for 2010 was 971 pounds per acre, up 200 pounds per acre from 2009. Cotton yields in the delta averaged approximately 1050 pounds per acre while the hill region of the state averaged approximately 750 pounds per acre.

Thrips pressure across the state was light to moderate both in the hills and delta region. Seed treatments continue to gain popularity in MS for control of thrips due to convenience and ease of use. Approximately 26% of the cotton acreage received a foliar application for thrips.

Tarnished plant bug ranked as the number one damaging pest in 2010. The delta region of the state averaged 6. spray applications for plant bugs while the hill region of the state averaged only 2 spray applications. The chloro-nicotinyl class of chemistry, such as, Trimax and Centric was widely used in pre-bloom cotton to control tarnished plant bugs in 2010 with “standards” such as Orthene, Bidrin, and Vydate getting more use in post-bloom cotton tank mixed with pyrethroid insecticides. Plant bug numbers in parts of the delta region of the state were extremely high again in 2010 but on average, overall populations were lower compared to previous years.

Bollworm/Budworm pressure was very high on average in 2010 with average number of foliar sprays at 2.5 for cotton in the delta region of the state. The hill region of the state received on averaged 1.0 foliar applications. Although 2010 had significantly higher pressure from cotton bollworm, the increase in dual toxin Bt cotton to 90% prevented high numbers of foliar sprays targeted at cotton bollworm. However, as a function of extremely high pressure, there were more escapes noted than in previous years. Fall armyworm pressure was extremely heavy in 2010 but consisted mostly of the grass strain and economic loss was very limited in cotton.

Spider mites once again ranked as Mississippi’s third most damaging pest. Lack of rainfall allowed populations to persist for most of the growing season, requiring producer’s to treat a record percentage of acres for this pest. Approximately 161,000 acres were treated for spider mites in the state in 2010.

In summary, total insect control cost for the state in 2010 was $226.12 per acre up approximately $60.97 per acre compared to 2009. This was largely due to increased costs of insecticides and application fees and frequency of application. The 2010 harvest was one of the best in recent memory. Low rainfall accumulation allowed producer’s to harvest the crop in record time and very little loss was attributed to boll rots and hard lock. **(Angus Catchot)**.

New Mexico

This was a very unusual year for insect pests in New Mexico. Some fields had no significant problems. Other locations had outbreaks of insects that have never or rarely been reported at pest levels in New Mexico cotton. Some of this was likely due to highly unusual weather in July which was moist and warm rather than hot and dry. Few days in mid July had highs over 90 which is typical. This unusual weather was considered the reason for an unprecedented and devastating infestation of cutworms in alfalfa but cotton was unaffected. Cotton yields overall were good but highly variable from excellent to fields that with over 15% losses.

Cotton square borer has been seen rarely in New Mexico at very low levels. This year was the first time populations were high enough to be a concern in some non Bt fields. Bollworm populations were higher than normal in non Bt fields, but as usual control in Bt fields was excellent. Losses from lygus were also higher than usual, particularly early season.
Two boll feeders were an issue this year. Some cotton fields were treated for damage from leaffooted bugs and still retained high damage. This was the first time we have seen damage from leaffooted bug in cotton or pecan in New Mexico, although there have been increasing reports from other states since about 2006.
Conchuela stinkbug was also a concern in 2010. It is an occasional pest of cotton bolls in New Mexico but this year populations were much higher than usual. Most years this pest is found along the edges of the field, but this year populations were so high that they were often found throughout cotton fields.
Surprisingly, no pink bollworms were captured in any of the over 50 traps from the Pecos Valley and Lea county in southeastern New Mexico. As expected, no pink bollworms were collected inside the pink bollworm eradication zone in the Mesilla Valley and Western New Mexico. For the fifth year no boll weevils were collected in New Mexico. **(Jane Pierce).**

North Carolina

Thrips levels were generally moderate in most areas of the state, though individual cases of very high and very low levels were seen in some areas. In two replicated thrips tests planted on April 28, no difference in yield was found between the most aggressive treatment (Temik at 5.0 lb. product/acre plus Aeris seed treatment) and the untreated check. In most years, lint gains range from 100 to 250 pounds per acre from the use of Temik or a seed treatment plus a foliar spray compared with untreated seed at planting. Foliar treatments were also relatively low in 2010 by North Carolina standards, with an average of just under 72 percent of the cotton acreage treated with a foliar insecticide following the use of a seed treatment such as Avicta or Aeris, and under 64 percent following Temik. In 2010, Temik was used on approximately 70 percent of North Carolina's cotton acreage (53 percent as Temik alone and 17 percent as Temik combined with a seed treatment); seed treatments were used on 60 percent of the cotton acreage (47 percent as a seed treatment alone and 17 percent as a seed treatment plus Temik).

Though the trend was not apparent in 2009 or in 2010, from 2004 to 2008 the odds of needing to treat for spider mites and cotton aphids were much higher following the use of seed treatments than following Temik.

Cotton Aphids were a minor problem on most farms, with only 0.1 percent of our cotton acreage treated for aphids in 2010. Growers and consultants have become more confident of the effectiveness of beneficial insects, primarily "mummies," and in the fungus *Neozygites fresenii* in reducing cotton aphids to sub-economic levels in most cases.

Plant Bugs occurred at higher levels for a number producers in 2010, with more cotton fields reaching treatable levels, particularly in the far eastern part of the state during the bloom period. Approximately 15% of North Carolina's cotton acreage was treated for plant bugs in 2010, the highest in 8 years.

Stink Bugs damage to bolls was low to moderate across most of the state in 2010, resulting in a mean of approximately 1.6, 3.8 and 3.3% internal damage to bolls on conventional, WideStrike, and Bollgard II cotton, respectively.

The major late-season **bollworm** moth flights were early and enormous in 2010. Moth flights were also the highest in decades in some areas of the state during mid-August to mid-September, unusual in North Carolina. Bollworms caused an average of 3.0, 0.73 and 0.37 percent damage to bolls on conventional, WideStrike, and Bollgard II cotton, respectively. Although the damage to both WideStrike and Bollgard II cotton was low, this damage was approximately threefold higher than the average damage of these 2-gene technologies over the past five years.

The migratory **fall armyworm** reached extremely high levels this past growing season, but resulted in essentially no damage to WideStrike and Bollgard II varieties. **Beet armyworms** also were present in impressive numbers in 2010, but did little damage to conventional cotton and no damage to WideStrike or Bollgard II cotton varieties, with the exception of some movement of medium and larger instars from pigweeds to adjacent cotton. **Soybean loopers** also were present in extraordinary numbers in 2010, but confined most of their damage to other crops such as soybeans.

Bt Cotton varieties were planted on over 99 percent of the state's cotton acreage in 2010. Beginning in 2011, only 2-gene cotton varieties such as WideStrike and Bollgard II will be permitted, with no cotton refuge requirements (conventional, non-Bt cotton may still be planted).

As of this mid-December writing, North Carolina cotton producers are expected to harvest approximately 700 pounds of lint per acre on 534,000 acres. Cotton acreage is expected to rise significantly in 2011. **(Jack Bacheler).**

Oklahoma

Acres planted were 274,264 as reported by the Oklahoma Boll Weevil Eradication Program. Growing conditions were good following July 4th and production will be at or near 800 lbs of lint per acre when harvest is completed.
Our growing areas received rainfall from late May through the first of July which allowed fleahoppers to persist although in furrow granules were used. From one to three applications were made for fleahopper control which was ineffective due to persistent rains. A few acres received stink bug applications late in the season. These were limited to areas adjacent to woods and pastures that were not grazed. **(Terry Pitts).**

South Carolina

Cotton was planted on about 200,000 acres in South Carolina during 2010 – two-thirds of the amount planted in the state during 2006, the most recent year with the highest planted acreage for the state. Almost 99% of cotton acres were planted with varieties containing Bt technology, with almost all of the varieties containing dual-gene Bt technology. Early-season issues with insects were characterized as having light-to-moderate levels of thrips. Mid-to-late-season problems with insects consisted of bollworm, stink bugs, and fall armyworms primarily. Although many areas of the state and other crops developed problems with fall armyworms, much of the cotton was minimally impacted by armyworms due to dual-Bt predominance in acreage. Localized heavy populations of bollworm were observed, but Bt cotton performed well in suppressing numbers. Supplemental insecticides were used for a combination of bollworm and stink bugs, with stink bugs as the primary trigger. Populations of secondary pests such as aphids and spider mites were sporadic. Adequate amounts of rainfall during August were extremely beneficial to final yields, and an estimated 840-lb average yield is reported. Losses were due mostly to less-than-perfect environmental conditions, herbicide-resistant weeds, and moderate levels of pestiferous insects. **(Jeremy Greene)**.

Tennessee

Tennessee harvested about 390,000 acres of cotton in 2010, about a 100,000 acre increase over the previous year. About 98% of the crop was *Bt* cotton, and 93% of these acres were planted with Bollgard II® or WideStrike® varieties. The most commonly planted variety was PHY375 WRF. In part, this variety was planted in response to glyphosate resistant palmer amaranth as it allows the application of Ignite® (glufosinate) over the top. There was a short planting window in late April followed by 10-16 inch rainfall event in early May. Thus, most cotton was planted from May 10 to June 1. Flooding prevented cotton from being planted in low lying fields and flood plains. Subsequent rainfall patterns varied but most areas suffered from drought and excessive heat for at least part of the growing season. Almost no rainfall occurred during harvest which had beneficial effects on fiber quality and minimized harvest related losses. The average lint yield for Tennessee in 2010 is estimated at about 905 lb/acre, similar to 2009.

The 2010 season was characterized dry and hot conditions and by highly variable populations of arthropod pests. Statewide insect-induced yield losses were estimated at 5.7%. Much of this loss was associated with chronic infestations of tarnished plant bugs and/or green stink bugs in Haywood, Hardeman, Madison, Gibson, Carroll and parts of Crockett Counties. Bollworm pressure was moderate to high in several southwestern counties bordering the Mississippi River. However, the adoption and Bt cotton and lower than normal cotton acreage in this area helped minimize crop losses. *Bt* cotton traits generally performed well in controlling infestations of lepidopteran pests, but supplemental insecticide applications were needed in some areas to control higher than normal populations of corn earworm and fall armyworm. Unusual levels of corn earworm survival were reported for isolated fields of Bt cotton, especially WideStrike. Spider mites caused some yield loss, although infestations were not as severe as expected given the hot and dry conditions. An epizootic fungus that occurred during July reduced spider mite populations in many fields. Thrips populations were typical but caused relatively little damage because insecticidal seed treatments were used on almost all acres and growing conditions were generally favorable following planting. Few foliar applications for thrips control were needed. Cotton aphids were present in many fields, but few insecticide applications were made to control this pest. Beet armyworm, loopers, whiteflies, European corn borers, other insect pests and slugs were of little or no importance in 2010. For the second straight year, no boll weevils were found in Tennessee during 2010. The entire state is in a maintenance phase of eradication. No yield losses caused by boll weevils have been reported for nine consecutive years. The total average cost of insect control was estimated at $60.22 per acre. About 50% of this cost was for foliar insecticide applications. Most of the remaining costs were for *Bt* technologies, insecticide seed treatments and scouting fees.

As previously mentioned, bollworm populations were moderate, but high pressure was observed in some areas during late July and August. In a limited late season survey, we found an average of 0.48% boll damage caused by caterpillar pests in fields of Bt cotton (Bollgard II = 0.78%, WideStrike = 0.19). Unfortunately, no non-Bt fields were included in the survey during 2010. In this same survey, late-season boll injury caused by plant bugs and stink bugs averaged about 4%, considerably lower than 2009 (9.2%) but fairly typical of other years since 2003. Many insecticide and insect management trials were performed in 2010. The results of many tests and other information are available on-line at www.utcrops.com. **(Scott Stewart).**

Texas

In contrast the to 2009 crop, the 2010 Texas cotton crop was one of the best on record. Drought conditions that plagued the state in 2009 subsided and a warm wide open fall matured the crop in the northern Panhandle. Texas planted ~5.6 million acres, harvested almost 5.4 million acres, and averaged about 720 lbs-lint per acre. This resulted in about 8.1 million bales.

Insect pressure was moderate in 2010 with thrips being the most prevalent pest across the state. However, the most news worthy pest was cotton fleahopper. Cotton fleahoppers were problematic throughout much of the state with the coastal and central portion of the state reporting record outbreaks. While fields in the Rolling Plains and Southern Plains primarily required only one insecticide application for fleahopper control, fields along the Coastal Bend, Winter Garden, and Blacklands required 3-4 insecticide applications.

Cotton bollworm/tobacco budworm pressure was moderate throughout the state. By far bollworm was the most predominate species encountered. Approximately 412,000 acres were treated for bollworms. Although most insecticide applications targeting bollworms were relegated to non-Bt cotton, some Bollgard II and Widestrike acreage required treatment in the Coastal Bend and Blacklands areas. Problems with beet armyworms and fall armyworms occurred in portions of the western half of Texas, but these were relatively minor.

Statewide, almost 3.8 million acres were reported infested with aphids, and over 900,000 acres requiring treatment. Most of these acres occurred in the South Plains where 687,000 were treated for aphids.

Stink bugs were common throughout the state, with the Coastal Bend reporting the most problems. Across the state, approximately 535,000 acres were treated for stink bugs.

Over 2 million acres were infested with Lygus, but only 160,000 acres required treatment. Similarly, spider mites were extremely common in 2010 with over 1.1 million acres being infested. However, only about 124,000 acres required pesticide mediation.

Panhandle (PH). In the Panhandle region of Texas, contained about 760,000 acres of cotton in 2010. Bt cotton was more prevalent than during 2009 accounting for about 30% of the acreage.

Cool conditions slowed emergence and delayed planting for most growers until late May. Early growing conditions were wet and timely rains were experience for much of the growing season, resulting in high yields, averaging about 900 lbs per acre. The extended warm fall insured good lint quality.

Thrips continued to be the predominate pest in this region, with 95% of the acres requiring treatment. Because of the wet conditions, Temik, which usually provides 24 or more days of control, was short lived due to leaching. Thus, follow-up foliar insecticide applications were more important than in most years.

Cotton fleahoppers were common and approximately 152,000 acres of cotton was treated for this pest. Aphids were present in low numbers but did not require treatment.

Bollworms and other lepidopteran cotton pests were not a major issue, even with the large percentage of non-Bt cotton acreage. Some late populations required treatment.

South Plains (SP). South Plains Texas growers planted ~2.75 million acres of cotton in 2010; roughly 50:50 dryland: irrigated. Conditions during early to mid-May were dry and cool, and cold soil temperatures deterred much planting. Most cotton was seeded in mid-May through mid-June. Conditions were extremely wet during June and July, especially early July. Cloudy cool conditions during early July caused significant square shed across the region. The remainder of the season was fairly dry and warm through November.

The average yield across all acres was estimated at 915 lbs-lint per acre; ~3.72 million bales. Because of the warm extended fall, lint quality was good.

Early-season thrips pressure was moderate across the South Plains. Counties south of Lubbock experienced significant damage from thrips in early planted cotton. Much of the cotton north of Lubbock was planted under warm conditions and did not suffer heavy damage from thrips.

Cotton fleahoppers were abundant in the central and eastern areas of the South Plains, but a single insecticide application was all that was required for control. An estimated 412,000 acres was treated for cotton fleahopper. However, because of the extended warm fall, fleahopper damage in non-treated cotton caused little yield loss.

Aphids were abundant in the southern, central and eastern South Plains. Approximately 700,000 acres of cotton were successfully treated for aphids.

Lygus were abundant in the central, northeastern and western South Plains, and occurred earlier than normal. However, most Lygus remained relegated to weedy areas. Approximately 140,000 acres were treated for Lygus.

Stinkbugs were prevalent in light to moderate numbers throughout the South Plains. Because of the infrequency of this pest on the South Plains, insecticide applications and timings were sometimes sub-optimal. Only 137,000 acres were treated for stinkbugs.

Lepidopterous pests were problematic in non-Bt cotton in the southwestern central, western and northern portions of the South Plains. These included bollworms, fall armyworms, beet armyworms, yellowstriped armyworms and cotton square borers. Populations of bollworms and cotton square borers occurred during mid to late July in the western and southwestern counties and throughout August most other areas.

Spider mites were a problem in the Lubbock area, particularly east of Lubbock. Approximately 70,000 acres were treated for mites.

Grasshoppers were troublesome in some areas in the extreme eastern and westerns portion of the South Plains, in areas adjacent to rangeland or CRP.

Permian Basin (PB). The Permian Basin Area had an average to above average dryland cotton crop with yields from 0.5-1.5 bales per acres. Irrigated cotton yields were average to slightly below.

Rainfall was high during the spring and early summer, but terminated around July 10th causing late season stress. There was also a period of heavy fruit shed during late June & early July following very heavy rainfall, cool temperatures and cloudy weather for about 2 weeks that negatively affected irrigated cotton yields.

Most insect activity was light to moderate this year. A good many acres were treated for fleahoppers during this late June period of stress and fruit shed. Ninety-nine percent of cotton acres were planted to Bt cotton and worm activity was very light. Cotton aphids infested approximately 20% of acreage and stink bugs 10%.

No boll weevils were captured by the Boll Weevil Eradication Program. Several pink bollworms moths were captured near a couple of organic fields late season.

Trans Pecos (TP). Approximately 28,635 acres were planted in El Paso/Hudspeth Counties. Upland cotton occupied 33% of that acreage (9,526.8 acres). The rest of the crop was planted to Pima varieties. Planting dates occurred a little later than usual due to a cold and wet spring. The average planting date was around April 29. Plant stand densities ranged between 30,056 and 63,278 plants/acre. In fields planted at 40 inches between rows, the average number of plants/foot of row was 3.6 which correspond to 47,045 plants/acre. In fields planted at 38 inches between rows, the average number of plants/foot of row was 4 or equivalent to 55,024 plants/acre.

Bollworms were the key insect pest in Pima fields, but careful monitoring and timely insecticide applications reduced their damage potential. No boll weevils or pink boll worms were trapped by the Texas Boll Weevil Eradication Foundation, Inc., and consequently no acres were treated for these two pests. In regards to plant diseases, Phymatotrichopsis root rot (PRR) was the top concern. 2010 was one of the worst years for Texas cotton root rot or Phymatotrichopsis root rot (*Phymatotrichopsis omnivora*) in recent history. PRR affected not only cotton, but also alfalfa, and pecan trees in Far West Texas and southeastern New Mexico. PRR was particularly severe in cotton fields near Fort Hancock and Esperanza. Many of those fields had not been affected by PRR in the recent past. High temperatures coupled with high humidity provided the ideal conditions for PRR development. There was very low incidence of Southwestern cotton rust, but some fields had up to 10% of foliage with symptoms of this disease. Alternaria leaf spot was not an issue this season. Heavy rains and strong winds, in mid September, resulted in fields with strung out cotton. Overall, the 2010 field season should be considered above average in regards to both yield and fiber quality in El Paso and Hudspeth Counties.

Rolling Plains (RP). Planting conditions started out well with good subsoil moisture and slightly below average temperatures. Planting in mid-May went well with some dry conditions near the soil surface but all fields came to a good stand. Temperatures remained below average in May and June and moisture was below average. Dry conditions in June led to a rainy spell in early July that ranged from 4 to 7 inches across the area. Conditions then deteriorated to hot and dry. The San Angelo area set a record with 29 days above 100 degrees F. Ultimately, dryland yields varied from 200 to 600 lbs of lint per acre and irrigated yields averaged 1200 lbs lint per acre. The area produced a slightly above average crop.

Insect populations continue to be low for the region and growers had limited inputs for pest management for the crop. Thrips and cotton fleahoppers were the primary insect pests. Producers are investing in seed treatments to protect their investment of the transgenic crops and thus very little foliar treatments for thrips were required. Cotton fleahoppers hit historical highs in the area and some irrigated fields received two applications. Cotton aphids were a problem on 25% of the acreage and fields were treated once. Spider mite populations never fully developed and only a few fields in the area were treated. Bollworm and fall armyworm populations were present but not in damaging levels due to dry conditions.

Blacklands (BL). Approximately 40 percent of the cotton in Ellis and Navarro Counties was planted during mid-April. Heavy rainfall delayed planting of the remaining 60 percent of the crop until early to mid-May, 2010. An estimated 98 percent of the crop was planted to Round Flex Bollgard II or Wide Strike varieties. Generally, soil moisture was adequate through June. As usual, the months of July and August were quite dry with near average temperatures in the mid to upper 90s.

Much of the crop (92%) was planted to seed treated with Cruiser, Gaucho Grande, Avicta, Orthene or a double rate of Orthene to control early season thrips and aphids. The seed treatments provided good control of these early season insect pests. Most of the cotton acreage was treated with 1 foliar insecticide; Bidrin, dimethoate or Orthene.

Cotton fleahopper numbers were heavy and relentless throughout the first 3 to 4 weeks of squaring. An estimated 65 percent of fields required up to 3 to 4 insecticide applications to bring fleahoppers numbers down below an economic threshold of 15 percent. Of the remaining cotton acreage, 18 percent was treated 2 times, 12 percent treated once and 5 percent being not treated. Insecticides applied were; Bidrin, dimethoate, Orthene, Centric, Leverage or Endigo.

Bollworm/tobacco budworm numbers were light. Only a hand full (5) of non-Bt fields were treated with a synthetic pyrethroid insecticide. Generally, moderate beneficial insect activity aided in control of worms.

Approximately 45 percent of the cotton acreage was treated with 1 insecticide application to control stink bug spp. Insecticides were; Bidrin, Leverage, Endigo or Karate.

Measurable rainfall during the last few days of August and early September greatly enhanced the production and yield of late May planted cotton. Yields ranged from 425 to 680 lbs./A. for April cotton and 650 to 1,107 lbs./acre for May cotton. Overall, it was an outstanding cotton season with above average yields and near record prices/lb. of lint cotton.

Winter Garden (WG). Growers planted 35,000 acres of cotton in the Winter Garden area of Texas in 2010, 100% of which received insecticidal seed treatments. All of the cotton planted was Bt cotton with 88% planted to Bollgard II and 12% to Widestrike. Growers planted 98% of their cotton in an optimum window for planting; those acres that were planted late were mostly due to growers following vegetable crops. The Winter Garden went into the season with excellent soil moisture that came in late 2009 and in January 2010, but with no subsequent rain until July.

Since there was no rain to delay planting, everything went smoothly during planting and growers finished planting in a very timely manner, once they began. Soils were cooler than usual, so growers, for the most part, did not rush planting but waited for warmer soil temperatures. Thus, most of the cotton crop came up quickly and got off to a really good start. Most of the cotton in the Winter Garden is irrigated, with probably fewer than 1,000 acres of dryland cotton planted in 2010. The rains that came in July were almost perfect so very little fruit was shed. Some dryland cotton yielded as well as some of the irrigated cotton.

Because of excellent growing conditions, thrips problems were virtually non-existent and there was no cotton treated for thrips. During the early-season, less than 5% of the cotton was treated for spider mites. By season's end, about 75% of the Winter Garden cotton was treated for spider mites and about 5% received two treatments for mites.

Fleahoppers were the heaviest anyone could remember and 100% of the cotton received two applications of insecticides to control them. About 50% of the acreage was treated for aphids, much of which was flared by ULV-malathion treatments applied for boll weevil eradication. Approximately 30% of the acreage was treated for whiteflies whose populations exploded late in the season and also which were primarily induced by applications for boll weevil eradication. Whitefly populations in 2010 were among the three heaviest ever.

Bollworm populations in cotton were at the lowest levels that anyone could recall and no cotton was treated for bollworms. There were more stink bugs than in past years and we hope this is not a trend in the Winter Garden that has been seen throughout the Cotton Belt.

In terms of boll weevil eradication efforts, the Winter Garden made excellent progress for the second year in a row with approximately a 92% reduction in trapped weevils in 2010 (90% reduction in 2009). We attribute the continued reduction to several factors, one of which is the continued aggressive trapping undertaken by the Texas Boll Weevil Eradication Foundation, wherein the previous year's (2009) cotton fields were trapped in 2010 regardless of the cropping status of those fields in 2010. Additionally, credit is given to the wet weather through the fall and winter which either caused cotton seed to germinate or rot in the soil. Those seeds that germinated were killed by the unusually cold weather the Winter Garden experienced in December and January. Finally, further attribution is given to temperatures in the low-to mid-teens which killed all of the volunteer cotton in the Winter Garden that had become a problem during the previous years in which we did not have killing freezes.

Overall, it was a very good year for cotton in the Winter Garden with moderate insect pressure. Cotton yields reflected the low insect pressure and excellent growing conditions, with lint yields averaging 1,500 lbs for the Winter Garden.

Coastal Bend (CB). Adequate soil moisture was available for establishing stands and for early plant growth. Insects of concern in the early growth stages included thrips generally at lower levels than in past years with their numbers increasing as plants put on more leaves or at about the 5-leaf stage. Even though it had been cool early, the late increase in thrips had little effect on cotton growth except near grown-up pastures where they entered cotton earlier in high numbers. There was also early evidence of aphids and spider mites, but this concern did not last long as their populations declined.

As cotton began to produce squares the cotton fleahopper attained treatment threshold (15/100 plants) in nearly all fields. Fleahoppers continued to increase with subsequent migration into cotton from weed hosts. Insecticide treatment reduced fleahopper numbers well below the economic injury level, but within a week in many areas their number again exceeded damaging numbers. It took about 3 insecticide treatments to adequately protect the crop although some growers applied more treatments than necessary. Fruit loss where some insecticide protection was provided was compensated for by the cotton plant. During the squaring period spider mite numbers increased to alarming numbers and so did aphids; a few fields were treated for aphids. Bollworm damage was evident in conventional cotton, and larvae could also be found in Bt cotton. The damage level in Bt cotton was much less than that observed in non-Bt cotton. The plant bug Creontiades and stink bugs presented some problems but were generally lower in number than in the past few seasons.

The boll weevil is still present in low numbers in the western growing regions of the Coastal Bend and continues to be of concern as far as complete eradication. It appears that these low numbers were reduced by 90% in 2010

Lower Rio Grande Valley (LR). Early season thrips and aphid numbers in the Lower Rio Grande Valley were very light with only a few fields requiring treatment. Later fleahopper numbers increased but it occurred after cotton had generally developed beyond the susceptible stage. On average one treatment was applied for the fleahopper. Heavier damage was caused the Creontiades plant bug especially near the Gulf of Mexico which required one treatment in these specific fields. Spider mites reached fairly high levels with some fields treated two times and other fields developed enough aphids to require treatment. These problems may have developed due to extensive fields being treated by the Texas Boll Weevil Eradication Foundation. In late season whitefly infestations were observed, but they never developed into devastating numbers. Excessive rainfall from a hurricane and tropical storm cause delays in the boll weevil program and loss of cotton due to flooding. **(Submitted by David Kerns and Colleagues).**

<u>Virginia</u>

An estimated 83,000 acres of cotton were planted in Virginia, up from 65,000 in 2009. Cotton planting was generally timely across the state but soils were very dry which resulted in uneven stands both in research trials and throughout many commercial fields. Dry conditions prevailed throughout much of the season with rains occurring too late to improve crop potential. Temperatures were hot for Virginia, exceeding 100°F for 10 consecutive days and reaching a high of 108°F. The combination of dry, hot weather caused early cutout in many fields when plants were short and boll load was minimal. The average yield is estimated at 650-700 lb lint/acre which is well below normal for Virginia, with losses due mainly to drought and early cutout. These weather conditions did have a positive side in that stink bug populations were very low and early maturity made plants less attractive to bollworms (discussed below).

An estimated 2% of the acreage was planted to RR or RF varieties. Sixty percent of the remaining acreage was to BG2/RF varieties and 40% to WS Phytogen varieties. Forty percent of the acreage was treated with an insecticide seed treatment, and 60% with an in-furrow applied insecticide (aldicarb).

Thrips— Thrips pressure was extreme and feeding damage was exacerbated by slow seedling growth due to dry soils. One-hundred percent of the growers used either insecticide seed or in-furrow treatments, and a small percent used both. All growers made at least one foliar insecticide application for thrips control, and a small percent made two. The timing of foliar applications was difficult due to uneven seedling emergence and the different sizes and stages of maturity of plants in the same field. Tobacco thrips was the primary species and western flower thrips numbers in research trials and growers' fields were lower than in 2009 (perhaps also influenced by the dry weather?).

Plant bug/Stink bug— Populations were very low. We reckoned this to also be a result of the dry, hot conditions and the impact on early season alternate weed hosts. To our knowledge, no fields reached threshold for either pest, although some fields were treated pre-bloom with neonicotinoid insecticides, but not based on random field sampling of damaged bolls and justified need.

Bollworm— Based on the July field corn survey (see more details below) corn earworm levels were high in field corn (avg. 54% infested in the cotton counties compared with 45% in 2009). Moth flights began earlier than normal and lasted longer than normal with at least two rather distinct peaks (based on moth capture with a series of black light traps operated throughout eastern Virginia). Because of the rapid maturity and early cutout of many fields, cotton was not attractive to bollworm and damage was less severe than in 2009, with only 10% boll damage vs. 30% in 2009, in unprotected cotton (no BG/BG2/WS, and no bollworm insecticide).

Other mid- to late-season insect/mite pests— No economic infestations of other pest species occurred and there were no reported acres treated for aphids, spider mites, or other species.
(Ames Herbert).

Research Progress and Accomplishments:

California

Data analysis for landscape monitoring studies for Lygus continued as part of the USDA-CREES-RAMP grant to examine sampling, natural enemy community, and inter-field movement as a function of host-plant. Microcosm field studies of Pima cotton, alfalfa forage, safflower and black-eye pea were conducted for a second year at Kearney Research and Extension Center to understand local movement and impact on fruit set in Pima cotton.

Efficacy studies were conducted against western flower thrips, spider mites, Lygus bugs, cotton aphids and whiteflies; studies were done in Pima and Acala cotton for thrips, aphids, and whiteflies. Above threshold pest pressure was encountered in all studies and that allowed excellent evaluation of treatment effects and significant yield responses in the Lygus studies. Lygus bug insecticide susceptibility, against active ingredients from four classes of chemistry, was monitored during June and July at three SJV locations. Studies were conducted to optimize the contact activity Lygus bioassay to develop a method that might be applicable to newer insecticides with alternative modes of action. Results look promising for flonicamid. Studies are ongoing designed to examine cotton aphid overwintering in the San Joaquin Valley.

Lygus sampling efficacy, damage and developmental studies continue at the USDA ARS- Shafter Cotton Research Station. Results suggest that young female adult Lygus are captured less effectively by the sweep net than are males or older females. Concurrent greenhouse studies indicated that young adult Lygus produce more damage to squaring cotton than do older adults, regardless of gender. Laboratory feeding assays comparing third- and fifth-instars to young adults indicated differences in feeding behaviors among the groups of insects, but total feeding time for each group was similar. Continuing laboratory studies provided little evidence that the diapause response of Lygus reared in the laboratory for up to four generations is different from the response of field-collected bugs. Studies of egg and nymphal temperature-dependent development rates suggest a need to reexamine the upper and lower temperature thresholds. **(Peter Goodell)**.

Louisiana

In 2010, pheromone-baited wire cone traps and the adult vial test (AVT) were used to survey pyrethroid susceptibility in bollworm, *Helicoverpa zea* (Boddie). Susceptibility levels of >2,200 bollworm moths to a pyrethroid, cypermethrin, were determined using the adult vial test (AVT) from May to Sep in Louisiana. Adult survival at a discriminating dose of 5 µg/vial during May, Jun, Jul, Aug, and Sep was 30%, 30%, 51%, 40%, and 28%, respectively, with a mean annual survival of 39%. Adult survival at a discriminating dose of 10 µg/vial during Jun, Jul, Aug, and Sep was 16%, 31%, 21%, and 16%, respectively, with a mean annual survival of 23%. These survival levels were similar compared to survival levels recorded during 2009. These results continue to show that bollworm populations are becoming less susceptible to pyrethroids in adult vial tests. Bollworm tolerance to pyrethroids and high pressure within fields could lead to some control problems in fields treated with only a pyrethroid. When bollworms are the target pest, pyrethroids should be co-applied with acephate or other OP's to provide an additional mode of action and reduce the probability of field control failures.

During 2010, reports of unsatisfactory insecticide acephate performance against tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois), were lower than in 2008 -09. Acephate and thiamethoxam susceptibility was evaluated in Louisiana populations of TPB using laboratory bioassays. For both insecticides, some of the populations exhibited LC_{50} values that were significantly higher than that for a susceptible standard population. Several field trials evaluated dose-responses of these insecticides against native infestations of TPB. Selected rates and a non-treated control for each insecticide were placed in trials on LSU AgCenter Research Stations. Treatment efficacy was collected four to seven days after treatment using a one meter black shake sheet. Although the lowest rates included in each trial significantly reduced tarnished plant bugs compared to that in the non-treated plots, those rates did not reduce numbers below the action threshold. The highest labeled rates of acephate and thiamethoxam were required to consistently control infestations. The 2010 results suggest that thiamethoxam susceptibility in Louisiana populations of tarnished plant bug is shifting in a manner previously observed for acephate. This change was associated with a decrease in field performance, especially with the lower use rates of thiamethoxam.

The second year of a study designed to determine if a single insecticide could be relied on for full season control of tarnished plant bug was completed in Louisiana. Eleven insecticides (three total applications) including Acephate 90S (0.75 lb form./acre), Bidrin 8EC (6 oz form./acre), Vydate 3.77L (12 oz form/acre), Centric 40WG (2 oz form./acre), Trimax Pro 4.44SC (1.5 oz/acre), Carbine 50WG (2.5 oz form./acre), Leverage 2.7SE (4.5 oz form./acre), Intruder 70WSP (1.1 oz form./acre), Endigo 2.06SC (5.0 oz form./acre), Diamond 0.83EC (9 oz form./acre), Brigade 2EC (5.12 oz form./acre) and a non-treated control were evaluated for efficacy. Pre-treatment numbers of TPB across the test area were above the Louisiana Cooperative Extension Service recommended action threshold (AT, 6 insects/10 row ft) to initiate insecticide sprays for all application dates. Significant treatment effects in post-treatment samples were detected in one or more treatments after each of the three applications. Selected insecticides reduced TPB numbers below the AT in all samples. The seasonal mean results showed all treatments significantly reducing nymphs below that in the non-treated control and below the AT. Three applications of acephate and Centric exceeded the total allowable AI/acre/year on their respective labels. Insecticide costs for the three applications ranged from $16 to $37/acre. All plots, except those treated with Brigade and Intruder, significantly out-yielded the non-treated control. No phytotoxicity was observed with any insecticide treatment in this test.

Considerable interest in ultra low volume (ULV) applications (0.25 GPA) for managing cotton insect pests has prompted a study of droplet patterns and insecticide efficacy. The objective of this study was to examine an alternative spraying system that could provide a range of applications volumes with an initial starting point of ultra low volume (ULV) GPA. The plane was equipped with Davidon rotary nozzles capable of delivering <1.0 GPA of total spray, an AG-NAV 3 computer system, Trimble GPS, Auto-Cal II liquid flow controller, and variable speed electric fan pump. The first trial demonstrated a consistent droplet pattern in an acceptable range at 0.25 GPA (ULV) with rotary nozzles compared to that for a conventional (3.0 GPA standard) water application system and a standard fixed ULV system at 0.25 GPA. A field test evaluated the rotary nozzles effect on insecticide efficacy using a ULV of 0.25 GPA to support the results of the previous droplet deposition research. A pyrethroid (gamma-cyhalothrin) and Malathion tank mix applied in this application system significantly reduced tarnished plant bug nymphs compared to that in a non-treated control. Treatment efficacy was sufficient to reduce numbers below the prescribed action threshold that would initiate additional sprays. These results are limited in scope, but suggest additional testing is necessary to validate the performance of the system at other application volumes.

The impact of spider mite infestations on cotton yields was determined by infesting plants during discrete periods of development. Plants were infested at several growth stages ranging from the 3-leaf stage to 1000 heat units after flowering. The most severe injury appeared to occur during the infestation applied to vegetative stage cotton plants. Seedcotton yields were significantly affected by spider mites and were most yield-limiting in those plots infested pre-flowering and infested during the week of flowering. The latter infestations (flowering + ≥200 heat units) did not impact yields in this test.

An acaricide screening trial evaluated the efficacies of eight miticides (Brigade 2EC, Dicofol 4EC, Portal 5EC, Zeal 72%WG, Zephyr 0.15EC, Zephyr 0.15EC, Oberon 4F) at recommended rates against a mixed population. Twospotted spider mites accounted for approximately 90% of the total spider mite population across the test area prior to treatment. At 3 days after treatment (DAT), all insecticides except Brigade and Zephyr (0.0047 lb AI/acre) significantly reduced spider mites from that in the non-treated plots. Populations in all plots were considerably lower at 7 DAT, but all insecticide-treated plots except for those treated with Brigade and Zephyr (0.0047 lb AI/acre) had significantly fewer spider mites than that in the non-treated plots. No significant treatment effects were detected at 10 DAT. No phytotoxicity was observed with any treatment during this test.

Several insecticide screening trials were conducted against cotton aphid in 2010. The efficacies of selected insecticides ranged from 55% to >90% at two to seven DAT. Several products provided acceptable levels of control (>75%) of cotton aphids, including Carbine (0.088 AI/A), GF-2372 (0.022 AI/A), and Intruder (0.044 AI/A). Products that provided <75% control of cotton aphids in these trials included Belay (0.067 AI/A), Centric (0.05 AI/A), and Trimax Pro (0.063 AI/A). The highest labeled rate of Intruder was the only neonicotinoid insecticide that provided adequate control of cotton aphid in these trials. In the early 2000's, excellent control (85-100%) of cotton aphids was routinely achieved with the neonicotinoid insecticides Intruder, Centric, and Trimax in Louisiana. Field control issues in the Mid-South suggest that cotton aphid susceptibility to neonicotinoid insecticides is declining, but there is considerable variability in susceptibility both within a population and across populations. Sulfoxaflor (GF-2372), an experimental compound from Dow AgroSciences, demonstrated excellent control of cotton aphids in Louisiana in limited small-plot trials.

Susceptibility of fall armyworm, *Spodoptera frugiperda* (J.E. Smith), larvae to *Bacillus thuringiensis* (Bt) crystal (Cry) proteins expressed in cotton fruiting forms was evaluated in field caging studies in Louisiana in 2009-2010. All tests were performed on larvae (L3 stage; 30-45 mg) of a laboratory colony originating from collections originating in cotton and corn. The colony was validated as the corn strain of fall armyworm using mitochondrial markers. Cotton lines expressing Cry1Ac (Bollgard), Cry1Ac + Cry2Ab (Bollgard II), and Cry1Ac + Cry1F (WideStrike) were evaluated against this colony. A conventional non-Bt expressing no Cry proteins was also tested as a negative control. A single larva was placed on an individual fruiting form (square, white flower, or boll) and enclosed with a nylon mesh exclusion cage. Larvae and fruiting forms were evaluated at 2-3 DAI (squares) and 5-6 DAI (white flowers, bolls) for larval survivorship and penetration of the fruiting form. Differences were observed between cotton lines for larval mortality and damaged fruiting forms. Cotton lines expressing Cry1Ac + Cry1F consistently resulted in decreased larval survivorship and fruiting form penetration regardless of structure (square, white flower, boll) evaluated. **(Louisiana State University Agricultural Center's Northeast Region, St. Joseph and Winnsboro, LA; Louisiana Cooperative Extension Service, Winnsboro, LA; and Department of Entomology, Baton Rouge, LA).**

Table 1. Promising pesticides and transgenic technologies screened in Louisiana during 2010 for control of cotton arthropod pests.

Pesticide (formulation)	Target Pest (s)
VipCot (transgenic)	Bollworm, Tobacco budworm, Fall armyworm
Bollgard 3 (transgenic)	Bollworm, Tobacco budworm, Fall armyworm,
TwinLink (transgenic)	Bollworm, Tobacco budworm
Coragen	Bollworm, Soybean looper
Cyazypyr	Fall armyworm, Tarnished plant bug, cotton aphid
Belt	Fall armyworm, Soybean looper
Radiant	Thrips, Cotton aphid, Fall armyworm
Brigadier	Tarnished plant bug, Southern green stink bug, Bollworm
Athena	Two-spotted spider mite, Tarnished plant bug
Tolfenpyrad (NAI-2302)	Cotton aphid, Tarnished plant bug
Transform (Sulfoxaflor)	Cotton aphid, Tarnished plant bug
NNI-0101	Thrips, Cotton aphid
Malathion + ULV	Tarnished plant bug, Southern green stink bug, Brown stink bug

New Mexico

Research on the taxonomy and ecology of Heteroptera continues with an emphasis on Pentatomoidea and Reduviidae. Evaluations of Lygus injury and compensation are ongoing.

The impact of hay on predation in cotton was examined for a third year. Predation rates were consistently lower in cotton compared to adjacent alfalfa. Spiders and nabids were more prevalent in hay than cotton but ladybugs and green lacewings were at similar levels in both crops. Surprisingly, cutting alfalfa did not increase predation rates in cotton, but typically decreased predation in cotton.

Pink bollworm traps were placed late season in 21 fields and in a trapline from the New Mexico Pecos valley to just beyond the Texas border in cooperation with Texas A & M University and the USDA/Aphis Methods Development Lab in Phoenix. No pink bollworms were collected in any of the traps placed in New Mexico.

Dr Ellington's lab has continued a collaborative project with USDA/APHIS to develop image recognition software to identify insects. The system currently has a 96% level of accuracy. Use of precision agriculture to control insects pests of cotton is also an area of ongoing research.

A number of first year field trials were conducted to evaluate glandless cotton in New Mexico. Damage from insects was less than expected despite relatively high insect pressure. **(Jane Pierce).**

North Carolina

Much of our project's applied research effort was directed toward thrips and stink bug management and in efficacy evaluations of new *Bt* cottons in 2010. Most of our two projects' 2010 applied cotton research results may be found at:

http://ipm.ncsu.edu/cotton/insectcorner/Research/2010/index.html

Six at-planting insecticide tests evaluated the impact of granular insecticides, seed treatments, foliar applications, and combinations on plant development, maturity, and yield. Two of these tests were in cooperation a Ph.D. student in Crop Science; these tests primarily focused on the feasibility of inter-planting cotton into wheat with specialized planting and harvesting equipment, and the implications of this approach on thrips management. Two other at-planting tests included at-planting granular insecticides, seed treatments, and granular and foliar insecticides, with early and late planting dates. Two final tests, one planted in the Coastal Plain and one planted in the Tidewater area, were part of the Beltwide national protocol effort (from TX to VA), evaluating the relationship between the timing of foliar sprays and various cotton plant parameters following the use of Temik, Aeris seed treatment and unprotected seed.

Three stink bug threshold tests were conducted as part a follow-up to a southeast regional Cotton Incorporated State Support grant "Identifying Practical Knowledge and Solutions for Managing the Sucking-Bug Complex in Cotton: Research in the Southeast Region" in cooperation with Jeremy Greene of Clemson and Phillip Roberts of UGA.

A pocket-sized scouting device was developed in 2010 for use in the Southeast to encourage 1) a higher adoption of stink bug scouting in cotton, 2) better field identification of boll damage symptoms, and 3) that proper scouting protocols are followed, The template was based on a new dynamic threshold and is designed to be an essentially "self-contained" scouting guide. This plastic scouting tool provides a "dynamic threshold by week of bloom" table, lists scouting procedures, provides measuring holes to help select the correct boll size range for damage assessments, and contains images of internal and external boll damage. The device should improve stink bug management based on the stages of maximum crop susceptibility through lower thresholds during weeks 3 through 5 of the bloom period and utilizing higher thresholds during cotton stages of lower vulnerability to stink bug damage (weeks 1 to 2 and weeks 6 to 9 of the bloom period). This device was distributed, along with a companion publication < http://ipm.ncsu.edu/cotton/insectcorner/PDF/AG_730_WPrint-NC.pdf>, to county agents, consultants and summer scouts. Additional funding is presently being sought for an additional printing of the field cards.

A series of additional tests was carried out to evaluate 1) the efficacy of new and traditional insecticides on conventional cotton in the Coastal Plain and 2) the impact of selected new and conventional insecticides on plant bugs in the Tidewater area.

Our project's annual damaged boll survey, http://ipm.ncsu.edu/cotton/insectcorner/Research/2010/index.html (item 13) continued in 2010 and included 122 total conventional, Bollgard II, and WideStrike producer-managed cotton fields. Stink bug damage to bolls was 1.6, 3.3, and 3.8% for the above technologies, respectively. Bollworm damage to bolls was 3.0, 0.37, and 0.73%, respectively, for these technologies. European corn borer and fall armyworm damage to bolls was virtually nonexistent in 2010.

An annual survey of North Carolina's licensed independent crop consultants working on cotton was continued in 2010:
http://ipm.ncsu.edu/cotton/insectcorner/Research/2010/2010.Crop.Consultants.Insect.Survey.pdf
to gather data on how thrips, cotton aphids, and plant bugs, bollworms and stink bugs were managed by these individuals in conventional and in *Bt* cotton lines. Additional growers and selected county agents were contacted to make the survey more representative of North Carolina's producer population. Most of the results from this survey are provided in the North Carolina Cotton Insect section above. Of interest in 2010 was that BGII and WideStrike cotton suffered more bollworm damage than in the past, though boll damage averaged over the surveyed fields was less than 1%. **(Jack Bacheler and Dominic Reisig).**

Texas

Bollworm pyrethroid resistance monitoring. The Texas statewide monitoring program that evaluated pyrethroid resistance in male bollworm (*Helicoverpa zea* (Boddie)) was conducted from April to October, 2010. The survey included Parmer, Swisher, Gaines, Hockley, Burleson, Nueces and Uvalde counties. Moths were trapped near cotton fields using pheromone, Hercon Luretape® with Zealure. Cypermethrin coated vials were prepared in the Toxicology Laboratory, Department of Entomology at Texas A&M University, College Station, Texas, and shipped as needed to Texas AgriLife Extension Service personnel. Data from all areas in Texas were sent to the Toxicology Laboratory for analysis, including estimation of lethal concentration of cypermethrin that kills 50% of the population (LC_{50}), 90% of the population (LC_{90}), LC_{50} and LC_{90} resistance ratios (these indicate how many times more insecticide is required to kill either 50% or 90% of insects from the field population than those of a susceptible population, respectively), and the statistical significance test for these resistance ratios. Results: most cotton areas surveyed had lower resistance ratios than in previous seasons (except for Parmer County), and lower bollworm densities in cotton than in previous years. It appears that areawide suppression of *H. zea* as bollworm is resulting from the increased surface area dedicated to *Bt* cotton and corn. Populations exhibiting the highest LC_{50} cypermethrin resistance ratios were from Nueces and Burleson Counties, with resistance ratios of 3.95 and 3.42, respectively. All the counties had LC_{50} resistance ratios of less than 5 and all of these values are lower than those observed in previous seasons, except for Parmer Co. that had a resistance ratio of 3 in July. A few moths from each county in Burleson, Uvalde, Gaines and Nueces survived 5µg/vial. Overall, populations in Hockley, Gaines, Swisher and Uvalde counties were susceptible while those in Nueces, Parmer and Burleson counties were moderately resistant to cypermethrin. **(Pietrantonio, TAMU/Texas AgriLife Research, College Station and Texas AgriLife Extension Service collaborators, M. Cattaneo, R. Parker, K. Siders, N. Troxclair, M. Vandiver). Funded by TSSC, Cotton Inc.**

Bollworm mechanism of resistance to pyrethroids. The target of pyrethroid insecticides, the voltage-gated sodium channel was cloned from *Helicoverpa zea*. Mutations associated with pyrethroid resistance were identified such as *kdr* (knock down resistance) and other mutations previously reported from pyrethroid resistant budworm (*Heliothis virescens)* sodium channel. In addition novel mutations were also identified in cypermethrin resistant field-collected insects from Texas. **[Hopkins, B.W. and P.V. Pietrantonio TAMU/Texas AgriLife Research, College Station; *Insect Biochem. Mol. Bio.* 40: 385-393 (2010)]. Funded partially by IRAC and Cotton Inc.**

Overexpression of cytochrome P450 as a mechanism of resistance in bollworms to cypermethrin. Overexpression of cytochrome P450 enzymes is a common mechanism of insecticide resistance. We have determined that transcriptional overexpression of the cytochrome P450 enzymes *CYP6B8/CYP6B28* and *CYP6B9* is present in field-collected male bollworms that survive high dosages of cypermethrin, indicating that in addition of mutations previously found in the sodium channel (the pyrethroid target site), oxidative metabolism may be responsible for survival to cypermethrin in bollworm field populations. **(Hopkins, B.W. and P.V. Pietrantonio, TAMU/Texas AgriLife Research, College Station; *Pest Management Sci.* (2010) (wileyonlinelibrary.com) published online ahead of print; DOI 10.1002/ps.2034)**. **Funded partially by IRAC and Cotton Inc.**

Establishment of spider mites in a semi arid environment. Spider mites are commonly reported pests on cotton in China; Arkansas; or Australia, and they are known to infest all development stages of the plant. However in the Southern High Plains (SHP) of Texas, spider mites are only considered occasional pests associated with drought stress, and they have only been reported as pests on late season cotton. However, under greenhouse conditions in the SHP, spider mites frequently attack cotton in cotyledon stage. In the SHP, wheat is harvested around May, which is when cotton is in the cotyledon stage, and wheat can host considerable spider mite populations, so theoretically spider mites could disperse from maturing wheat into developing cotton. However, this does not seem to occur, and our overall goal with this study is to explain why. Here, we report spider mite establishment in three environments: 1) field plots 2) greenhouse and 3) rain shelter. In each environment, plastic bottles were placed around cotton plants in cotyledon stage, while other plants were uncovered, and all cotton plants were infested with spider mites. The results showed that spider mites are favored by high temperature and low relative humidity, but the spider mite development was highest on a drought susceptible compared to a drought tolerant genotype. Moreover higher infestation rate in rain shelter and greenhouse suggests that factors such as wind and/or presence of thrips contribute to regulate spider mites population under field conditions. **(Kincy N., Texas Tech University Lubbock; Martini X., Dever J., Nansen C., Texas AgriLife Research, Lubbock.)**

Plant drought stress and genotype interact to influence oviposition of spider mite. It is known that spider mites invasions are favored by hot and dry conditions. High temperatures reduce development time and increase egg laying rate. However, direct influence of plant drought stress on spider mites is not well understood. We present results from a series of experiments that examine the influence of cotton genotype in cotyledon stage and water level on oviposition and female behavior at a constant temperature. Based on experimental infestation of individual cotyledon plants (no-choice) from five genotypes and subsequent counting of spider mite oviposition during 48 hours, we observed that spider mite oviposition on a thrips resistant genotype was low (i.e., reduced oviposition) but only when well watered. Conversely, spider mites oviposition on a drought resistant genotype was lowest when plants were growing under drought stress. Based on choice tests, results from no-choice tests were corroborated as we showed clear correlation between changes in drought stress with changes in the oviposition preference by spider mite females. In another study, we monitored spider mite population development and leaf temperatures during 10 days on the five genotypes and showed that the drought resistant line was the only genotype to not show an increase of oviposition and leaf temperature under drought stress. Finally, we found no significant difference in the hatching rate of the eggs on different genotypes or under different drought-regimes. The results from this study will be used to discuss varietal drought resistance and its association with pest susceptibility. **(Martini X., Texas AgriLife Research, Lubbock; Kincy N., Texas Tech University Lubbock; Nansen C., Texas AgriLife Research, Lubbock.)**

Western Flower Thrips in Cotton: Pest or beneficial natural enemy? Omnivory by Western Flower Thrips involves consumption of various types of plant material in addition to eggs of spider mites (*Tetranychus urticae*). Thus, depending on the amount of plant vs. prey material consumed, WFT could be considered a pest or a beneficial natural enemy. A laboratory project was initiated and our goals were three fold: 1) to assess the relative amount of plant and mite-egg consumption by adult female (AF) and immature (IM) Western Flower Thrips, 2) to investigate host-plant resistance (HPR) on each of six varieties of cotton, (*Gossypium hirsutum* and *G. barbadense*) to AF and IM, and 3) to determine if the relationship between plant and mite-egg consumption is compensatory for AF and IM. Plant consumption by adult female thrips was nearly twice that of immatures whereas the consumption of mite-eggs was similar between life-history stages. This indicates both life-history stages are equally beneficial, but adult female thrips cause a greater risk to cotton growers than immatures. Since Temik (a preventative, systemic insecticide) will be phased out by 2018 and seed-treated insecticides do not provide as long lasting protections as Temik, use of foliar pesticides are expected to increase. Our results differentiating the impact of thrips life-history stages can be used to create more targeted and timely action thresholds for follow-up foliar pesticide applications. Variation in HPR among varieties was significant and similarly expressed on both life-history stages. These results support the potential for plant breeding programs to introgress thrips-resistance into elite cultivars as resistant traits do not appear to be specific to each life-history stage. Finally, we found no evidence for omnivory to be compensatory which means that as a cultivar becomes more resistant to thrips (via HPR breeding) this is not expected to drive thrips to feed on larger amounts of mite eggs. **(Justin Fiene, Department of Entomology, Texas A&M University, College Station; Christian Nansen, Xavier Martini, Texas AgriLife Research, Lubbock; Lauren Kalns, Pete Krauter, Julio Bernal, and Marvin Harris, Department of Entomology, Texas A&M University, College Station)**

New methods for rearing and study different life stages of spider mites. A new methodology for small-scale studies on Two-spotted spider mites, *Tetranychus urticae* Koch: Rearing, sorting life-history stages, and quantifying. The two-spotted spider mite, *Tetranychus urticae* Koch, is an important agricultural pest causing economic damage to cultivated plants in greenhouse and field conditions throughout the world. Research efforts into pest management of spider mites would benefit from methodologies that rear, sort, and quantify mites with minimal effort and high efficiency. In this study, we provide a new methodology for small-scale research on spider mites. Mites were reared on excised bean leaves that had rooted in a cotton-substrate which were kept in small plastic containers. Overall, the rearing method is cheap, composed of readily available basic supplies, requires minimal space and time to maintain, and can be used for experimental housing units. To assess population parameters of spider-mites, we developed a small-scale method that strains mites from water suspension and sorts them according to life-history stage (eggs, larvae and adult males, and adult females, respectively). We plan to use these techniques in combination to investigate the efficacy of miticides and the evolution of resistance. **(Kalns, Fiene, Bernal, Krauter, TAMU, College Station; Nansen, Texas Tech/ Texas AgriLife Research, Lubbock)**

Impact of boll weevil sprays on predators and key insect pests. This study evaluated the impact of the area-wide boll weevil eradication on abundance of predatory arthropods and key pests of cotton during four years in central Texas.

Multiple applications of malathion ULV significantly reduced seasonal mean densities of spiders, predatory bugs (*Orius* spp. *Pseudatomoscelis seriatus, Nabis* spp*, Geocoris* spp.), Chrysopidae larvae and red-imported fire ant, *Solenopsis invicta*, collected from the cotton canopy. In contrast, densities of beet armyworm, *Spodoptera exigua*, heliothine and other lepidopteron larvae, cotton aphid, *Aphis gossypii,* and adult and larval convergent lady beetle, *Hippodamia convergens*, often increased in cotton fields under boll weevil eradication. The density of total predators measured during the mid-season (period of blooming and early boll development) was significantly and negatively correlated with density of beet armyworm larvae during the late season (boll maturation period). Results suggest that the community of predatory arthropods in the cotton canopy, rather than one or several key predators, is important in suppressing outbreaks of *S. exigua* and other lepidopteran pests in cotton. Furthermore, the potential to use densities of generalist predators in mid-season to anticipate late-season outbreaks of beet armyworm during boll weevil eradication is discussed. Results were published as: "Impact of area-wide malathion on predatory arthropods and secondary pests in cotton during boll weevil eradication in Texas" and authored by **A. E. Knutson, J. Butler, J. Bernal, C. Bográn and M. Campos**, in the Journal of Crop Protection. 2011.

COTMAN monitoring of agronomic and entomological parameters in evaluating nitrogen fertility rate in drip irrigated cotton. An experiment (third year of a multi-year field study) was conducted to quantify the effect of nitrogen fertilizer on cotton aphid population dynamics under a drip irrigation system. Five nitrogen levels (0, 50, 100, 150, and 200 lbs per acre) were evaluated in a randomized block design with 4 replications at the Helms Farm near Halfway, TX. Soil residual nitrogen was determined for each treatment plot before treatment application and leaf nitrogen was monitored for 10 weeks during July-October. In all years, zero and 50 lbs/acre N treatments showed lower fruit production, but in 2010, zero-N exhibited consistently lower fruit production than in other plots past peak squaring. Average aphid abundance was significantly lower in zero-N than in other treatments in all years. In 2010, aphid populations surpassed the economic threshold of 50/leaf for 2 weeks in all N-augmented plots, whereas aphids remained below 50/per leaf, except for 1 week, in zero-N plots. Higher rates of applied N (>100 lbs/acre) resulted in significantly higher leaf chlorophyll content than in lower or zero-N treatments. All N-augmented treatments resulted in higher lint yield than in control. A strong correlation was found between leaf chlorophyll content and lint yield, 0.97 and 0.91 in 2009 and 2010, respectively. **(Parajulee and Kerns, Lubbock)**

Cotton fruit Lygus *damage potential*. Experiments were conducted to quantify the age (degree-days from boll formation) at which bolls are safe from *Lygus hesperus* damage. A boll damage assessment based on heat unit-delineated maturity provided a boll-safe cutoff value of 350 HU for *L. hesperus*. A penetrometer and digital force gauge were used in determining the amount of pressure required to penetrate the carpel wall of cotton bolls of different ages. Linear regression analyses established the relationship between *L. hesperus* damage and the amount of pressure required to puncture boll carpel walls. It is estimated that cotton bolls are relatively safe from *Lygus* damage when the pressure required to penetrate the carpel wall is >0.69 lb/ft2. *Lygus* adults and nymphs both caused external lesions on bolls throughout boll development. However*, Lygus* generally could not cause internal damage to bolls that were older than 350 HU under a no-choice field-cage study. Late-instar nymphs caused significantly more damage to maturing bolls than adults. Consequently, nymphs caused 23, 29, and 15% more loss in lint yield, seed weight, and seed counts per boll, respectively, than adults. For *Lygus* management in West Texas cotton, insecticide intervention is unnecessary beyond 350 HU past cut-out. However, under field conditions, *Lygus* may not cause significant damage to bolls beyond 250 HU. **(Parajulee and Kerns, Lubbock)**

Development of landscape-level pest management guidelines to reduce Lygus infestations in cotton. The project involved surveying and sampling the agricultural landscapes of several sub-regions of the southwestern United States, including the Southern High Plains of West Texas for *Lygus hesperus*. It was a 4-year project that began in 2007. Geographic information from 2008 and 2009 has been compiled using a software-based geographic information system. In July of each year, 50 cotton fields (the majority of which were under irrigation) were selected as "focal fields" for the Texas *Lygus* Project landscape insect survey. These focal fields were sampled via sweep-net weekly for 10 weeks. This effort also included sweep-net sampling of up to six occurrences of non-cotton target insect habitats within a three-kilometer radius of ten of the aforementioned fields. Processing of retrieved samples was performed in tandem with weekly surveying and sweeping activities. Seasonal average *Lygus* abundance data were regressed with 27 focal field characteristics (variables), including habitat-specific land cover, distance between focal fields and non-cotton habitats (centroid to centroid), longitude, latitude, elevation, habitat heterogeneity index, and several environmental/ecological variables. Significant variables were selected by using both backward and forward selection procedures in a stepwise regression at 15% probability rate. A 10-parameter linear model explained 93% of the variation in the data. While we are still refining the model, we feel that corn and sunflower acreage contributed the most to increased probability of *Lygus* infestation in adjacent cotton. Other variables that contributed significantly to variation in *Lygus* abundance in cotton were focal field distances from playa, mixed weeds, corn, CRP grasses, and non-crop habitats, longitude, and habitat heterogeneity index. **(Parajulee, McSpadden, Shrestha, and Kerns, Lubbock)**

Varietal difference in compensation of Lygus-induced fruit loss in cotton. Two cultivars, DP 104 B2RF (early season) and DP 161 B2RF (full season), were evaluated. Different levels of pre-flower square loss were achieved by augmenting natural populations of plant bugs with laboratory reared nymphs released three times at weekly intervals during the first three weeks of squaring. Insect release treatments included: 1) augmentation of 2 bugs per plant, 2) augmentation of 4 bugs per plant, 3) 0 bugs augmented (naturally occurring background density), and 4) 0 bugs achieved through insecticide application. The test was deployed in a 2 (cultivar) x 4 (insect release treatment) factorial arrangement with randomized complete block design. Both cultivars showed exceptional lint yield compensation for 40-54% early fruit loss. The early terminating cultivar (DP 104 B2RF) compensated fully for both 40 and 48% pre-flower fruit loss, whereas the full-season cultivar (DP 161 B2RF) compensated for 52 and 54% fruit loss. In both cultivars, insect-induced early fruit loss caused fruit overcompensation. An upward shift and delayed cut-out, as is shown by 2010 Squaremap data, in insect-induced fruit loss, resulted in compensation/overcompensation of 40-54% early fruit loss. **(Parajulee and Kerns, Lubbock)**

Ontogenic morphometry of Lygus hesperus*. Lygus hesperus* and *Lygus lineolaris* are two sympatric species commonly found in the Texas High Plains region. Ontogenic shape changes in these two *Lygus* species were evaluated using elliptical Fourier analysis of body-outline of five nymphal stages. Ten insects from each species were reared in a laboratory individually on green beans from egg to adult. Insects were photographed using a digital camera mounted on a stereo microscope at five nymphal stages and upon reaching adulthood. The boundary outlines of each *Lygus* bug were digitized from their dorsal view photographs using tpsdig2 software. The first 15 harmonic Fourier coefficients were used for multivariate statistical analysis to discriminate these species during different developmental stages. A discriminant function analysis (DFA) showed that *L. lineolaris* and *L. hesperus* shapes were two distinct groups with little overlap in their discriminant function (DF) scores. ANOVA revealed that DF scores of *L. lineolaris* and *L. hesperus* were significantly different. A two-way MANOVA test, using the first 10 principal component (PC) scores, revealed that the difference between the two species' PC-scores was highly significant. Likewise, the PC-scores between different growth stages were also significantly different. The UPGMA tree of Mahalonobis distances showed *L. hesperus* and *L. lineolaris* as two distinct clades except that the fifth instar of these two species were in a single clade. This study showed that elliptical Fourier analysis of body shape is a good approach for differentiating immature *Lygus,* especially when they are small in size and do not have clear landmarks, or when only a relatively low-resolution image acquisition facility is available. **(Shrestha and Parajulee, Lubbock)**

Genetic diversity study of Lygus in the Texas High Plains. A molecular population genetic diversity study was designed to determine the population genetic structure of *L. hesperus* in the Texas High Plains region. *Lygus hesperus* samples (n=48) were collected from four different locations, each 40 to 65 miles apart, spanning 150 miles on a north-south axis across the Texas High Plains, with a north-to-south land elevation gradient from 3,600 feet to 3,000 feet above sea level. *Lygus* samples were genotyped by Polymerase Chain Reaction (PCR) and Polyacrylamide Gel Electrophoresis (PAGE) using six previously developed and characterized microsatellite markers. This study demonstrated that microsatellite markers are useful molecular tools for study of neutral genetic variation of *L. hesperus* populations in the Texas High Plains. Within the 150-mile geographic sample range, *L. hesperus* was genetically differentiated into two distinct populations, constituting northern and southern population clusters. It is hypothesized that genetic differentiation results from differences in the ecological environment such as hosts, habitat, and others, possibly due to the 600-ft north-south elevation gradient. A larger-scale landscape genetics study is planned to determine the relationships between the ecological parameters and Texas High Plains *L. hesperus* population genetic diversity. **(Shrestha and Parajulee, Lubbock)**

Characterization of intercrop movement behavior of convergent lady beetles in an alfalfa-cotton system. A two-year study was conducted to evaluate the intercrop movement behavior of convergent lady beetles in an alfalfa-cotton system where lady beetle movement between the two crops was monitored weekly throughout the cotton growing season. For this test, an alfalfa strip (40 x 600 ft) was planted in a manner in which it was adjoined bilaterally by cotton. Protein marker solutions were used to mark insects in the field for tracking purposes. Following capture of marked insects, protein markers were detected via indirect enzyme-linked immunosorbent assay (ELISA). Egg white solution was applied in alfalfa and non-fat dry milk solution was applied in cotton weekly for 11 weeks beginning at the 3-4 true leaf cotton stage. Sampling was performed in both crops 24 hours after field protein marking. Based upon positive or negative protein marker detection, insects were then classified as either "transient," "resident," "immigrant," or "unmarked." Results indicated that convergent lady beetles moved bidirectionally between alfalfa and cotton. Net movement into cotton from alfalfa was not affected by cotton phenological stage. **(Shrestha, Porter, Carroll, and Parajulee, Lubbock)**

Seasonal dynamics of insect community in cotton. A study was designed to examine the community composition of canopy-dwelling arthropods in cotton and alfalfa during the cotton growing seasons of 2008 and 2009. Cotton and alfalfa were sampled using a blower-type sampler weekly. The canopy-dwelling insect community in cotton was comprised of arthropods from the orders Coleoptera, Hemiptera, Diptera, Hymenoptera, Aranea, Lepidoptera, Neuroptera, and Orthoptera, and within these orders, 41 discrete families were identified. Members of Hemiptera, Coleoptera, and Diptera appeared in the greatest abundances. Analyses revealed a disparity in insect distribution between cotton and alfalfa, with the majority of arthropods and taxa in alfalfa. Some arthropod taxa were unique to each crop, but alfalfa harbored more unique taxa than cotton. Arthropods from these two crops were also classified on the basis of their ecological function (pests, predators, parasitoids, and pollinators). Total counts of all arthropods assigned to particular ecological functions were higher in alfalfa than cotton. This study showed that alfalfa supports higher abundance and diversity of arthropod taxa. Information produced in this study may be valuable in developing a holistic, ecologically intensive approach to management of target pest species in cotton, in a cotton-alfalfa agroecosystem. **(Bastola, Shrestha, Porter, and Parajulee, Lubbock)**

Population level genetic variability of cotton fleahopper in the United States. Cotton fleahopper is one of the major sucking insect pests of cotton. However, severe infestations and corresponding crop loss are mainly observed in southern Texas. This is the first study to determine the geographic genetic structure of cotton fleahopper populations in the United States. Cotton fleahoppers were collected from cultivated cotton in Arizona, Texas, Oklahoma, Arkansas, Mississippi, Louisiana, Alabama, Florida, Georgia, South Carolina, and North Carolina during the summer in 2009-2010. Amplified fragment length polymorphism (AFLP) was used to detect genetic structure. An understanding of fleahopper population structures provides insight on their movement patterns between regions and/or local adaptation, in addition to providing information aimed at improving fleahopper management strategies. **(Barman, Parajulee, Sansone, and Medina, College Station, Lubbock, and San Angelo)**

Developing an action threshold for thrips. This study has been on-going since 2007. Cotton was treated with acephate at 3 oz/ac at the 1st week, 2nd week, 1st & 2nd week, 1st, 2nd & 3rd weeks, 2nd & 3rd weeks post emergence, and at threshold. Thrips were counted weekly and correlated with yields. Correlations suggest that the current action threshold should be reduced by 50% to prevent more than 10% yield loss. Temperature does not appear to influence the number of thrips necessary to cause damage, but suppressing cotton growth keeping the cotton at a more susceptible stage for a longer period of time. **(Kerns, Texas AgriLife Extension Service, Lubbock; Parajulee, Texas AgriLife Research, Lubbock; Vandiver, Texas AgriLife Extension Service, Farwell; Patman, Texas AgriLife Extension Service, Crosbyton). Funded by TSSC, Cotton Inc.**

Developing a binomial sampling plan for thrips. Research was conducted in a number of commercial cotton fields in the South Plains, Permian Basin and Trans Pecos regions, evaluating two thrips sampling methods (visual and cup) and collecting data to develop a binomial sampling plan. Both sampling methods proved effective, but the cup method was slightly less variable. The cup sample method would require a maximum sample number of 28, compared to 31 for the visual. Regardless of sample method, the enumerative sample plans required a >56% increase in the number of samples needed to estimate the same density as the binomial sample plans. The average sample times for the enumerative sample plans were 79.1 and 43.6 seconds per sample for the visual and cup sample methods, respectively. Sample number requirements were similar for both sample methods; however, the cup sample method was more cost effective, with a relative efficiency of 0.55. Even though the cup sample method is more cost efficient when using enumerative sampling, the binomial sampling plan requires far fewer samples to make a management decision and will undoubtedly be much more cost effective. **(Kerns, Texas AgriLife Extension Service, Lubbock; Muegge, Texas AgriLife Extension Service, Ft. Stockton; Parajulee, Texas AgriLife Research, Lubbock; Vandiver, Texas AgriLife Extension Service, Muleshoe: Multer, Texas AgriLife Extension Service, Garden City; Doederlein, Texas AgriLife Extension Service, Lamesa; Patman, Texas AgriLife Extension Service; Crosbyton). Funded by Cotton Inc.**

Insecticide efficacy towards thrips. The preventive treatments: Temik at 3.5 and 5 lbs/ac, Aeris, Avicta Complete Cotton, were compared to each other and foliar applications of Orthene at 3 oz/ac, Bidrin at 3.2 oz/ac and Bidrin XP at 3.2 oz/ac. We could not detect any differences in thrips control between the two rates of Temik; both provided at least 26 days after planting. Avicta and Aeris performed similarly; proving efficacy for 13-19 days after planting. Orthene and Bidrin XP provided similar efficacy and appeared slightly better than Bidrin. (**Kerns, Texas AgriLife Extension Service, Lubbock**).

Aphicide efficacy and impact on lady beetles. The objectives of this two-year study included: 1) to determine the efficacy of commonly used aphicides at mitigating aphid populations in cotton, 2) to determine which aphicides have the least detrimental impact on key aphid predators, and 3) to collect data to support or refute the current aphid action threshold. Bidrin at 8 oz/ac, Intruder at 0.6 oz/ac, Carbine at 1.5 oz/ac, Sulfoxaflor, and an Imidacloprid/Spirotetramat mixture all provided excellent aphid control. Centric at 2.0-2.5 oz/ac provided moderate efficacy while Trimax Pro at 1.8 oz/ac and Belay at 6 oz/ac provided poor control. All the neonicotinoid insecticides were harsh on lady beetle larvae. Carbine was least detrimental to lady beetle larvae while Bidrin and Sulfoxaflor were intermediate. Although limited, our data suggest that pre-bloom cotton should rarely be treated for aphids, cotton during early boll filling should have a threshold of 50 aphids/leaf, and high stressed cotton (heavy boll filling) should have a threshold of 25 aphids/leaf. (**Kerns & Baugh, Texas AgriLife Extension Service, Lubbock)**.

Insecticide efficacy towards Lygus. A number of insecticide efficacy trials targeting Lygus were conducted in 2010. These trials demonstrated that Endigo at 5.5 oz/ac, Bidrin at 8 oz/ac, Bidrin XP at 12.8 oz/ac, Ammo at 5 oz/ac, Orthene at 1.0 lb/ac, Carbine at 2.5 oz/ac, Belay at 6 oz/ac and Sulfoxaflor all provided good control of western tarnished plant bug on the High Plains. Lower rates of Belay and Intruder at 1.1 oz/ac appear weak on Lygus, and Sulfoxaflor at 1.07 lbs-ai/ac exhibited longer residual activity that Orthene or Carbine. **(Kerns & Baugh Texas AgriLife Extension Service, Lubbock; Patman Texas AgriLife Extension Service, Crosbyton).**

Developing an action threshold for Lygus based on boll damage. A test was conducted where plots were treated with 5 rates of Orthene ranging from 0.75 to 0.125 lbs/ac. Lygus density and boll damage was estimated, and yields were taken. Data from this test was pooled with data collected over the past three year. Based on linear correlations, the threshold of 4 Lygus per 6 ft-row appears acceptable. Additionally, it appears that 67 internal damaged locules, or 400 external stings, per 100 dime to nickel size bolls along with the presence of Lygus, may be a viable action threshold. However, more data is needed to strengthen the models, especially the relationship between Lygus density and yield production. **(Kerns & Baugh Texas AgriLife Extension Service, Lubbock; Patman Texas AgriLife Extension Service, Crosbyton).**

Early season fruit loss compensation. A test was conducted to evaluate the ability to compensate for early-season fruit loss, such as that due to cotton fleahopper. Cotton plots had 0, 20, 40, 60 80 or 100% of its fruit removed at about 18 days into squaring. There were no differences in yield among treatments suggesting compensation. We experienced an extended and warm fall in 2010 which may have promoted compensation. Compensated fruit tended to be 3rd and later position bolls, and there was no vertical influence. Although yield was not impacted, the compensated fruit appeared to have more immature fiber and thus somewhat lower quality. Thus, during years where extended, warm falls are encountered, then impact of cotton fleahoppers on cotton yield is negligible. (**Kerns, Texas AgriLife Extension Service, Lubbock; Doederlein, Texas AgriLife Extension Service, Lamesa; Baugh, Texas AgriLife Extension Service, Lubbock; Patman Texas AgriLife Extension Service, Crosbyton).**

Managing mixed populations of bollworms and fall armyworms. Insecticides were evaluated for efficacy towards a mixed population of bollworms and fall armyworms. Against bollworms, the pyrethroids Mustang Max, Cypermethrin, and Karate were all efficacious at high rates, while Belt (a diamide) at 2 oz/ac (low rate) was weak. Belt at 2 oz/ac and all of the pyrethroids were weak on fall armyworm, while Belt at 2 oz/ac mixed with a Mustang Max was highly effective towards both species. **(Kerns & Baugh Texas AgriLife Extension Service, Lubbock; Cattaneo, Texas AgriLife Extension Service, Seminole; Patman Texas AgriLife Extension Service, Crosbyton).**

Influence of thiamethoxam seed treatments (Cruiser) on the ability of foliar applications of thiamethoxam (Centric) to control cotton aphids. Cotton treated with Cruiser had fewer aphids than non-treated seed 30 days after planting, although aphids still exceeded the action threshold. This suggests that at-planting use of seed treatments can exert resistance selection pressure on aphids mid-season. Centric failed to provide adequate control of the aphid populations regardless of seed treatment. This suggests that resistance to thiamethoxam was not selected for by the seed treatment but may have been preexisting. (**Kerns & Baugh, Texas AgriLife Extension Service, Lubbock)**.

Miticde efficacy. Two tests were conducted evaluating the efficacy of various miticides towards twospotted spider mites in cotton. GWN-1708 at 20-24 oz/ac, Portal at 1 pt/ac, Athena at 13.5 oz/ac, Oberon at 4-8 oz/ac, Epi-Mek at 8 oz/ac and Zeal at 1 oz/ac were all highly active toward mites. Zeal was somewhat slow acting and the addition of 28% UAN to Oberon seemed to slightly inhibit its activity. Brigade at 6.4 oz/ac exhibited good knockdown of the mite population, but the mites rebounded by 19 days after treatment. (**Kerns & Baugh, Texas AgriLife Extension Service, Lubbock)**.

Mite action threshold evaluation. The Texas mite action threshold was evaluated by conducting a replicated test where 0, 30, 50, 70 and 100% mite hits were treated with Oberon at 4 oz/ac. The 30% threshold was missed, but yields were highest at the 50% threshold. The untreated did not differ in yield from the 70 or 100% thresholds. Thus the current threshold does preserve yield, but lower thresholds need to be evaluated. (**Kerns & Baugh, Texas AgriLife Extension Service, Lubbock)**.

Transgenic aphid resistance. Cotton genetically modified for overexpression of the protein osmotin was evaluated for resistance to cotton aphids. Demographic life table data suggest a slight reduction in the intrinsic rate of increase in aphids reared on cotton engineered for the overexpression of osmotin. (**Salimath, Tripathy & Chapman, University of North Texas, Denton; Kerns, Texas AgriLife Extension Service, Lubbock**).

Preventive treatments for thrips and oversprays. Two studies were conducted to evaluate various systemic insecticide seed treatments for thrips and aphids. In the first study the seed treatments evaluated included Gaucho Grande, Cruiser, Aeris, and Avicta. The Aeris and Avicta treatments were also evaluated in combination with Temik; and Temik alone was evaluated at two rates. Few thrips were encountered in the test resulting in few statistical differences in thrips or spider mite numbers, but significantly fewer cotton aphids were observed at the 2-leaf stage. No differences were observed in plant vigor rating, fiber characteristics or lint yield. In the second study Temik, Gaucho Grande, and Cruiser were used alone or oversprayed on 3 dates with Orthene. Thrips numbers were reduced by all at-plant seed and granular treatments, but by the 4-leaf stage the at-plant treatments used alone had more thrips than did the nontreated cotton; Orthene oversprayed plots contained reduced numbers of thrips compared with the at-plant treatments alone but this reduction did not result in any better plant damage rating. All insecticide treated cotton had a better plant damage rating than the nontreated cotton. All insecticide treated cotton except where Orthene was used alone had higher lint yield (not always statistically different) compared to the nontreated cotton **(Parker, Texas AgriLife Extension Service, Corpus Christi).**

Insecticide efficacy toward cotton fleahopper. Research continued on cotton fleahopper treatment timing, and two studies were conducted to compare insecticides for their control. One insecticide study included new materials compared to our standard (thiamethoxam = Centric) and included sulfoxaflor, clothianidin (Belay), and CMT4586 (Bayer). All insecticides were effective in reducing fleahopper numbers. Although statistically significant yield effects were not observed, all insecticide treated cotton yields were greater than the nontreated cotton. In the other insecticide comparison study Centric, Intruder, Trimax Pro, Orthene, Bidrin, Bidrin + Discipline, and Discipline were evaluated under very heavy fleahopper infestation. Higher cotton aphid numbers were found especially in plots where the pyrethroid insecticide (Discipline) was applied. Statistical yield differences were not found but all insecticide treated cotton had higher lint yield ranging from 72 to 132 lb/acre compared to the nontreated cotton **(Parker, Texas AgriLife Extension Service, Corpus Christi).**

Application timing for cotton fleahoppers. In the fleahopper treatment timing study yield results from insecticide application were somewhat similar to those in earlier studies in which the most aggressive treatment (every week for 4 weeks) resulted lower dollar return (actually a negative return in 2010); whereas, treatments applied in squaring week 1; weeks 2, 3, and 4; weeks 3 and 4; and week 4 all showed positive dollar returns. The positive yield response to insecticide treatment in the 2010 test was based on strong trend in yield increase instead of statistical significance possibly due to spindle picker problems. Spider mite damage ratings were greater where the highest number of treatments were applied **(Parker, Texas AgriLife Extension Service, Corpus Christi).**

Rolling Plains Insecticide Efficacy Tests. Trials included looking at combinations of pymetrozine (Fulfill) and thiamethoxam (Centric) for cotton aphid control. A combination of spirotetramat and imidacloprid was evaluated for cotton fleahopper and cotton aphid control. A cotton fleahopper timing trial was evaluated as well as evaluating Poncho/Votivo for nematode control. **(Sansone and Minzenmeyer, Texas AgriLife Extension, San Angelo)**.

Virginia
Bollworm Trials
Double-insect-toxin varieties have continued to replace single-insect-toxin varieties available to U.S. cotton producers. Previous research has shown that these insect-resistant varieties still require at least one bollworm pesticide application to achieve yields comparable to that of conventional cotton that has received two sprays. Since 2006, research has been conducted annually at the Tidewater Agricultural Research and Extension Center (TAREC) in Suffolk, Virginia, to evaluate the effectiveness and costs associated with conventional (RR, RF, LL, or conventional), single (BG), and double-insect-toxin (BG2 or WS) cotton varieties.

In all years, varieties were selected based on OVT performances in Virginia and North Carolina using the highest yielding varieties from each grouping. Varieties were planted in early May at TAREC using a four-replicate split-plot experimental design with insecticide treatment (treated vs. untreated) as the main plot and variety as the sub-plot. Treated plots received bollworm protection with one (BG, BG2, WS) or two (RR, RF, LL) Baythroid XL applications in August, while untreated plots received no insecticides for bollworm. Plots were four rows by 35 ft long with 36-in row centers. Bollworm was monitored by assessing external bollworm-induced boll damage on 25 randomly selected bolls per plot in late August and early September. Yield and the net value per acre for bollworm protection were determined for each variety using the formula: lint value (55¢/lb [2006-2008], 68¢ [2009], 72¢ [2010]) x protected yield – treatment cost ($9.37/acre for one application, $17.06/acre for two) – technology fee ($17.40/acre for BR, $22.80/acre for BG2, $11/acre for WR).

From 2006-2010, percent bollworm damage to bolls in untreated cotton varieties was numerically or statistically higher in conventional cotton than in single or double-insect-toxin varieties. With few exceptions, lint yields increased when varieties were protected with an insecticide targeting bollworm. The conventional varieties saw the greatest yield increase, averaging an additional 379 lb lint/acre. BG2 and WS varieties benefitted from a bollworm insecticide application, with lint gains averaging 70 (BG2) and 111 (WS) lb lint/acre over all varieties and years evaluated.

The value of the lint gain due to protection against bollworm via insecticide applications was most apparent in the conventional varieties (mean of $206/acre across all years). The greatest lint gains occurred in 2006 and 2008, corresponding with high bollworm pressure. Gains in genetically-protected varieties averaged $52 (BG), $33 (BG2), and $58 (WS).

Overall value for bollworm protection showed that BG, BG2, and WS varieties benefitted from a single bollworm insecticide application, and that conventional varieties with two bollworm insecticide applications can achieve comparable values.

In summary, small-plot research in Virginia and field surveys in North Carolina show that BG2 and WS cotton varieties sustain some bollworm damage. The amount varies from year to year depending on the level of pest pressure. Data and annual surveys indicate that BG2 and WS varieties benefit from a single bollworm insecticide application. Bollworm treatment increased lint yields by an average of 70 (BG2) and 111 (WS) lb lint/acre over all varieties and years evaluated. When factoring in bollworm insecticide costs and estimated insect protection seed technology fees, BG2 and WS varieties provided economic returns in terms of bollworm control. RR and RF varieties made equivalent yields when protected with bollworm insecticide programs.

Thrips Trials
In the Regional Thrips Trial, when averaged across all participating states (Virginia to Texas) automatic foliar applications of Orthene 97 for thrips did not significantly increase cotton yields in Temik 15G or Aeris treated plots. Because of the great variability among states (weather, varieties, thrips species, and intensity of thrips pressure) these findings do not necessarily apply to all locales. For example, in one trial in Virginia, application of Orthene 97 at 4 oz/acre at first true leaf stage increased yields for Aeris, Avicta CP, and Temik 15G treated cotton.

In trials to evaluate thrips control options in both early (April 26) and late (May 27) cotton planting dates, there were significant differences in thrips per plant and thrips-induced plant injury due to application of insecticides, and there were numerical but not significant differences in yields among treatments. This was primarily due to the unusually dry early season conditions that caused very uneven seeding emergence in these trials which resulted in a large variability in yields that 'overshadowed' the treatment effects. However, it was determined that thrips control could be achieved in later-planted cotton using lower insecticide rates and fewer insecticide applications.

The single most important findings from this project may be related to the discovery of the effectiveness of a new insecticide, cyantraniliprole (Cyazypyr™, Dupont), in controlling thrips in cotton. In our field trials, under very intensive thrips pressure, Cyazypyr™ treatments ranged in efficacy from moderate to excellent depending on the rate and technique applied. A combination of in-furrow treatments followed by a single first true leaf spray resulted in thrips numbers and plant injury ratings similar to or better than those provided by Temik 15G at the 5 lb/acre rate. Yields were statistically the same as Temik 15G followed by a first true leaf application of Orthene 97 at 4 oz/acre. Based on the success of Cyazypyr™ in protecting cotton seedlings under severe thrips pressure that was demonstrated in these field trials, we have formed a collaborative effort with Dupont to pursue developing cyantraniliprole as a cotton seed treatment. Seed is being prepared for a 2011 collaborative trial with cotton entomologists in VA, NC, SC and GA. With the pending loss of Temik 15G, the insecticide seed treatments will become the primary tool for growers to management thrips in U.S. cotton. Registration of Cyazypyr™ as a cotton seed treatment would be a huge contribution to the cotton industry.

In laboratory bioassays, preliminary LC_{50} values were determined for several insecticides for tobacco thrips adults: Cyazypyr™ = 270 parts per million (ppm), Warrior T = 0.126 ppm; and thrips larvae, Warrior T = 60 ppm. Orthene concentrations that were used in 2010 were not significantly different from zero and will need to be modified in future research.

Annual CEW Field Corn Survey

To conduct the field corn survey, the number of corn earworms found in 50 ears of corn was recorded in 5 randomly selected corn fields in each of 26 counties, totaling 6,250 ears and 125 fields sampled. When fields were known to contain Bt or non-Bt corn, this was noted. Otherwise, samples were considered to be random and assumed to be representative of the actual Bt/non-Bt composition in each county. Age of earworms, or if they had already exited the ears, was also recorded. Statewide, 40% of ears were infested with earworms in 2010. This is up from 36% in 2009. Regional averages were 12% infested in Northern, 25% in the Northern Neck, 39% in Mid-Eastern, 54% in the Southeast, and 46% on the Eastern Shore. Survey results were provided via the Virginia Ag Pest Advisory and at grower meetings and field days.

CEW AVT Cypermethrin Monitoring

Adult corn earworms were captured live from ten pheromone-baited traps at the Tidewater AREC in Suffolk, VA, from late May through mid-September 2010. Moths were returned to the laboratory on the day of collection to be assessed for resistance using the adult vial test with scintillation vials pre-treated with cypermethrin, including untreated vials as a control. Moths were assessed for survival 24 hours after being placed into vials by categorizing them as dead, down (unable to fly), or live. A total of 2,619 months were tested in 2010, with a mean survival of 29.8% in the cypermethrin-treated vials (some weeks were greater than 40%). These levels indicate a high risk of development of pyrethroid resistance. Data summaries with a brief discussion of the results were compiled and updated weekly, and forwarded to agents, growers and the ag sector via the Virginia Ag Pest Advisory.

Regional Products/Publication

A hand-held device was developed for assisting growers and crop advisors in determining thresholds for stink bugs. This hand-held device provides growers and consultants with step-by-step instructions on determining stink bug thresholds. It explains how to pull a boll sample and has size indicators to assist in selecting properly-sized bolls. The hand-held device then recommends sorting bolls into piles with or without obvious external lesions (with detailed images as a reference), followed by cracking and inspecting those with external lesions for internal warts and stained seed or lint (with detailed images as a reference). Next, it refers the user to the dynamic threshold table to determine whether the stink bug threshold has been met for that week, and whether it is necessary to inspect any remaining bolls for internal damage. Finally, the hand-held device states to treat the field only if the threshold is met for that week. A total of 3,500 hand-held devices were produced for Virginia, North Carolina, South Carolina, Georgia, and Alabama with 'custom' copies with logos and indicia for each university.

A companion extension publication was developed, printed and distributed that serves as an expanded instructional piece for the hand-held field decision aid (Scouting for Stink Bug Damage in Southeast Cotton: Description and Use of a Pocket Scouting Decision Aid, VCE Publ. 3005-1445). It is a 2-sided, 8 x 11-inch fact sheet that contains more detail on how the decision aid was developed, what it provides, how to use it in the field, and high resolution, color images of stink bug feeding damage symptoms to bolls. Each cooperating university (VT, NCSU, Clemson, UGA, AU) supplied their respective logos and indicia so copies could be 'custom' made for each state. Copies were sent to each state (200 for VA, 500 for NC, 700 for GA, 200 for SC, and 200 for AL) for local use and distribution. **(Ames Hebert).**