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Abstract

There were 13,938,000 acres of U.S. Cotton (Upland and Pima) harvested with an average of 839 pounds of lint per acre (USDA –January 2006 report) in 2005.

Arthropod pests of cotton reduced yield by 4.47% in 2005. The bollworm/budworm complex reduced yields by 1.50%. The bollworm was the predominant species to attack cotton in 2005. Bollworms were estimated to make up 95% of the population *Lygus* (0.9%) were 2nd in losses. Stink bugs (0.64%) were 3rd and Thrips (0.43%) were 4th. Spider mites (0.35%) rounded out the top five cotton arthropod pests for the year. Beltwide, direct insect management costs amounted to $56.62 acre. Cost plus loss is estimated at $1.256 billion. (see M.R. Williams, this proceedings).

Crop and Arthropod Pest Conditions:

Alabama

In the central and southern cotton growing regions of the state, stink bugs were the dominant economic insect pest over central and south Alabama in 2005. Stink bugs were present in many fields prior to bloom. They began attacking small bolls, resulting in abortion, as soon as the bloom dropped. Two to five applications were required to prevent excessive economic damage. Bollworms and tobacco budworms occurred in significant numbers but were somewhat localized. One or more oversprays to Bollgard cotton were necessary. Often these sprays were made in conjunction with a stink bug application. Conventional cotton required more applications than growers were willing to make, which resulted in significant boll damage in most conventional fields. A three or four county area of southeast Alabama, similar to adjacent areas of Florida and an even larger area of Georgia reported control failures with pyrethroids on bollworms during a 2-3 week period in August. Two to four pyrethroid sprays were made in a 2 week window and yet escape larvae caused up to 15-20% boll damage. Other than a localized area no other significant numbers of lep pest occurred, although soybean looper, southern armyworm, beet armyworms and fall armyworms could be detected in many fields. This exception was a small area of extreme southeast Alabama were all lepidopteran species have occurred at economic levels for several consecutive years. Average yields from central and south Alabama were 750-850 lbs./ac. due to good rainfall patterns throughout the fruiting season and a dry harvest season. Hurricane damage in Alabama was confined to the extreme southwestern county of Mobile where losses were in the 50-75% range.

In the north, seedling cotton suffered through a multitude of problems, most of which were associated with cool temperatures. Cutworm problems were minimal, but while investigating those similar damage caused by vegetable weevils was found. Numbers of weevils were not high, but the distribution was wide. Thrips populations were average, but due to retarded seedling development thrips injury was significant and a number of foliar applications were required for thrips control. Aphid problems occurred on a limited acreage of seedling cotton, but were lower than average for the remainder of the season. Very heavy infestations of two-spotted spider mites were found on cotyledonary stage cotton and problems persisted through mid July. Mite control was poor due to growth dilution and resistance to some acaracides. The worst and earliest mite problems were associated with the use of neonicitinoid seed treatments and conservation tillage systems where winter annual weeds were common. Tarnished plant bugs were slow to develop with many fields not approaching threshold levels until late July. Stink bugs were noticeable but damage was insignificant in most fields. Corn earworm and tobacco budworm populations (ca. 4:1) peaked during the second and third week of August and demanded multiple insecticide applications in most non Bt cotton. Corn earworm survivors were easily high enough in most Bt cotton fields to warrant a pyrethroid application. Noticeable differences in Bt expression were observed and seemed to vary according to variety. Low levels of fall armyworms were present throughout the area during late season. Average lint yields in north Alabama should be close to 800 lbs./ac. on 270,000 acres. In addition, seedling cotton conditions, thrips populations, aphids and tarnished plant bug numbers, as described for north Alabama, were the same for the remainder of the state.

Arkansas

The season began with moderate infestations of tobacco thrips across the state. In-furrow insecticides (predominantly Temik) and seed treatments gave less than satisfactory control. The season began on a very dry note and the lack of soil moisture most likely accounts for the lack of efficacy from in-furrow and seed treatment insecticides. Foliar applications were required on a large number of acres.

Tarnished plant bug pressure was low early in the season, probably due to the dry spring that was experienced. Few wild weed hosts were available early on to build up plant bug numbers. Pressure did not pick up until around mid-July and plant bugs were a problem in most areas from that time on through the rest of the season. Acephate, Bidrin, Vydate, and Centric were the predominant products used, and did give good control. The average number of applications was near 3-4 sprays for the season.

Tobacco budworm pressure was extremely light again this year all across the state. Very few fields required treatment for this pest alone. Bollworm pressure light to moderate in the north, with heavier pressure in the south this year. Pyrethroids performed well in controlling this pest.

Spider mites were common in fields across the state, with many fields requiring treatment for this pest. Again, due to the dry weather early on, this pest came on early and kept causing problems season long. Zephyr and Abba performed very well, as did Kelthane and Comite when it was available.

Capture did a very poor job early on. In many cases it flared mites to levels higher than before treatments, but did begin to give some level of control later in the season. Zeal worked well, but did require some time to work. Cotton aphids were almost non-existent, with very few fields requiring treatment.

Fall armyworms caused significant problems in the central part of the state mid to late season. Many growers treated 2 or more times for this pest, often only getting 50-60% control. Products of choice were Intrepid, Steward and Tracer. Some growers did get control with high rates of pyrethroids tank mixed with Acephate as well.

Beet armyworms were a problem in NE Arkansas late in the season. Many fields had a complex of beets, falls and saltmarsh caterpillar. Steward performed well in these fields. It was also noted that fields that had received applications of Diamond earlier for plant bugs, had fewer beet armyworms.

Boll weevil eradication is progressing with the southwest area and portions of the southeast are of the state being basically eradicated at this time. The rest of the state is progressing towards nearing eradication.

California

There were 636,605 acres of cotton planted in CA in 2005. The San Joaquin Valley planted 95% of the total acres with the remainder being cultivated in the Southern Desert Valleys (23,710 acres) and Sacramento Valley (5,515 acres). Within the San Joaquin Valley, 405,605 acres were planted to upland varieties (*Gossipium hirsutum*) and 231,000 acres planted to Pima varieties (*G. barbardense*). There were 28,670 acres planted to Bt cotton.

Yield was predicted to be 1,219 lbs/acre for upland and 1,274 lbs/acre for Pima. Planting conditions in March and April were mixed. The earliest planting conditions were ideal to adequate for early emergence plant development. However, between March 18 and May 18 2005, 25 days were in the inadequate and marginal zones. The average five-day accumulated heat units from March 10 to May 15 was 17.4 with 62% of the days being ideal or adequate and 38% were marginal to inadequate. Substantial rain occurred during April and May.

These conditions led to a split planting season with early plantings facing very poor conditions, including rain and cool temperatures. Cotton vigor was variable, depending on root development, disease pressure and insect pressure. Many fields had poor root development and suffered throughout the year. Conditions for growth and development were excellent through June but a string of 100° F. days in July affected fruit set and boll size. Cooler temperatures in September and October limited the amount compensation the plants could provide.

Insect pressure was moderate to severe in many locations. Early thrips caused widespread problems. *Lygus* were reported to the worst in 10 to 20 years. Aphids were widespread but not excessive. Whitefly was very limited in the San Joaquin Valley but very heavy in the Imperial and Palo Verde Valleys. Spider mites were seen as a larger problem then in the recent past. *Lygus* were problematic in scattered areas in July as populations moved from senescing crops and into cotton. Worm pests were not a major issue again this year.

Florida

Approximately 88,000 acres of cotton were planted in Florida in 2005. Jackson County planted most of the acreage (approximately 28,000 acres) followed by Santa Rosa County with approximately 19,265 acres. Statewide, approximately 80% of the crop was planted to transgenic Bt varieties, with Deltapine 555 BR being the dominant variety.

Although a small percentage of the acreage was planted in April, cool temperatures and excess rainfall during late April and early May delayed planting and stand establishment in most fields until after mid-May. Hurricane Dennis struck west Florida on July 10 resulting in extensive crop damage, which further delayed crop maturity. Damage was minimal in the eastern panhandle. Adequate rainfall and good growing conditions persisted throughout north Florida until August 29. At this time cotton in west Florida suffered additional wind damage from Hurricane Katrina. Adverse weather resulted in loss of approximately one-quarter of the crop yield potential in west Florida.

Thrips injury was minimal in west Florida due to rapid crop emergence and growth with adequate uptake of soil applied insecticides. The use of insecticide treated seed continued to increase. In the eastern panhandle, thrips were more common causing damage to fields that were not treated.

Stand reduction from grasshoppers was minor, although it was detected in on the margins of some reduced tillage fields.

Aphids infested most fields at low to moderate levels during late June and early July. The beneficial fungus disease, Neozygites spp began reducing populations in early July and they did not rebound the remainder of the season. Some fields required treatment in the eastern panhandle.

Tarnished plant bug was populations were generally low all season. Early season square set was high and less than 4 % of the acreage received an application for plant bugs.

Beneficials were generally abundant all season where insecticides were not used. They developed on the early aphid population and helped provide control of worm pests. Fire ants were abundant all season in fields grown under strip-tillage. (Approximately 75% of fields were grown using this method of conservation tillage in west Florida.)

Bollworm moth trap catches were consistently high during July through mid September. However, widespread infestations failed to develop and only scattered fields required treatment during August. Most of the treated fields were planted to conventional varieties however; more Bollgard fields were treated than in previous years. In Jackson County, a number of fruit were lost per plant on Deltapine 555 BR in fields that were not treated.

Fall armyworm infestations were generally low throughout the season. Southern armyworms were found at low to moderate levels in scattered fields during mid August. Only a few fields required treatment specifically for these pests.

Stink bug populations were noted in late June and increased during mid to late season and were generally higher than last year. Some fields experienced damaging levels following migration from peanuts during late August - early September. Highest infestations occurred in field borders adjacent to peanuts. Some growers obtained adequate control by treating peanut fields or field borders next to peanuts. Approximately 90% of fields received at least one application for stink bugs with some receiving two or more.

Georgia

Approximately 1.21 million acres of cotton were harvested in Georgia during 2005. Growing and harvest conditions were generally good and above average yields were obtained. Insect populations ranged from moderate to heavy depending on location. The primary insect pests which required treatment included stink bugs, corn earworm, thrips, and soybean loopers.

Thrips populations were moderate in most areas. However a cool spring slowed seedling development which resulted in the need for foliar treatment on some fields. Other seedling pests such as grasshoppers and cutworms were uncommon. Aphid populations increased during late June and early July. Few insecticides were applied for aphids and the naturally occurring fungus caused populations to crash during early to mid July. The fungal epizootic or the crash of aphid populations occurred over a more extended time than in previous years. This may have been due in part to the light to moderate aphid populations. Spider mites were observed in a few isolated and localized areas, but did not reach treatable levels.

Tarnished plant bugs continued to be a minor pest in most areas, however some problems with square retention were observed. Although plant bugs were a causal agent of square shed in some fields, in many cases environmental conditions were thought to be the primary reason for poor fruit set. Clouded plant bugs were observed in parts of the state. Beet armyworm, fall armyworm, and southern armyworm were observed in many areas, but relatively few insecticide applications were made for these pests. Soybean loopers were present in many areas of the state during late August. When treatment was needed very good control of soybean loopers was achieved.

Tobacco budworm populations were light to moderate in most areas. Due to the high adoption of Bt cottons it is difficult to truly estimate population levels. Corn earworm populations were light to moderate during July but increased during mid to late August. Corn earworm escapes were more common on Bt cotton during August than in previous years. This increased incidence of survival is most likely related to increased infestation levels. Control of corn earworm with pyrethroids appeared to be reduced compared with previous years. This observation was easily observed on non-Bt cotton in some areas. On Bt cotton acceptable control of CEW with pyrethroids was often achieved but multiple applications were needed in some areas. In some fields excessive boll damage occurred when multiple pyrethroids were applied.

Stink bugs were the most common insect pest treated with insecticide. Stink bug populations were moderate to heavy with most fields needing treatment. Stink bugs were first observed in pre-bloom cotton and infestations were sustained for the remainder of the season in some areas. Populations during 2005 were similar to those observed during 2003 but growers did a much better job with management. No boll weevils were captured in Georgia during 2005.

Louisiana

Mississippi

Cotton producers in Mississippi planted approximately 1.2 million acres of cotton in 2004. Approximately 87% of cotton in MS was planted to transgenic single gene Bt varieties. Only 0.08% or about approximately 1000 acres was planted to dual toxin transgenic Bt varieties. The most popular varieties planted in 2005 was Deltapine 555BG/RR, Stoneville 5599BG/RR, and Deltapine 444BG/RR. These three varieties made up approximately 71.5% of the total acres planted in 2005.

Progress was made in the Mississippi Boll Weevil Eradication Program in 2005. Significant reductions in the number of boll weevils captured occurred in Regions 1B, 2, and 3. Although a 79.9 percent increase in number of boll weevils captured occurred in Region 1A, it was basically localized in Tunica County in the northern area of the region. There was only a one weevil reduction in the number captured in Region 4 (from 20 in 2004 to 19 in 2005). An increase in the percentage of weevil free fields occurred in all regions except Region 4. There was no evidence that boll weevil reproduction occurred in Regions 1B, 2, or 4. The weevils captured in these regions were captured either early in the season as an over-wintered weevil and no more caught in that field, or the weevil was captured as a single capture late in the season indicating that it was a migrant. The 2005 goal of the Mississippi Boll Weevil Eradication Program of being able to declare all fields as boll weevil free at the end of 2005 was not achieved, but good progress was made.

Total insect losses in MS were higher in 2005 than in 2004. Overall losses from insect pests in 2005 were 4.47% compared to 3.79% in 2004. Mississippi averaged 6.33 foliar applications to control pests in 2005 for an average foliar insect control cost of $51.88 per acre. Final cotton yield estimates for 2005 was 864 pounds per acre, down 170 pounds per acre from 2004. Cotton yields in the delta averaged approximately 910 pounds per acre while the hill region of the state averaged approximately 725 pounds per acre. Hurricanes Katrina and Rita also had adverse affects on the crop reducing yields in the delta in some fields by as much as 40%.

Thrips pressure across the state ranged from light to moderate depending on location. Seed treatments continue to gain popularity in MS for control of thrips due to convenience and ease of use. Less than 50% of the cotton acreage received a foliar application for thrips averaging 0.52 foliar applications for this pest.

Tarnished plant bug ranked as the number one damaging pest in 2005. The delta region of the state averaged 4.9 spray applications for plant bugs while the hill region of the state averaged only 1.45 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 2005 with "standards" such as Orthene, Bidrin, and Vydate getting more use in post-bloom cotton. Due to drought conditions during May and June tarnished plant bug numbers were lower than usual prior to first bloom but numbers increased rapidly in late July and August.

Bollworm/Budworm pressure continued to be light on average in 2005 with average number of foliar sprays at 0.8 for B.t. cotton in the delta region of the state and 1.35 foliar sprays in non-B.t. cotton in the delta. In the hill region of the state B.t. cotton received on average 0.53 foliar applications and non-B.t. cotton received 0.57 foliar applications for the budworm/bollworm complex. . Fall armyworms pressure was moderate to high in the state in 2005 requiring treatment in many fields. In the extreme southern part of the state fall armyworm pressure was intense and some fields required as many as three applications to control this pest.

Spider Mites were the most notable problem producers faced in the central delta region of the state prior to bloom in 2005. Spider mites attacked cotton very early in the growing season in 2005 and populations increased rapidly due to the hot and dry conditions in June. Approximately 278,000 acres were treated for spider mites in the state in 2005. Record losses occurred in 2005 from spider mites with producers in the state losing approximately 20,000 bales to this pest.

In summary, total insect control cost for the state in 2004 was $95.15 per acre up approximately $1.18 per acre compared to 2004. Although yields for Mississippi were down compared to 2004, yields were higher than the 5-year average for the state.

Missouri

New Mexico

Yields were high with an estimated 864 lb/acre statewide, despite some low summer temperatures due to a long, warm fall in New Mexico. Total cotton acreage has remained steady, despite over 50% reduction in acreage the Pecos Valley. Acreage of cotton in the two northeastern counties, Roosevelt and Curry increased in the last few years, replacing corn. This eastern high Plains area of New Mexico now has approximately 50% of the total acreage in NM. This shift in acreage also resulted in yields being relatively steady despite higher yield in southern counties over the last few years. The northeastern counties on the western edge of the High Plains have lower yields due to their location with lower heat units. Cotton is profitable, however, since some production costs are lower. The eastern High Plains counties, for example, have higher rainfall (approximately 17" /year) compared to the Mesilla and Pecos Valleys which have only 8-12"/year.

A pink bollworm eradication program is ongoing in the Mesilla Valley in south Central New Mexico in conjunction with nearby Texas counties. Pink bollworm numbers in the Mesilla Valley have been reduced 99.6% since the program's inception. Boll cracking late-season in 40 fields (1600 bolls total) produced 257, 2 and 0 pink bollworms in 2003-2005 respectively. Boll cracking of 2500 bolls from fields with a history of pink bollworm produced 4 pink bollworms in the Pecos Valley.

No boll weevils have been captured in the Mesilla Valley for three years. The Pecos Valley had 3 boll weevils in 2005, down from 188 in 2004. Lea, Roosevelt and Curry counties on the east side, bordering the Texas High Plains, had a total of 8 boll weevils trapped in 2005. Pressure from all other insects was average to below average.

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North Carolina

Thrips levels were generally only moderate in many areas of the state; however, extended cool conditions during early cotton development resulted in vulnerable seedlings for an expended period. Cotton seedlings often took up to 6 to 7 weeks to reach the "thrips-safe" stage of 5 to 6 true leaves. In replicated thrips insecticide trials, lint yields in the untreated check plots were often 300 to 400 pounds less than several of the better treatments. Approximately 70% of our state's cotton acreage received a foliar application for thrips. Temik was used on about 75% of the cotton acreage; seed treatments on the remainder. Western flower thrips appeared to be a minor problem in 2005.

Early tobacco budworms were on the light side during the pre-bloom period, and only developed into a minor headache in a few areas in 2005. With over 90% of North Carolina's cotton acreage now planted to Bt cottons, tobacco budworms have only the remaining 10% to potentially infest.

Cotton aphids were generally a minor problem on most farms in 2005, with 7.4% of our cotton acreage treated. Growers and consultants appear to be showing increasing confidence in the effectiveness of beneficial insects and in the fungus *Neozygite fresenii* in reducing cotton aphids to subeconomic levels.

Spider Mites were a far greater problem for cotton producers here in 2005 than in the previous 8 to 10 years, with approximately 1.8% of the state's acreage treated for this pest. That compares with and average of less than 0.3% of the cotton acreage being treated from 2001-2004. Cotton receiving Temik 15G at at-planting appeared to experience far less mite outbreaks than fields planed with a seed treatment followed by a foliar application for thrips.

Plant bugs were about average during the pre-bloom period, with just over 7% of our acreage treated. Additionally, *Lygus* levels did not build into a significant late season problem this past growing season.

Stink bugs and their damage were down considerably from the extensive damage of 2004, a watershed year for NC producers. However, stink bugs were still a significant late season pest on significant acreage, causing a mean of approximately 7% internal damage to bolls across the state on Bollgard cotton based on our project's annual damaged boll survey. Throughout most of the boll production period, the harder-to-control brown stink bug, *Euschistus servus*, constituted the minor portion of the brown vs. green (mostly *Acrosternum hilare*) complex.

The major late season **bollworm** moth flights from corn were much later and lighter than average, even lagging behind the state's late cotton crop. On conventional cotton, the bollworm/budworm complex boll damage at 4.3%, was about par for North Carolina, as was bollworm damage to bolls on Bt cottons (1.4%). An average of approximately 2.6 and 1.2 late season applications were used on conventional and Bollgard cotton, respectively, in 2005.

Other caterpillars were generally on the light side, although fall armyworms persisted, occasionally at treatable levels, in a few of our eastern counties, as was the case in 2004. Beet armyworms and cabbage loopers, although detected, were again little more than curiosities in 2005. European corn borers again remained at almost undetectable levels on conventional cotton.

As of this December writing, North Carolina cotton producers are expected to harvest approximately 850 pounds of lint per acre on 804,000 acres.

Oklahoma

A total of 242,982 acres (Oklahoma Boll Weevil Eradication Organization figures) were planted and harvested in 2005. Growing conditions favored cotton development throughout the state which is reflected by the state's production average projected at 800 lbs. of lint per acre.

Despite widespread use of at-planting insecticides, thrips infestations built to damaging levels across the state requiring treatment. Cotton fleahopper infestations reached damaging levels in late-June. Many fields received two insecticide applications to prevent significant yield loss. Bollworm pressure was spotty emphasizing the importance of scouting. Conventional cotton received 1 or 2 insecticide applications to prevent worm damage. Populations spilled over into Bt cotton requiring over-sprays in approximately 22% of the Bt acreage estimated at 92,000 acres.

South Carolina

Early season thrips populations, mainly tobacco thrips, were moderate-heavy in 2005. Temik 15G (5 lbs.) provided better control than the seed treatments of Gaucho and Cruiser. At 14DAP, all treatments were controlling nymphs; at 27DAP, Temik was significantly better than either of the seed treatments. This is similar to what has been seen in previous years. Foliar applications or Orthene were not affected when applied in combination with Roundup. In SC, 95%+ of the cotton acreage was treated at planting with some rate of Temik 15G (usually 5-6 lbs.).

In 2005, 83% of SC cotton acreage was BG/RR, 3% was BGII/RR, and 13% was RR only. Bollworm/armyworm pressure was light throughout the year. Very little cotton was treated for the “worm” complex. Where bollworm treatment was necessary, synthetic pyrethroids were the materials of choice. One location was reported to have possible resistance; surviving larvae from this location were identified as bollworm.

Piercing/sucking bugs were the major pests of cotton in SC in 2005. Lygus numbers were high during early-mid boll set with stinkbugs becoming the predominant pests from mid-late boll set. Consultants and crop advisors use the 20% boll damage threshold to initiate piercing/sucking bug treatments. The treatment of choice is a high rate of a synthetic pyrethroid; very little organophosphate is used in SC. The predominant stink bug species this year was green stink bug, followed by brown and Southern green stink bugs. Most of the acreage was treated 2X with some being treated 3X for the piercing/sucking bug complex.

Tennessee

Tennessee planted and harvested about 610,000 acres of cotton in 2005. About 94% of the crop was *Bt* cotton, with DP444 BG/RR being the dominant variety. Other commonly planted varieties included ST5599 BR, PM1218 BG/RR, FM960BR and DP432 RR. There was an excellent early May planting window, and most cotton in Tennessee was planted from May 3 - May 20. This planting window was followed by dry weather, and many fields received little or no rainfall after planting and during June. Dry weather persisted in some areas during July. Despite the lack of early-season rainfall, the final yield average in 2005 was ≈ 800 lb lint/acre and is the second highest yield on record for Tennessee. The highest recorded yield for Tennessee was observed in 2004 (900 lb lint/acre).

Like 2004, the 2005 season was characterized by relatively few insect problems. Statewide insect-induced yield losses were among the lowest on record, estimated at 3.26%. The estimated average cost of insect control was $63/acre, including the cost of boll weevil eradication (≈ $12/acre) and *Bt* technology fees (≈ $16/acre). Overall insect control costs have dropped significantly in the last two years because of decreases in costs for *Bt*-technology fees and assessments for boll weevil eradication. Price structuring for *Bt* and glyphosate technology traits make it difficult to partition Bt technology costs when producers select Bt/RR stacked varieties.

Boll weevil eradication efforts continued throughout West Tennessee, and no yield losses caused by boll weevils have been reported for four consecutive years. A total of 162,214 boll weevils were captured during 2005 in West Tennessee. This is a 68% reduction in the number of weevils captured compared with 2004. Middle Tennessee, representing about 26,000 acres of cotton, is in a maintenance phase of eradication and continues to be free of boll weevils.

Thrips infestations were generally light to moderate. At-planting insecticide applications, including seed treatments, are used in over 95% of cotton fields in Tennessee. However, some foliar post-emergent applications were made to control thrips. Prior to bloom, light to moderate populations of tarnished plant bugs were treated in many fields. A high percentage of growers continue to make scheduled, often unnecessary applications of Centric, Trimax or other insecticides during this time frame. Early, intense spider mite infestations occurred in isolated areas, mostly in Carroll, Dyer and parts of Gibson Counties. Populations developed in seedling cotton and persisted through much of June and early July. Many fields in these areas were treated, usually with Kelthane (dicofol), which provided good control.

Tobacco budworm infestations were rare in 2005, and bollworm populations were also low with an unusually late flight that occurred after August 10 in some areas. In a late-season survey, we found an average of 1.5% boll damage caused by caterpillar pests in non-*Bt* fields, slightly less than in 2004. On average, only 0.1% of bolls in *Bt* cotton fields were damaged by caterpillar pests, again slightly less than in 2003. Some isolated, late fall armyworm infestations may have also contributed to this injury. Many *Bt* fields were not sprayed for bollworms or other caterpillars pests.

Stink bugs infestations were fairly common in West Tennessee, and some cotton fields were sprayed specifically for this pest in 2005 during July and early August. Depending upon location, tarnished and/or clouded plant bugs were also common pests during late July and August of 2005, and many fields were treated for plant bugs during this time frame. In a damage survey, late-season boll injury caused by stink bugs and plant bugs averaged about 4.3% (about 1% more than 2004). Hemipteran pests continue to be important in the low-spray environments resulting from boll weevil eradication and the use of *Bt* cotton.

Cotton aphids, beet armyworm, loopers, whiteflies, European corn borers, other insect pests and slugs were of minor importance in 2005. One uncommon pest observed in 2005 was the vegetable weevil, cutting stems in seedling cotton similar to cutworm injury. Several no-till fields in Haywood County required treatment for this pest. Pyrethroid insecticides appeared to provide adequate control.

Various insecticide and insect management trials were performed in 2005. The results of these evaluations and other information are available at www.utcrops.com.

Texas

Overall, the Texas crop was another record setting crop with a projected 5.5 million acres harvested and a projected 8.2 million bales. Planted acreage is projected at 5.9 million acres with most of the acreage lost in the High Plains due to two weather events. Despite the record yields across the state, there was wide variability among the different production regions.

All of the production regions entered the planting season with adequate moisture to establish a stand. However, most of the state went through a hot, dry period during May, June and most of July. This dry period had a severe impact on cotton in the eastern production regions and most yields in those areas (Lower Rio Grande Valley, the Coastal Bend, the Wintergarden and the Blacklands) had normal or below normal yields. The Coastal Bend and Lower Rio Grande Valley suffered some small losses to Hurricane Emily in late July but the overall impact was small. Timely rains in late July and August made the West Texas crop. Heat unit accumulations stayed above normal for most of the fall which allowed producers to produce high yields even in the northern production regions. Some later planted cotton yielded well but micronaire was affected by the cooler temperatures.

Most of the state relies on Roundup Ready® technology. Bollgard® (Bt) technology is planted on approximately 20% of the acreage up from 17% in 2003. The increase is primarily due to the adoption of longer season varieties in the High Plains of Texas. Bollgard® still dominates in the eastern part of the state where bollworms are more of threat and the Far West where pink bollworms are a key pest.

Insect problems depended on which part of the state was reporting. Overall, insect pressure was generally reduced compared to 2004. Although thrips were a problem in the production regions north of Texas, overall thrips damage was light due to favorable growing conditions early in the season. Cotton fleahopper populations were expected to be high due to good fall and late winter rains that produced numerous wild hosts, but populations remained low. This allowed the crop to have one of the best initial square sets in years. One unusual pest in the Coastal Bend was the cabbage looper. Infestations developed on small cotton and persisted for two to three weeks. Some fields were treated due to loss of leaf tissue and terminals. Cotton aphid problems were scattered across the state, but again, good growing conditions and limited early season insecticide applications allowing natural enemies to increase kept cotton aphid populations in check. Bollworms were a problem in the eastern part of the state and in the southern part of the Rolling Plains production region. The most severe damage occurred in the Rolling Plains. In addition, fall armyworms were a problem in the Coastal Bend and caused some economic damage in the Rolling Plains and Far West production regions. The Bt cotton technology required at least one application for bollworms and fall armyworms in areas where populations reached thresholds. Bollgard® II did not require any insecticide for lepidopteran pests although there were some reports of damaged bolls from fall armyworms in some of the FiberMax varieties. No reports of field failures with the pyrethroids were reported, however, overall control was not as high as in previous years in the Coastal Bend. Stink bugs were also a minor problem in the Coastal Bend region.

All of the state is now in boll weevil eradication. The Lower Rio Grande Valley (LRGV) and the Northern Blacklands were in the first year of eradication and went through fall diapause applications. Populations of boll weevils in the LRGV are high with significant trap captures occurring in November and December despite all the cotton being out of the field. Most of the state saw lower numbers for the year with some late season migration causing trap numbers to peak.

Lower Rio Grande Valley (LRGV). The crop weather was poor for the Lower Rio Grande Valley (LRGV) dryland and good for the irrigated farms in 2005. Heat units were below average in March, April and May and above average in June, July, and August, 2005. The 2005 total monthly accumulated heat units was above the average total monthly accumulated heat units. The higher heat unit accumulations were the result of less cloud cover throughout the growing season. No significant rainfall was recorded during most of the production period of February through July. Hurricane Emily made landfall on July 20 approximately 100 miles south of the Texas border, bringing destructive rain and wind to the valley. Unfortunately most of the dryland cotton farms and some irrigated acreage were defoliated and ready to harvest. Estimated cotton yield loses ranged from 1 to 40 percent. An estimated 10% of the cotton crop was harvested prior to the hurricane. The later maturing fields that had adequate irrigation water and timely rain showers produced good yields. However, for the majority of the cotton crop, the yields were less than average. Total planted acres in the LRGV in 2005 were approximately 181,594, down from the near 207,000 acres planted in 2004. Total bales harvested this season were 154,369 compared to 328,500 in 2004. Overall, yields averaged 0.85 bales per acre, based on 2005 planted acres.

The Boll Weevil Eradication Foundation began their fall diapause sprays during the week of June 20, 2005. The Boll Weevil Eradication Foundation assessment was $14 per dryland acre and $28 per irrigated acre. The heat units accumulated rapidly and several fields within Willacy County had reached 10% cracked boll July 4. Growers received a 2% discount if the Boll Weevil Eradication Program assessment was paid in full by June 30. Additional, growers received a $2.00 per acre credit if stalks were destroyed by August 18 and the field remained free of hostable plants until December 31, 2005.

Boll weevils were the only insect that posed any significant threat to the yield potential of this year's crop. Boll weevils were present throughout the season and prevented most of the top crop from becoming harvestable. Cotton fleahoppers were an issue in April and May, with some fields being treated. Thrips were observed in larger numbers close to or adjacent to maturing onion fields in April, particularly in the mid-valley area. Damage to cotyledon stage plants was reported, with some fields requiring insecticide applications. Cabbage looper larvae were observed starting at the 1st of April and continued through May. A large population of cabbage looper moths was observed in northern Willacy County at the end of May, after which the population of looper larvae and adults declined. In mid-April beet armyworms started appearing in scattered spots throughout the valley, particularly on dryland farms. Terminal and square feeding was observed in some fields. Scattered fields held beet armyworms throughout the production season, but had minimal impact on yields. Spider mites were very sporadic and there were a few reports of whole fields being treated. The dry weather conditions probably enhanced the mite problems. Silverleaf whitefly infestations started to occur after bloom (mid-May and later). No significant impact on overall yield was indicated. Rains received during the month of July, washed off most off the accumulated honeydew and sooty mold on leaves and helped to reduce the insect populations.

Coastal Bend (CB). Cotton was generally planted in the favorable March and April periods except for about 25% that was planted late due to rainfall in the Lower Coast and Uvalde areas. Early moisture was generally good, but as the season progressed, drought conditions prevailed over much of the area and resulted in about a 27% reduction in yield; in some areas, the yield loss due to drought was much greater. Variety selection was about equally divided between FiberMax and Deltapine types.

Thrips populations were generally low until plants were in the five true-leaf or greater stage. At that time, very large migrations occurred, but plants were able to sustain growth due to warm conditions and advanced stage of plant growth. Fields planted late sustained thrips damage and required one insecticide treatment. Aphids did reach high numbers in a high percentage of fields but generally these infestations were short in duration and caused little damage. Cotton fleahopper infestation was generally low until near bloom. Most fields were treated at least one time for fleahoppers, but little impact was observed on lint yield. The bollworm accounted for the majority of Heliothines in cotton and required treatment on most of the non-Bt acreage; some Bt fields were also treated. Some loss was sustained from the bollworm and the insect was again difficult to control with pyrethroid insecticide during a three-week period. Fall armyworm egg lay was widespread and sustained late in the season about the time cotton of cut-out. In many cases the larvae never damaged fruit, but in some fields obvious damage was noted. About one half the treatments applied were actually needed since larvae simply did not survive long in many fields. Spider mites were widespread throughout all regions but generally did not cause significant damage. Stink bug numbers varied greatly throughout the region but continue to be of concern to growers. Some fields required treatment for stink bugs, but their numbers in general were less than in 2004. The boll weevil eradication program made excellent progress in the Upper Coastal Bend Zone and in parts of the South Texas/ Winter Garden Zone. The exception to obvious progress was in southern part of the zone and in the Winter Garden area. Boll weevil reproduction was obvious in many fields in the Winter Garden area. Late in the season treatment intervals in that area were reduced to five days. Cotton stalk destruction was considered very good, especially in the Lower Coast.

Blacklands (BL). Boll weevil dominated pest management activities in Blacklands cotton in 2005. Weevil infestations were widespread and intense and up to seven insecticide applications were applied for this pest. Also, boll weevil eradication began in this region. The first applications were made in mid-August. Although dry, open weather favored early harvest, cotton re-growth from shredded fields was common and many fields were treated multiple times by the Eradication programs in the fall. Stubble destruction by tillage was difficult due to dry soil. Thrips infestations were more intense than usual while fleahopper numbers were moderate to less than normal in some areas. Numbers of boll worm and other caterpillar pests were especially low and very few fields reached treatment thresholds. An estimated 65% of the acreage was planted to Bt varieties. Yields were above normal in the Northern Blacklands, averaging about 600 lbs/acre.

Rolling Plains (RP). Moisture conditions were good going into planting however, lack of rainfall in May, June and the early part of July impacted the establishment of plant stands. Soil temperatures were adequate by early May and a small percentage was planted the first two weeks of May. The use of Bollgard® increased dramatically, primarily in dryland acreage, increasing from 25% of the region to 40%. Planting moisture was somewhat limited in the last two weeks of May and the majority of the acreage was planted during the month of June. Once planted, growing conditions were favorable prior, except for moisture, to square initiation. Cotton aphids were present early but never built up to large numbers. Thrips populations were highly variable but generally well below threshold in the majority of the fields. Even in fields with high counts, growing conditions favored rapidly growing plants and damage was light across the area. Grasshoppers caused isolated problems in the southern part of the Rolling Plains. Cotton fleahopper numbers were normal and not many acres received an insecticide application. The area experienced two peaks of the bollworm egglay - in the second week of July and the second week of August. Although cotton tolerated the early flight, the cool, cloudy conditions seemed to prolong the flight and emergence and the northern area again experienced one of the toughest bollworm seasons in nine years. Approximately 40% of the fields were treated once for bollworms and a small percentage (<5%) received two applications in late July and early August. Bollgard® technology held up however 3% of these fields received an insecticide for bollworms. Some control failures with pyrethroids were reported north of Abilene but the problem turned out to be a misidentification of the larvae which were fall armyworms. Fall armyworms were a problem and adequate control was never achieved. Spider mites were a problem in cotton surrounded by corn. Harvest conditions were excellent with early yields of dryland fields were well above average and irrigated fields were averaging close to 1500 lbs lint. Cotton yields were above normal in the central region of the Rolling Plains but micronaire values were impacted due to later planting and cooler temperatures as fiber was maturing.

High Plains (HP). The 2005 season began with excellent subsoil moisture conditions from previous fall rains but turned dry in April and May, which impeded dryland planting and emergence in dryland fields. Rains began in earnest by July and continued into August for the southern acreage, with some communities receiving over 10 inches. Some areas to the northwest of Lubbock got heavy rains and some hail in late August. The late start for much of the dryland acreage (waiting on a planting rain) was beneficial as it resulted in summer rainfall patterns to fall in line to optimize yields. Timely rains reduced the needed for supplemental watering on irrigated land and moderate temperatures produced near optimal conditions for cotton production, maximizing the genetic potential of the current list of planted cotton cultivars. Rainfall totals at Lubbock were below the normal of 18.5 inches with just slightly over 15 inches through November. Some other areas finished up with above average rainfall amounts. Open weather and higher than usual humidity levels added to optimal production conditions. While it was cool in June above average temperatures and no significant rainfall in October and November has resulted in fiber quality greatly improved over last year. The exception could be lower micronaire, because of the addition of a later maturing top crop and bolls in 2^{nd}, 3^{rd} and 4^{th} fruiting branch positions that normally would not have opened. The open fall weather has shortened the harvest season considerably compared to last year's extended harvest period. But the sheer size of the crop will push ginning well into March 2006. A delayed plant-killing freeze occurred again in late November. Much of the cotton did receive harvest aid chemical applications, allowing harvest to begin well before the late November freeze.

Irrigated acreage will again yield up to 5 bales with an average across all acres predicted at about 713 pounds. A record production year is on track with 5.3 million bales projected for 3.45 million acres. This will beat the 2004 record of 4.8 million bales. Approximately 3.7 million acres were planted with about 100,000 acres lost to weather early and the rest later in the season. Abandonment was about 7%, significantly below average for the area. Seedling disease was minimal but verticillium wilt was widespread although not tremendously damaging to yields.

Insects reduced yield by 4.5%, up from 4% last year. But significantly reduced weather losses (11.3%) and record yields will mask most of this loss. Thrips infestations were high in the fields north of Lubbock where maturing winter wheat historically provides the source for much of these western flower thrips. Unlike the last couple of years, thrips infestations were of short duration, often disappearing by the 5^{th} true leaf stage. The use of at-plating insecticides usually provided sufficient residual activity to cover the infestation period. The Cruiser seed treatment has gained in popularity but still lasts 5-7 days less than Temik at the 3.5 pound per acre rate. Gaucho Grande did not appear to provide enough control improvement over Gaucho as a seed treatment for western flower thrips to make it competitive with Cruiser.

Square retention was again exceptionally high with most fields averaging over 95% for the first several weeks of squaring. The absence of early area-wide cotton fleahopper or western tarnished plant bug infestations, coupled with good growing conditions contributed to this high square set. Both of these pests were a minor problem in most fields during the early season with some increases in plant bugs later in the season. Fleahopper numbers were highest in the areas north of Lubbock but few fields required treatment. Only a very few fields required treatment for western tarnished plant bug infestations and these were usually associated with weed or crop hosts that were rendered unsuitable by mowing or by drying up.

Boll weevil numbers increased in a number of areas, especially late in the season. The entire High Plains area was under an eradication program but the spread of overwintering populations out of the St. Lawrence and Permian Basin Zones and optimal cotton growing conditions favored increased boll weevil problems. Weevil numbers were up in all zones with some reproduction detected in the Permian Basin (extensive), Western High Plains (isolated), and the Southern High Plains/Caprock (isolated) zones. The Panhandle Zone continues to detect zero weevils while the Northwest Plains Zone caught one weevil, probably a hitchhiker. The Northern High Plains zone trapped 17 weevils, the Southern High Plains/Caprock zone 368 weevils, the Western High Plains zone 354 weevils and the Permian Basin zone 27,046 weevils. Most of the area of the five High Plains zones was in Phase II of the Maintenance program with the Panhandle most likely scheduled to move to Phase III in 2006. This will greatly reduce trapping and extend trap-monitoring intervals except along highways.

Bollworm infestations were light in the northern areas until September when a heavy egg lay occurred from moths coming from maturing corn. Only a single major wave of activity was observed. Infestations of small larvae ranged between 2,000-120,000 per acre with most infestations averaging around 12,000 per acre. Our nominal threshold is 10,000 small larvae per acre. Approximately 80-90% of all these fields required a single application of a cypermethrin insecticide at a cost of about $6.00 per acre. Most of the Bollgard® fields required treatment but none of the Bollgard® II fields triggered an application. Acreage south of Lubbock was exposed to two generations of bollworms and later fall armyworms. Misidentifications often lead to the selection of an inappropriate insecticide and poor control when armyworms were involved. Up to three applications were made with only the first involving purely bollworms. The third application was probably unwarranted. Bollworms were treated on 50% of the acreage south of Lamesa. Fall armyworms were treated on 85-90% of this acreage at least once. No control problems were thought to be associated with resistance this year.

Aphid numbers were exceedingly low across much of the area again this year, probably due to a limited amount of early spraying and higher numbers of beneficial arthropods. Both aphids and spider mites were a problem south of Lubbock where multiple applications of pyrethroids and other insecticides reduced natural enemies and flared these pests. Up to 75% of the acreage around Lamesa and south was sprayed for aphids and 30-35% sprayed for spider mites. Many of these spider mite applications were probably unnecessary.

Pink bollworm infestations were less a problem this year than in 2004. Reduced overwintering survival as measured in emergence cage studies and increased use of Bollgard cultivars may have contributed to this decline. Planted Bollgard® acreage across the High Plains remains low at about 13%. An area-wide trapping program indicated pink bollworm moths were in virtually all High Plains cotton growing areas except the extreme north but field infestations were limited to the southern acreage. While over 20 insecticide applications were made to some fields in 2004, most infested fields received 3 or fewer applications with most addressing the emerging overwintered population of moths.

Far West Texas (FWT). Cotton producers across the Far West Texas production area generally experienced average seasonal temperatures and rainfall. In areas where predominately dryland cotton is grown precipitation was considerably above average and came at the most opportune timing, resulting in the highest yields reported for the area in over 25 years. Although yields were exceptional for this area of west Texas so were insect problems. Bollworms and beet and fall armyworms caused considerable problems over much of the area with some Bt cotton requiring treatment. Fall armyworms proved most difficult to control with less than acceptable control regardless of insecticide used. The El Paso and Trans-Pecos regions of west Texas; however, generally did not experience any serious threat from insect pests. Cotton fleahopper and Western tarnished plant bug were sporadic and wide spread with few acres treated.

Virginia

An estimated 93,000 acres of cotton were planted in Virginia. Early season conditions were generally challenging for cotton as cooler than normal temperatures persisted well into early June. This slowed seedling growth and resulted in increased levels of seedling disease. The remainder of the season was unusually hot and mostly dry. Although most of the cotton did get adequate rainfall, several localized areas experienced drought conditions. The fall season was very favorable with unseasonably warm conditions lasting well into October. The high summer temperatures and late fall allowed most of the crop to 'catch up', with the exception of the driest areas where cotton cutout early. With the exception of the driest areas, yields are expected to be in the 800-1100 lb lint per acre range. USDA is predicting a state average of 675 lb lint per acre – but our cotton specialist estimates a 940 lb state average. An estimated 6% of the cotton acreage was planted to Roundup Ready, alone, varieties, primarily DP 432RR and DP 434RR. Less than 2 percent were planted to conventional varieties. The majority (90+ percent) was planted to stacked gene varieties, primarily RR/BG varieties.

Thrips – The long, cool spring slowed seedling growth, but also delayed thrips emergence. When temperatures warmed, both began to 'catch up', which resulted in large migrations of adult thrips into fields just as seedlings were beginning to grow. Unprotected (not treated with insecticide) seedlings experienced severe levels of injury and many were killed. This resulted in an ideal environment for assessing insecticide control options. The delay in growth also resulted in loss of efficacy of some in-furrow and seed applied insecticides, which caused many producers to make foliar insecticide applications. Collections of adult thrips throughout the season showed that greater than 90 percent were *Frankliniella fusca*.

Aphids – Cotton aphid populations were reported in some fields early in the season, basically disappeared, then reappeared (along with whitefly, species unknown) after bollworm sprays later in the season (mid-August and September). Natural enemy populations were aggressive and in most cases, eliminated aphids before insecticide treatments were needed. No acres were known to have been treated. Some honeydew collected on leaves and terminals, but no cotton was known to develop sooty mold on open boll lint.

Survey to track levels of stink bug and bug induced boll damage – A total of 22 cotton fields in eight southeast Virginia counties were scouted from squaring (July 7) to boll formation (August 2) for stink bugs and levels of internal boll damage. Insects were monitored using a total (all fields, all dates) of 310 25-sweep net samples and 310 6-foot beat sheet samples. After boll formation, a random sample of 100 quarter-sized bolls was removed and inspected for internal damage caused by bug feeding. The survey showed that there was a total of only 13 (nymphs

+ adults) green stink bugs and 13 brown stink bugs found for all sites, all sample dates. The level of internal boll damage symptoms was also low, ranging from zero to less than 10 percent.

Bollworm – Bollworm populations were low compared with most years. This was predicted based on the mid-July field corn survey (only non-Bt corn varieties were surveyed). A total of 7,750 ears were sampled from commercial corn fields in 23 eastern Virginia counties. Percent infested corn ears for the cotton growing counties averaged 30.7 percent compared with 53.5 percent in 2004. Moth activity was also generally low throughout the season, based on weekly trap catch data from a series of 19 blacklight traps placed throughout eastern Virginia. Egg thresholds did occur in conventional (non-Bt) cotton, but were delayed by 7-10 days compared with most years.

Pyrethroid resistance was monitored using the vial testing program (G. Payne supplied pre-treated vials). A total of 1812 moths were tested from three locations and had mean survival rates of 1.3 and 0.3 percent at the 5ug and 10ug cypermethrin rates, respectively. These were similar to survival rates determined in the previous years.

Spider mite – Spider mites persisted at low levels in many fields causing some leaf reddening. An estimated 1000 acres were treated for spider mites.

Boll weevil – none trapped.

Others – No damage to cutworm, European corn borer, fall armyworm, beet armyworm or loopers was reported.

Research Progress and Accomplishments:

Arizonia

Arkansas

Colonies of Helicoverpa zea and Heliothis virescens continue to be assayed for Cry1Ac susceptibility in diet incorporation assays at the University of Arkansas. Variability among H. virescens colonies is low. Efforts continue to develop baseline susceptibilities for H. zea and H. virescens to Cry2AB and Vip3a proteins.

Efforts to understand spatial and temporal patterns of insect infestations across large cotton production units continued in 2005. Historical data for Wildy Farms in Mississippi County, Arkansas and R.A. Pickens and Sons in Drew County serves as a benchmark for this effort and as a management example for other systems. The collective dataset includes pheromone trap captures, insect scouting records for individual fields, COTMAN observations, production inputs, and yield as associated with spatial arrangement of crops across the large farms.

Plant bug sampling study was conducted evaluating the efficiency of various sampling methods including shake sheet, sweep net, modified whole plant search, blooms, etc. The shake sheet and sweep net appear to be the most efficient methods for sampling for plant bugs in cotton. Insecticide termination studies continue for late-season stink bugs in second-generation Bt cotton.

Extension of ARS research on area-wide early season suppression of tarnished plant bug by controlling broadleaf weeds in late winter-early spring continued for the second year in 2 areas in Arkansas. Dry weather early in the year reduced weed populations overall with differences not being as great in both areas as in the previous year.

Research continues on defining the interactions of plant bugs and other stresses on the cotton plant such as irrigation timing, etc. and their effects on yield.

A recently developed aphid threshold incorporating beneficial insect counts, specifically coccinelids was again verified in several grower fields this season. On average, growers saved one insecticide application with no yield loss with the new threshold.

A study was conducted evaluating the effect of burndown timing of wheat cover-crop on in-furrow insecticides and seed treatments efficacy against thrips. Due to the extremely dry conditions early in the season, data was highly variable. Plans are to repeat the study in 2006.

Insecticide efficacy trials were conducted targeting spider mites, thrips, plant bugs, stink bugs, bollworm, tobacco budworm, fall armyworm and cotton aphids at several locations across the state.

California

Research on late-season aphid ands whitefly continued in 2005. A defoliation/insecticide study was conducted at two locations to address some of these questions. The Tulare County location was primarily infested with whiteflies and the Kern County location had an aphid infestation. Various combinations of harvest aids with and without an insecticide were evaluated. Pest levels, honeydew production, defoliation success, regrowth amount, lint sugars, and lint stickiness were evaluated in this team effort of entomologists and agronomists. **(Kern and Tulare County, UC Cooperative Extension; UC Davis; USDA-ARS, Shafter)**

Efficacy studies were conducted on lygus bugs, spider mites, and cotton aphids. On lygus bugs, F1785 50DF (flonicamid – 2.56 oz/A) and BAS320 (11.4, 13.7, and 16 oz./A) were compared with grower standards. On spider mites, Denim (8 and 12 fl. oz.) and Prev-Am (0.6%) were compared with standard materials and newly registered products. Aphid control was evaluated with F1785 50DF (flonicamid – 2.02 and 2.56 oz/A) and Prev-AM (0.6%) plus new formulations of Lorsban and Assail. Seed treatment trials with Avicta were conducted to evaluate early season insect control. **(Cooperative Extension, UC Davis)**

Biological control of *Lygus* continues with isolates of *Beauveria bassiana* from California populations as well as commercial strains **(USDA-ARS Shafter)**. *Peristenus* for *Lygus hesperus* management continued to be evaluated. **(California Dept of Food and Ag).**

Research continues to be conducted on *Lygus* movement between crops and the role of the cropping landscape on infestations in cotton in the San Joaquin Valley. Weedy rangeland provided a research opportunity to investigate the role of wild hosts in contributing to *Lygus* population densities in neighboring crops. Specific studies measuring movement of *Lygus* from alfalfa were conducted **(USDA-ARS; UC Cooperative Extension).**

Louisiana

Several studies evaluated the efficacy of selected insecticides for control of tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), in cotton. In one test, Centric 40WG, Vydate 3.77L, Orthene 90S, Bidrin 8E, and Diamond 0.83EC significantly reduced nymphs compared to Trimax 4F and the non-treated control. In a second test, all insecticide treatments (Orthene, Orthene + Diamond, Trimax + Diamond, Bidrin + Diamond, Centric + Diamond, Vydate + Diamond, and Dimethoate 4EC+ Diamond) significantly reduced adults and nymphs compared to the non-treated control. All of the insecticide treatments resulted in significantly higher seedcotton yields compared to the non-treated control. In a third test, plots treated with Orthene + Diamond, Trimax + Diamond, Bidrin + Diamond, or Centric + Diamond had significantly fewer adults compared to plots treated with Orthene and the non-treated plots. All insecticide treatments significantly reduced nymphs compared to the non-treated control. All insecticide treatments, except Orthene, resulted in significantly higher seedcotton yields compared to the non-treated control. In another trial, total numbers of adults and nymphs exceeded action levels (thresholds) to initiate treatments on 11, 7, and 2 of the 15 sample dates in the 5%, 10%, and 20% threshold plots, respectively. The 5%, 10%, and 20% threshold plots received 8, 6, and 2 insecticide applications, respectively. The 5% and 10% threshold plots produced significantly higher seedcotton yields compared to the 20% threshold plots.

The effects of liquid spray nozzles on insecticide efficacy were evaluated in field tests against selected cotton pests. Air induction (low-drift, venturi-type) nozzles have been effective in herbicide applications while reducing off-target drift of sprays. Hollow cone nozzles are highly effective in insecticide applications, but generally produce a droplet spectrum that is prone to drift off-target. The results consistently showed that insecticide efficacy levels are lower using air induction nozzles compared to that for hollow cone nozzles. Insecticides applied through air-induction nozzles produced significantly lower mortality or reduced field control on thrips, *Frankliniella spp.,* cotton aphid, *Aphis gossyppi* Glover; bollworm, *Helicoverpa zea* (Boddie); and brown stink bug, *Euschistus servus* (Say), than that recorded with insecticides applied through hollow cone nozzles.

The second year of another study validated the influence of Southern green stink bug, *Nezara viridula* (L.), adults (female and males), and nymphs (fourth-fifth instar) on boll abscission and yield loss. Cotton bolls of several age classes (0-50, 51-100, 101-150 through 551-600 heat units) were infested with one insect of each gender or life stage for 72 h. Seedcotton yields of bolls infested with adults and late instar nymphs in age classes of 0-500 heat units beyond anthesis were significantly lower compared to that of non-infested bolls. There were no significant differences in boll abscission and boll weights between bolls infested with adults and nymphs or between bolls infested with adult males and adult females compared to that of non-infested bolls.

In 2005, pheromone-baited wire cone traps and the adult vial test (AVT) were used to survey pyrethroid susceptibility in bollworm. Over 2,000 moths were evaluated for pyrethroid susceptibility using the adult vial test (AVT) from May to Sep during 2004 and 2005. In 2004, bollworm survival at 5 µg/vial during May, Jun, Jul, Aug, and Sep was 9%, 16%, 30%, 21%, and 30%, respectively, with a mean survival of 23%. In 2005, survival at 5 µg/vial during May, Jun, Jul, Aug, and Sep was 23%, 34%, 43%, 43%, and 38%, respectively, with a mean survival of 38%. Bollworm survival during 2005 was at the highest level recorded in Louisiana. Mean annual survival of bollworm exposed to 10 µg/vial for 2004 and 2005 was 12% and 22%, respectively. In 2004, LD_{50}'s of bollworm larvae from Louisiana field colonies collected at St. Joseph, Bossier, and Winnsboro in topical bioassays were 1.28, 3.24, and 6.12 µg/g, respectively. The Winnsboro colony tested in 2004 had a resistance ratio that was 7 to 22 fold higher than the pyrethroid-susceptible colonies tested during 1998. In 2005, LD_{50}'s of Louisiana colonies from samples collected near Somerset, St. Joseph, Sicily Island, St. Francisville, and Winnsboro were 0.68, 2.04, 2.04, 2.20, and 3.48 µg/g, respectively. Although these data clearly show bollworms are becoming less susceptible to pyrethroids in laboratory tests, no field control failures of bollworms with pyrethroids have been reported in Louisiana to date.

The performance of transgenic *Bacillus thuringiensis* (Berliner) *var. kurstaki* (Bt) cotton lines from Monsanto (Bollgard 2), Dow AgroSciences (WideStrike), and Syngenta (VipCot) were evaluated against selected pests during 2005. In field trials, all Bt cotton lines significantly reduced tobacco budworm, *Heliothis virescens* (F.), and bollworm damaged and infested fruiting forms compared to non-transformed parental cotton lines. The available data for these technologies shows higher efficacy against bollworm and satisfactory control of a wider spectrum of lepidopteran pests compared to other single Bt protein technologies. A laboratory study quantified heliothine survivorship on reproductive structures of a VipCot cotton line and showed nearly 100% mortality on VipCot plant terminals and flower petals. Tobacco budworm larval mortality was significantly lower on whole squares, square bracts, and bolls of VipCot compared to that for bollworm larvae. Fall armyworm, *Spodoptera frugiperda* (J. E. Smith), (2-d- and 5-d-old larvae) were exposed to WideStrike, Bollgard, and Bollgard 2 technologies using two methods. Larvae were confined on the white flowers of field-grown plants with cages and also infested on excised cotton tissue in plastic dishes within the laboratory. In field tests, WideStrike plants had significantly fewer abscised bolls, injured bolls, and numbers of larvae compared to that on non-Bt plants. Bollgard 2 significantly reduced the percentage of bolls penetrated by 5-d-old fall armyworm larvae compared to non-Bt cotton. In the laboratory tests, WideStrike significantly reduced larval survival compared to larvae on the non-Bt control. Mortality of 2-day-old larvae on Bollgard 2 occurred significantly faster compared to that on Bollgard or non-Bt cultivars.

A macro-scale project evaluating the effects of native winter-spring host plant management on tarnished plant bug infestations in cotton was conducted in Tensas Parish, LA during 2005. This study was conducted on commercial farms near Newellton and Waterproof, LA. Two sites, a treated and a non-treated site, were established. The treated site was ca. 1554 ha (3840 acres) and the non-treated site was ca. 2331 ha (5760 acres). Each site was divided into four quadrants and during January, 100 sample locations were established at each site (25 per quadrant). These locations were sampled with a 38.1 cm diameter sweep net from February until June at least bi-weekly to estimate densities of tarnished plant bug adults and nymphs. During late February to early March, a combination of 2, 4-D, mecoprop, and dicamba (Strike 3EC; Agriliance, LLC, St. Paul, MN), was applied to the field margins at the treated sites to destroy all broadleaf plants. These herbicide applications were made ca. three to five weeks prior to cotton planting. Random cotton fields within each quadrant at each site were sampled with a sweep net at least weekly to estimate the densities of tarnished plant bug adults and nymphs from June until August. Plant bug densities on native vegetation were similar at each site prior to herbicide application. Following herbicide applications to field margins, densities of tarnished plant bug adults and nymphs at the treated sites declined and remain low until the end of sampling in May. Densities of tarnished plant bug adults and nymphs collected from cotton fields at treated and non-treated sites were generally similar during mid to late June. Densities of tarnished plant bug adults were ca. 2.6 fold higher in cotton fields at the non-treated site compared to fields at the treated site during early July. During mid to late July, plant bug adult densities were higher in cotton fields at the treated site compared to the non-treated site. Densities of tarnished plant bug nymphs were 1.1 fold to 2.2 fold lower in cotton fields at the treated site compared to fields at the non-treated site from mid June to late July.

A USDA-IFAFS and NASA-AG2020 sponsored project continued during 2005 with the objective of adapting precision agricultural technologies for use in Mid-South cotton IPM strategies. Four years of experiments (2002-2005) have evaluated spatially variable insecticide (SVI) application technologies in Louisiana. These studies compared the efficacy and value of SVI (yield-based and crop profit-based prescriptions) applications to that of whole-field broadcast treatments. Twenty-two insecticide applications were successfully accomplished during this period of testing. Using standard statistical analyses, no significant differences in yields between the SVI prescriptions and whole-field broadcast treatments were detected. Insecticide inputs were reduced by $5 to $14 per acre and the actual sprayed acreage was reduced 13% to 32% using the SVI prescriptions compared to that of the whole-field broadcast sprays. These data suggest that management zones for reducing insecticide inputs in cotton can be developed from geo-referenced yield and crop profit maps. Additional data analyses and validation studies are being performed to confirm these results. The benefits of SVI applications in cotton include lower production costs, less total pesticide load in the environment, and a decrease in off-target drift of spray. **(LSU AgCenter's Northeast Research Station, St Joseph and Winnsboro, LA; Louisiana Cooperative Extension Service, Winnsboro, LA; and Department of Entomology, Baton Rouge, LA)**

Mississippi

Missouri

New Mexico

With boll weevil and pink bollworm eradication programs in place most research is addressing bollworm or lygus control. The impact of microclimate on insect pest populations is being evaluated with an emphasis on bollworm mortality. Field tests were conducted to evaluate the impact of irrigation on crop microclimate, bollworm mortality and egg predation.

Yield compensation testing for simulated bollworm injury indicated that removal of up to four squares did not result in significant yield losses. Removal of eight squares over two weeks however did produced losses, 23-26% less than undisturbed plots. Removal of four bolls one time resulted in 10-31% losses. Removal of eight bolls over two weeks resulted in 49-57% losses. Plants compensated for injury primarily by retaining more squares or bolls. Some square removal treatments resulted in significantly larger bolls with more lint per lock.

A study was initiated this year to determine potential economic impact of lygus damage. A secondary objective is to develop a guide to lygus feeding signs in squares and bolls. Other research on lygus for the last three years indicated that lygus can be controlled by the beneficial complex in the Mesilla Valley of New Mexico. Predator/ prey ratios were highest when no insecticides were used. Lygus numbers were lowest under no insecticide use.

A study was conducted with the USDA Cotton Ginning Laboratory to determine potential impact of thermal defoliation on insects impacting sticky cotton. Results are reported elsewhere in 2006 Proceedings.

North Carolina

Much of this project's applied research effort was directed toward thrips and stink bug management in 2005. Most of our project's 2005 applied research results may be found at:
http://ipm.ncsu.edu/cotton/insectcorner/Research/2005/index.html

Four at-planting insecticide tests evaluated the impact of granular insecticides, seed treatments, foliar applications, and combinations, on plant development, maturity, and yield. Moderate thrips pressure, coupled with extended cool conditions provided good yield separations between some treatments, with differences between recommended standards (primarily Temik 15G at 5.0 lb./acre, or a seed treatment plus an Orthene foliar spray @ 1st true leaf stage) and check plots exceeding 300 pounds lint /acre averaged over three tests. Cruiser and Gaucho Grande with the above overspray proved statistically similar to each other and to Temik 15G in all parameters tested (thrips levels, stand establishment, plant heights, dry weights, node of first fruit, node to height ratios, maturity indices, and yield). A late-planted (May 19) at-planting insecticide test confirmed our general recommendation of significantly less insect protection needed in late planted cotton.

Seven major stink bug tests were carried out as part of 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" Our project was responsible for research toward two of the grants' objectives: 1) development of practical treatment thresholds for sucking-bugs in cotton, and 2) efficient detection methods for sucking-bugs or their damage in cotton. In seven, 8-treatment, replicated small plot tests (2 in cooperation with Phillip Roberts and John Ruberson at UGA Tifton), weekly data were taken on square retention, bugs collected via drop cloth sampling, dirty bloom assessments, all bugs collected via crawling through treated plots, boll diameter measurements for determination of number of bolls/acre of all sizes throughout the season, damage of both quarter-sized and year end bolls, yields and quality. These tests were set up as progressively protected plots ranging from an untreated check up through plots that were treated 7 times beginning at anthesis. In this initial year's series of studies, NC's stink bug populations were dominated by green and brown stink bugs while the southern green stink bugs were the most common species collected in GA. In 2005, plant bugs constituted a small component of the sucking bug complex in most tests. The relationship between stink bug damage to both quarter-sized and year end bolls was extremely variable, varying from less that half a pound of lint lost per 1% boll damage up to approximately 7 pounds. Protection from stink bugs appeared most critical in weeks 4, 5 and 6 of blooming and less so during the 2-3 weeks of blooming and after the 6^{th} week of blooming.

In connection with the above stink bug study, PhD graduate student Eric Blinka (directed by Drs. Bradley and Van Duyn) utilized 35 of our project's statewide network of black light traps to investigate the temporal and special relationship cropping patterns and green sink bug levels.

An 18-treatment replicated test of various cotton insecticides were evaluated for green and brown stink bug nymphs and adults in a large soybean field.

Our project's annual damaged boll survey continued in 2005 and included 186 total conventional, Bollgard, Bollgard II, and Widestrike producer managed cotton fields. Stink bug damage to bolls was 5.8, 6.8, 8.1, and 10.1% for the above technologies, respectively. Bollworm damage to bolls was 4.32, 1.2, 0.16 and 0.5%, respectively, for these technologies. Although the BG2 fields showed only slightly lower bollworm damage than the Bollgard cotton fields (0.16 vs. 1.2%), very small in both cases, the approximately 8 to 9 fold higher survivorship in the Bollgard cotton fields, in line with numerous other studies, illustrates the resistance management advantage for this higher toxin dose technology. European corn borer and fall armyworm damage to bolls was virtually nonexistent in 2005.

An annual survey of North Carolina's licensed independent crop consultants working on cotton was continued in 2005 to gather data on how second generation (June and early July) tobacco budworms, late-season bollworms, thrips, cotton aphids, and plant bugs were managed by these individuals in conventional and in Bollgard cotton. 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 the 720,000 acres of Bollgard cotton planted in NC in 2005, 10.2% was not treated, 68.7% was treated one time, 20.0% was treated 2 times, and 1.1% was treated 3 times.

Oklahoma

Several Bt cotton trials were conducted in 2005 to further evaluate the value of this technology under Oklahoma conditions. Eighty percent of the Bt varieties grown under irrigation produced significant more cotton fee than their parental varieties to compensate for their technology rental compared to 69% for Bt varieties under dryland production.

This was the ninth year that Heliothine infestations failed to reach levels in economic threshold trials to activate insecticide applications. Heliothine pressure remained below 5 larvae (> 3/8 inch long) per 100 terminals in all varieties. Insecticide protection was planned in Bt varieties if infestations approached 10 larvae (> 3/8 inch long) per 100 terminals. Biweekly tagging of eggs and newly hatched larvae revealed no Heliothine survival on Bt tagged plants. All newly hatched larvae died before any of the larvae reached ½ inch long.

A cotton thrips insecticide trial revealed no significant differences in yields between treatments. However, the untreated check 1398 lbs lint /acre out produced the Cruiser plus Orthene treatment 1339 lbs lint/acre.

A cotton fleahopper insecticide test was conducted on both Bt and conventional cotton varieties. Cotton fleahopper densities were significantly less for all the insecticide treatments from the untreated check for both Bt and conventional cotton 3 DAT and 7 DAT. There were no significant differences in treatment yields. The top yielding treatment was the same for both varieties - Intruder .026lbs AI / A plus Crop oil produced 1,382 lbs (Bt) and 887 lbs lint/acre compared to the untreated check which yielded 1,145 lbs (Bt) and 735 lbs lint/acre.

South Carolina

Studies were conducted in 3 locations using two varieties in an attempt to refine the current 20% boll damage threshold. Treatments were: 1) weekly beginning at first bloom, 2) 20% threshold, and 3) untreated. Lint yields were used to determine differences among treatments. Treatments were pyrethroids at high rates. The 20% treatment threshold (sprayed 2X or 3X depending upon location) increased yields an average of 165 lbs. of lint compared to the untreated check. An additional 64 lbs. of lint was acquired by the weekly treatment (sprayed 5X or 6X). The yields from these studies indicate the established 20% boll damage threshold for piercing/sucking bugs is valid.

Tennessee

The granular experimental insecticide from Bayer (KC 791230) was evaluated for a second year for thrips control on seedling cotton. Thrips damage ratings in the KC 791230 plots were significantly lower than in the Temik plots, but did not differ from Cruiser and Gaucho Grande. Thrips larval numbers 25 DAP were significantly lower in treated plots compared to the control, but at 32 DAP, only larval numbers in Temik and KC plots differed from the control. Aphid and mite numbers, flower counts and yield were not affected by treatment. In a second test comparing Gaucho Grande, Gaucho Grande + Poncho, and Cruiser, damage ratings in Gaucho and Cruiser plots were lower than in the control. Gaucho + Poncho ratings were intermediate, but lower than in the control. At 33 DAP, there was no damage rating or leaf area difference among treatments and all were lower than in the control. Thrips larval numbers 32 DAP were lower in Gaucho and Cruiser treatments, but Gaucho + Poncho did not differ from the control. Aphid numbers and yield did not differ among treatments and the control. The seed treatment nematicide, Stan, was evaluated in combination with Cruiser for thrips control. Cruiser was compared to Temik, Gaucho and Gaucho Grande for thrips control, but the latter were not used in combination with Stan. There were no negative effects of combining the nematicide with Cruiser. Leaf area among treatments 33 DAP did not differ among treatments, but all were different from the control and Stan. Thrips larval numbers at 17 DAP were lower in all treatments compared to the control, but numbers in all insecticide treatments were lower than the Stan treatment. At 25 DAP, thrips larval numbers were lower in all treatments (except Gaucho Grande) compared to the control, but the high Temik rate was superior to all treatments except the Temik treatment at 4 lb. At 32 DAP, only the Temik treatments differed from the control. At 32 DAP, mite numbers were significantly higher in Cruiser treatments compared to the control. Yield did not differ among treatments and the control. Avicta Complete Pak was compared to Cruiser and Temik treatments. Thrips damage ratings were reduced by all insecticidal treatments compared to the control and several Cruiser treatments were superior to the Temik treatments. Leaf area did not differ among treatments. At 32 DAP, thrips larval numbers in insecticide treatments were lower than in the control. Temik treatments had lower numbers than the Cruiser treatments. Aphid and mite numbers did not differ among treatments. Yield was higher in insecticide treatments compared to the control. Seventeen treatments were evaluated for plant bug control June 24 and July 1. Three DAT1, there were no nymphal differences among treatments and all were different from the control. Five DAT2, there were no differences among treatments. The treatments were applied again August 5 and 12 with high numbers of clouded plant bug. Clouded plant bug nymphal numbers were reduced 3 DAT3 by all treatments except Carbine, Centric, Diamond and Intruder compared to the control. Yield was not affected by multiple application treatments. Tarnished and clouded plant bugs and green stink bugs were caged on squares and bolls of know ages for 3.5 and 7 days. The effects of these infestations on fruit set, boll and lint damage are presently being measured in the laboratory. Roundup Flex, WideStrike Flex, Bollgard and Bollgard II Flex cottons were compared in sprayed and unsprayed plots for efficacy and yield. Square damage and numbers of larvae 86 DAP were reduced by all treatments compared to the Roundup Flex unsprayed control. Terminal, square damage and the number of larvae 93 DAP was comparably reduced. Fall armyworm feeding on bracts and the number of larvae 95 DAP was reduced in both WideStrike and Bollgard II unsprayed cottons compared to Roundup Flex and Bollgard unsprayed lines. Boll damage September 30 was reduced by technology or spraying. In the unsprayed portion, yields were higher in the Bollgard and Bollgard II lines. In the sprayed portion of the test, highest yields were obtained in the Bollgard plot and the others did not differ from each other.

Texas

A screening program to identify host plant resistance to cotton fleahopper evaluated 108 genotypes representing *Gossypium barbadense, G. mutselinum, G. tomentosum* and converted race stocks from Mexico. Plants were exposed to cotton fleahopper adults in cages in no-choice trials and squares were rated for damage by examination with a dissecting scope. Also, screening 150 wild race stocks from Mexico was initiated late in the fall when these day sensitive genotypes began squaring under shorter day lengths. Many of these exotic lines have not been previously evaluated for plant bug resistance and may provide unique sources of genetic resistance to cotton fleahopper and related plant bugs (**Knutson, TCE/TAES, Dallas**).

A statewide monitoring program for adult male *Helicoverpa zea* moths was conducted from May to October. Vials were prepared in the Department of Entomology Toxicology Laboratory at Texas A&M University, College Station, Texas. Moths were collected in Burleson, Nueces, Tom Green, Fisher, Hale, Ellis, Williamson, Pecos, Castro, Hockley and Uvalde counties. Over 4000 moths were tested and all data were analyzed in College Station using Probit-PC. High levels of resistance are present in Nueces and Williamson Counties. Burleson County saw a shift towards susceptibility in 2005. (**Pietrantonio, TAMU/TAES, College Station**).

Field experiments were conducted to quantify the effect of nitrogen fertilizer on cotton aphid population dynamics under a drip irrigation system. Soil residual nitrogen was determined for each treatment plot before treatment application and leaf nitrogen was monitored weekly for 5 weeks during July-August. Data will be used to establish a relationship between soil nitrogen and leaf nitrogen. (**Parajulee, TAES, Lubbock**)

The cotton arthropod predator complex was investigated in cotton as affected by crop management practices, including planting date, tillage system and cotton cultivar. Two tillage systems and two planting dates were evaluated looking at both conventional and transgenic Bt cotton cultivars. Cage studies were continued looking at predator-prey ratios. (**Parajulee, TAES, Lubbock**)

Two separate studies were continued to examine the ecology and behavior of *Lygus* spp. in the Texas High Plains. The first study looked at the influence of planting date (timely and late) on plant bug abundance. The second study measured the influence of irrigation on plant bug abundance. This study compared irrigation methods (drip and LEPA (low energy precision application) and irrigation levels (50%, 75% and 100% of ET (evapotranspiration) replacement). (**Parajulee, TAES, Lubbock**)

Lygus surveys were conducted in mid- to late April in 25 counties of the Texas High Plains. Surveys continued on a weekly basis in three of the counties. (**Parajulee, TAES, Lubbock**)

The role of transgenic Bt cotton in a low bollworm environment was investigated for the third year. The study compared a Roundup Ready cultivar, a Roundup Ready-Bollgard cultivar and a Roundup Ready-Bollgard II cultivar with the same recurrent parent line. Data show that even in a reduced bollworm environment that the evidence of damage is different in each of the cultivars with Bollgard II having significant less damage and bollworms. (**Parajulee, TAES; Leser, TCE, Lubbock**)

Insecticides include Cruiser, Gaucho Grande, and Orthene seed treatments. The Gaucho Grande and Orthene treatments are applied to seed at higher rates than in previous years. Granular materials include the standard Temik and a numbered granular material from Bayer (KC 79130). Pest insect numbers were generally not high enough to obtain striking results. (**Parker, Mott, Fromme, Jungmann, Sansone, Minzenmayer, TCE)**

Trials were established to look at new formulations of acetamiprid (Intruder) and imidacloprid (Trimax). All rates and both formulations of Intruder and Trimax provided excellent aphid control of a short-duration aphid infestation in cotton. Aphid numbers were not sustained long enough in the test to affect lint yield or quality. (**Parker, Sansone, Mott, Minzenmayer, TCE)**

A number of comparisons were conducted across the state looking at WideStrike and Bollgard. Most trials had extremely low bollworm infestations therefore, no insecticide treatments were applied to the conventional or Bt cotton varieties. There were no statistical differences in lint production. (**Parker, Minzenmayer, Sansone, TCE)**

Insecticides evaluated for use against cotton fleahoppers included Centric, Intruder, Trimax, Diamond, Orthene, and Bidrin. All products performed well. (**Parker, Sansone, Mott, Minzenmayer, TCE)**

Boll weevil resistance monitoring to malathion occurred in South Texas. Weevils from Cameron and Willacy Counties have statistically significant **resistance ratios** for both the LC50 and the LC90 with respect to the Mission susceptible laboratory colony. Boll weevils in Cameron and Willacy Counties may be more difficult to control with malathion. If other organophosphates are intensively used in the area, the weevils may have been non-targets but still may have been exposed and develop resistance. Willacy County should be the most closely watched since the LC50 is 3 times above that of the Mission Colony; we normally consider a "resistant population" when the resistant ratio is 5, but by then the frequency of resistance and the level of resistance from individual weevils (dose tolerated) may be too high for the insecticide to still be effective in controlling field weevils. We are also seeing that no mortality occurs at the lower vial concentrations, the line in the probit analysis appeared shifted to the right with respect to the Mission Susceptible colony. The slope for Cameron is high, all dying approximately within one log scale of concentrations (not too spread out) but dying at higher concentrations. (**Pietrantonio, TAES and Parker, TCE**).

Virginia

Thrips control – Eight field trials were conducted evaluating a total of 71 insecticide treatments for levels of thrips control and effect on lint yields. Treatments included Gaucho Grande, Poncho 600, Cruiser 5FS, Temik 15G, Orthene 97 and several experimental compounds (see below). Treatment timings included seed treatment, in-furrow at planting, or as foliar applications at either the late cotyledon-1st true leaf, or 2-3 true leaf stages. Lint yields for treatments ranged from 1134 to 1809 lb lint/A with an overall mean of 1481 lb lint/A. The untreated controls ranged from 802 to 1240 lb lint/A with an overall mean of 937 lb lint/A.

Bollworm control – Two field trials were conducted to evaluate varieties for effectiveness in managing damage by bollworm. In trial one, PHY 470WR, PHY 475WRF, PHY 440W, PHY 410R were evaluated alone, or treated two times with Tracer at 2.5 oz/A. There was essentially no boll damage in any treatments except PHY 410R with 53 percent boll damage when treated with Tracer, and 57 percent boll damage when left untreated. In trial two, varieties with three levels of genetic bollworm protection were evaluated, each treated with the recommended number of pyrethroid oversprays: level 1=no genetic protection (DP 432RR, DP 434RR, FM 989RR, ST 5303R); level 2=single Bt gene protection (DP 444BG/RR, DP 455BG/RR, FM 989BR, ST 4892BR); level 3=double Bt gene protection (FM 989B2R, ST 4646B2R, PHY 470WR). Level 1 varieties were treated two times with Baythroid – with 2.0 oz/A at egg threshold and again in 5-7 days with 4.0 oz/A; level 2 varieties were treated one time with Baythroid at 4.0 oz/A; and level 3 varieties were left untreated. With the exceptions of DP 432RR (5 percent boll damage) and FM 989BR (3 percent boll damage), all varieties had one percent or less boll damage.

Spider mite control – A nine-treatment test was conducted to evaluate efficacy against twospotted spider mite (Kelthane at 2.0 pt/A, Comite at 2.0 pt/A, Capture at 3.8 oz/A, Danitol at 1.0 pt/A, Danitol at 10.6 oz/A + Zeal at 0.66 oz/A, Danitol at 1.0 pt/A + Zeal at 0.66 oz/A, Zeal at 1.0 oz/A, and Oberon at 4.0 oz/A). On most post treatment sample dates, Kelthane, Comite and Danitol + Zeal (tank mixed) provided significantly better control compared with Oberon. The fewest mites were found in plots treated with Kelthane, or Danitol at the high rate (1.0 pt) + Zeal at 0.66 oz.

Association of external and internal boll symptoms with hard lock, lint yield, and quality – Five fields, three in North Carolina and two in Virginia, were determined to have adequate infestation levels of sucking bugs to be included in a detailed study. In each of those fields, an area large enough to accommodate the study was sectioned off using white poles and flagging tape.

To minimize further damage by insects, each study area was treated weekly with Assail 30SG at 0.002 lb ai/A plus Capture 2EC at 0.01 lb ai/A. Treatments were applied with a CO_2-pressurized backpack sprayer (39 PSI, 10 gallons per acre) using an offset boom with two TX10 hollow cone nozzles, one nozzle over the top of each row.

In each study area, 300 quarter-sized bolls were identified. The node above cotyledon on which the boll was found was recorded, as well as the number of external sucking bug feeding punctures (sunken lesions). Bolls were divided into three subsets of 100 bolls each: Same-day=bolls removed on the day the study was initiated; Time-skip 1=bolls removed at maturation (black seed coat); and Time-skip 2=bolls removed when fully opened. The bolls selected for Time-skip 1 and Time-skip 2 samples were identified with a numbered plastic tag and left in the field.

After removal, Same-day bolls were taken to the Virginia Tech Tidewater Agricultural Research and Extension Center, where they were dissected to determine levels of internal damage. Observations were focused on two areas: internal carpel walls and seeds. Carpel walls were inspected for the number of puncture marks, small warts, and large warts. Warts were categorized as large if they were 3 mm in diameter or larger. Seeds were teased from the lint and were assigned as undamaged, stained, underdeveloped, or killed (only damaged seed were counted).

Time-skip 1 bolls were dissected in the laboratory and lint from individual locks was assigned to one of six lint damage categories: no damage; minor damage=1 small stained area; moderate damage=several small stained areas or one large stained area; severe=mostly stained; destroyed=completely rotted; or hard locked. The lint from each damage category (except the destroyed and hard locked) was grouped and will be ginned and graded separately. Time-skip 2 bolls were dissected and lint damage was categorized as described for Time-skip 1 samples. Results are currently being analyzed in preparation for presentations at the upcoming annual Beltwide Cotton Conferences.

Brown stink bug field cage residual activity study – A field experiment was conducted to evaluate the residual activity of three insecticides known to be toxic to brown stink bug adults. Bidrin at 6.0 oz/A, Capture at 6.0 oz/A, and Orthene 97 at 12.0 oz/A were applied to plots of cotton (4 rows wide, 40 ft long, 4-replicate, RCB design) using a conventional high-clearance sprayer. Laboratory-reared adults were placed singly into small mesh bags enclosing a single cotton boll – just prior to treatment (DAT 0), and at 24 hours post treatment (DAT 1). A total of 128 adults were tested: 4 per plot x 4 treatments (Bidrin, Capture, Orthene and an untreated control) x 4 replicates x 2 evaluations (DAT 0 and DAT 1). After 24 hours in the field, adults were returned to the laboratory where they were placed into rearing chambers containing food (green beans/peanut kernels) and water. Mortality was determined after 24 hours. Results showed that Bidrin, Orthene and Capture killed 94, 88, and 81 percent of adults, respectively, at DAT 0, but only 12.5, 12.5 and 0.0 percent, respectively, at DAT 1.

Additions to Insecticides/Miticides Registered for Cotton Pest Control:

New products registered for use against cotton pests are listed in Table 1. by the reporting state.

Changes in State Recommendations for Arthropod Pest Control in Cotton:

Additions and deletions of recommended pesticides by state extension organizations for the 2005 crop year are listed in Table 2. Included also are changes in thresholds or indications for certain pests.

Insecticide/Miticides Screened in Field Tests:

Pesticides (experimental materials or pesticides not labeled/recommended for use yet on certain pests) tested by state and federal researchers during the 2005 crop year for control of arthropod pests of cotton are listed in Table 3 by the reporting state.

Table 1. New products registered for use against cotton arthropod pests in 2005.

State	Pesticide	Target Pest
Arkansas	Carbine (flonicamid) Diamond (novaluron) Zeal (etoxazole)	
California	Oberon 2SC	
Louisiana		
Tennessee	imidacloprid (Trimax Pro 4.4) flonicamid (Carbine 50WP) abamectin (Zephyr 0.15)	Aphids, plant bugs Aphids, plant bugs Spider mites
Virginia	Gaucho Grande	

Table 2. Changes in state recommendations for treatment for arthropod pests of cotton for 2005.

State	Pesticide	Target Pest
Arkansas Additions	Carbine Diamond	Aphids and Plant Bugs Plant Bugs (tank-mix only)
Georgia Additions	Gaucho Grande	Thrips
Georgia Deletions	Lorsban Curacron Dimethoate Lannate Lorsban Lorsban Monitor Di-Syston Thimet	Fall Armyworm Plant Bugs Plant Bugs Plant Bugs Plant Bugs Spider Mites Spider Mites Thrips Thrips
North Carolina Deletions	Scout X-tra 0.9 EC Fury 1.5 EC	Various Caterpillar Species
Tennessee Additions	gamma-cyhalothrin (Prolex 1.25) dimethoate 4	Cutworms, Bollworms Spider Mites (suppression)
Virginia Additions	Karate 1EC Gaucho Grande Warrior T	1.92 – 2.56 oz/A for Thrips 2.56 – 3.84 oz/A for Plant Bug 3.2 – 5.1 oz/A for Bollworm 3.2 oz/A for ECB 1.92 oz/A for Cutworm 0.375 mg ai/seed for Thrips 1.92 oz/A for Cutworm
Virginia Deletions	Gaucho 480	Thrips
Virginia Rate Changes	Vydate C-LV	From 8.5 oz/A to 12.7 – 17.0 oz/A

Table 3. Promising pesticides screened in 2005 for control of cotton arthropod pests.

State/Pesticide (rate)	Target Pest(s)
Arkansas	
KN-128 (0.09, 0.104 lb ai/A)	Plant bugs
S1812 (0.15 lb ai/A)	Heliothis
V-10132 (6 oz/acre)	Heliothis
Oberon (8 – 16 oz/acre)	Spider mites
Zeal (0.75 oz/acre)	Spider mites
Louisiana	
Discipline 2EC	Southern green stink bug, Brown stink bug
Vydate 3.77L	Southern green stink bug, Brown stink bug
Centric 40WG	Southern green stink bug, Brown stink bug
Intruder 70WP	Southern green stink bug, Brown stink bug
S-1812 35WP	Bollworm, Tobacco budworm
Carbine (Flonicamid, F-1785)	Cotton aphid, Tarnished plant bug
BAS 320I	Tarnished plant bug, Bollworm, Tobacco budworm
Diamond 0.83EC	Tarnished plant bug, Fall armyworm
Battery 2.5EC	Thrips
Orthene 90SP	Red banded stink bug
Fanfare 2EC	Bollworm, Southern green stink bug
Silencer 1EC	Bollworm, Southern green stink bug
Virginia	
KC791230 (0.525, 0.75 lb ai/A)	Thrips
Avicta 500FS (0.15 mg ai/seed)	Thrips
A9765 (0.3 and 0.34 mg ai/seed)	Thrips
STP 15273 (250 g/100 kg seed)	Thrips
Mon3539 + Orthene 97 (0.945 + 0.24 lb ai/A)	Thrips
Venom 1.77SC (75, 150, and 200 g ai/cwt seed)	Thrips
V-10170 2.32SC (75, 112, and 150 g ai/cwt seed)	Thrips
DPX-HGW86100SC(0.022,0.044,0.067,0.134 lb ai/A)	Thrips
Poncho 600 (100 g ai/100 kg seed)	Thrips