# 61ST ANNUAL CONFERENCE REPORT ON COTTON INSECT RESEARCH AND CONTROL

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**Abstract**

There were 10,492,200 acres of U.S. Cotton harvested with an average of 871 pounds of lint per acre (USDA – January 2008 report) in 2007.

Arthropod pests of cotton reduced yield by 3.62% in 2007. The bollworm/budworm complex reduced yields by 0.913%. The bollworm was the predominant species to attack cotton in 2007. Bollworms were estimated to make up 92% of the population *Lygus* (0.683%) were 2nd in losses. Thrips (0.578%) , cotton fleahoppers (0.477) were 3rd and aphids (0.320%) were 4th. Stink bugs (0.274%) rounded out the top five cotton arthropod pests for the year. Beltwide, direct insect management costs amounted to $57.23 acre. Cost plus loss is estimated at $877 million. (see M.R. Williams, this proceedings).

## Crop and Arthropod Pest Conditions:

### Alabama

The central and southern regions of Alabama planted 220,000 acres of cotton. Weather (rainfall and temperature) fit a similar pattern as northern Alabama. Insect numbers and losses in this region were somewhat similar to the northern area of the state. Insects that caused significant yield losses were: thrips, bollworms, and stink bugs. Stink bugs were below average in number and late occurring. Yields ranged from 250 to 450 lbs of lint except where irrigated or from cotton located in the Gulf Coast region of southwest Alabama. More normal rainfall occurred in a 3-5 county area in that region resulting in yields of 700-1000 lbs of lint **(Ron Smith)**.

In the north, the year dawned in the presence of severe drought. An Easter freeze followed by continued drought delayed cotton emergence in some areas. The drought intensified until late June/early July when general rains provided a brief respite. By late July the impact of drought was again serious and its effects in August were catalyzed by a long string of triple digit temperatures.

Significant cotton acreage was replaced with grain crops and subdivisions. An estimate of Bt cotton acreage is 85%. Planted acreage for north Alabama was 170,209. Yields will vary and range from substandard to disastrous.

Thrips pressure was variable. Extreme numbers of migrating adult onion thrips from maturing wheat were observed. Little or no reproduction occurred and, on an individual basis, this species appears less injurious than the species among our historic thrips complex; despite that, the extreme numbers compelled control.

False chinch bug infestations were encountered widely and serious damage occurred, though in relatively isolated locations. These pests were found on other crops as well, and for the most part, were associated with conservation tillage utilizing a winter-fallow system. Furthermore, the false chinch bug populations were highest around common groundsel carcasses. This weed is a relative new comer for us, but there is no reason to speculate that drought was not the overriding factor prompting the problem, or that other weed species could be the prime correlate in other geography or years. Control was erratic and often less than satisfactory.

Plant bug populations were low in the extreme. Some damage was observed in late July, but arose more from inattentiveness than pressure. Stink bug numbers too were low.

A modest number of insecticide applications were required for cotton aphid control and results were acceptable, but barely so. The epizootic, Neozygites fresenii, followed 2006's behavior by being slow to provide control and operating field by field rather than on an area basis.

Two-spotted spider mite infestations were common, but few reached threshold levels.

Tobacco budworm populations were low. Corn earworm populations were high and long lasting. Where the caterpillars were not ignored, pyrethroid applications provided poor to modest control. Heat was a complicating factor. Corn earworm damage was extensive **(Barry Freeman)**.

**Arkansas**

The season started out dry and many growers had to irrigate seedling cotton. Dry conditions continued into June. Some areas of the state received good rainfall in late June and July. Overall the crop grew off well despite dry conditions. Extremely hot conditions in August moved the crop along and many fields reached cutout early. Most fields defoliated and harvested well. Yields were better than average. However, many growers reported lower yields from DP117B2RF this year.

**Insect Pests**- Thrips pressure was high early on and was compounded by the dry conditions in many fields. Many growers had to make at least one foliar application for thrips. Spider mites also showed up early, particularly in Northeast Arkansas where they traditionally have problems from this pest. Some areas required miticide applications on seedling cotton. As the season progressed, mites flared in several areas across the state, but did not reach high levels despite the hot dry conditions. Tarnished plant bugs and cotton flea hoppers moved into fields earlier than usual on pre-blooming cotton. Overall plant bug numbers were lower in the northern portion of the state. Growers north of I-40 averaged 1.5 applications for plant bugs. However, pressure was much higher in the southern part of the state with growers averaging 3-4 applications. The hard freeze in April may have had an effect on plant bugs keeping numbers lower in the north. Bollworms were heavy in some areas in the southern part of the state. In these areas, Bollgard and Widestrike cotton did require oversprays with a pyrethroid. Some fields of Bollgard II were sprayed as well **(Glenn Studebaker)**.

**California**

There were 452,005 acres of cotton planted in CA in 2007. The San Joaquin Valley planted 95% of the total acres with the remainder being cultivated in the Southern Desert Valleys (18,840 acres) and Sacramento Valley (4,440 acres). For the first time, the number of acres planted to Pima (260,005) surpassed the number of acres planted to upland Acala (168,720). An estimated 25,000 acres of upland Bt cotton were planted, primarily in the Southern Desert Valleys. Roundup-ready varieties of upland and upland Acala continue to be widely planted.

Yield was predicted to be 1,410 lbs/acre for upland and 1,345 lbs/acre for Pima. Planting conditions in March and April were generally good with 87% of the days recording ideal to adequate conditions recorded at the Westside REC between March 10 through May 1. A cool period between April 10 and 20 were the only days in which planting conditions were marginal or unfavorable.

Conditions for early growth and development were generally good through June. Low winter rainfall and warm, dry winds in May in the San Joaquin Valley resulted in some dry seedbed conditions and early root development problems in many fields. Seedling disease was present in some areas which were planted during the period of cool temperatures but most fields recovered during June. Temperature conditions were ideal through most of the growing season with moderate nighttime temperatures and adequate daytime temperatures. Fruit retention was generally very good and some fields experienced early cutout as a result of heavy boll loads and where water was limiting. The fall was open and harvest continued through November.

Insect pressure was generally light. A lack of rainfall in late winter and early spring eliminated external pest pressure. Thrips were more problematic than expected given the excellent spring conditions for early-season cotton growth. Many Pest Control Advisors who monitor natural enemies reported good populations and survival well into the cotton season in many areas. Spider mites were low in 2007. Lygus were problematic in scattered areas in June and July, especially near safflower, seed alfalfa or sugar beet fields. Usually a single pulse migration occurred and reproduction was limited in most cotton fields. Aphids were not widely reported as problems and did not develop into large widespread problems, however some treatments were required in locations. Worm pests were less prevalent than in 2006, especially beet armyworm. Some Pest Control Advisors report an increase in bollworm due to the increasing acreage of corn. Silverleaf whitefly was not a major concern in the San Joaquin Valley generally but was noted in widely scattered locations **(Peter Goodell)**.

**Georgia**

Approximately 1.01 million acres of cotton were harvested in Georgia during 2007. Dry conditions during early season delayed planting and emergence of many dryland acres until early June. Dry and hot conditions were generally the norm for much of the season. When and where rains were received, cotton responded favorably. Dryland yields were highly variable depending on moisture conditions, irrigated yields were average to above average depending on location. Insect populations were generally light on a statewide basis; however various pests caused problems for growers on a more localized scale.

Thrips populations were moderate to heavy on cotton planted prior to mid-May. Thrips numbers were unusually low on late May and June planted cotton. A few reports of false chinch bugs were reported on seedling cotton. Other seedling pests such as grasshoppers and cutworms were rarely encountered.

Aphid populations were generally low, but built to high numbers in some areas. The naturally occurring fungus which causes aphid populations to crash eliminated infestations as numbers increased. Spider mites continued to be observed in cotton in South Georgia; however infestations just lingered and did not build to treatable populations on many acres. Spider mites are pests which are becoming more common and are a concern.

Corn earworm populations were low to moderate with high populations in localized areas. Control of corn earworm with pyrethroids was generally good; however concern remains relative to increases in tolerance to pyrethroids. Results of adult vial tests to monitor pyrethroid susceptibility indicated higher survival or increased tolerance, especially in early to mid June. During late July and August, survival in adult vial tests moderated. It is difficult to estimate tobacco budworm populations since a large percentage of cotton planted in Georgia is Bt cotton, however pheromone trap captures were generally below normal. Fall armyworm infestations were localized and sporadic. Beet armyworm and soybean looper populations were generally low.

Stink bug populations were generally low to moderate. Perhaps the dry conditions observed during the spring and summer negatively impacted populations. However, late in the season stink bug populations reached treatable levels. Silverleaf whiteflies built to high populations and required treatment in localized areas.

No boll weevils were captured in Georgia during 2007 **(Phillip Roberts)**.

**Mississippi**

Cotton producers in Mississippi planted approximately 666,097 acres of cotton in 2007. This was a 46% decrease in acres compared to 2006. Approximately 76% of cotton in MS was planted to transgenic single gene Bt varieties and 14% of cotton acres was planted to dual toxin transgenic Bt varieties. The most popular varieties planted in 2005 was Deltapine 555BG/RR, Deltapine 444BG/RR, and Deltapine 445BG/RR. These three varieties made up approximately 60.3% of the total acres planted in 2005. The most widely planted dual toxin Bt variety planted was Stoneville 4554BGII/F, making up 6.9% of cotton acres.

Total insect losses in MS were slightly lower in 2007 than in 2006. Overall losses from insect pests in 2007 were 2.63% compared to 2.71% in 2006. Mississippi averaged 6.3 foliar applications to control pests in 2007 for an average foliar insect control cost of $54.08 per acre. Final cotton yield estimates for 2007 was 975 pounds per acre, up 146 pounds per acre from 2006. Cotton yields in the delta averaged approximately 1050 pounds per acre while the hill region of the state averaged approximately 800 pounds per acre.

Thrips pressure across the state ranged from moderate in the hills to extremely heavy in the delta depending on location. Seed treatments continue to gain popularity in MS for control of thrips due to convenience and ease of use. Approximately 50% of the cotton acreage received a foliar application for thrips averaging 0.55 foliar applications for this pest.

Tarnished plant bug ranked as the number one damaging pest in 2007 with a record number of applications made to control this pest. The delta region of the state averaged 7.5 spray applications for plant bugs while the hill region of the state averaged only 0.66 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 2007 with "standards" such as Orthene, Bidrin, and Vydate getting more use in post-bloom cotton. Plant bug numbers in parts of the delta region of the state were extremely high. This was partly due to a significant increase in corn acres. Mississippi planted 980,000 acres of corn in 2007, compared to 325,000 in 2006.

Bollworm/Budworm pressure continued to be light on average in 2007 with average number of foliar sprays at 0.6 for Bt cotton in the delta region of the state and 1.98 foliar sprays in non-Bt cotton in the delta. In the hill region of the state Bt cotton received on average 0.15 foliar applications and non-Bt cotton received 0.75 foliar applications for the budworm/bollworm complex. . Fall armyworms pressure was extremely light in 2007.

Spider Mites were the most notable problem producers faced in the central and south delta region of the state prior to bloom in 2007. Spider mites attacked cotton very early in the growing season again in 2007 and populations increased rapidly due to the hot and dry conditions in June. July rains that persisted for several weeks slowed spider mite development late season with populations rebounding in August. Approximately 231,000 acres were treated for spider mites in the state in 2007.

In summary, total insect control cost for the state in 2007 was $117.84 per acre up approximately $30.80 per acre compared to 2006. This was largely due to extremely high numbers of applications made to control tarnished plant bugs in the delta region of the state **(Angus Catchot)**.

**Missouri**

There were approximately 390,000 acres of cotton planted, down 110,000 acres from last year. All but 1,000 acres were harvested. Yields ranged from 400-500 lbs/acre (non-irrigated) to 4 bales per acre, with an average yield of 950 lbs/acre. Our number one problem in Missouri this year was a hot (36 consecutive days above 90 degrees), dry summer (7.25 inches from May-August, 50% less than average).

Missouri had a late freeze which likely killed many alternate hosts of tarnished plant bug. In terms of number of insecticide applications plant bugs were our number one pest; however, they were not as problematic in other cotton producing states.

We encountered a hot, dry summer. The conditions were good in terms of bollworms because the cotton matured and was no longer vulnerable when moth flights peaked. However, plants were drought stressed and lead to mite problems.

2007 marked the completion of the boll weevil eradication program. On April 3, 2007, Missouri cotton producers voted in favor of the post-eradication program with a 72% majority vote **(Kelly Tindall)**.

**New Mexico**

For a second year no boll weevils were captured in New Mexico. The south central eradication zone has not captured a weevil in five years. Boll weevil eradication programs in the eastern half of the state were begun later and are administered by the Texas Boll Weevil Eradication Program. The Pecos Valley had no weevils for the second year after capturing 3 in 2005 and 188 in 2004.

A pink bollworm eradication program is in progress in south central New Mexico in the Las Cruces area in conjunction with the Far West Texas program. Pink bollworm populations have been reduced over 99.9% since the program's inception. Boll cracking late season in 40 fields (1600 bolls total produced 257, 2, 0, 0 and 0 pink bollworms in 2003-2006 respectively.

Total cotton acreage, as in many states, was impacted by an increase in corn acreage. Yields were very variable. A very late spring caused concern, particularly in the northeastern growing areas near Lubbock, but a warm September resulted in good yields averaging 1118 lb/A. statewide .

Insect pressure was exceptionally light in southern New Mexico, the Mesilla and Pecos Valleys. Pink bollworm populations were extremely low in the Pecos Valley outside the eradication zone **(Jane Pierce).**

**North Carolina**

**Thrips** levels were moderate to high in most areas of the state, and extended hot dry conditions hindered insecticide uptake. Up to three foliar insecticide applications were sometime required (mean = 1.4 applications), sometimes with less than desired results. Approximately 90-plus % of our state's cotton acreage received at least one foliar application for thrips, probably a record high. Temik 15G was used on approximately 50% of the cotton acreage, seed treatments on the remainder, with 5-6% of the state's producers using a seed treatment plus Temik. Western flower thrips also added to control headaches in some fields.

Given the more than 95% cotton acreage planted to *Bt* cotton in 2007, **tobacco budworms** were of only minor concern in 2007. However, some conventional cotton fields appeared to sustain boll damage following pyrethroids from budworms resulting from this species being part of the major bollworm moth flight. Overall, our droughty conditions resulted in relatively minor damage.

**Cotton aphids** were generally a minor problem on most farms in 2007, with 1.5% of our cotton acreage treated. Growers and consultants appear have become more confident in the effectiveness of beneficial insects, primarily "mummies" and in the fungus *Neozygites fresenii* in reducing cotton aphids to subeconomic levels in most cases.

**Plant bugs** were also very light during the pre-bloom period in 2007, with approximately 2% of our acreage treated. Additionally, *Lygus* levels did not build into a significant late season problem this past growing season

**Spider mite levels** were similarly very low in 2007, with 2.3% of the state's cotton acreage being treated for this pest. This was unexpected after the high use of organophosphate foliar applications for thrips control, the high use of seed treatments, and our dry weather. I would have thought that these conditions would have resulted in significant spider mite outbreaks.

**Stink bug** damage was light across most of the state in 2007, probably a result of both our "Easter Freeze" and the unattractiveness of our droughty cotton. Green (*Acrosternum hilare*) and brown (*Euschistus servus*) stink bugs caused a mean of approximately 3.2% internal boll damage to bolls on Bollgard cotton based on our project's annual damaged boll survey.

The major late season **bollworm** moth flight from corn was moderate in 2007, and Bollgard cotton was generally unattractive due to the extended drought in most areas. On conventional cotton, the bollworm/budworm complex resulted in generally low boll damage (2.6%), while bollworm damage to bolls on *Bt* cottons, at 0.55%, was light. Bollgard II and WideStrike varieties showed very little bollworm damage to cotton in producers' fields – a small fraction of 1%. An average of 1.6 and 0.76 late season insecticide applications for bollworms and stink bugs was used on conventional and Bollgard cotton, respectively, in 2007.

**Other caterpillars** were generally on the light side; fall armyworms persisted, but not at treatable levels. Beet armyworms and cabbage loopers, although detected, were again little more than curiosities in 2007. European corn borers remained (for more than a decade now) at almost undetectable levels on even conventional cotton.

As of this late December writing, North Carolina cotton producers are expected to harvest approximately 560 pounds of lint per acre on 493,000 acres **(Jack Bacheler).**

**South Carolina**

Cotton was planted on about 180,000 acres in South Carolina during 2007. That was a reduction of about 40% from that planted in 2006. Most of the reduction was due to increased acreage planted to corn and soybeans. About 95% of the cotton acres were planted with varieties containing Bt technology. Early-season problems were characterized by dry conditions and moderate levels of thrips. Minor problems were encountered with miscellaneous pests (false chinch bugs, burrower bug, etc.) during the early-season window. Mid-to-late-season insect problems consisted of bollworm primarily. There were some areas that developed problems with fall armyworms. Populations of secondary pests such as aphids and spider mites were generally not problematic. In most locations of the state, numbers of sucking bugs (i.e. stink bugs) were extremely low in comparison with those of previous years. In summary, the bollworm was a significant pest of SC cotton during 2007 in certain locations, but Bt cotton performed well in suppressing their numbers. Losses were due mostly to the extreme drought conditions that persisted for much of the season **(Jeremy Greene)**.

**Tennessee**

Tennessee planted and harvested about 500,000 acres of cotton in 2007, almost 200,000 acres less than the previous year. About 95% of the crop was *Bt* cotton, and about 30% of the acres were planted with Bollgard II® or WideStrike® varieties. DP444 BG/RR was planted on about 45% of the acres. Other commonly planted varieties included STN4554 B2RF, STN5242 BR, PHY370 WR, DP445 BR, DP432 RR and DP117 B2RF. There was a short planting window in late April, but most cotton was planted from May 8 to May 20. Few problems were encountered with stand establishment. Little rainfall occurred in July. Drought conditions persisted in most areas during August, significantly reducing yields. The average lint yield in Tennessee is estimated at 550 - 580 lb/acre. This contrasts with an average yield of 904 lb/acre in 2006.

The 2007 season was characterized by drought and generally light infestations of insect. Statewide insect-induced yield losses were estimated at about 4%. Most of this loss was associated with infestations of thrips, twospotted spider mites and the hemipteran pest complex (plant bugs and stink bugs). *Bt* cotton traits performed well in controlling infestations of lepidopteran pests. However, bollworm and fall armyworm populations were low. Few *Bt* cotton fields required a foliar insecticide application for these pests. The estimated average cost of insect control was $63/acre. Much of this expense includes relatively fixed fees such as boll weevil eradication, *Bt* technology, insecticide seed treatments and scouting. Insect control costs have remained relatively flat the last few years.

Boll weevil eradication efforts continued throughout West Tennessee, and no yield losses caused by boll weevils have been reported for six consecutive years. A total of 8,125 boll weevils were captured during 2007 in West Tennessee. This is about a 90% reduction in the number of weevils captured compared with 2006. Middle Tennessee, representing about 20,000 acres of cotton, is in a maintenance phase of eradication and continues to be free of boll weevils.

Thrips infestations on seedling cotton were variable but significant in many fields. In particular, western flower thrips were common than usual. At-planting insecticide applications, primarily seed treatments, are used in over 95% of cotton fields in Tennessee. However, these treatments did not provide adequate control, and foliar post-emergent applications were made on many acres. With few exceptions, light populations of tarnished plant bugs were observed prior to bloom. Many growers continue to make “convenience”, often unnecessary applications of Centric, Trimax or other insecticides during this time frame. As seen in recent year, early-season spider mite infestations occurred in several areas (primarily Carroll, Gibson, Dyer and Lake Counties). Dicofol was the primary miticide used during the early season and provided good control. Late season infestations of spider mites were sporadic but affected some acres in all areas of the state. Drought conditions exasperated injury from spider mites.

Tobacco budworms were relatively uncommon in non-*Bt* cotton fields in 2007, but some non-*Bt* fields reached treatment threshold during the early season in the southern counties of West Tennessee. As previously mentioned, bollworm populations were low. There was a moderate moth flight during August that was too late to affect many acres. In a late-season survey, we found an average of 0.72% boll damage caused by caterpillar pests in non-*Bt* fields, by far the lowest recorded since this survey began in 2002. On average, only 0.18% of bolls in Bollgard cotton fields were damaged by caterpillar pests. Fields of Bollgard II or WideStrike averaged 0.08% and 0.13% boll damage, respectively.

Treatment level infestations of stink bugs and plant bugs were relatively uncommon after first bloom, and only about one-half of fields were treated for this complex of pests. In a damage survey, late-season boll injury caused by stink bugs and plant bugs averaged about 2.8%. Based upon regional research efforts, Tennessee’s sweep net threshold for tarnished plant bugs after first bloom was reduced to 15-20 nymphs or adults per 100 sweeps. A window-approach encouraging the rotation of insecticide classes for plant bugs was also recommended because of concerns with insecticide resistance.

Cotton aphids, beet armyworm, loopers, whiteflies, European corn borers, other insect pests and slugs were of little or importance in 2007. The false chinch bug was observed causing substantial seedling mortality in several few fields, and multiple insecticide applications were required to prevent stand loss.

Various insecticide and insect management trials were performed in 2007. The results of these evaluations and other information are available on-line at www.utcrops.com. **(Scott Stewart)**

**Texas**

Overall, the Texas cotton crop is one of the best on record. The crop was the second largest with a projected 4.7 million acres harvested and a projected 8.1 million bales. The majority of increase in bales comes from the High Plains where they are now expected to harvest 5.3 million bales. Not only were the yields among the highest ever, but the quality appears to be unsurpassed.

Most of Texas experienced frequent and well timed precipitation. Many of the production regions entered the planting season with adequate to excessive moisture with many areas having delayed plantings due to wet conditions. However, crop failures were generally low. Most regions experienced cooler than normal early season conditions which exasperated seedling disease and thrips problems, but warmer than normal late season temperatures resulted in prime conditions for boll development. Whereas most of the state experienced dry conditions at harvest, the Lower Rio Grande Valley suffered heavy precipitation which hampered harvest.

Most of the state relied heavily on Roundup Ready, Roundup Flex, or Liberty Link weed management technologies with approximately 85% of the acreage utilizing these traits. Bt technology, primarily Bollgard and Bollgard II, was planted on approximately 46% of the acreage, about the same as in 2006. However, Bt-cotton acreage was up in some areas, particularly in the High Plains. Many producers are making cotton variety selection decisions based on the yield and fiber characteristics for their production region and not necessarily on the need for bollworm/tobacco budworm control.

Overall, insect pressure was greater in 2007 than in 2006. Thrips were a problem in the production regions north of Lubbock, the Blacklands, the Lower Rio Grande Valley, and in the Winter Garden area. In these areas, most thrips damage was averted with the utilization of preventive at-planting insecticides, but damage was evident were control measures were not instituted. Cotton fleahopper populations were higher than in recent memory and with the exception of the Blacklands, occurred in high numbers statewide resulting in heavy insecticide use in some areas. Fleahoppers were particularly troublesome in the Lower Rio Grande Valley and along the Coastal Bend. Saltmarsh caterpillars were common in the western one half of Texas, but damage was minimal. Cotton aphid problems were common throughout the state and although natural enemies prevented many fields from requiring treatment, over 1.4 million acres were treated for aphids. Spider mites were common across the state but reached treatable densities infrequently.

With the exception of the Lower Rio Grande Valley, the Blacklands and the Rolling Plains, cotton bollworm/tobacco budworm problems were low to moderate. All problems were associated primarily with non-Bt cotton plantings, although 2.4% of Bt-cotton was treated for bollworm/budworm primarily in the Blacklands. Across the state, cotton bollworm was the predominate bollworm complex pest, comprising 98% of the population. However, the Lower Rio Grande Valley's bollworm complex was approximately 75% tobacco budworm. Consequently the most severe bollworm/budworm problems occurred in the Lower Rio Grande Valley where an estimated 15% yield reduction was attributed to this pest. Fall armyworms were only a problem is localized areas of the High Plains and the Rolling Plains; but did not pose a significant problem.

Whiteflies problems were relegated to the Lower Rio Grande Valley and Far West Texas in the El Paso area; damage was not severe although some insecticide applications were required. Stink bugs were also a minor problem in the Blacklands but were a severe pest along the Gulf Coast where over 78% of the acreage required treatment.

Boll weevil eradication in West Texas is getting close to reaching the goal of eliminating the weevil from the region. Through 16 September a total of 234 weevils had been caught on the 4,887,700 land acres of cotton mapped in 2007. The majority of these - 149 weevils - were caught as they moved into the south and east side of the Southern Rolling Plains zone during the last three weeks. This zone, around San Angelo, had been previously free of weevils all year long. Boll weevils began showing up in traps there the same week that tropical storm Erin moved through the area with more weevils having been caught in subsequent weeks.

The St. Lawrence area has made good progress with only 54 weevils caught through mid-September compared with 667 weevils caught through the same period in 2006. Weevil catches in the Permian Basin zone are also well below levels caught there last year. Only 28 weevils have been caught compared with 234 through mid-September last year. The only other captures in West Texas have been a single weevil south of Morton, TX in the Southern High Plains/Caprock zone and 2 weevils in the southwestern part of the Rolling Plains Central zone. Six West Texas zones – El Paso/Trans Pecos, Northern High Plains, Northern Rolling Plains, Northwest Plains, Panhandle and Western High Plains - with over 2 million cotton acres have not caught a single boll weevil this year. Well over 99 percent of the fields in the West Texas region have been trapped all season without catching a boll weevil.

In the five zones in South and East Texas the boll weevil eradication program had many obstacles to overcome during the extremely wet 2007 growing season. Trapping muddy turn rows and getting fields treated as the rains continued week after week were challenges. In addition, the rainy weather made treatments less effective. In spite of these difficulties, boll weevil populations were reduced by over 70 percent in the five South and East Texas zones. Compared with captures through mid-September 2006, the Northern Blacklands and Upper Coastal Bend zones, attained population reductions of over 90 percent - 98.7 and 92 percent, respectively. Southern Blacklands and the Lower Rio Grande Valley were able to reduce weevil captures 75 percent and 68 percent, respectively from 2006. In South Texas/Winter Garden, captures were not reduced. Captures in 2006 through mid-September were 31,447 and through the same period in 2007 49,012 weevils were caught. Seventy-four percent of the fields in the South Texas/Winter Garden area had caught no boll weevils through mid-September. But poor detection because of muddy fields combined with undetected migration of weevils into previously clean fields allowed boll weevils to become established in a relatively small number of fields. Relatively high boll weevil captures occurred late in the season in these fields.

**Lower Rio Grande Valley (LRGV).** The 2007 cropping season started off with sufficient planting moisture in a majority of the LRVG. Some fields had to be replanted or were planted to grain sorghum due to excessive rain amounts during the early months of the year. The year 2007 was at an eleven year low with only 100,000 acres planted to cotton. As the season progressed, dry conditions set in and there was no precipitation until late May. Conditions remained wet through August with flooding in some fields. Early in the season temperatures were below optimal levels for proper cotton growth and development, but by mid-April warm temperatures returned and remained for the remainder of the season.

Insect populations varied throughout the year depending on location and crop stage. Thrips damage on cotyledon through 5 leaf stage cotton was limited to those fields in the vicinity of maturing onion fields. Cotton fleahoppers were first observed in fields during the first week of April. Insecticide applications began once the cotton started to set squares. Cotton fleahoppers remained a problem for several areas of the LRGV till the end of May. Growers reported up to three applications for cotton fleahoppers.

Aphid populations began to build in cotton fields during early May. We observed two peaks in aphid populations, 21 May and 25 June. Beneficial insects and entomopathogenic fungi was attributed to the decline in aphids after the June peak. Spider mite populations were spotty and only a few fields were treated. Adult and immature whitefly populations began building in cotton fields during the first week of May. The building whitefly populations were limited mainly to the areas west of Weslaco. Some fields reached treatment thresholds during the first week of July. Bollworm and tobacco budworm larvae were observed in several fields throughout the LRGV. Two peaks were observed in larval populations, 11 June and 2 July. Monitoring of adult bollworm and tobacco budworm moth trap catches indicated that a majority of the populations were tobacco budworm from June to August.

The Texas Boll Weevil Eradication Program began their LRGV Program in 2005 with diapause sprays. A month long moratorium was included in the 2006 program, allowing beneficial insect populations to rebuild during the month of May. A month long moratorium was not included in the 2007 program. Malathion ULV was applied in fields that had "triggered" according to trap catches and had pin head size squares or larger. Frequently precipitation hampered boll weevil monitoring and treatment efforts.

The LRGV yield was approximately 120,000 bales. Harvesting was delayed due to weather and insect pressures during the cropping season.

**Winter Garden (WG).** The season started off wet for the area with regular and often heavy rainfall continuing throughout most of the growing season.

Thrips pressure was heavy throughout the region with many fields receiving at least two foliar applications after the seed treatments or granular insecticides had played out. Cotton fleahopper pressure was moderate throughout most of the area with some fields experiencing enough pressure to require treatment. Most growers set a good to excellent bottom crop but the middle crop for many was very light to almost non-existent due to constant rain and extended periods of cloudy weather. This scenario set up much of the cotton in the area for rank growth which could not be controlled with growth regulators. As a result of uncontrolled rank growth, many growers lost their bottom crop. With no middle crop and loss of the bottom crop, growers had only a top crop to try to finish out. Overall, cotton yields for the Winter Garden were down significantly compared to the last several years, with average yields less than two bales per acre. There were very few fields in which yields exceeded four bales and not many exceeded three bales per acre.

Overall lepidopteran pressure was very low with only a few fields of non-Bt cotton requiring treatment. In spite of the wet weather, a few fields of seedling cotton were treated for spider mites. In general, for the Winter Garden, insect and mite pressure was lower than it has been in a very long time. That being said, boll weevil was the exception, with the Winter Garden losing ground on the eradication front. There was a significant increase in numbers of weevils trapped at year's end compared to last year. While much of the set-back can be attributed to the constant rainfall and the inability to treat fields that triggered, not all can thus be excused. One issue that may be figuring prominently in the set-back is the lack of control of volunteer cotton.

**Coastal Bend (CB).** Cold conditions resulted in very short internodes on the Lower Gulf Coast at the beginning of the season with less effect due to later planting dates on the Upper Coast. An extended dry was experienced from initiation of squaring until early bloom. Excessive rainfall was then received over a 3 month period.

Thrips numbers were low on the lower coast and heavy on the upper coast. Cotton fleahopper numbers where heavy throughout the region even as first squares were being set. Fleahopper control was adequate enough to set an excellent crop. Stink bug numbers continue to increase with most of the region requiring two insecticide treatments. Bollworm numbers were generally low to moderate with some areas and fields experiencing one generation at fairly high numbers. Few problems were experienced with control of any caterpillar pest. There were more spider mite problems along the mid-coast where numerous insecticide treatments including boll weevil eradication treatments were being made. The boll weevil program lost considerable ground in 2007. As cotton began to open rainfall generally on a daily basis resulted in boll rot, hard locked bolls, and loss of lint from bolls. Yields ranged from very low due to the weather to excellent. Average yield was surprisingly high at 714 lb lint/acre.

**Blacklands (BL).** Like much of Texas, the Blacklands experienced above average rainfall and subsequently, above average yields. Yields ranged from 480 to 750 lbs or lint/acre.

Thrips were moderate to heavy but extensive damage was averted with the use of at-planting insecticides. Approximately 87% of the cotton acreage was planted to seed treated with Cruiser or Gaucho Grande. Cotton fleahopper numbers were relatively light compared to 2006. Malathion applications made by the North Texas Blacklands Boll Weevil Eradication Zone during early squaring further minimized problems with fleahoppers.

Boll weevils were held in check by efforts of the eradication effort. This was the second full season of boll weevil eradication in the northern Blacklands and the program has significantly reduced the numbers of weevils caught in pheromone traps compared to 2006. Growers reaped the benefits of boll weevil eradication by producing a top crop which greatly enhanced yields. Secondary pests; cotton aphid, spider mites, beet and fall armyworms were not a factor. However, stink bugs are becoming a more frequent pest with a number of fields requiring treatment.

Bollworms caused extensive fruit injury to non-Bt cotton (2,500 acres) and Bollgard type Bt cotton varieties (5,000 acres) in central and northern Ellis County during late July. Above average rainfall and mild temperatures during May, June and early July delayed crop development by about 2 weeks and promoted excessive vegetative growth making plants more attractive to ovipositing bollworm moths. Higher temperatures during late July encouraged moths to lay eggs lower in the plant canopy in blooms and on bloom tags. Factors contributing to bollworm injury to Bollgard cotton were; heavy moth flight during peak bloom, rank cotton being more attractive, and eggs laid lower in plant canopy in blooms and on bloom tags where little or no toxin is expressed. No control failure with pyrethroids were reported.

**Rolling Plains (RP).** Conditions started off cold and wet, but cotton development was good despite the cool temperatures. Frequent well timed precipitation throughout the season resulted in outstanding, record setting yields. Warm dry weather in September and October facilitated boll development and an efficient harvest.

Thrips numbers were low in 2007 and damage was very light, while cotton fleahoppers populations were higher than normal requiring insecticide treatment throughout the region. Cotton aphids showed up early and were present throughout the growing season. Infestations in Jones County were extremely high resulting in severe stress symptoms. Where cotton was lush and tall, and aphid populations were high, effective control with insecticides was problematic.

Cotton bollworm activity was high is some areas and a number of non-Bt fields required 2 to 3 insecticide applications to mitigate these infestations. Bollworm infestation is other areas were primarily managed by natural enemies although some fields required insecticide treatment. Fall armyworm numbers were heavy in grain sorghum and forage sorghums throughout the growing season which added to our worm pressure in cotton. Some cotton fields were treated specifically for fall armyworms and where control failures were noted fall armyworms were also present in the field.

Stink bugs (Southern green, Rice, and Conchuela species) were not a problem in cotton although there were heavy numbers in grain sorghum heads.

**High Plains (HP)**. The 2007 season started off cool and wet, resulting in delayed plantings. These cool, wet conditions also resulted in delayed seed germination and plant emergence, and was compounded by seedling diseases and thrips, particularly in the northern areas. Frequent precipitation occurred throughout the first half of the season resulting in reduced demand on irrigation and vigorous high yielding dryland cotton which comprises about 50% of the total cotton acreage. Higher than normal temperatures from August through October made up for the shortage of heat units experienced early in the season. The yield across irrigated acreage was estimated at about 1200 lbs/ac while dryland was expected to average about 580 lbs/ac. Per acre lint yields are at record levels, and overall fiber quality is the highest ever obtained.

Insect pressure was higher in 2007 than normal resulting in an estimated 7.6% reduction in yield. Much of this loss is thought to be due to losses in dryland cotton which is not as intensively scouted or managed for insects as irrigated cotton.

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. Cotton not treated with at-planting insecticides suffered the most damage. Cotton fleahopper and *Lygus* populations were more severe than normal resulting in significant square loss where not treated, although most early square loss was compensated for particularly in the southern areas because of good growing conditions and the warm extended fall.

Saltmarsh caterpillars were common in most areas and were a nuisance early in the season. Large numbers were observed infesting cotton from CRP land and other weedy habitats. Although some fields were treated for saltmarsh caterpillars, damage was minimal.

Aphid populations in 2007 were high and very widespread, infesting almost 2 million acres, 65% of which was treated with insecticides. Lady beetles and a sharp rise in temperature were instrumental in reducing aphid numbers in mid-August; later infestations were mitigated by lady beetles, parasitoids and fungi. Sticky cotton was not an issue.

We had approximately 325,000 acres infested with spider mites in late August and September. Most of these acres were only lightly infested, but some severe infestations were noted, centered on the Lubbock area.
Boll weevils were non-existent due to the boll weevil eradication program. Pink bollworms were relegated to only a few counties, and even there, were extremely light. Bollworm infestations were light except late in the season in the northern areas where they were most problematic in late developing non-Bt fields. Acreage planted to Bt cotton is increasing on the High Plains, up to 23% from 13% in 2006. Almost all of this acreage is irrigated cotton.

**Panhandle (PH).** Conditions in the Texas Panhandle were drier than experienced for most of the state, particularly early in the season. However, precipitation events were well timed and with a warmer than normal late summer and fall resulted in extremely high yields and high quality cotton in both irrigated and dryland acreages.

Insects attributed to approximately 5% of the yield loss for this area with thrips, bollworms, cotton fleahoppers and aphids being the predominant pests. Western flower thrips were very common, particularly in cotton planted near wheat. Over 70% of the cotton was treated for thrips, most was treated preventively with at-planting insecticides. Bt cotton comprised about 20% of the cotton acreage, with the ten most northern counties having no Bt-cotton due to regulatory restrictions. Bollworms were treated on about 10% of the acreage, all non-Bt cotton. Cotton fleahoppers were much more prevalent than in recent years with over 50,000 acres infested and over 18,000 acres requiring treatment. *Lygus* were more common than normal, but only 6% of the cotton was treated for this pest. Cotton aphids were widespread but natural enemies prevented most fields from requiring insecticide applications.

**Far West Texas (FWT)**. Cotton producers across the Far West Texas production area generally experienced average seasonal temperatures, but received above normal rainfall. In areas where predominately dryland cotton is grown precipitation was considerably above average and came at opportune times, resulting in the exceptional yields and the best crop on record for the area.

Generally, insect pests caused relatively little damage. The boll weevil has been declared suppressed in all Far West Texas and the ongoing pink bollworm eradication program continued to experiences successes in the El Paso/Trans Pecos region. Saltmarsh caterpillars were very common in the Saint Lawrence/Permian Basin zones, but did not result in much cotton damage. The most abundant insect pests were bollworms and cotton fleahopper, but still were sporadic with only around a combined 7% of the cotton acreage treated. Over 95% of the cotton planted in the St. Lawrence area was Bt varieties. Where non-Bt cotton required treatment for bollworms with pyrethroids, subsequent insecticide applications were required for cotton aphid control. The El Paso area was the only area in Far West Texas that experiences damaging densities of *Lygus* bugs and silverleaf whitefly. This year was no exception, with a 12% combined treated acreage for these two pests **(Submitted by David Kerns and Colleagues).**

**Virginia**

An estimated 56,000 acres of cotton were planted in Virginia. Early season growth was compromised by dry conditions and little residual soil moisture. Thrips pressure was extreme and in combination with dry conditions, presented a challenge to growers. Even though remedial insecticide treatments were applied, lack of moisture prevented regrowth so plants still appeared damaged. Drought or near-drought conditions prevailed over most of the cotton growing area. Rainfall from May 1 through September 30 averaged 12.25 inches, or less than 1/5 inch per week, 10 inches below normal. The prolonged drought caused early cutout, reduced susceptibility to insects, and greatly reduced yield potential. The average yield is estimated at 650 lb lint/acre (optimistic) with losses due mainly to dry weather. Palmer amaranth was confirmed in many locations.

An estimated 1% of the acreage was planted to conventional cotton varieties; 8% to Roundup Ready, alone, varieties, and most of the remainder to RR/BG or RR/WS varieties. A limited acreage was planted to BG2/RFlex varieties.

**Thrips—**Thrips pressure was very heavy pressure. Two large adult migration peaks occurred (usually only one), the first occurring almost two weeks earlier than previous years. Western flower thrips were confirmed for the first time in at least 3 fields. There were a few problem fields where multiple foliar sprays failed to provide control (most insecticide seed treated).

**Plant bug/Stink bug—** Populations were spotty, heavy in isolated fields, field edges next to corn, field pockets next to trees/shrubby areas. Fewer growers made pre-bloom sprays. Stink bugs tended to congregate in soybeans near cotton.

**Bollworm—***H. zea* levels were high in field corn (avg. 50% infested statewide). The moth flight was delayed, moderate but lasted several weeks longer than normal. Boll damage was not as severe as 2006 (25% vs. 60% in unprotected cotton). Infestations were severe in soybean (most fields treated twice, some 3 times).

**Spider mite—** Infestations were spotty but persistent during mid season. They generally disappeared from even during dry periods (???). Mites moved to peanuts and soybeans.

**Aphid—**Only a very few fields became infested with low level aphid populations.

**Other Leps—** There were scattered infestations of beet armyworms in September but not at economic levels **(Ames Herbert).**

## Research Progress and Accomplishments

### Arkansas

The second year of a study on a treatment threshold for tarnished plant bugs was completed. This was part of a multi-state cooperative project with Missouri, Tennessee, Mississippi and Louisiana. Results of this study indicate that the treatment level for plant bugs falls near 3 bugs/5 row feet.

Research validating the insecticide termination rules for plant bugs was completed in 2007. Data indicates that under normal growing conditions insecticide termination for plant bugs at cutout (NAWF=5) plus 260 heat units results in no yield loss. Under adverse growing conditions and in fields with uneven growth and maturity the bollworm/budworm cutout rule (NAWF=5 plus 350 heat units) should be followed.

Studies continue investigating varietal resistance to tarnished plant bugs. Initial results indicate significant differences in tolerance/attractiveness of some varieties to tarnished plant bugs. ST4554B2RF and DP117B2RF appear to be somewhat tolerant or less attractive to tarnished plant bugs.

A study was initiated in 2007 investigating the economic benefits of bollgard, bollgard II and Widestrike varieties across the state. Each technology along with a non-bt variety was compared in large plots in 3 locations across the state from north to south. Economic inputs will be analyzed to determine the returns for each technology for Arkansas growers in different regions of the state **(Glenn Studebaker).**

### California

Efficacy studies were conducted on thrips, spider mites, lygus bugs, cotton aphids and whiteflies. On thrips, efficacy of aldicarb, fugimite, acramite, a foliar standard and an organic compound were compared. Against low to moderate populations of spider mites and cotton aphids, the efficacy of long-time registered standards was compared against newly-registered products in four separate tests. The primary effort in this area was exerted in examining the fit of experimental products, newly-registered flonicamid, and standards against a high and persistent population of lygus bugs. Lygus bug counts, levels of beneficials, plant mapping data, and lint yield were collected in this study. Finally, studies continued on late-season insect populations and sticky cotton incidence and concentrated on pima cotton.

Landscape monitoring studies for Lygus increased with the initiation in 2007 of the USDA-CREES-RAMP grant to examine sampling, natural enemy community, and inter-field movement as a function of host-plant. Large scale areas were sampled weekly to monitor Lygus, natural enemies and cotton development. Forty-one focus fields were sampled weekly as well as surrounding crops. Field level mark-recapture studies were conducted to measure movement from sources of Lygus. Another Cotton Incorporated study monitored source and sink habitats to determine if a population level connection may be calculated for the influence of inter-field dispersal, including data on seasonal populations of Lygus and natural enemies in responses to weather and host plant distribution. The explicit verification of source field emigration supports the large scale studies of association between Lygus and surrounding crop configuration. Research was also conducted on biological control of *Lygus hesperus* by generalist predators and the impact of *Lygus hesperus* on cotton yield. **(USDA-ARS, Shafter, UC Cooperative Extension, Kearney, UC Davis).**

### Louisiana

During 2007, isolated fields again experienced excessive numbers of cotton aphids on seedlings. In a few instances, these populations persisted on plants well into the flowering period. The results of insecticide efficacy screening tests (Carbine, Centric, Intruder, and Trimax) against these populations indicated less than satisfactory control. Control levels with these products did not exceed 80% at seven to ten days after treatment. A summary of all neonicotinoid efficacy data against cotton aphid for the period 2001-2007 in Louisiana clearly indicated a decline in product performance against this pest. In addition, cotton aphid reproduction was observed on insecticide-treated leaves within 72 hours after application. Collection of cotton aphids exposed to thiamethoxam (Centric) from

Louisiana in a laboratory bioassay demonstrated three-fold higher $LC_{50}$ values compared to that for an insecticide-susceptible cotton aphid colony.

Several studies were continued to collect information that can be used to improve sampling methods and action levels (thresholds) for triggering insecticide applications against tarnished plant bug. One study focused on the initial effort to develop an action threshold for tarnished plant bug that would trigger insecticide applications based on external and internal feeding evidence on squares. These results indicate that to manage square feeding evidence (SFE) at levels of ≤5%, insecticides would likely need to be applied at least weekly, or in some instances more often. Lint yields were comparable in plots receiving sprays applied weekly, or triggered at ≥5% and ≥10% SFE. Additional data is needed, but these results suggest that an action threshold of 10-20% SFE could be effective in reducing insecticide applications without sacrificing cotton lint yield. Another series of studies performed found tarnished plant bug nymphs consistently preferred squares above other reproductive structures during the flowering and boll maturation stages of plant development. Treatments of several insecticides during flowering caused nymphs to become more common in the middle canopy on third and fourth position squares compared to pre-treatment locations in the upper one-third of the plant.

In 2006 and 2007, pheromone-baited wire cone traps and the adult vial test (AVT) were used to survey pyrethroid susceptibility in bollworm. Susceptibility levels of >2,200 bollworm moths to a pyrethroid, cypermethrin, were determined using the adult vial test (AVT) from May to Sep during both years in Louisiana. In 2006, adult survival at a discriminating dose of 5 µg/vial during May, Jun, Jul, Aug, and Sep was 24%, 57%, 48%, 33%, and 47%, respectively, with a mean annual survival of 42%. In 2007, survival at the 5 µg/vial dose during May, Jun, Jul, Aug, and Sep was 13%, 29%, 33%, 28%, and 44%, respectively, with a mean annual survival of 30%. During 2007, bollworm survival was lower when compared to survival levels recorded during 2005 and 2006. The $LD_{50}$ values of a field-collected bollworm colony from Winnsboro, Louisiana in topical bioassays were 6.12, 3.48, 3.50, and 2.80 µg/g larval weight, respectively in 2004, 2005, 2006, and 2007. The $LD_{50}$ value for the 2004 Winnsboro colony was the highest observed for a field collection from Louisiana and demonstrated resistance ratios (RR) of 7 to 22-fold above a $LD_{50}$ range of previously established pyrethroid-susceptible bollworm colonies. The cypermethrin $LD_{50}$ values of two pyrethroid-susceptible colonies (LSU and DuPont) were determined to be 0.20 and 0.21 µg/g larval weight, respectively. These results clearly show that field populations of bollworms are becoming less susceptible to pyrethroids in laboratory tests.

In a rynaxypyr treated-diet assay, several bollworm colonies had similar $LC_{50}$ values ranging from 0.038-0.089 µg/ml diet. These bollworm colonies were collected from five states and represent a broad geographical range across the United States. The Louisiana colony that demonstrated moderate tolerance to pyrethroid insecticides appeared to express a moderate level of susceptibility to rynaxypyr when compared to pyrethroid-susceptible colonies (LSU lab and DuPont lab). Preliminary studies do not appear to indicate cross-resistance between pyrethroids and rynaxypyr in bollworm.

A series of field studies during 2005-2007 evaluated the performance of transgenic cotton expressing the Vip3A insecticidal protein against native and artificial infestations of bollworm and tobacco budworm. The conventional non-Bt cotton cultivar, 'Coker 312', and two *Bacillus thuringiensis* (Bt) cotton lines expressing either a single protein (Vip3A) or combination of proteins (Vip3A + Cry1Ab [VipCot™]) were sampled throughout these production seasons for larval injury to fruiting forms and surviving larvae. Species composition and levels of native infestations varied within a season and across seasons, but both Bt cotton lines had significantly fewer damaged fruiting forms and surviving larvae compared to those found on Coker 312 plants. VipCot™ cotton plants also had lower numbers of damaged fruiting forms and fruiting forms infested with larvae compared to that on Vip3A plants. In addition, selected Coker 312, Vip3A, and VipCot™ plants in field plots were infested with either bollworm or tobacco budworm larvae. These plants were visually inspected at 3 d after infestation and every 2 d thereafter, until larvae were no longer detected. Lower levels of damaged fruiting forms and fewer larvae for both species were recorded on Vip3A and VipCot™ plants compared to Coker 312 plants. A bollworm larva injured an average of 8.6, 4.6, and 1.0 fruiting forms on Coker 312, Vip3A, and VipCot™ plants, respectively. A tobacco budworm larva injured an average of 9.2, 5.9, and 0.9 fruiting forms on Coker 312, Vip3A, and VipCot™ plants, respectively. The patterns of seasonal efficacy generally showed the VipCot™ plants to be more durable with less fruiting form injury than that recorded on Coker 312 and Vip3A, especially during periods of peak heliothine infestations. The combination of two insecticidal proteins expressed in the VipCot™ cotton line improved efficacy levels against a complex of heliothines above that of the single protein in the Vip3A line.

Additional experiments quantified bollworm and tobacco budworm larval survival on plant structures of a non-transgenic cotton, Coker 312, and transgenic cottons expressing Vip3A and VipCot™ proteins. Vegetative and reproductive structures including terminal leaves, flower bud (square) bracts, intact, but debracted squares, flower petals, flower anthers, and intact capsules (bolls) were harvested from plants in field plots. Each structure was infested with 2 d-old larvae from one of the two heliothine species. Larvae were allowed to feed for 96 h on fresh tissue. Survivorship at 96 h after infestation was significantly lower on all structures of Vip3A and VipCot™ cotton lines compared to similar structures on Coker 312. VipCot™ plant structures generally resulted in lower larval survivorship compared to similar structures of the Vip3A cotton line. Bollworm survivorship ranged from 3.6 to 28.4% and 0.9 to 19.1% on Vip3A and VipCot™ plant structures, respectively. Tobacco budworm survivorship ranged from 13.3 to 44.6% and 2.2 to 12.2% on Vip3A and VipCot™ plant structures, respectively. Tobacco budworm survivorship was higher on ViP3A plant structures compared that for bollworm on similar structures. These differences between species were not observed on plants from the cotton line expressing VipCot™ proteins.

The age-specific mortality of bollworm and tobacco budworm larvae was quantified on flower buds (squares) of transgenic Bt cotton expressing Vip3A and VipCot™ (Vip3A + Cry1Ab) proteins. Cumulative mortality levels for both species and all larval ages (2 d, 4 d, 6 d, and 8 d-old) were significantly higher on squares of the Vip3A and VipCot™ cotton lines compared to that for Coker 312. In general, bollworm and tobacco budworm larvae demonstrated significantly lower survival on VipCot™ squares compared to larvae that were offered Vip3A squares. The final cumulative mortality levels of bollworm larvae occurred more rapidly than that observed for tobacco budworm larvae on Vip3A squares. However, the effects of VipCot™ cotton squares on time to complete mortality (100.0%) were similar between species. No larvae of either species were capable of completing pupation on squares of the VipCot™ cotton line. The combination of two insecticidal proteins expressed in the VipCot™ cotton line improved heliothine efficacy levels above that of the single protein in the Vip3A line**. (Louisiana State University Agricultural Center's Northeast Research Station, St Joseph and Winnsboro, LA; Louisiana Cooperative Extension Service, Winnsboro, LA; and Department of Entomology, Baton Rouge, LA).**

**New Mexico**

With boll weevil and pink bollworm eradication programs in progress, most research is directed toward lygus, or cotton bollworm. Field trials are ongoing to evaluate the impact of lygus to ultimately determine potential economic impact of lygus damage. Additional lygus research suggests lygus is generally controlled by the beneficial complex in the Mesilla Valley of New Mexico. Precision agriculture tests also continue and are indicating that lower levels of nitrogen can reduce lygus populations.

The impact of microclimate on insect pest and beneficial populations is being evaluated. Field tests were conducted to evaluate the impact of irrigation and plant population on crop microclimate, bollworm mortality and egg predation.

Yield compensation testing for simulated square and boll losses indicated that removal of 8 squares plant produced no significant loss up to 26% yield loss. Removal of 8 small bolls/plant resulted in 28-57% yield loss. There was no loss of quality in length, or strength. Results are reported in elsewhere in this years Proceedings.

Field trials were also conducted to evaluate the impact of alfalfa hay on predation in cotton. Results suggest that cotton in NM may rely on relatively constant immigration of predators from hay.

An automated system for quantifying and identifying insects in the field is ready for field testing **(Jane Pierce).**

**North Carolina**

Much of this project's applied research effort was directed toward thrips and stink bug management and in efficacy evaluations of new *Bt* cottons in 2007. Most of our project's 2007 applied research results may be found at: http://ipm.ncsu.edu/cotton/insectcorner/Research/2007/index.html.

Five at-planting insecticide tests evaluated the impact of granular insecticides, seed treatments, foliar applications, and combinations on plant development, maturity, and yield. Two of these tests were in cooperation with our nematologist; these tests included at-planting granular insecticides, seed treatments, and various seed coat, granular and liquid nematicides and, in addition to thrips levels, plant impacts, and yields, also included assays of nematode levels. Five stink bug threshold tests were conducted part of the third year 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" in cooperation with Jeremy Greene of Clemson and Phillip Roberts of UGA. One further 'reverse spray" test was carried out to provide additional information on the return on investment of treating at various periods of the bloom period. Results to date suggest that protection from stink bugs appears 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. An additional reverse spray and threshold test was carried out by PhD graduate student Eric Blinka (directed by Drs. Van Duyn and assisted by Dr. Ames Herbert).

A series of additional tests were carried out to evaluate 1) the efficacy of Bollgard, BGII, Widestrike and VIP cotton against bollworms, 2) the efficacy of 2 new and conventional insecticides against bollworms in non-*Bt* cotton, 3) the quantification of possible yield-enhancement of chloronicotinoids, and 4) the potential contribution of pyrethroid plus chloronicotinoid tank mixes to provide broad spectrum control of bollworms and stink bugs.

Our project's annual damaged boll survey < http://ipm.ncsu.edu/cotton/insectcorner/Research/2007/Damaged%20Boll%20Survey.2007.pdf> continued in 2007 and included 129 total conventional, Bollgard, Bollgard II, and Widestrike producer managed cotton fields. Stink bug damage to bolls was 3.3, 3.2, 3.4, and 1.8% for the above technologies, respectively. Bollworm damage to bolls was 2.58, 0.55, 0.08, and 0.0%, respectively, for these technologies. Although the BG2 fields showed only slightly lower bollworm damage than the Bollgard cotton fields (0.08 vs. 0.55%), very small in both cases, the approximately 7 fold higher survivorship (an assumption based on the number of worm-damaged large bolls) 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 2007.

An annual survey of North Carolina's licensed independent crop consultants working on cotton was continued in 2007 < http://ipm.ncsu.edu/cotton/insectcorner/Research/2007/2007.Agriculture.Crop.Consultants.Survey.pdf> to gather data on how thrips, cotton aphids, and plant bugs, bollworms and stink bugs were managed by these individuals in conventional and in 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 475,000 acres of Bollgard/BGII/Widestrike cotton planted in NC in 2007 and taken together, 14.3% was not treated, 67.5% was treated one time, 16.2% was treated 2 times, and 1.7% was treated 3 times for late season stink bugs and plant bugs **(submitted by Jack Bacheler).**

**Texas**

Three neonicotinoid and one organophosphate insecticide were evaluated for efficacy against cotton aphids (*Aphis gossypii* Glover) and compared to an untreated check (UTC). All neonicotinoids (Carbine, Centric and Intruder) significantly reduced number of cotton aphids compared to the UTC at 3 d.a.t. Aphid population reduction in the organophosphate (Bidrin) was not statistically different from that of the UTC at 3 d.a.t. (**Castro, Texas AgriLife Research/Texas AgriLife Extension Service and Cattaneo, Texas AgriLife Extension Service, Weslaco**).

One replicated large-strip and one replicated small-plot tests were conducted to evaluate lepidopterous efficacy and yield differences between several commercially available Bt corn varieties compared to conventional non-Bt cotton varieties. All WideStrike, BollGard and BollGard II varieties significantly reduced the number of bollworms and tobacco budworms infesting selected components of the cotton plant. An average yield advantage of 300 lb lint per acre was observed on Bt varieties compared to the non-Bt variety (**Castro, Texas AgriLife Research/Texas AgriLife Extension Service, Weslaco**).

Six sprayed leaf-disk bioassays were conducted during the 2007 cotton season in the LRGV to measure efficacy of selected insecticides on adult boll weevils. Assays were conducted on overwintered adult boll weevils collected from pheromone traps (one assay), adult boll weevils reared out from infested squares (four assays) and adult boll weevils collected from pheromone trap during post-harvest (one assay). A summary of mortality at 72 hours indicated that Malathion ULV (Fyfanon ULV); encapsulated methyl parathion (Penncap M); bifenthrin (Capture 2EC) and endosulfan (Thionex 3EC) consistently rated as the four top materials to cause highest adult boll weevil mortality. Malathion ULV was the only insecticide to cause 100% mortality in all bioassays where it was tested and no evidence of efficacy problems were detected during the experiments. Conversely, oxamyl (Vydate C-LV), cyfluthrin (Baythroid 1.0L) and the different rates of carbaryl (Sevin XLR Plus) resulted only in moderate or low adult boll weevil mortality (**Castro, Texas AgriLife Research/Texas AgriLife Extension Service and Armstrong USDA/ARS, Weslaco**).

A lepidopterous moth monitoring program was initiated in the Lower Rio Grande Valley during the cotton season 2007. Pheromone charged cone and bucket traps were placed along selected commercial and experimental fields to monitor bollworm, tobacco budworm and beet armyworm adult activity. The monitoring program will help cotton producers and consultants to make informed decisions when planning scouting activities and deciding on appropriate insecticide program implementation (**Castro, Texas AgriLife Research/Texas AgriLife Extension Service and Cattaneo, Texas AgriLife Extension Service, Weslaco**).

A large-plot field trial was conducted to assess thrips damage to seedling cotton of a newer variety. Treatments included Temik at planting, an untreated control, and portions of both the Temik-treated and untreated control sprayed when thrips reached economic threshold. Both thrips numbers and leaf damage ratings were higher in the untreated control than in the Temik-treated and sprayed check plots. At the time of ratings, numbers of leaves per plants was variable and inconclusive and no difference was detected among treatments for effects of thrips feeding on apical dominance of plants. Yields also were variable and inconclusive with respect to effects of thrips feeding (**Troxclair, Texas AgriLife Extension Service, Uvalde**).

A number of research tests were conducted in the Coastal Bend area including: (1) Evaluation of systemic seed and granular applied insecticides [5 tests] (2) Comparison of insecticides on cotton fleahopper (3) Evaluation of treatment timing for cotton fleahopper (4) Boll worm monitoring for pyrethroid resistance (5) Comparison of cotton varieties based on seed costs in a large scale planting (6) Evaluation of 2,4-D for cotton stalk destruction on shredded and standing stalks at two spray volumes (7) Long term Texas AgriLife Extension boll weevil pheromone trap line operation. Insecticides evaluated in 2007 included aldicarb, thiamethoxam, imidacloprid, thiodicarb, acephate, and clothianidin (**Parker, Texas AgriLife Extension Service, Corpus Christi**).

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, Texas AgriLife Extension Service, Dallas**).

Insecticides evaluated for use against cotton fleahoppers included Carbine, Centric, Intruder, Trimax, Diamond, Orthene, and Bidrin. All products performed well. (**Parker, Texas AgriLife Extension Service, Corpus Christi; Sansone, Texas AgriLife Extension Service, San Angelo and Minzenmayer, Texas AgriLife Extension Service, Ballinger**)

A project to evaluate the population dynamics and economic thresholds for cotton fleahopper was established in three growing regions (Blacklands, Southern Rolling Plains and High Plains). Population dynamics are still not well understood in the western part of the state where wild hosts are not as plentiful. The population dynamics study also incorporates a molecular component study host associated differentiation. Preliminary studies in the Blacklands indicate that cotton fleahoppers may fly into fields from two primary hosts and that those populations do not interact in cotton. Threshold work indicates that current thresholds are adequate in the eastern part of the state but the number of applications needed to maintain populations below damaging levels can be reduced. Threshold work in the western part of the state shows that thresholds may need to be revised upward. This may be due to the lack of wild hosts and thus less long term invasion on cotton. (**Medina, Texas AgriLife Research; Parajulee, Texas AgriLife Research, Lubbock; Barman, Texas AgriLife Research; Sansone, Texas AgriLife Extension Service, San Angelo and Suh, USDA-ARS, College Station**)

A variety of applied research projects were conducted on the High Plains including: (1) Evaluating in-furrow, seed treatments and foliar insecticides for managing thrips. In this test Temik proved to be the most effective and had the greatest net profit return relative to several seed treatments and foliar applications of Orthene. Seed treatments relying solely on imidacloprid for control of western flower thrips were not effective. (2) Early-season thrips action threshold evaluation. In this test it was found that very low thrips populations can significantly impact yield and that protection of cotyledon to first true leaf cotton maybe critical. (3) Several insecticide tests were conducted evaluating insecticides for management of cotton fleahopper. These tests suggested that broad range of foliar insecticides have activity towards fleahoppers including Orthene, Centric, Trimax, Intruder, Carbine, and spirotetramat. (4) Several cotton aphid insecticide tests were conducted. Bidrin, Endosulfan, Centric, Intruder and Carbine all exhibited good activity. (5) Miticides tests were conducted on populations of carmine spider mites. Oberon was found to be very effective; other effective treatments included Zephyr, Comite II, Fujimite and Onager. (6) A late-season bollworm test was conducted which received significant precipitation following application. Rynaxypyr and cypermethrin both exhibited good rainfastness, whereas Tracer did not (**Kerns, Texas AgriLife Extension Service, Lubbock; Vandiver, Texas AgriLife Extension Service, Farwell; Baugh, Texas AgriLife Extension Service, Lubbock; Cronholm, Texas AgriLife Extension Service, Plainview and Nino, Texas AgriLife Extension Service, Dimmitt**).

A test was conducted to evaluate the residual toxicity of insecticides to *Lygus*. Cotton was treated with foliar insecticides and leaves were collected at 0, 3, 7 and 14 DAT. Adult *Lygus* were exposed to these leaves and mortality was assessed. Cypermethrin, oxamyl, and flonicamid exhibited the longest residual, resulting in approximately 80% mortality at 7 DAT. Acephate provided about 3 days of good toxicity and endosulfan, although it caused excellent initial mortality, was very short lived. Bifenthrin performed inconsistently, but did exhibit 80 to 95% mortality at 3 DAT (**Kerns, Texas AgriLife Extension Service and Parajulee, Texas AgriLife Research, Lubbock**).

Year 4 of the field experiment was conducted to quantify the effect of nitrogen fertilizer on cotton aphid population dynamics under the drip irrigation system. Five levels of nitrogen (0, 50, 100, 150, and 200 lbs per acre) were evaluated in a randomized block design with 4 replications at the Helms Farm near Halfway. Soil residual nitrogen was determined for each treatment plot before treatment application and leaf nitrogen was monitored for 5 weeks during August-September. Cotton aphid populations increased with increase in soil nitrogen and peaked at 150 lbs/A plots and declined at 200 lbs/A, indicating a non-linear rate response (**Parajulee, Texas AgriLife Research, Lubbock)**.

Experiments were conducted to quantify the age of the boll (degree-days from boll formation) that is safe from *Lygus hesperus* damage. Boll damage assessment based on heat unit-delineated maturity provided a boll-safe cutoff value of 350 HU for *L. hesperus*, similar to that found for the tarnished plant bug in the Southeast. A penetrometer was used in determining how much pressure was required to penetrate the carpel wall of a cotton boll of different ages. Linear regression analyses established the relationship between *L. hesperus* damage and the amount of pressure required to puncture the carpel wall of a boll (**Parajulee, Texas AgriLife Research, Lubbock)**.

The objective of this research is to survey large number of cotton focal fields and other landscape habitats within a 3 km radius of the focal field to measure the influence of proximity and abundance of landscape habitat mixture on *Lygus* abundance in cotton focal fields. Fifty cotton focal fields were selected in mid-July and all crops and other vegetation were mapped within a 3-km radius from the center of the focal field. All focal fields were sampled weekly for *Lygus* and arthropod predator abundance while 8-10 fields were sampled for non-cotton habitats. Five vegetation categories from the Texas High Plains survey included cotton, alfalfa, mixed weed, lake-bottom vegetation mix, and sorghum. Data collected over a 3-year period will be used to develop a landscape-level management model for *Lygus*. This is a large-scale regional project in cooperation with NM, AZ, and CA researchers.
Influence of non-cotton hosts on life history characteristics of *Lygus hesperus*. Non-cotton weed hosts (pigweed, alfalfa, and Russian thistle), artificial diet, green bean, cotton square, and young cotton bolls were used as food source to evaluate life history parameters such as stage-specific developmental duration, survivorship, and fecundity. These data will be used to characterize the field population dynamics of *Lygus hesperus* in non-cotton hosts and cotton based on survey data (**Parajulee, Texas AgriLife Research, Lubbock)**.

Objectives of this project were to: a) Quantify compensation of *Lygus*-induced fruit loss in pre-flower and early flower cotton under limited-irrigation production, b) Quantify compensation of *Lygus*-induced fruit loss in pre-flower and early flower cotton under high input drip irrigation production system, and c) Compare the compensation potential of cotton in limited versus full irrigation after cotton fleahopper-induced square loss. These three sub-projects will collectively provide information to growers in determining the level and timing of *Lygus*/FH infestation that they can tolerate without having to treat with insecticides if we know the amount of compensation plants can attain for a given level of fruit loss. Timing is even more critical because the compensation of square or early boll loss will have much different impact on boll maturity delays and lint quality. Research projects during the past several years has addressed these sub-objectives where we established four treatment regimes for each set of the study: i) natural infestation of *Lygus* or FH, ii) insecticide sprayed control, iii) 1 plant bug (*Lygus* or FH) per plant, and iv) 3 plant bugs per plant. Bugs were released for three consecutive weeks before (pre-flower) or after (early flower) the initiation of flowering. Plant mapping was conducted weekly throughout the study period until crop cut-out. It appears that cotton can compensate 25-35% early fruit loss depending on the phenological stage of the crop and production system (**Parajulee, Texas AgriLife Research, Lubbock)**.

A microsatellite-enriched partial genomic DNA library of *Lygus hesperus* was generated and screened by sequencing. Ten polymorphic microsatellite marker loci were characterized by genotyping 92 insect samples. The observed number of alleles ranged from three to seven with an average of 4.5, while the effective number of alleles ranged from 1.2 to 3.0 with an average of 2.1. Seven of the *L. hesperus* markers could be transferred to *Lygus lineolaris*. One hundred ISSR markers were screened by PCR and agarose gel electrophoresis. Eighteen polymorphic ISSR markers have been identified and their PCR conditions had been optimized by gradient PCR and varying amount of MgCl2 and dNTP. Characterization of these ISSR markers and more SSR markers for population level genetic study is underway. AFLP marker and RAPD markers will be developed and the comparative study of SSR, ISSR, AFLP and RAPD marker will be conducted this year (**Parajulee, Texas AgriLife Research, Lubbock)**.

The statewide monitoring program that evaluated pyrethroid resistance in male bollworm (*Helicoverpa zea* (Boddie)) was conducted from April to September 2007, surveying twelve Texas Counties, as well as Tamaulipas, Mexico. Moths were trapped near cotton fields using pheromone, Hercon Luretape® with Zealure. Vials were prepared in the Toxicology Laboratory, Department of Entomology at Texas A&M University, College Station, Texas, and shipped as needed to Texas Cooperative Extension personnel (Texas AgriLife Extension Service). Data from all areas in Texas were sent to Texas A&M University Toxicology Laboratory for analysis, including estimation of lethal concentration of cypermethrin that kills 50% of the population (LC50), 90% of the population (LC90), resistance ratios (how many more times resistant the field population was than a susceptible population at the LC50 and LC90), and the statistical significance test for these resistance ratios. A great variability in response to cypermethrin was detected in bollworm across the state. Higher resistance ratios and survivorship at higher concentrations were present in the more southern counties, especially Uvalde, Nueces, Williamson, and Burleson, where resistance ratios were greater than five times that of the susceptible baseline population and survivorship was observed at 10 µg/vial and higher. In addition, survivorship of few individuals at high concentration (10 µg/vial) was also observed in Ellis County and in Tamaulipas, Mexico, so these areas must be monitored to determine how resistance evolves in the coming seasons. Resistance ratios in Uvalde Co. climbed steadily throughout the season, with a final resistance ratio of 10 in September, which was about 3 times greater than in June. Heavy pyrethroid use throughout the season in multiple crops was the likely explanation. The most susceptible populations were from Swisher, Hockley, Tom Green, Parmer, Jones, and Hidalgo Counties (**Pietrantonio, TAMU/Texas AgriLife Research, College Station and Texas AgriLife Extension Service collaborators**).

## Virginia

**Evaluation and comparison of termination rules strategies for determining last effective insecticide spray date on Lepidopteran-resistant cotton varieties—** The baseline premise of this 2-year study was that the percentage of bolls susceptible to insect damage decreases as cotton matures and bolls harden, and at some point in the season, further insecticide sprays would not protect enough fruit to offset cost. In year one, 12 different termination points based on two strategies (physiological maturity, or number of nodes above white flower (NAWF); and heat unit accumulation, or DD 60s) were evaluated using a single variety, DP 434 RR. Based on year-one results, the best four termination points were applied to three varieties with different maturity rates, PHY 370WR, DP 455BG/RR, and ST 5599BR. Research was conducted at the Virginia Tech Tidewater Agricultural Research and Extension Center in Suffolk, Virginia. Plots were four rows by 35-ft long (36-inch row centers) and arranged in a four-replicate randomized complete block design. Three 1-m sections of row were marked in randomly selected areas of each plot. Nine plants in those 1-m sections were tagged—the tag placed on the main stem above the uppermost first position bloom on the node appropriate for that treatment. Lint from plants in the 1-m sections of row were hand-harvested from the following three zones on each plant: *zone 1*—first position bolls above the termination point, *zone 2*—first position bolls below the termination point, and *zone 3*—non-first position bolls including all 2nd and 3rd position bolls and bolls from vegetative branches. Samples from each zone, from each 1-m section were pooled for weighing and ginning. To determine yield potential for the test field, cotton was harvested with a spindle picker from eight randomly selected areas.

Results showed that yields with the spindle picker were 796 lb lint/acre in 2006, and 1647, 1669, and 1754 lb lint/acre for ST 5599BR, DP 455BG/RR, and PHY 370WR in 2007. In the hand-harvested termination point plots, approximately 70 to 75 percent of the lint came from first position bolls (*zones 1* and *2*, combined), and about 30 to 25 percent came from *zone 3*, the non-first position and vegetative branch bolls. For this study, it was assumed that any first position bolls above the termination point (those in *zone 1*) would have been left unprotected with insecticide and vulnerable to any late season insect damage and thus unharvestable. In 2006, lint from *zone 1* represented nearly 49, 38 and 15 percent of the total yield at the NAWF 7, 6 and 5 termination points, respectively. With 250 additional heat units, contribution was reduced to only 8, 12 and 2 percent at NAWF 7, 6 and 5, respectively; and with 350 heat units, contribution was further reduced to 7, 5 and zero percent. Contribution at the last effective flower date termination point was only 1.5 percent, and zero with additional heat units. In 2007, lint from *zone 1* was not different among the varieties for the different termination points. Combined across varieties, lint from the NAWF 5, +100 HU, +200 HU, +300 HU termination points was 30, 11, 2, and < 1 percent of the total yield, respectively. In viewing calendar date, contribution of *zone 1* bolls dropped below 5 percent of total yield with any terminations points after August 11 in 2006, and below 4 percent after August 3 in 2007.

Applying these percentage losses to spindle picker yields showed that loss of *zone 1* bolls would have resulted in a loss of 392 to zero lb lint/acre in 2006, and 499 to 16 lb lint/acre in 2007, depending on termination point. In this scenario, if cotton value was estimated at $0.50/lb and insecticide plus application cost was estimated at $15/acre, the break-even loss point would have been 30 lb/acre. The 30 lb lint/acre break-even loss point occurred on August 11 in 2006 and August 3 in 2007, and coincided with NAWF 5 + 200-250 HU in both years. These results indicate that the amount and value of lint protected after these termination points will not offset treatment costs.

**Assessment of Lepidopteran-resistant cotton varieties—**Research was conducted at the Virginia Tech Tidewater Agricultural Research and Extension Center in Suffolk, Virginia, in 2006 and 2007. Varieties were selected from three groupings based on level of insect resistance: non-insect resistant, or conventional (RR or RF); single insect resistant gene, or single-gene (BG); and double insect resistance gene, or double-gene (BG2 or WS). Varieties were selected based on official variety test performances in Virginia and North Carolina using only the highest yielding varieties from each grouping. Plots were 4 rows (36-inch row center) and 35 feet long. Experimental design was a four-replicate split-plot with insecticide treated vs. untreated as the main plot and variety as the sub-plot. Two insecticide applications were made to treated plots, one in late July and the second in early August: (2006) Baythroid @ 2 oz/acre plus Centric @ 2 oz/acre, and Baythroid @ 4 oz/acre plus Centric @ 2 oz/acre; (2007) Baythroid XL @ 1.6 oz/acre plus Centric @ 2 oz/acre, and Baythroid XL @ 2.56 oz/acre plus Centric @ 2 oz/acre. Plant bug and stink bug were monitored by assessing square retention on five randomly selected plants per plot and percent internal bug-induced boll damage on 10 randomly selected bolls per plot. Bollworm was monitored by assessing external worm-induced boll damage on 25 randomly selected bolls per plot. Cotton was harvested from two rows of each plot using a commercial John Deere cotton picker. A one-pound subsample was ginned from each plot to determine the lint:seed/trash ratio. The value of each variety was determined by comparing lint value ($0.55/lb) to insecticide treatment cost ($28/acre), based on Baythroid XL at $1.68/oz (x 1.6 oz and 2.56 oz), and Centric at $3.98/oz (x 2 oz) plus application cost of $5/acre (x 2 applications).

Results showed that in 2006, square retention in untreated cotton was 91-100% and internal bug-induced boll damage was <5%. In 2007, square retention in untreated cotton was 97-100% and internal boll damage was 0-10%. The high square retention and low internal boll damage in untreated cotton indicates low plant bug and stink bug pressure in both years. In general, bollworm damage to untreated bolls was higher in 2006 than in 2007. In 2006, untreated double-gene varieties (including Widestrike) had 5-13% bollworm damage, single-gene had 12-30%, and conventional had 49-62% and there was a significant difference among varieties ($P < 0.01$). In 2007, bollworm damage in cotton was 0, 1-2, and 3-21% for these gene categories and there was a significant difference among varieties ($P < 0.01$). Treated cotton in both years had < 3% bollworm damage and there was no significant difference among varieties in either year ($P=0.19$, $P=0.77$) which indicates the effectiveness of insecticide treatments.

In 2006 in untreated cotton, double- and single-gene varieties had significantly higher yields than conventional cotton (P< 0.01). In 2007 in untreated cotton, four of the five single-gene varieties and one conventional variety had numerically higher yields than the double-gene cotton. There was no difference in yields of insecticide-treated varieties in 2006 (P=0.28), but in 2007 there were differences among conventional varieties (1286-1930 lb lint/acre), and between conventional, single-, and double-gene varieties (P=0.01).

In 2006, insecticide-treated double-gene, single-gene, and conventional varieties had average yield increases of 18, 176, and 500 lb lint/acre over untreated cotton. In high worm-pressure years, applying an insecticide treatment in conventional cotton returned 210-282 dollars/acre more than untreated cotton. Single-gene varieties would have returned 22-146 dollars/acre from insecticide treatment. However, in double-gene varieties, the value of the lint returned was not enough to offset the cost of insecticide treatment.

In 2007 when bollworm pressure was less compared with 2006, insecticide treatment returned less value in all varieties. Insecticide-treated double-gene, single-gene, and conventional varieties had average yield increases of 64, 85, 157 lb lint/acre over untreated cotton. As in 2006, conventional varieties tended to return more value with insecticide treatment compared with single- or double-gene varieties, but only four varieties, three of which were conventional, returned more than 40 dollars/acre compared with untreated cotton **(Ames Hebert).**