UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: EPA Review of Field Efficacy Data for the Mycogen Brand Cry1F (synpro)/Cry1Ac (synpro) Construct 281/3006 Cotton, Submitted by Dow AgroSciences [Reg. No. 068467-G; Decision Number 214150; DP Barcode: D290936; Case: 071326; MRID 458084-07]

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ACTION REQUESTED: To review field efficacy data submitted by Dow AgroSciences to support their application for a Section 3 Registration for Mycogen Brand Cry1F (synpro)/Cry1Ac (synpro) Construct 281/3006 Cotton

CONCLUSIONS

The results of 19 evaluations in trials from 2001 to 2002 indicate that Cry1F/Cry1Ac transgenic cotton line MXB-13 provided effective control against the eight cotton insect pests evaluated: tobacco budworm (TBW), *Heliothis virescens* (F.); cotton bollworm (CBW), *Helicoverpa zea* (Boddie); pink bollworm (PBW), *Pectinophora gossypiella* (Saunders); beet armyworm (BAW), *Spodoptera exigua* (Hubner); southern armyworm (SAW), *Spodoptera eridania* (Stoll); fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith); soybean looper (SBL), *Pseudoplusia includens* (Walker); and cabbage looper (CL), *Trichoplusia ni* (Hubner). That is, in all trials and for all insect pests evaluated, MXB-13 (sprayed and unsprayed) provided as good or better control when compared to the sprayed or unsprayed non-transgenic control line, PSC35 (the recurrent parent for both the Cry1F and Cry1Ac transgenic cotton events).

Results of five trials over a two-year span indicate MXB-13 provides a high level of control of TBW. The level of control is at least equal to, and in many cases far superior to optimum chemical spray programs used during ideal environmental conditions. Results also indicate that MXB-13 surpassed the effectiveness of chemical spray programs under non-ideal environmental conditions such as sustained periods of rain. Efficacy against TBW was demonstrated in both the early fruit development stage and in the late season boll maturation stage.

Also, in five trials spanning two years, MXB-13 was shown to effectively control CBW. A total of 80 individual evaluations was made comparing MXB-13 plots to unsprayed PSC355 plots. In 96% of these comparisons, the MXB-13 line exhibited equal to or less damage than the unsprayed control with 53% of the differences being statistically significant. Likewise, MXB-13 plots had equal or less damage in 58% of the comparisons to the sprayed PSC355 plots with optimum insecticide control. There were no evaluations where MXB-13 had significantly more damage or infestation than the chemically controlled PSC355 plants. No significant differences in yield were found between the unsprayed MXB-13 line and the sprayed PSC355.

MXB-13 was shown to have excellent control of PBW with no measurable boll infestation compared with 23-75% for the non-transgenic control variety. In both field trials and bioassays, MXB-13 was effective at controlling various armyworm species including BAW, SAW, and FAW. In addition, data from field trails indicate that MXB-13 controls two species of loopers: SBL and CL (though data were only from one trial).

Field efficacy testing is not a substitute for the high dose testing required for the major target pests. High dose testing for TBW (MRID# 45808417), CBW (MRID# 45808418), and PBW (MRID# 46071901) is reviewed separately.

CLASSIFICATION: ACCEPTABLE

I. Test Material

Test Substance

The Cry1F and Cry1Ac events, 281-24-236 and 3006-210-23 respectively, were separately introgressed under greenhouse conditions by conventional backcrossing into cotton variety PSC355. Introgressed lines of the two events at the BC3F1 generation were cross-pollinated to produce an F1 line that contained both transgenes. F1 plants were self pollinated and the F2 generation was planted in the greenhouse and allowed to segregate for the transgenes. A total of 169 F2 plants was identified containing both homozygous transgenes. Bulking of some F3 seed from these 169 F2 plants were the basis for the seed lot for the 2001 trials. The 2002 seed lot was developed by first self-pollinating F3 plants in the field. F4 seed was then planted in an isolated nursery in Puerto Rico during the winter of 2001/2002. Plants were allowed to open pollinate to produce F5 seed for the 2002 trials. The stacked line 281-24-236/3006-210-23 (Cry1F/Cry1Ac) was tested in multiple locations against a wide array of lepidopteran pests of cotton. This line was assigned the field designation of MXB-13.

Control Substance

Cotton variety PSC355, the recurrent parent for the Cry1F and Cry1Ac transgenic cotton events, was used as the control material in these experiments.

II. Methods and Results

Numerous field efficacy studies were conducted in 2001 and 2002 at multiple field locations for several target lepidopteran insects exposed to MXB-13 cotton. The field methods and results are presented together for each of the eight target insects evaluated. These insects were: tobacco budworm (TBW), *Heliothis virescens* (F.); cotton bollworm (CBW), *Helicoverpa zea* (Boddie); pink bollworm (PBW), *Pectinophora gossypiella* (Saunders); beet armyworm (BAW), *Spodoptera exigua* (Hubner); southern armyworm (SAW), *Spodoptera eridania* (Stoll); fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith); soybean looper (SBL), *Pseudoplusia includens* (Walker); and cabbage looper (CL), *Trichoplusia ni* (Hubner).

Statistical analysis was performed using Pesticide Research Management (PRM) software to determine significant differences in treatment means. Analysis of variance was used to determine significant differences and means separation was determined using LSD at P=0.05 or Tukey's HSD at P=0.05.

1. Tobacco Budworm (*Heliothis virescens*) Efficacy Trials

Three trials were conducted in 2001 to determine efficacy of MXB-13 against the tobacco budworm (TBW). These trials were located at Wayside, MS; Starkville, MS; and Winnsboro, LA. Data is also presented for 2002 trials at Starkville, MS and Winnsboro, LA.

Field Test Site 1. Wayside, MS (2001)

A split plot design with four replications was used with areas of "sprayed" and "unsprayed" designed as the main plots and subplots containing the MXB-13 and PSC355 cotton lines. In "sprayed" main plots, conventional insecticides were used for optimum control of lepidopteran pests. In "unsprayed" main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was two rows wide by 40 ft long with 40" row spacing. Two blank rows were used between subplots and four blank rows were used between main plots to minimize movement of larvae between plots. Artificial infestations were carried out on the "unsprayed" main plots on a weekly basis for six weeks. Neonate larvae were applied to the terminal of the plants in a corn grit carrier at a rate of 10 larvae per row-foot. Evaluations of efficacy were made 4-6 days after inoculation on 40 plants per plot. Evaluations of tissue damage and larval infestation were made on 40 squares and bolls per plot. A calculation of season mean damage/infestation was made across the five evaluation dates. Lint yield was determined by harvesting seedcotton and applying the lint percent from a handpicked boll sample. Percent potential yield was also calculated. Percent potential yield is the yield of a variety under no lepidopteran spray conditions expressed as a percentage of its yield under typical lepidopteran spray control.

Results (Tables 2a-e) indicate artificial infestations were successful as measured by the high damage and infestation values obtained in the unsprayed non-transgenic control (PSC355). The mean damage of squares and bolls was 24.1 and 13.7%, respectively. Square and boll infestation was 5.8 and 4.3%, respectively. For the MXB-13 line, season mean damage and infestation was significantly less than the unsprayed control and not significantly different from the sprayed PSC355. Square and boll damage was 1.5% for MXB-13 plots over the season, while the level of infestation of squares and bolls was 0.1 and 0.2%, respectively. There were no significant differences in lint yield among treatments. However, the unsprayed PSC355 plots had the lowest nominal yield and low percent potential yield (75%). This represents a 25% decrease in yield as a result of uncontrolled TBW infestation. In contrast, the percent potential yield of MXB-13 plots was 105% indicating no decrease in yield due to uncontrolled TBW infestation.

Field Test Site 2. Starkville, MS (2001)
The test design consisted of main plots with "sprayed" and "unsprayed" plots and subplots containing the MXB13 and PSC355 cotton lines. The main plots were not randomized, therefore creating two side-by-side randomized complete block trials. Subplots were replicated four times. In "sprayed" main plots, conventional insecticides were used for optimum control of lepidopteran pests. In "unsprayed" main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was two rows wide by 30 ft long with 40" row spacing. Two blank rows were used between subplots and four blank rows were used between main plots to minimize movement of larvae between plots. Artificial infestations were carried out on the "unsprayed" main plots twice weekly for six weeks. Neonate larvae were applied to the terminal of the plants in a corn grit carrier at a rate of 10 larvae per row-foot. Evaluations of efficacy were made 4-6 days after inoculation on 20 plants per plot in July and continued for six weeks. Evaluations of tissue damage and larval infestation were made on 20 squares and 20 bolls per plot. Counts were not made for boll damage and infestation in the first three weeks because of low boll counts during that stage of plant development. A calculation of season mean damage/infestation was made across the six evaluation dates. Lint yield was determined by harvesting seedcotton and applying the lint percent from a handpicked boll sample. Percent potential yield was also calculated. Percent potential yield is the yield of a variety under no lepidopteran spray conditions expressed as a percentage of its yield under typical lepidopteran spray control.

Results (Tables 3a-f) indicate artificial infestations were successful as measured by the high damage and infestation values obtained in the unsprayed non-transgenic control (PSC355). The mean damage of squares and bolls was 19.38 and 7.08%, respectively. Square and boll infestation was 8.33 and 2.5%, respectively. For the MXB-13 line, season mean damage and infestation was significantly less than the unsprayed control and not significantly different from the sprayed PSC355. The low level of damage and infestation in the sprayed PSC355 plants indicates that the chemical sprays used in the "sprayed" treatments adequately controlled the natural infestations. However, MXB-13 added an additional level of control above the use of sprays as indicated by significantly lower terminal and boll infestation as well as square damage. The season mean of terminal infestation for the unsprayed MXB-13 line was higher than expected based on the trends in the whole data set for the trial. For example, the value for July 18 was 25%, which is high, but does not appear to represent the MXB-13 line based on the other five values recorded throughout the season. If this one high value is removed, the terminal infestation mean drops from 6.88% to 3.25%.

Lint yield between treatments was not reflective of the efficacy against TBW. The MXB-13 line and the sprayed PSC355 plots had comparable yields as would be expected. However, the unsprayed PSC355 plots also had lint yield that was comparable to the other treatments. Most likely, delayed harvesting due to sustained rains allowed bolls which set late in untreated plots to fully mature and contribute to the final yield thus making the unsprayed PSC355 yield comparable to the sprayed PSC355 and the MXB-13 yields.

Starkville, MS (2002)

The design and procedures used in the 2002 trials at Starkville were nearly identical to those used in 2001 (described above) except the plot size was four rows wide and there were three replications. Infestation and evaluation procedures plus the relative timing of the procedures were the same. Yield results were not available at the time of this writing.

Results (Tables 4a-e) indicate artificial infestations were successful as measured by the high damage and infestation values obtained in the unsprayed non-transgenic control (PSC355). The mean damage of squares and bolls was 13.33 and 5.0%, respectively. Square and boll infestation was 2.5 and 1.67%, respectively. As in the 2001 trial, the MXB-13 line, season mean damage and infestation was significantly less than the unsprayed control and not significantly different from the sprayed PSC355 plots. There were no significant differences for infestation evaluations in terminals, squares or bolls. Within the sprayed treatment, MXB-13 had significantly less square and boll damage as well as square infestation compared to the sprayed non-transgenic control. Terminal and boll infestations were not significantly different; however, MXB-13 was numerically lower than the non-transgenic PSC255 line in both cases.

Field Test Site 3. Winnsboro, LA (2001)

A split-plot design with four replications was used with areas of "sprayed" and "unsprayed" plots and subplots containing the MXB13 and PSC355 cotton lines. In "sprayed" main plots, conventional insecticides were used for optimum control of lepidopteran pests. In "unsprayed" main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was four rows wide by 30 ft long with 40" row spacing. This trial relied on natural infestation of TBW for determining efficacy. Evaluations were made on a five to 10 day schedule starting on July 25 and continuing until September

10. Twenty-five squares per plot in each of the four replications were examined for damage and the presence of larvae. A calculation of season mean damage/infestation was not made across the evaluation dates because natural infestation was variable and limited on some dates. Seedcotton yield was determined by harvesting and directly weighing seedcotton in the field. Percent potential yield was calculated.

Results (Tables 5a-c) indicate a natural infestation of TBW was encountered at the trial site between August 22 and September 10. Pheromone trap counts indicate that TBW accounted for 94 to 100% of the Heliothine moths during that time period. Peak square damage was 28% over the 3-week period while peak square infestation was 9% over the same period. The MXB-13 line provided excellent control of TBW. Square damage for MXB-13 plants over the 3-week period was 0.00-2.0% while square infestation was 0.0-1.0%. These values were significantly lower than the unsprayed control variety. Relative seedcotton yield of the unsprayed PSC355 line (1139 lbs./acre) was lower than the MXB-13 yield (2218-2257 lbs./acre) by approximately 50% as would be expected from TBW damage. However, the sprayed PSC355 line was also significantly lower (1444 lbs/acre) by approximately 35%. This is mostly like due to rainfall conditions that resulted in untimely chemical spray applications.

Winnsboro, LA (2002)
The design and procedure used in the 2002 trial at Winnsboro were nearly identical to that used in 2001 described above. Differences were in the sampling evaluations. The number of squares evaluated at each sampling date was decreased from 25 to 10 while the number of dates increased from seven to 11. Also, damage and infestation were evaluated for terminals in addition to squares. Yield results were not available at the time of this writing.

Historically, the Winnsboro area has had Heliothine flights that consisted of cotton bollworm (CBW) in early season followed by heavy infestation of TBW in mid to late season. However in 2002, the CBW infestation was greater and lasted farther into the growing season. Damage and infestation ratings on squares and terminals of the unsprayed PSC355 plants indicate a slight peak on July 25 followed by a larger peak on August 19. Results (Tables 6a-d) indicate the MXB-13 unsprayed line provided excellent control of CBW/TBW throughout the season with mean season terminal and square damage of 4.5 and 2.7%, respectively. The nontransgenic PSC355 damage was 14.8 and 18.5% for CBW and TBW, respectively. Larval infestation values for terminals and squares were 1.8% and 0.7% for MXB-13 plots while for the PSC355 plots the ratings were 4.8 and 7.5%. The season mean values for all variables were lower for the unsprayed MXB-13 plants versus the unsprayed PSC355 plants. An example of the seasonal trends is shown in Figure 1 graph of square damage under non-sprayed conditions.

Summary of <u>Heliothis virescens</u> Efficacy Field Trials
Five TBW trials consisting of both artificial and natural infestation techniques were conducted by multiple cooperators in 2001 and 2002. Results indicate that MXB-13 is able to effectively control TBW infestations under field conditions. The level of control is at least equal to, and in many cases far superior to optimum chemical spray programs used during ideal environmental conditions. Results also

indicate that MXB-13 surpassed the effectiveness of chemical spray programs under non-ideal environmental conditions such as sustained periods of rain. The results of the trials have been consistent in showing a high level of efficacy. Additionally, the level of control was shown to be effective during both the early fruiting period in July (Figure 2) as well as the late boll maturation period in late August and early September (Figure 3).

2. Cotton Bollworm (*Helicoverpa zea*) Efficacy Trials

Three trials were conducted in 2001 to determine efficacy of MXB-13 against the cotton bollworm (CBW). These trials were located at Wayside, MS; Starkville, MS; and Jamesville, NC. Data is also presented for 2002 trials at Starkville, MS and Jamesville, NC.

Field Test Site 1. Wayside, MS (2001)

The procedures used for this trial were identical to those used for the TBW trial at Wayside in 2001 (see Section 1 for details).

Results, presented in Tables 7a-e, indicate artificial infestations were successful as measured by the high damage and infestation values obtained in the unsprayed non-transgenic control (PSC355). The mean damage of squares and bolls was 22.9 and 9.4%, respectively. Square and boll infestation were 4.8 and 1.5%, respectively. For the MXB-13 line, season mean damage and infestation were significantly less than the unsprayed control and not significantly different from the sprayed PSC355. Square and boll damage were 3.1 and 0.8% for MXB-13 over the season, while the levels of infestation of squares and bolls were 0.3 and 0.1%, respectively. There were no significant differences in lint yield among the "protected" treatments, i.e., MXB-13, MXB-13 sprayed, and PSC355 sprayed. However, the unsprayed PSC355 had a low percent potential yield (67%) compared to the MXB-13 of 104%. This indicates a 33% decrease yield as a result of CBW infestation.

Field Test Site 2. Starkville, MS (2001)

The procedures used for this trial were identical to those used for the TBW trial at Starkville in 2001 (see Section 1 for details).

Results, presented in Tables 8a-f, indicate artificial infestations were successful as measured by the high damage and infestation values obtained in the unsprayed non-transgenic control (PSC355). The mean damage of squares and bolls were 17.1 and 10.0%, respectively. Square and boll infestation were 6.5 and 6.7%, respectively. For the MXB-13 line, season mean damage and infestation were significantly less than the unsprayed control and not significantly different from the sprayed PSC355. Efficacy against CBW did not translate in a yield advantage. The MXB-13 line and the sprayed PSC355 had comparable yields as would be expected. However, the unsprayed PSC355 also had lint yield that was comparable to the other treatments. Most likely, delayed harvesting due to sustained rains allowed bolls which set late in unsprayed plots to fully mature and contribute to the final yield thus making the unsprayed PSC355 yield comparable to the sprayed PSC355 and the MXB-13 lines.

Starkville, MS (2002)

The procedures used for this trial were identical to those used for the trial at Starkville in 2001 with the exception that the plot size was four rows wide. Yield results were not available at the time of this writing.

Results, presented in Tables 9a-e, indicate artificial infestations were successful, although the season mean values were lower than in 2001. This had the effect of reducing the power of the test to show significant differences among treatments as noted by the large number of evaluations, by date and season means that did not have no significant differences. Unsprayed MXB-13 plots had significantly less square damage and terminal infestation than did the unsprayed PSC355 plots. There were no significant differences between the unsprayed treatments for square and boll infestations and boll damage although the MXB-13 was numerically lower in all cases.

Field Test Site 3. Jamesville, NC (2001)

A split-plot design with four replications was used with areas of “sprayed” and “unsprayed” plots and subplots containing the MXB-13 and PSC355 cotton lines. In “sprayed” main plots, conventional insecticides were used for optimum control of lepidopteran pests. In “unsprayed” main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was two rows wide by 30 ft long with 36" row spacing. This trial relied on natural infestation of CBW for determining efficacy. Evaluations were made on three dates in August at approximately weekly intervals. Fifty (50) bolls per plot in each of the four replications were examined for damage and the presence of larvae. A calculation of season mean damage/infestation was not made across the evaluation dates because natural infestation was variable and limited on some dates. Seedcotton yield was determined by harvesting and directly weighing seedcotton in the field. Percent potential yield was calculated.

Results, presented in Tables 10a-c, indicate a natural infestation of CBW was encountered at the trial site between August 14 and August 28. Laboratory identifications of larvae indicated 95% as CBW. Boll damage in the unsprayed PSC355 ranged from 33 - 56% and boll infestation ranged from 11.6 - 18.6%. The boll damage for MXB-13 plots was 6.0% - 7.6% while boll infestation was between 2 - 4%. On all evacuation dates, MXB-13 plots had significantly less damage and infestation than the unsprayed PSC355 and was not significantly different from the sprayed treatments. Seedcotton yield for the MXB-13 treatment was not significantly different from the PSC355 sprayed treatment. The unsprayed PSC355 suffered significant losses due to CBW infestation. Comparing values for percent yield potential, the MXB-13 line was 109% of the sprayed treatment while the PSC355 untreated plants had only 50% yield potential.

Jamesville, NC (2002)

The design and procedure used in the 2002 trial at Jamesville were nearly identical to that used in 2001 as described above. One difference was in the sampling evaluations. The number of bolls evaluated was 40. Yield results were not available at the time of this writing.

Results (Tables 11a-b) indicate the CBW natural infestation during the first half of August in North Carolina was larger than in past years. Percent damage for the unsprayed PSC355 ranged from 58.8 - 66.9% and boll infestation ranged from 0 - 22.5%. Boll damage and infestation for MXB-13 were significantly lower than the unsprayed PSC355 on all evaluation dates except for August 19. Also, unsprayed MXB-13 had significantly less boll damage than the sprayed PSC355 on the August 13th evaluation and numerically lower on the other two dates. The boll infestation levels of MXB-13 remained below the 3-4% threshold level that is typically used to apply chemical sprays. This level of control was maintained throughout the heavy infestation which peaked with about 67% damage in the unsprayed PSC355.

Summary of Helicoverpa zea Efficacy Field Trials
Five CBW trials consisting of both artificial and natural infestation techniques were conducted by multiple cooperators in 2001 and 2002. Results indicate that MXB-13 is able to effectively control CBW infestations under field conditions. For the five trials in two years, a total of 80 individual evaluations was made comparing MXB-13 plots to unsprayed PSC355 plots. In 96% of these comparisons, the MXB-13 line exhibited equal to or less damage than the unsprayed control with 53% of the differences being statistically significant. Likewise, MXB-13 plots had equal or less damage in 58% of the comparisons to the sprayed PSC355 plots with optimum insecticide control. There were no evaluations where MXB-13 had significantly more damage or infestation than the chemically controlled PSC355 plants. No significant differences in yield were found between the unsprayed MXB-13 line and the sprayed PSC355. These results indicate MXB-13 to be a commercially acceptable means for controlling CBW in cotton.

3. Pink Bollworm (*Pectinophora gossypiella*) Efficacy Trials
One trial was conducted in 2001 to examine the efficacy of MXB-13 against the pink bollworm (PBW). This trial was located in Maricopa, AZ in the center of the PBW infestation area of the southwestern United States.

Maricopa, AZ (2001)
The biology of PBW presents technical difficulties not encountered in evaluations of other lepidopteran pests. Neonate PBW enter the boll soon after hatching and spends the majority of their lifecycle inside the boll. Therefore, the means by which efficacy against this pest is measured is substantially different from that used with other lepidopteran pests. The trial design consists of two main plots. Within each main plot, subplots are organized in randomized block design with four replications. In “sprayed” main plots, conventional insecticides were used for optimum control of lepidopteran pests. In “unsprayed” main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was four rows wide by 39 ft long with 40" row spacing. Artificial infestations were carried out on the “unsprayed” main plots on three dates. An evaluation of natural infestation was made on both “sprayed” and “unsprayed” treatments approximately three weeks prior to harvest.

In this study, there are two terms that are used to describe efficacy. The first is “% infested bolls.” An infested boll is defined as one that has evidence of larval development to the third instar or beyond. In five measurements of infestation, MXB-13 had 0% infested bolls whereas the non-transgenic control was 23-75%. Out of 3450 boll entry holes, zero larvae developed to the third instar. “Control intensity” is the second term used to measure efficacy. This term is a weighted average of percent control that measures how quickly (which instar) larvae are killed. A 100% value indicates that all larvae are killed in the first instar whereas a 0% indicates that larvae develop to the third instar. Results shown in Table 12 indicate that PBW had no measurable boll infestation compared with 23-75% for the non-transgenic control variety. In the five infestations conducted (one trial), MXB-13 had a control intensity of 96-100%. The non-transgenic control range was 15-66%. In the five infestations conducted (one trial), MXB-13 had a control intensity of 96-100%. The non-transgenic control range was 15-66%. Results indicate MXB-13 has commercially acceptable efficacy in Arizona against PBW.

4. Beet Armyworm (*Spodoptera exigua*) Efficacy Trials

Two trials were conducted in 2001 to specifically examine the efficacy of MXB-13 against beet armyworm (BAW). These trials were located at Fresno, CA and Stoneville, MS.

Field Test Site 1. Fresno, CA (2001)

A split-plot design with four replications was used with areas of “sprayed” and “unsprayed” plots and subplots containing the MXB-13 and PSC355 cotton lines. In “sprayed” main plots, conventional insecticides were used for optimum control of lepidopteran pests. In “unsprayed” main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was two rows wide by 30 ft long with 40" row spacing. This trial relied on natural infestation for determining efficacy. Upon observation of egg mass deposition, larval counts were subsequently made on 10 plants in each of the four replications.

Results are shown in Table 13. A light infestation of BAW was obtained approximately 84 days after planting. The total number of larvae observed on 10 plants per plot was counted. MXB-13 treated plots had a significant decrease in the number of larvae found compared to the unsprayed PSC355. There was no significant difference between the unsprayed and sprayed treatments of MXB-13.

Field Test Site 2. Stoneville, MS (2001)

A split-plot design with four replications was used with areas of “sprayed” and “unsprayed” plots and subplots containing the MXB-13 and PSC355 cotton lines. In “sprayed” main plots, conventional insecticides were used for optimum control of lepidopteran pests. In “unsprayed” main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was two rows wide by 30 ft long with 40" row spacing. Artificial infestations were carried out on the “unsprayed” main plots. The insect colony used for this trial was developed from larvae collected from the field in the spring of 2001. On July 10, 11 and 12 a total of 42 egg masses per plot was clipped to the underside of mature leaves in the center of the canopy. On July 19, a minimum of 18 evaluations per plot was made of foliar damage on infested leaves and the total number of larvae determined by counting using drop cloths spaced within the plot covering 30 row-feet.

Results are shown in Table 14. A significant decrease was found in the amount of foliar feeding. The MXB-13 had less foliar feeding than the PSC355. Likewise, the MXB-13 had significantly fewer larvae than the unsprayed PSC355. In subsequent larvae counts, the number of small larvae and large larvae on the MXB-13 line was significantly less than on the unsprayed PSC355. Also, the number of large larvae on the unsprayed PSC355 was greater indicating substantial growth on the non-transgenic cotton. Even though there were a few small larvae still present on MXB-13 plants after 12-14 days, there was no indication of development to later instars.

Summary of Spodoptera exigua Efficacy Field Trials
The two BAW trials consisted of one natural and one natural infestation conducted at different locations in 2001. Results indicate that MXB-13 is able to effectively control BAW infestations under field conditions. Data indicate fewer larvae on the MXB-13 line. Although early instars were observed on MXB-13 and limited feedings occurred, the larvae were not able to develop into larger instars.

5. Southern Armyworm (*Spodoptera eridania*) Efficacy Trials
One trial in Baldwin County, Alabama in 2001 was used to evaluate the efficacy of MXB-13 against a natural infestation of southern armyworm (SAW).

Baldwin County, AL (2001)
A split-plot design with four replications was used with areas of “sprayed” and “unsprayed” plots and subplots containing the MXB-13 and PSC355 cotton lines. In “sprayed” main plots, conventional insecticides were used for optimum control of lepidopteran pests. In “unsprayed” main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was two rows wide by 30 ft long with 40" row spacing. This trial relied on natural infestation for the determination of efficacy. In early September, a large infestation of SAW was encountered. At 101 days after planting, an estimate of percent defoliation for each plot was made by visually approximating the percentage of leaves that were missing from individual plants. On the same day, the number of larvae in three row-feet per plot was determined using a drop cloth.

Results are shown in Table 15. A heavy infestation of SAW occurred at this trial site as evidenced by the high larvae counts in the unsprayed PSC355. The MXB-13 line had significantly lower larvae counts than the unsprayed PSC355. Some differences were observed in larvae counts between the MXB-13 line and the sprayed PSC355. A complicating factor was the high density of morning-glory weeds which served as additional food for the SAW and most likely accounted for the higher larvae counts for the MXB-13 line than the sprayed PSC355. Even though a large larvae population existed and developed into later instar larvae on the morning-glory, the percent defoliation on the MXB-13 was only 0.8%. However, in the unsprayed PSC355 plots, the percent defoliation was significantly higher (16.3%).

6. Fall Armyworm (*Spodoptera frugiperda*) Efficacy Trials
Two trials were scheduled in 2001 to evaluate for fall armyworms (FAW) in Baldwin, AL and Stoneville, MS, however, natural infestations did not develop at either site. A third trial in Starkville, MS was designed to develop bioassay data on FAW using field grown plants. This trial is discussed here.

Plant tissue for the bioassays was taken from the 2001 TBW field trial. Assays using leaf tissue were conducted on five dates at 7-14 day intervals from July 5 to August 16. Eight leaf samples were taken per plot across four replications. Leaf disks were punched from young expanding leaves and one neonate larva was used per disk. Assays were initially evaluated after six days for percent survival and average weight of surviving larvae.

Data are shown in Tables 16 and 17. Survival (leaf bioassay) on the MXB-13 for July 5-12 dates was 15.6 - 18.8% while on the other three dates ranged from 0 - 3.1%. For the unsprayed PSC355 leaf disks, survival for July 5 and August 3 dates was 59.4% and 84.4% while on the other three dates the range was 90.6 to 93.8%. The percent survival on the MXB-13 was lower on all evaluation dates except the first date of July 5. The mean survival of FAW on MXB-13 was only 8.1% while the PSC355 was 83.8%. Mean weight of surviving larvae feeding on MXB-13 was only 0.3mg compared to those feeding on the PSC355 control of 4.9mg. The low weight on MXB-13 indicates that the larvae did not develop much beyond the neonate stage. As was found with the leaf bioassay data, the bioassays on squares had a substantial level of variability across dates. However, MXB-13 had significantly lower survival on the August 3 evaluation data and for the mean over dates. In addition, the mean weight of the surviving larvae was substantially lower for the MXB-13 than for the PSC355 control.

7. Soybean Looper (*Pseudoplusia includens*) Efficacy Trials

Two trials were conducted in 2001 to specifically examine the efficacy of MXB-13 against soybean looper (SBL). These trials were located at Stoneville, MS and Winnsboro, LA.

Field Test Sites - Stoneville, MS and Winnsboro, LA (2001)

Data on efficacy against SBL were obtained from natural infestation in the BAW trial at Stoneville, MS and from the TBW trial at Winnsboro LA. In the Stoneville trial, larval counts were taken 83 days after planting. Larval counts were taken in the unsprayed PSC355 and MXB-13 plots using five drop cloths (30 row-ft). In the Winnsboro trial, larval counts were taken at 96 and 103 days after planting. Counts were taken with drop cloths from 12 row-feet in unsprayed PSC355 and MXB-13 plots.

Results are presented in Tables 18 and 19. The level of infestation was substantially higher at the Winnsboro site. In both trials, on all evaluation dates, the MXB-13 had significantly fewer larvae than the non-transgenic PSC355 plots. Using the PSC355 level of infestation as a basis, the percent control of SBL found in these trials was 91% at Stoneville and ranged from 96% - 98% at Winnsboro. Thus, MXB-13 efficacy against SBL ranges from 91% to 98% of the control. Based on these two trials, it can be concluded that MXB-13 has a very good efficacy against the SBL.

8. Cabbage Looper (*Trichoplusia ni*) Efficacy Trials

MXB-13 efficacy against a natural infestation of the cabbage looper (CL) was evaluated in one trail in 2001 in Fresno, CA. Larval counts were taken 49 days after planting in unsprayed PSC355 and MXB-13 plots. Results are presented in Table 20. The total larva from 10 plants per plot were determined. The level of infestation was relatively low on the PSC355 plants and averaged only 6.0 larvae per 10 plants. On the MXB-13, zero larvae were found on 10 plants per plot across each of four replications. The results of this one trial indicate that MXB-13 has a high level of efficacy against CL. Since there was only one trial, it is not possible to determine the efficacy across multiple environments.

9. Other Efficacy Trials - Puerto Rico

One trial was conducted in Puerto Rico in the winter of 2001-2002 to examine the efficacy of MXB-13 against natural infestations of the cotton bollworm (*Helicoverpa zea*) and the fall armyworm (*Spodoptera frugiperda*).

A split-plot design with four replications was used with areas of “sprayed” and “unsprayed” plots and subplots containing the MXB-13 and PSC355 cotton lines. In “sprayed” main plots, conventional insecticides were used for optimum control of lepidopteran pests. In “unsprayed” main plots, lepidopteran pests were not controlled with chemical sprays. Plot size was two rows wide by 25 ft long with 30" row spacing. This trial relied on natural infestation for the determination of efficacy. Since specific counts of larvae were not taken, observation of plots and qualitative insect scouting indicated the presence of plant damage typical of CBW and FAW. Evaluations for plant damage were conducted on 10 plants per plot on each of four replications. Boll position was rated as present or absent and if a boll was present it was rated as either open or closed. Crop loss estimates were made based on boll information.

The comparison of unsprayed PSC355 and the MXB-13 plots shows the effect of total lepidopteran activity (Figure 4). There was a low number of bolls in the PSC355 plots corresponding to the equivalent of 36 days maturity. Therefore, the majority of the typical boll load was missing. Because of the low boll load in PSC355, cotton plants continued to grow and set bolls at the top of the plant. The peak in bolls set for PSC355 plots corresponded to equivalent age between 36-45 days. Conversely, the MXB-13 plants had a typical boll load. The peak in bolls set for MXB-13 corresponded to equivalent age between 18 and 24 days. The total boll set on PSC355 plants was much lower than MXB-13 plants and the bulk of the boll load for PSC355 plants was shifted to the later maturing bolls at the top of the plant resulting in a reduced yield.

Table 1. List of Cry1F/Cry1Ac Cotton Field Efficacy Trials (p. 42; MRID 45808407)

Pest Species		Year	Cooperator	Location	Trial Type	Infestation Type
Heliothis virescens	TBW	2001	DAS	Wayside, MS	Split Plot	Artificial
Heliothis virescens	TBW	2001	Johnie Jenkins	Starkville, MS	Split Plot	Artificial
Heliothis virescens	TBW	2002	Johnie Jenkins	Starkville, MS	Split Plot	Artificial
Heliothis virescens	TBW	2001	Roger Leonard	Winnsboro, LA	Split Plot	Natural
Heliothis virescens / Helicoverpa zea	TBW/CBW	2002	Roger Leonard	Winnsboro, LA	Split Plot	Natural
Helicoverpa zea	CBW	2001	DAS	Wayside, MS	Split Plot	Artificial
Helicoverpa zea	CBW	2001	Johnie Jenkins	Starkville, MS	Split Plot	Artificial
Helicoverpa zea	CBW	2002	Johnie Jenkins	Starkville, MS	Split Plot	Artificial
Helicoverpa zea	CBW	2001	J.R Bradley / John Van Duyn	Jamesville, NC	Split Plot	Natural
Helicoverpa zea	CBW	2002	J.R Bradley / John Van Duyn	Jamesville, NC	Split Plot	Natural
Spodoptera exigua	BAW	2001	DAS	Fresno, CA	Split Plot	Natural
Spodoptera exigua	BAW	2001	John Adamczyk	Stoneville, MS	Split Plot	Artificial
Spodoptera eridania	SAW	2001	Ron Smith	Baldwin Co., AL	Split Plot	Natural
Spodoptera frugiperda	FAW	2001	Johnie Jenkins	Starkville, MS	Bioassay	Artificial
Pseudoplusia includens	SBL	2001	John Adamczyk	Stoneville, MS	Split Plot	Natural
Pseudoplusia includens	SBL	2001	Roger Leonard	Winnsboro, LA	Split Plot	Natural
Trichoplusia ni	CL	2001	DAS	Fresno, CA	Split Plot	Natural
Pectinophora gossypiella	PBW	2001	Peter Ellsworth	Maricopa, AZ	Split Plot	Artificial/Natural
Spodoptera frugiperda / Helicoverpa zea	FAW/CBW	2001/2002	DAS	Puerto Rico	Split Plot	Natural

Table 2. Weekly Evaluations of Efficacy Against TBW Under Artificial Infestation at Wayside, MS in 2001 (p. 43; MRID 458084-07)

Table 2a - Percent Squares with Damage*

Treatment		26-Jul	02-Aug	09-Aug	16-Aug	29-Aug	Season Mean
MXB13	Sprayed	nd	nd	1.3	0.0	0.0	0.4
PSC355	Sprayed	nd	nd	0.6	1.3	2.5	1.5
MXB13	Unsprayed	1.3	1.9	1.3	1.9	1.3	1.5
PSC355	Unsprayed	24.6	51.9	19.0	10.0	15.0	24.1
LSD (0.05)		4.2	9.9	4.7	4.2	4.5	6.0

Table 2b - Percent Squares with Larvae*

Treatment		26-Jul	02-Aug	09-Aug	16-Aug	29-Aug	Season Mean
MXB13	Sprayed	nd	nd	0.0	0.0	0.0	0.0
PSC355	Sprayed	nd	nd	0.0	0.0	0.0	0.0
MXB13	Unsprayed	0.6	0.0	0.0	0.0	0.0	0.1
PSC355	Unsprayed	9.9	11.6	1.7	4.1	1.7	5.8
LSD (0.05)		3.0	3.2	ns	ns	ns	1.3

Table 2c - Percent Bolls with Damage*

Treatment		26-Jul	02-Aug	09-Aug	16-Aug	29-Aug	Season Mean
MXB13	Sprayed	nd	nd	0.0	0.6	0.0	0.2
PSC355	Sprayed	nd	nd	1.9	1.3	3.8	2.3
MXB13	Unsprayed	0.6	1.9	0.0	1.3	3.8	1.5
PSC355	Unsprayed	10.8	9.3	16.7	14.5	17.0	13.7
LSD (0.05)		2.8	3.4	3.2	4.7	3.3	3.5

Table 2d - Percent Bolls with Larvae*

Treatment		26-Jul	02-Aug	09-Aug	16-Aug	29-Aug	Season Mean
MXB13	Sprayed	nd	nd	0.0	0.0	0.0	0.0
PSC355	Sprayed	nd	nd	0.0	0.0	0.0	0.0
MXB13	Unsprayed	0.6	0.6	0.0	0.0	0.0	0.2
PSC355	Unsprayed	5.8	4.1	1.6	4.1	5.8	4.3
LSD (0.05)		3.9	ns	ns	ns	4.0	0.9

Table 2e - Lint Yield

Treatment		Yield (LB/ac)	% Yield Potential
MXB-13	Unsprayed	1178	105
PSC355	Unsprayed	881.0	75
MXB-13	Sprayed	1120	
PSC355	Sprayed	1171	
LSD (0.05)		ns	

* 40 samples per replication with 4 replications

nd= not determined. No natural infestation on these dates.

Table 3. Weekly Evaluations of Efficacy Against TBW Under Artificial Infestation at Starkville, MS in 2001 (p. 44-45; MRID 45808407)

Table 3a - Percent Terminals with Larvae*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PSC355	Sprayed	1.25	5.00	1.25	1.25	0.00	0.00	1.46
LSD (0.05)		ns	3.33	ns	ns	ns	ns	1.00
MXB13	Unsprayed	0.00	25.00	8.75	3.75	3.75	0.00	6.88
PSC355	Unsprayed	22.50	32.50	25.00	16.25	11.25	8.75	19.38
LSD (0.05)		ns	ns	ns	ns	6.25	4.42	8.76

Table 3b - Percent Squares with Damage*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	1.25	0.00	0.00	0.21
PSC355	Sprayed	1.25	0.00	2.50	3.75	5.00	3.75	2.71
LSD (0.05)		ns	ns	ns	ns	3.27	ns	0.95
MXB13	Unsprayed	0.00	0.00	2.50	3.75	2.50	5.00	2.29
PSC355	Unsprayed	13.75	7.50	18.75	22.50	28.75	25.00	19.38
LSD (0.05)		8.11	ns	9.07	11.90	10.60	11.92	6.36

Table 3c - Percent Squares with Larvae*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	1.25	0.00	0.00	0.21
PSC355	Sprayed	0.00	0.00	1.25	0.00	0.00	0.00	0.21
LSD (0.05)		ns	ns	ns	ns	ns	ns	ns
MXB13	Unsprayed	0.00	0.00	0.00	1.25	0.00	0.00	0.21
PSC355	Unsprayed	6.25	2.50	7.50	7.50	12.50	13.75	8.33
LSD (0.05)		ns	ns	ns	ns	7.66	5.96	4.51

Table 3d - Percent Bolls with Damage*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	nd	nd	nd	0.00	0.00	0.00	0.00
PSC355	Sprayed	nd	nd	nd	2.50	1.25	2.50	2.08
LSD (0.05)					ns	ns	ns	ns
MXB13	Unsprayed	nd	nd	nd	0.00	3.75	1.25	1.67
PSC355	Unsprayed	nd	nd	nd	2.50	8.75	10.00	7.08
LSD (0.05)					ns	ns	7.33	ns

Table 3e - Percent Bolls with Larvae*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	nd	nd	nd	0.00	0.00	0.00	0.00
PSC355	Sprayed	nd	nd	nd	2.50	1.25	1.25	1.67
LSD (0.05)					ns	ns	ns	0.99
MXB13	Unsprayed	nd	nd	nd	0.00	1.25	0.00	0.42
PSC355	Unsprayed	nd	nd	nd	1.25	2.50	3.75	2.50
LSD (0.05)					ns	ns	2.00	ns

Table 3f - Lint Yield

Treatment		Yield (LB/ac)	% Yield Potential
MXB-13	Unsprayed	1631	103
PSC355	Unsprayed	1565	95
MXB-13	Sprayed	1589	
PSC355	Sprayed	1649	
LSD (0.05)		ns	

* 20 samples per replication with 4 replications
nd = not determined. No significant boll set.

Table 4. Weekly Evaluations of Efficacy Against TBW Under Artificial Infestation at Starkville, MS in 2002 (p. 46-47; MRID 45808407)

Table 4a - Percent Terminals with Larvae*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PSC355	Sprayed	0.00	0.00	1.67	1.67	0.00	0.00	0.56
LSD (0.05)		ns	ns	ns	ns	ns	ns	ns
MXB13	Unsprayed	3.33	0.00	0.00	1.67	0.00	0.00	0.83
PSC355	Unsprayed	1.67	3.33	6.67	10.00	5.00	0.00	4.44
LSD (0.05)		ns	ns	ns	ns	2.88	ns	ns

Table 4b - Percent Squares with Damage*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	1.67	0.00	0.00	1.67	0.00	1.67	0.83
PSC355	Sprayed	0.00	1.67	5.00	11.67	5.00	1.67	4.17
LSD (0.05)		ns	ns	ns	4.99	ns	ns	2.54
MXB13	Unsprayed	0.00	3.33	1.67	1.67	1.67	3.33	1.94
PSC355	Unsprayed	13.33	15.00	18.33	11.67	13.33	8.33	13.33
LSD (0.05)		7.62	7.62	11.41	ns	6.86	3.33	4.87

Table 4c - Percent Squares with Larvae*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PSC355	Sprayed	0.00	0.00	3.33	8.33	1.67	0.00	2.22
LSD (0.05)		ns	ns	ns	5.77	ns	ns	1.27
MXB13	Unsprayed	0.00	1.67	0.00	1.67	0.00	0.00	0.56
PSC355	Unsprayed	1.67	0.00	5.00	5.00	3.33	0.00	2.50
LSD (0.05)		ns	ns	ns	ns	ns	ns	ns

Table 4d - Percent Bolls with Damage*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	nd	nd	nd	1.67	0.00	0.00	0.56
PSC355	Sprayed	nd	nd	nd	6.67	10.00	3.33	6.67
LSD (0.05)					ns	ns	ns	0.96
MXB13	Unsprayed	nd	nd	nd	0.00	0.00	1.67	0.56
PSC355	Unsprayed	nd	nd	nd	5.00	3.33	6.67	5.00
LSD (0.05)					0.00	ns	ns	2.88

Table 4e - Percent Bolls with Larvae*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	nd	nd	nd	0.00	0.00	0.00	0.00
PSC355	Sprayed	nd	nd	nd	5.00	0.00	0.00	1.67
LSD (0.05)					ns	ns	ns	ns
MXB13	Unsprayed	nd	nd	nd	0.00	0.00	0.00	0.00
PSC355	Unsprayed	nd	nd	nd	1.67	3.33	0.00	1.67
LSD (0.05)					ns	ns	ns	ns

* 20 samples per replication with 3 replications
nd= not determined. No significant boll set.

Table 5. Weekly Evaluations of Efficacy Against TBW Under Natural Infestation at Winnsboro, LA in 2001 (p. 48; MRID 45808407)

Table 5a - Percent Squares with Damage*

Treatment		25-Jul	30-Jul	03-Aug	14-Aug	22-Aug	30-Aug	10-Sep
MXB13	Sprayed	0.0	0.0	0.0	0.0	0.0	0.0	1.0
PSC355	Sprayed	1.0	5.0	5.0	1.0	24.0	21.0	1.0
MXB13	Unsprayed	0.0	0.0	1.0	1.0	0.0	1.0	2.0
PSC355	Unsprayed	0.0	4.0	5.0	5.0	16.0	28.0	17.0
LSD (0.05)		ns	4.4	ns	ns	9.5	11.2	9.8

Table 5b - Percent Squares with Larvae*

Treatment		25-Jul	30-Jul	03-Aug	14-Aug	22-Aug	30-Aug	10-Sep
MXB13	Sprayed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PSC355	Sprayed	0.0	0.0	0.0	0.0	6.0	7.0	1.0
MXB13	Unsprayed	0.0	0.0	1.0	0.0	0.0	1.0	0.0
PSC355	Unsprayed	0.0	0.0	2.0	0.0	8.0	9.0	5.0
LSD (0.05)		ns	ns	ns	ns	5.4	4.6	3.4

Table 5c - Seedcotton Yield

Treatment		Yield (LB/ac)	% Yield Potential
MXB-13	Unsprayed	2218	98
PSC355	Unsprayed	1139	79
MXB-13	Sprayed	2257	
PSC355	Sprayed	1444	
LSD (0.05)		268	

* 25 samples per replication with 4 replications

Table 6. Evaluations of Efficacy Against TBW/CBW Under Natural Infestation at Winnsboro, LA in 2002 (p. 49; MRID 45808407)

Table 6a - Percent Terminal Damage*

Treatment		17-Jul	22-Jul	26-Jul	30-Jul	01-Aug	05-Aug	12-Aug	19-Aug	27-Aug	04-Sep	Season Mean
MXB13	Sprayed	2.5	0.0	0.0	2.5	0.0	0.0	5.0	2.5	5.0	0.0	1.8
PSC366	Sprayed	12.5	7.5	12.5	5.0	7.5	5.0	5.0	10.0	22.5	7.5	6.5
MXB13	Unsprayed	2.5	2.5	5.0	5.0	5.0	0.0	10.0	5.0	5.0	5.0	4.5
PSC366	Unsprayed	5.0	2.5	5.0	10.0	2.5	12.5	32.5	32.5	30.0	15.0	14.8
LSD(0.05)		8.1	6.3	ns	ns	ns	7.5	16.2	14.3	14.1	10.6	4.2

Table 6b - Percent Terminals with Larvae*

Treatment		17-Jul	22-Jul	26-Jul	30-Jul	01-Aug	05-Aug	12-Aug	19-Aug	27-Aug	04-Sep	Season Mean
MXB13	Sprayed	2.5	0.0	2.5	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.8
PSC366	Sprayed	10.0	2.5	2.5	2.5	0.0	5.0	2.5	7.5	5.0	0.0	3.8
MXB13	Unsprayed	0.0	2.5	0.0	2.5	0.0	0.0	2.5	10.0	0.0	0.0	1.8
PSC366	Unsprayed	5.0	2.5	5.0	2.5	0.0	2.5	12.5	10.0	7.5	0.0	4.8
LSD(0.05)		6.3	ns	ns	ns	ns	ns	10.4	ns	5.9	ns	1.8

Table 6c - Percent Square Damage*

Treatment		17-Jul	22-Jul	26-Jul	30-Jul	01-Aug	05-Aug	12-Aug	19-Aug	27-Aug	04-Sep	11-Sep	Season Mean
MXB13	Sprayed	0.0	0.0	2.5	0.0	0.0	0.0	2.5	2.5	2.5	0.0	5.0	1.4
PSC366	Sprayed	2.5	5.0	15.0	5.0	7.5	2.5	15.0	10.0	12.5	7.5	0.0	7.5
MXB13	Unsprayed	0.0	2.5	2.5	2.5	2.5	0.0	5.0	2.5	5.0	5.0	2.5	2.7
PSC366	Unsprayed	5.0	7.5	17.5	12.5	7.5	10.0	22.5	50.0	43.0	15.0	12.5	18.5
LSD(0.05)		ns	4.7	10.5	12.0	ns	7.3	11.3	17.3	9.6	6.1	6.1	3.3

Table 6d - Percent Squares with Larvae*

Treatment		17-Jul	22-Jul	26-Jul	30-Jul	01-Aug	05-Aug	12-Aug	19-Aug	27-Aug	04-Sep	11-Sep	Season Mean
MXB13	Sprayed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.2
PSC366	Sprayed	2.5	5.0	5.0	0.0	0.0	0.0	15.0	5.0	5.0	0.0	0.0	3.4
MXB13	Unsprayed	0.0	0.0	2.5	0.0	0.0	0.0	2.5	2.5	0.0	0.0	0.0	0.7
PSC366	Unsprayed	5.0	2.5	2.5	5.0	2.5	2.5	15.0	23.0	17.5	5.0	2.5	7.5
LSD(0.05)		4.3	4.3	ns	3.0	ns	ns	7.9	7.1	6.3	3.0	ns	1.5

* 10 samples per replication with 4 replications

Table 7. Weekly Evaluations of Efficacy Against CBW under Artificial Infestation at Wayside, MS in 2001 (p. 50; MRID 45808407)

Table 7a - Percent Squares with Damage*

Treatment		26-Jul	02-Aug	09-Aug	16-Aug	29-Aug	Season Mean
MXB13	Sprayed	nd	nd	1.3	0.0	0.0	0.4
PSC355	Sprayed	nd	nd	0.6	1.3	2.5	1.5
MXB13	Unsprayed	4.4	6.9	1.3	2.5	0.6	3.1
PSC355	Unsprayed	25.6	40.6	21.9	12.5	13.8	22.9
LSD (0.05)		6.0	6.9	5.9	2.8	1.8	4.7

Table 7b - Percent Squares with Larvae*

Treatment		26-Jul	02-Aug	09-Aug	16-Aug	29-Aug	Season Mean
MXB13	Sprayed	nd	nd	0.0	0.0	0.0	0.0
PSC355	Sprayed	nd	nd	0.0	0.0	0.0	0.0
MXB13	Unsprayed	0.0	1.3	0.0	0.0	0.0	0.3
PSC355	Unsprayed	11.3	7.5	1.3	0.6	3.1	4.8
LSD (0.05)		3.1	3.3	1.1	ns	1.5	2.0

Table 7c - Percent Bolls with Damage*

Treatment		26-Jul	02-Aug	09-Aug	16-Aug	29-Aug	Season Mean
MXB13	Sprayed	nd	nd	0.0	0.6	0.0	0.2
PSC355	Sprayed	nd	nd	1.9	1.3	3.8	2.3
MXB13	Unsprayed	0.0	0.0	1.3	1.9	0.6	0.8
PSC355	Unsprayed	1.9	6.9	15.6	13.1	9.4	9.4
LSD (0.05)		1.1	3.2	5.6	3.3	2.2	3.1

Table 7d - Percent Bolls with Larvae*

Treatment		26-Jul	02-Aug	09-Aug	16-Aug	29-Aug	Season Mean
MXB13	Sprayed	nd	nd	0.0	0.0	0.0	0.0
PSC355	Sprayed	nd	nd	0.0	0.0	0.0	0.0
MXB13	Unsprayed	0.0	0.0	0.6	0.0	0.0	0.1
PSC355	Unsprayed	0.6	1.3	4.4	0.6	0.6	1.5
LSD (0.05)		ns	ns	1.4	ns	0.5	1.2

Table 7e - Lint Yield

Treatment		Yield (LB/ac)	% Yield Potential
MXB-13	Unsprayed	1170	104
PSC355	Unsprayed	783	67
MXB-13	Sprayed	1120	
PSC355	Sprayed	1171	
LSD (0.05)		209	

* 40 samples per replication with 4 replications
nd = not determined. No natural infestation on these dates.

Table 8. Weekly Evaluations of Efficacy Against CBW Under Artificial Infestation at Starkville, MS in 2001 (p. 51-52; MRID 45808407)

Table 8a - Percent Terminals with Larvae*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PSC355	Sprayed	1.25	5.00	1.25	1.25	0.00	0.00	1.46
LSD (0.05)		ns	3.33	ns	ns	ns	ns	1.00
MXB13	Unsprayed	2.50	2.50	2.50	2.50	2.50	1.25	2.29
PSC355	Unsprayed	20.00	15.00	10.00	16.25	27.50	7.50	16.04
LSD (0.05)		ns	8.84	ns	ns	ns	ns	6.34

Table 8b - Percent Squares with Damage*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	1.25	0.00	0.00	0.21
PSC355	Sprayed	1.25	0.00	2.50	3.75	5.00	3.75	2.71
LSD (0.05)		ns	ns	ns	ns	3.27	ns	0.95
MXB13	Unsprayed	5.00	3.75	5.00	7.50	5.00	5.00	5.21
PSC355	Unsprayed	15.00	8.75	11.25	23.75	18.75	25.00	17.08
LSD (0.05)		4.42	ns	ns	8.54	10.70	9.26	3.69

Table 8c - Percent Squares with Larvae*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	1.25	0.00	0.00	0.21
PSC355	Sprayed	0.00	0.00	1.25	0.00	0.00	0.00	0.21
LSD (0.05)		ns	ns	ns	ns	ns	ns	ns
MXB13	Unsprayed	2.50	0.00	1.25	0.00	1.25	2.50	1.25
PSC355	Unsprayed	5.00	1.25	0.00	13.75	10.00	8.75	6.46
LSD (0.05)		ns	ns	ns	5.03	ns	5.37	2.50

Table 8d - Percent Bolls with Damage*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	nd	nd	nd	0.00	0.00	0.00	0.00
PSC355	Sprayed	nd	nd	nd	2.50	1.25	2.50	2.08
LSD (0.05)					ns	ns	ns	ns
MXB13	Unsprayed	nd	nd	nd	0.00	2.50	1.25	1.25
PSC355	Unsprayed	nd	nd	nd	10.00	6.25	13.75	10.00
LSD (0.05)					5.50	3.53	ns	3.83

Table 8e - Percent Bolls with Larvae*

Treatment		11-Jul	18-Jul	25-Jul	01-Aug	08-Aug	15-Aug	Season Mean
MXB13	Sprayed	nd	nd	nd	0.00	0.00	0.00	0.00
PSC355	Sprayed	nd	nd	nd	2.50	1.25	1.25	1.67
LSD (0.05)					ns	ns	ns	0.99
MXB13	Unsprayed	nd	nd	nd	0.00	1.25	0.00	0.42
PSC355	Unsprayed	nd	nd	nd	8.75	1.25	10.00	6.67
LSD (0.05)					5.50	ns	ns	3.56

Table 8f - Lint Yield

Treatment		Yield (LB/ac)	% Yield Potential
MXB-13	Unsprayed	1631	103
PSC355	Unsprayed	1565	95
MXB-13	Sprayed	1589	
PSC355	Sprayed	1649	
LSD (0.05)		ns	

* 20 samples per replication with 4 replications
nd = not determined. No significant boll set.

Table 9. Weekly Evaluations of Efficacy Against CBW Under Artificial Infestation at Starkville, MS in 2002 (p. 53-54; MRID 45808407)

Table 9a - Percent Terminals with Larvae*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	1.25	0.00	0.00	0.00	0.21
PSC355	Sprayed	0.00	1.25	3.75	6.25	1.25	0.00	2.08
LSD (0.05)		ns	ns	ns	3.83	ns	ns	1.41
MXB13	Unsprayed	0.00	0.00	0.00	5.00	1.25	0.00	1.04
PSC355	Unsprayed	5.00	6.25	6.25	20.00	5.00	2.50	7.50
LSD (0.05)		3.26	ns	ns	10.00	ns	ns	2.79

Table 9b - Percent Squares with Damage*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	0.00	0.00	1.25	0.00	0.21
PSC355	Sprayed	0.00	1.25	0.00	6.25	6.25	0.00	2.29
LSD (0.05)		ns	ns	ns	ns	4.22	ns	1.88
MXB13	Unsprayed	1.25	3.75	0.00	2.50	3.75	2.50	2.29
PSC355	Unsprayed	10.00	16.25	10.00	10.00	20.00	11.25	12.92
LSD (0.05)		ns	8.53	ns	5.17	4.80	ns	3.12

Table 9c - Percent Squares with Larvae*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	0.00	0.00	1.25	0.00	0.00	0.00	0.21
PSC355	Sprayed	0.00	0.00	0.00	3.75	1.25	0.00	0.83
LSD (0.05)		ns	ns	ns	ns	ns	ns	ns
MXB13	Unsprayed	0.00	0.00	0.00	5.00	1.25	0.00	1.04
PSC355	Unsprayed	2.50	0.00	1.25	2.50	5.00	2.50	2.29
LSD (0.05)		ns	ns	ns	ns	ns	ns	ns

Table 9d - Percent Bolls with Damage*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	nd	nd	nd	1.25	0.00	0.00	0.42
PSC355	Sprayed	nd	nd	nd	5.00	3.75	1.25	3.33
LSD (0.05)					ns	2.75	ns	ns
MXB13	Unsprayed	nd	nd	nd	1.25	0.00	0.00	0.42
PSC355	Unsprayed	nd	nd	nd	2.50	5.00	5.00	4.17
LSD (0.05)					ns	ns	ns	ns

Table 9e - Percent Bolls with Larvae*

Treatment		10-Jul	17-Jul	24-Jul	31-Jul	07-Aug	14-Aug	Season Mean
MXB13	Sprayed	nd	nd	nd	1.25	0.00	0.00	0.42
PSC355	Sprayed	nd	nd	nd	5.00	1.25	0.00	2.08
LSD (0.05)					ns	ns	ns	ns
MXB13	Unsprayed	nd	nd	nd	0.00	0.00	0.00	0.00
PSC355	Unsprayed	nd	nd	nd	2.50	2.50	3.75	2.92
LSD (0.05)					ns	ns	ns	ns

* 20 samples per replication with 4 replications
nd= not determined. No significant boll set.

Table 10. Weekly Evaluations of Efficacy Against CBW Under Natural Infestation at Jamesville, NC in 2001 (p. 55; MRID 45808407)

Table 10a - Percent Bolls with Damage*

Treatment		14-Aug	20-Aug	28-Aug
MXB13	Sprayed	1.0	0.6	0.0
PSC355	Sprayed	6.6	3.6	2.6
MXB13	Unsprayed	7.0	7.6	6.0
PSC355	Unsprayed	33.0	56.0	48.6
LSD (0.05)		9.1	8.5	7.1

Table 10b - Percent Bolls with Larvae*

Treatment		14-Aug	20-Aug	28-Aug
MXB13	Sprayed	0.0	0.0	0.0
PSC355	Sprayed	3.6	0.6	0.0
MXB13	Unsprayed	2.0	4.0	2.0
PSC355	Unsprayed	15.0	18.6	11.6
LSD (0.05)		3.7	4.7	2.5

Table 10c - Seedcotton Yield

Treatment		Yield (LB/ac)	% Yield Potential
MXB-13	Unsprayed	2608	109
PSC355	Unsprayed	1410	50
MXB-13	Sprayed	2399	
PSC355	Sprayed	2798	
LSD (0.05)		215	

* 50 samples per replication with 4 replications

Table 11. Weekly Evaluations of Efficacy Against CBW Under Natural Infestation at Jamesville, NC in 2002 (p. 56; MRID 45808407)

Table 11a - Percent Bolls with Damage*

Treatment		06-Aug	13-Aug	19-Aug
MXB13	Sprayed	1.9	0.6	1.3
PSC355	Sprayed	6.9	11.9	7.5
MXB13	Unsprayed	1.9	2.5	1.3
PSC355	Unsprayed	58.8	66.9	59.5
LSD (0.05)		9.1	5.3	10.7

Table 11b - Percent Bolls with Larvae*

Treatment		06-Aug	13-Aug	19-Aug
MXB13	Sprayed	0.0	0.6	0.6
PSC355	Sprayed	1.9	0.6	0.0
MXB13	Unsprayed	0.6	0.6	1.3
PSC355	Unsprayed	21.9	22.5	0.0
LSD (0.05)		4.0	2.4	ns

* 40 samples per replication with 4 replications

Table 12. Evaluation of Efficacy Against PBW Under Artificial and Natural Infestation at Maricopa, AZ in 2001 (p. 57; MRID 45808407)

Table 12a - Percent Infested Bolls (SE)

Treatment		21-Aug	*	05-Sep	*	02-Oct	*	08-Nov	**
MXB13	Sprayed	nd		nd		nd		0.00	b
PSC355	Sprayed	nd		nd		nd		47.00 (5.74)	a
MXB13	Unsprayed	0.00	b	0.00	b	0.00	b	0.00	b
PSC355	Unsprayed	23.33 (10.36)	a	24.21 (9.19)	a	57.65 (4.34)	a	75.10 (10.05)	a

* Artificial infestation

** Natural infestation

nd = not determined

Means within the same column and spray treatment that share the same letter are not significantly different (P>0.05; Tukey's HSD test).

Table 12b - Control Intensity - percent (SE)

Treatment		21-Aug	*	05-Sep	*	02-Oct	*	08-Nov	**
MXB13	Sprayed	nd		nd		nd		96.16 (2.29)	b
PSC355	Sprayed	nd		nd		nd		24.70 (10.67)	a
MXB13	Unsprayed	97.35 (1.22)	b	100.00 (0.00)	b	99.91 (0.09)	b	98.42 (1.09)	b
PSC355	Unsprayed	66.38 (7.82)	a	64.41 (5.12)	a	29.42 (16.84)	a	15.26 (3.97)	a

* Artificial infestation

** Natural infestation

nd = not determined

Means within the same column and spray treatment that share the same letter are not significantly different (P>0.05; Tukey's HSD test).

Table 13. Summary of BAW Efficacy Evaluation Under Natural Infestation at Fresno, CA in 2001 (p. 58; MRID 45808407)

Treatment		Total Larvae *
MXB13	Sprayed	0.3
PSC355	Sprayed	0.0
MXB13	Unsprayed	0.5
PSC355	Unsprayed	2.3
LSD (0.05)		0.4

* Total Larvae obtained from 10 plants per plot with 4 replications.

Table 14. Summary of BAW Efficacy Evaluation Under Artificial Infestation at Stoneville, MS in 2001 (p. 59; MRID 45808407)

Treatment		Foliar Damage * July 19	Total Larvae ** July 20	1st-2nd Instar** July 24	3rd-5th Instar** July 24
MXB13	Unsprayed	1.45	6.3	0.5	0
PSC355	Unsprayed	2.52	37.8	2.8	6.8
LSD (0.05)		0.26	13.6	1.7	2.5

* 0-3 Scale:
0=no damage;
1=slight damage, little feeding, few worms;
2= moderate foliar damage, feeding and larvae easily noted;
3=severe foliar damage to the point of defoliation.

** Larvae obtained in 30 row-feet.

Table 15. Summary of SAW Efficacy Evaluation Under Natural Infestation in Baldwin Co., AL in 2001 (p. 60; MRID 45808407)

Treatment		% Defoliation		Total Larvae*
		101 DAP	116 DAP	101 DAP
MXB-13	Sprayed	nd	nd	1.5
PSC355	Sprayed	nd	nd	0.3
MXB-13	Unsprayed	0.8	1.3	20.5
PSC355	Unsprayed	16.3	36.3	60.3
LSD (0.05)		1.8	3.8	19.9

* Total larvae obtained from 3 row-ft.
nd= not determined

Table 16. Summary of Percent Survival and Larval Weight Gain After Six Days for a FAW Leaf Tissue Bioassay at Starkville, MS in 2001 (p. 61; MRID 45808407)

Entry	Percent Survival											
	Mean Over Reps						Standard Error					
	7-05-01	7-12-01	7-26-01	8-03-01	8-16-01	Mean	7-05-01	7-12-01	7-26-01	8-03-01	8-16-01	Mean
MXB-13	15.6	18.8	3.1	3.1	0.0	8.1	15.6	8.1	3.1	3.1	0.0	3.7
PSC355	59.4	90.6	90.6	84.4	93.8	83.8	21.3	3.1	3.1	11.8	6.3	5.4
LSD (0.05)	50.3	15.7	15.0	18.9	20.8	10.9						

Entry	Larval Weight (mg)											
	Mean Over Reps						Standard Error					
	7-05-01	7-12-01	7-26-01	8-03-01	8-16-01	Mean	7-05-01	7-12-01	7-26-01	8-03-01	8-16-01	Mean
MXB-13	0.3	0.4	0.1	0.1	.	0.3	0.0	0.2	0.0	0.0	.	0.1
PSC355	2.7	5.7	4.8	7.1	3.7	4.9	0.6	0.9	1.2	0.7	0.2	0.5

Table 17. Summary of Percent Survival and Larval Weight Gain After 6 Days for a FAW Square Tissue Bioassay at Starkville, MS in 2001 (p. 62; MRID 45808407)

	Percent Survival						Larval Weight					
	Mean			Standard Error			Mean			Standard Error		
Entry	7-26-01	8-03-01	Mean	7-26-01	8-03-01	Mean	7-26-01	8-03-01	Mean	7-26-01	8-03-01	Mean
MXB-13	37.5	0.0	18.8	21.7	0.0	12.3	1.1	.	1.1	0.1	.	0.1
PSC355	65.6	65.6	65.6	7.9	13.9	7.4	2.0	1.4	1.7	0.4	0.3	0.3
LSD (0.05)	35.3	23.1	25.8									

Table 18. Summary of SBL Efficacy Evaluation Under Natural Infestation at Stoneville, MS in 2001 (p. 63; MRID 45808407)

Treatment		Total Larvae* 83 DAP
MXB-13	Unsprayed	0.5
PSC355	Unsprayed	5.3
LSD (0.05)		3.8

* Total larvae from 5 drop cloths with 4 replications

Table 19. Summary of SBL Efficacy Evaluation Under Natural Infestation at Winnsboro, LA in 2001 (p. 64; MRID 45808407)

Treatment		Total Larvae*	
		96 DAP	103 DAP
MXB-13	Unsprayed	2.0	0.3
PSC355	Unsprayed	48.5	12.8
LSD (0.05)		13.6	4.6

* Total larvae obtained from 12 row-ft

Table 20. Summary of CL Efficacy Evaluation Under Natural Infestation at Fresno, CA in 2001 (p. 65; MRID 45808407)

Treatment		Total Larvae*
MXB-13	Unsprayed	0.0
PSC355	Unsprayed	6.0
LSD (0.05)		3.7

* Total larvae obtained from 10 plants per plot

Figure 1. Efficacy Against TBW/CBW %Square Damage in Unsprayed Plots 2002 Winnsboro, LA (p. 66; MRID 45808407)

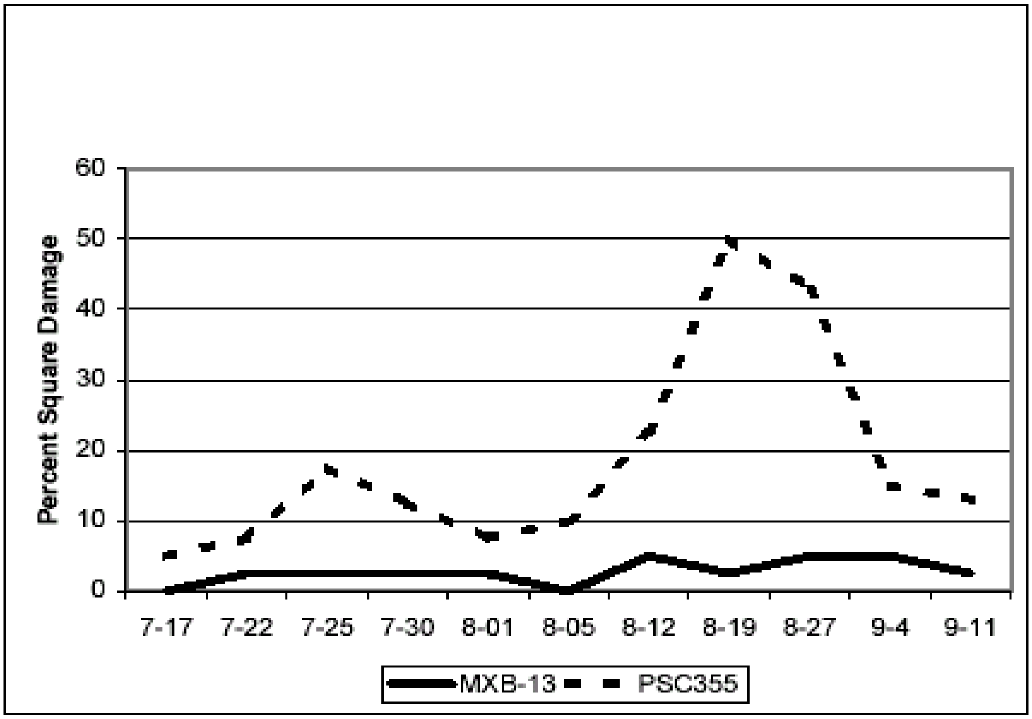

Figure 2. Efficacy Against TBW %Square Damage in Unsprayed Plots 2001 Wayside, MS (p. 67; MRID 45808407)

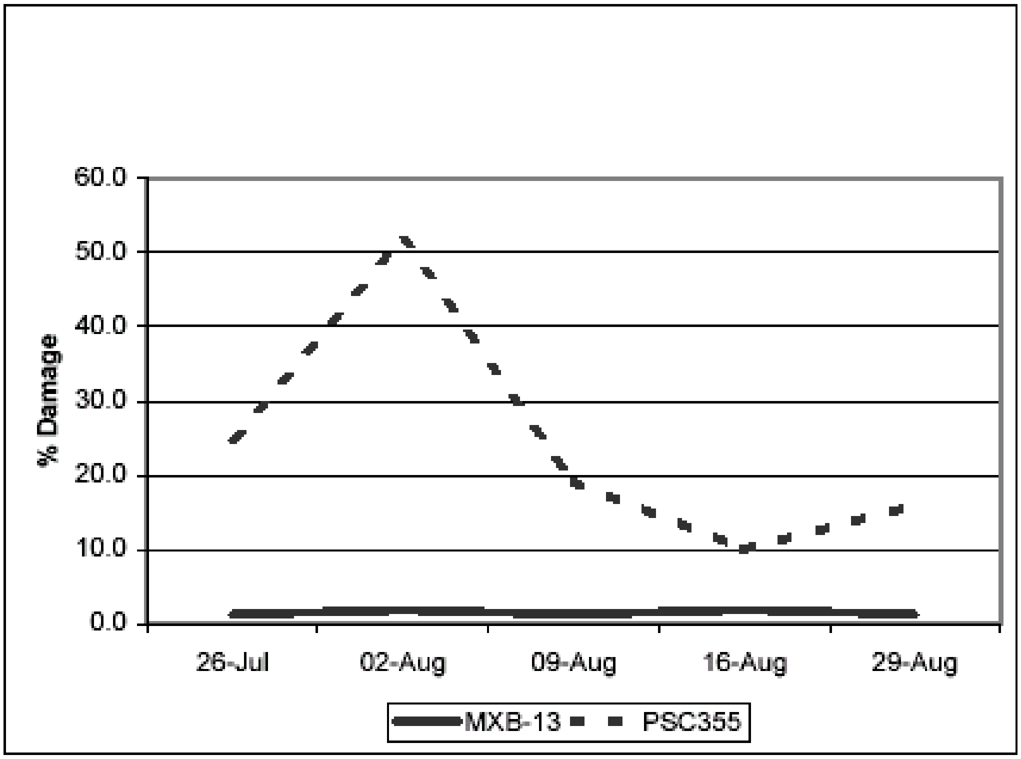

Figure 3. Efficacy Against TBW %Square Damage in Unsprayed Plots 2001 Winnsboro, LA (p. 68; MRID 45808407)

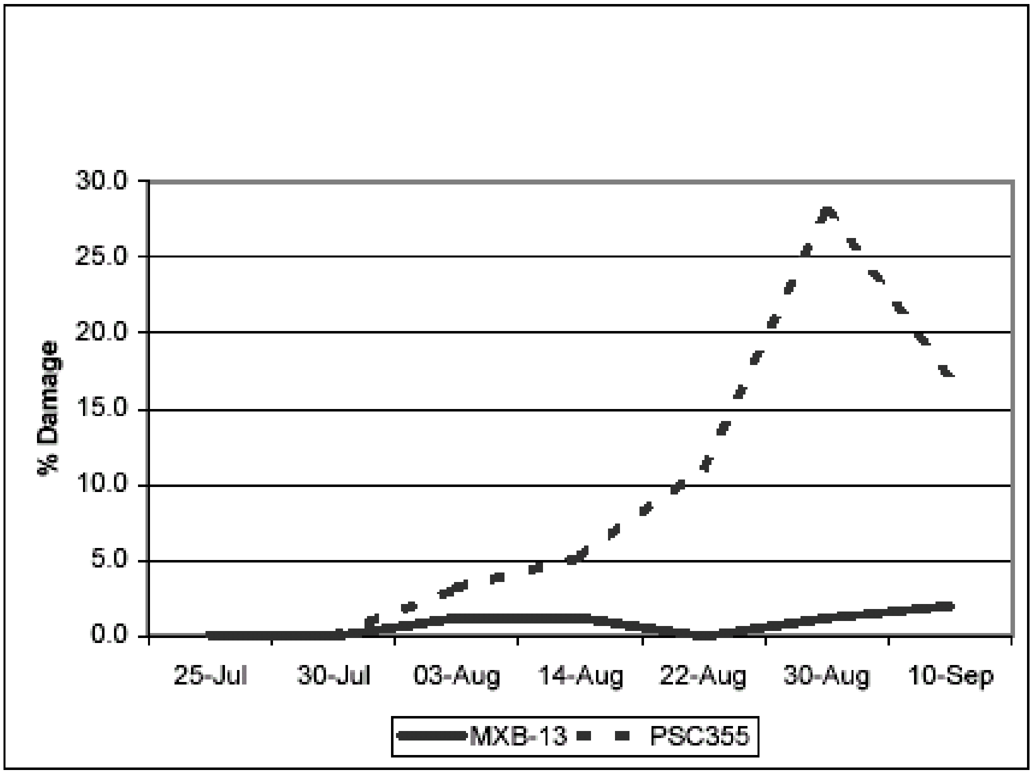

Figure 4. Plant Map Data for Unsprayed MXB-13 vs. PSC355 - Puerto Rico 2001-02 (p. 69; MRId 45808407)