

**SUSCEPTIBILITY OF BOLLWORM (*HELICOVERPA ZEA*) ADULTS FROM ACROSS
THE MID-ATLANTIC STATES TO PYRETHROID INSECTICIDES-2003-2005**

Greg Payne

State University of West Georgia

Carrollton, GA

Galen Dively

University of Maryland

College Park, MD

Joseph Ingerson-Mahar

Rutgers University

New Brunswick, NJ

Joanne Whalen

University of Delaware

Newark, DE

Thomas Kuhar

Virginia Tech

Painter, VA

Ames Herbert

Virginia Tech

Suffolk, VA

Shelby Fleischer

Pennsylvania State University

University Park, PA

Abstract

Although pyrethroid insecticides remain effective in the control of bollworm larvae throughout the southeast and mid-atlantic states, adult vial tests indicated an increased survival in populations collected from cotton, sweet corn and a variety of other host crops. Tests conducted using moths which were reared from field-collected larvae demonstrated a 7-fold increase in survival as compared to tests conducted using moths which were collected directly from the field. These results suggested that the standard AVT test may underestimate the survival of bollworm adults to pyrethroid insecticides and resistance in the field. Low percentages of resistant individuals may exist within these populations and efforts to monitor pyrethroid resistance in these populations should be continued; however, AVT monitoring protocols may have to be modified in order to detect and evaluate changes in the susceptibilities of field populations to pyrethroid insecticides.

Purpose of the Project

Between 1998-2002, Cotton Incorporated and the Insecticide Resistance Action Committee (IRAC-US) sponsored a monitoring program to assess the extent of pyrethroid resistance in bollworm populations throughout the mid-south/southeastern U.S. In 2003, an opportunity to extend this monitoring effort into the mid-Atlantic States was provided through a collaborative research project sponsored by the United States Department of Agriculture, Cooperative State Research, Education, and Extension Service. Although the major emphasis of this project was to contribute research and marketing information towards sustaining diversified vegetable farms in the northeast by advancing IPM for sweet corn cropping systems, one objective was to assess pyrethroid resistance of immigrating corn earworm (alias: bollworm, *Helicoverpa zea*) populations. Most (82%) of sweet corn is treated with insecticides to control three major lepidopterous pests (i.e., European corn borer, corn earworm and fall armyworm). The corn earworm (bollworm) is unique among these 3 pests because of the heavy reliance on pyrethroids for control. The 2002 commercial production recommendations used in VA, MD, DE, PA and NJ include 6 insecticide formulations: 5 of these 6 are pyrethroids. Numerous studies have reported pyrethroid-resistant bollworm populations in the southern U.S. The 1998-2002, Cotton Incorporated Project generated data suggesting that bollworm populations throughout the mid-south/southern U.S. have become more resistant to the effects of pyrethroid insecticides. Furthermore, resistance in some of the more northerly locations may be

due to immigration from more southern locations. It was hypothesized that emigrants from those populations affect earworm control in sweet corn in the northeast. Corn earworm populations throughout VA, DE, PA, MD, and NJ were evaluated for resistance to pyrethroid insecticides.

Research Methods

An adult vial test (AVT) was used to monitor the susceptibilities of corn earworm moths to cypermethrin. Male moths were collected and tested in five states (including Virginia, Delaware, Maryland, Pennsylvania and New Jersey). Wire cone traps, baited with *Helicoverpa zea* pheromone lures, were used to capture the moths. In general, the sampling season extended from June through September. Traps were placed in open areas, upwind of a likely source of moths, near the edges of corn or soybean fields and monitored on a regular basis. The insides of clean, borosilicate glass scintillation vials (20 ml) were coated with a residue of technical grade cypermethrin (94.4% pure, FMC Corp., Princeton, NJ). The insecticide concentrations used in this study were 5 µg cypermethrin/vial and 10 µg cypermethrin/vial. Control vials were treated with acetone alone. One moth was placed in each vial and the vials were capped loosely. The vials containing the moths were held at room temperature (ca. 24°C) and mortality counts were recorded 24 h after the test was initiated.

Results

To date, more than 22,000 moths have been evaluated. During 2003, eight of the 26 locations tested had survival at the 10 µg cypermethrin/vial rate. During 2004, six of the 10 locations tested had survival at the 10 µg cypermethrin/vial rate. During 2005, seven of sixteen locations tested had survival at the 10 µg cypermethrin/vial rate. However, the percentages of bollworm adults that survived the 10 µg rate were low (between 0.4% and 9%). Although the highest percent survival recorded for the 10 µg rate was 9% (Maryland-2005), percent survival at the 10 µg rate has been consistently recorded throughout Virginia, Delaware and Maryland (7 of 10 sites in 2003; 5 out of 9 sites in 2004; 6 out of 9 sites in 2005), the most southern states surveyed. During 2003 and 2005, survivals at the 10 µg rate were not recorded in the more northern sites located in Pennsylvania and New Jersey; however, low levels of survival (1.02%-2.94%) were recorded in Pennsylvania during the 2004 test season. During 2003, fifteen of the 26 locations tested had survival at the 5 µg rate; the highest survival rate recorded was 32.8% (Maryland). During 2004, survival at the 5 µg rate was recorded at each site evaluated; the highest survival rate recorded was 17.4% (Virginia). During 2005, ten of the 16 locations tested had survival at the 5 µg rate; the highest survival rate recorded was 18% (Maryland). In 2003, it was noted that the % survival was greater in June/July than in August/September. In 2004 and 2005, the highest % survivals were noted during August/September; however, fewer evaluations were conducted in June/July during the 2004-2005 seasons due to the low numbers of moths trapped. In addition, increases in the % survival of adults reared from field-collected larvae were recorded for both the 5µg (31.1% survival) and 10 µg rates (11.4% survival); these % survivals were ca. 7-fold greater than % survivals recorded from tests conducted on adults collected directly from the field. These data suggested that low percentages of resistant individuals may exist within these populations and that efforts to monitor pyrethroid resistance in these populations should be continued and that monitoring protocols may have to be modified in order to detect and evaluate changes in the susceptibilities of field populations to pyrethroid insecticides. It is recommended that results obtained from AVT conducted using field-collected moths be confirmed using standard laboratory protocols and comparison to known pyrethroid-susceptible and pyrethroid-resistant laboratory cultures.

Summary

- Pyrethroids are critical tools in the sweet corn IPM arsenal;
- This was the third and final year for this project. This research is providing the agricultural community with valuable baseline data that may be used for future research efforts;
- Continued monitoring and the development and implementation of effective resistance management plans should be a priority.

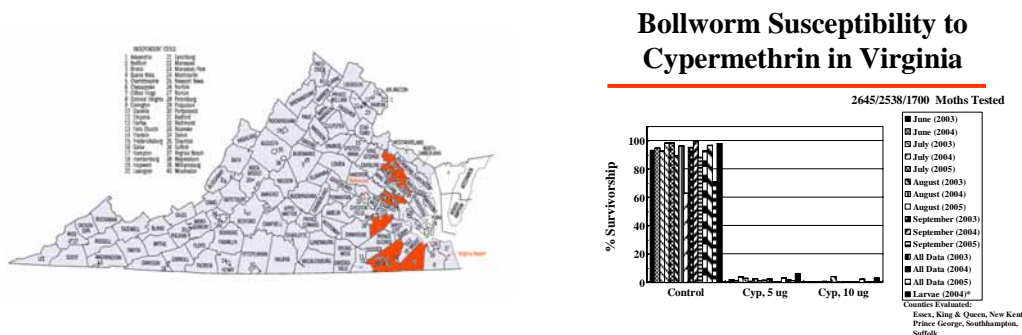


Figure 1. Survival of adult *Helicoverpa zea* to cypermethrin in Virginia.

* Collected as larvae from the field and evaluated as 1st Laboratory Generation Adults

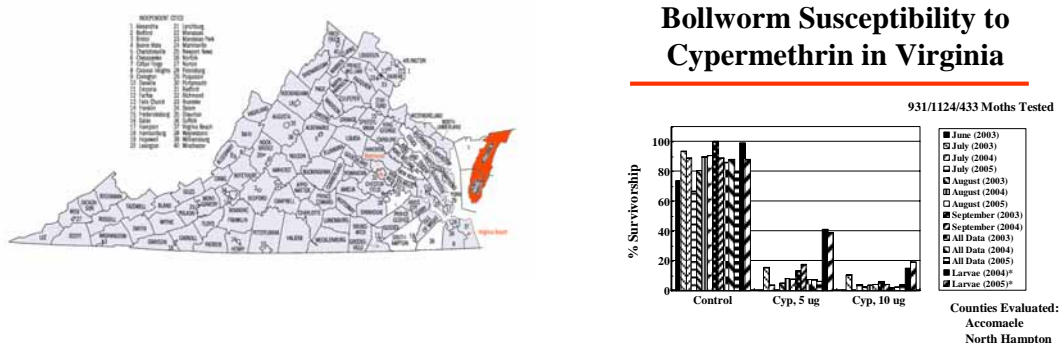


Figure 2. Survival of adult *Helicoverpa zea* to cypermethrin in Virginia.

* Collected as larvae from the field and evaluated as 1st Laboratory Generation Adults

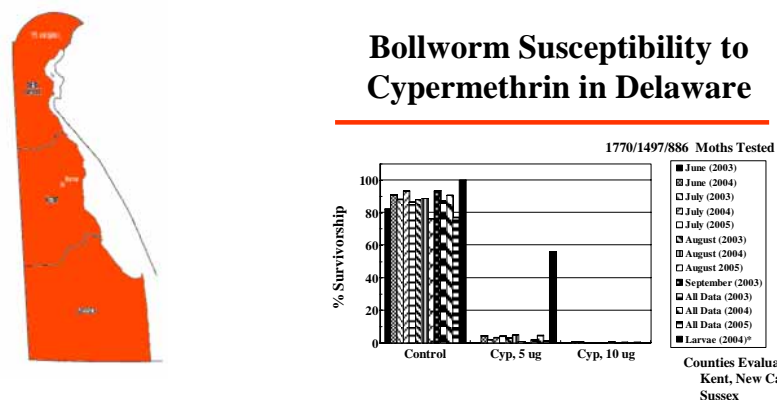
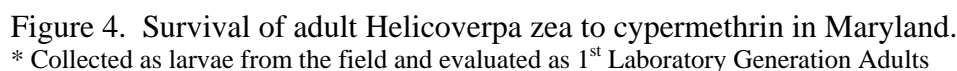


Figure 3. Survival of adult *Helicoverpa zea* to cypermethrin in Delaware.

Bollworm Susceptibility to Cypermethrin in Maryland



Bollworm Susceptibility to Cypermethrin in New Jersey

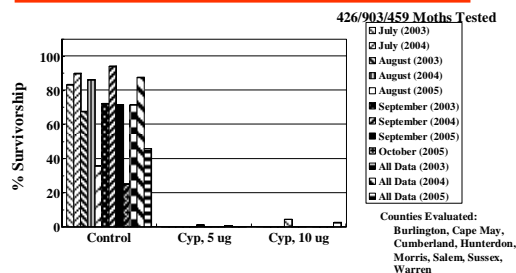


Figure 5. Survival of adult *Helicoverpa zea* to cypermethrin in New Jersey.
* Collected as larvae from the field and evaluated as 1st Laboratory Generation Adults



Bollworm Susceptibility to Cypermethrin in Pennsylvania

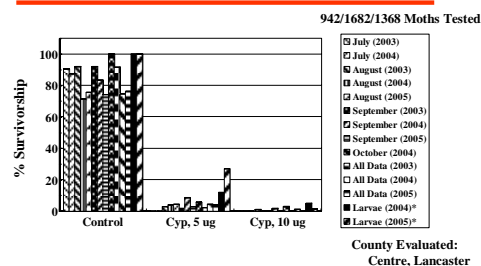


Figure 6. Survival of adult *Helicoverpa zea* to cypermethrin in Pennsylvania.

* Collected as larvae from the field and evaluated as 1st Laboratory Generation Adults