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SUSCEPTIBILITY OF BOLLWORM (HELICOVERPA ZEA) ADULTS FROM ACROSS THE MID-ATLANTIC STATES TO PYRETHROID INSECTICIDES-2004

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Abstract

In 2003, bollworm (*Heliverpa zea*) moths were collected from twenty six sites throughout five mid-atlantic states including Virginia, Maryland, Delaware, Pennsylvania and New Jersey and evaluated for resistance to the pyrethroid insecticide, cypermethrin. In 2004, moths were collected from 19 sites within those same states and evaluated for resistance to cypermethrin. One-third of the sites evaluated had moths that survived the 10 µg cypermethrin/vial rate. Two-thirds of the sites evaluated had moths that survived the 5 µg cypermethrin/vial rate. In 2003, survivals at the 10 µg rate were noted in Virginia and Delaware only; in 2004, survivals at the 10 µg rate were noted from sites located in Pennsylvania and Maryland also. Percent survivals were greatest later in the season during August/September. Percent survivals of moths collected from the field as larvae were 3- to 4-fold higher than percent survivals of moths taken directly from the field. Low levels of resistance to pyrethroid insecticides may exist within these populations, and efforts to monitor pyrethroid resistance in these populations should continue.

Introduction

Between 1998-2001, 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. (Payne et al. 2002). 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 16,000 moths have been evaluated. During 2003, eight of the 26 locations tested had survival at the 10 µg cypermethrin/vial rate (Payne et al. 2004). During 2004, seven of the 19 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 0.02% and 8.1%). Although the highest percent survival recorded for the 10 ug rate was 8.1% (Maryland-2003), percent survival at the 10 µg rate was more consistently recorded throughout Virginia and Delaware (5 of 8 sites in 2003; 5 out of 9 sites in 2004), the most southern states surveyed. During 2003, 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 13 of the 19 sites evaluated; the highest survival rate recorded was 17.4% (Virginia). In 2003, it was noted that the % survival was greater in June/July than in August/September; in 2004, the highest % survivals were noted during August/September. In addition, increases in the % survival of adults reared from field-collected larvae were recorded for both the 5µg (Delaware: 56%; Maryland: 49%; Pennsylvania: 12.3%; Virginia: 41.2%) and 10 µg rates (Delaware: 0%; Maryland: 32.6%; Pennsylvania: 5.4%; Virginia: 15.2%); these % survivals were ca. 3- to 4-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.

Figure 1. Bollworm Susceptibility to

Figure 2. Bollworm Susceptibility to Cypermethrin in Virginia

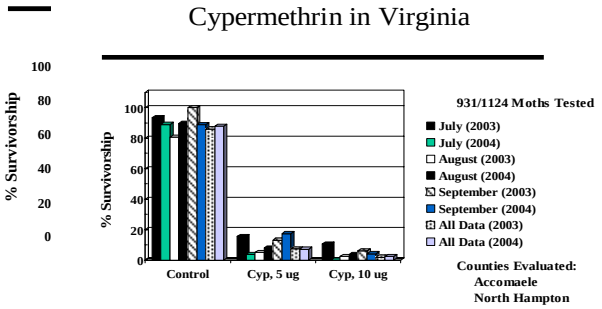


Figure 3. Bollworm Susceptibility to Cypermethrin in Maryland

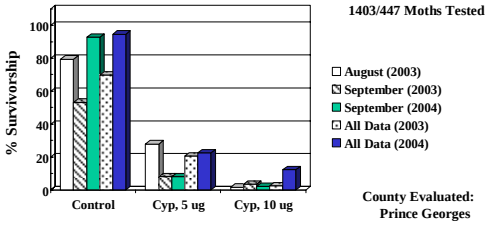


Figure 4. Bollworm Susceptibility to Cypermethrin in Delaware

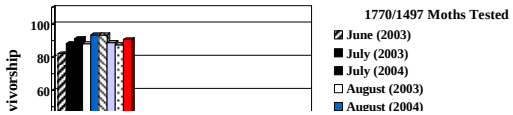


Figure 5. Bollworm Susceptibility to Cypermethrin in New Jersey

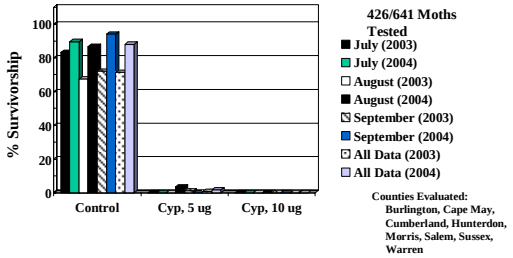
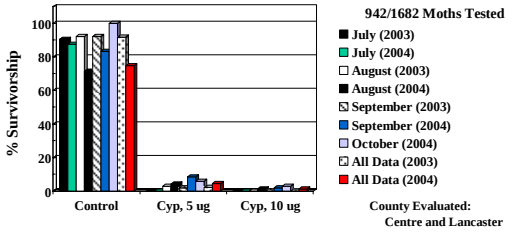


Figure 6. Bollworm Susceptibility to Cypermethrin in Pennsylvania



Conclusions

- Pyrethroids are critical tools in the sweet corn IPM arsenal;
- This was the second year of a three year 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;

Literature Cited

Payne, G.T., J. Adamczyk, J. Bacheler, R. Bagwell, M. Boyd, C. Brister, B. Freeman, A. Herbert, G. Herzog, D. Johnson, M. Layton, G. Lentz, B. Leonard, N. Liu, S. Martin, P. Pietrantonio, M. Roof, R. Sprenkel, M. Sullivan, J. Van Duyn and J. Weeks. 2002. U.S. Cottonbelt Survey: Testing the susceptibility of the bollworm, *Helicoverpa zea* (Boddie), to pyrethroid insecticides—2001 update. In: Proceedings of the Beltwide Cotton Production Research Conferences. National Cotton Council. Atlanta, GA.

Payne, G., G. Dively, S. Fleischer, A. Herbert, J. Ingerson-Mahar, T. Kuhar, J. Whalen. 2004. Susceptibility of bollworm (*Helicoverpa zea*) adults from across the mid-atlantic states to pyrethroid insecticides. In: Proceedings of the Beltwide Cotton Production Research Conferences. National Cotton Council. San Antonio, TX.