

Alabama Cotton Commission
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Summary

PROJECT TITLE: Production and Characterization of Bt resistance in Cotton Bollworm, *Helicoverpa zea*

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OBJECTIVES:

Insecticide Resistance Management (IRM) strategies are preregistration requirements for Bt cotton. These strategies and recommendations are based, at least partly, on research results from Bt resistant insects. However, although there has been substantial information arising from research dealing with Bt resistant tobacco budworm (TBW) and pink bollworm (PBW), little information was come from Bt resistant cotton bollworm (CBW). This lack of data from CBW is due, to a large extent, on the fact that there is no stable, highly Bt Cry1Ac-resistant CBW colony in the US, although several labs, including our own, have tried for many years. The inability to establish a highly Cry1Ac-resistant and stable CBW population is thought to be caused primarily by inbreeding, although other factors are possible. One such factor could be that when insects are selected with Cry1Ac using the formulation MVPII containing only 19.1% AI, over 80% of the selection against CBW using MVPII are non-Bt toxin components. Not only could selection be difficult to achieve, but resistant mechanisms arising from selection may not be resistant mechanisms specific to Bt. Additionally, because the Bt (Cry1Ac) that is present in Bollgard (Bt) cotton is not in the same form as that found in MVPII, laboratory selection using MVPII is not indicative of what is occurring in the field. The objective of this proposal is to use the form of Bt Cry1Ac found in Bollgard (Bt) cotton to select for Bt resistance, and to compare these results to a colony selected using MVPII.

Results

A susceptible laboratory strain of CBW was established from a Monsanto laboratory colony. The baseline susceptibility of this strain to MVP II and Cry1Ac toxin was 24µg/g and 9µg/g diet, respectively representing about a 2.7-fold difference in susceptibility. Subsequently, two Cry1Ac-resistant strains of CBW were selected using MVP II (MR) or activated Cry1Ac toxin (AR). Larvae that molted into second instar within seven days of selection were reared until pupation on regular diet (containing no Cry1Ac). Current resistant ratios for MR and AR strains are 12.6 and 35.9 fold after seven generations of selection, respectively. Selection studies indicated approximately three times quicker resistance development in the AR compared to the MR strain. Additionally, there were higher fitness costs in terms of fertility and fecundity in the MR compared to the AR strain.

This research demonstrates that CBW can develop resistance to Cry1Ac insecticidal proteins quicker (3 times faster) when selected using activated toxin (more representative of Bt cotton) compared to MVP II. Resistance development in the MR strain was slower and did not increase beyond 16-fold even after selecting for three more generations at higher concentrations. The fitness of this strain was adversely affected in terms of both fecundity and fertility. We believe that the 80.9% inert ingredients in the MVP II formulation might have an effect with the fitness of this strain, especially when selecting at 1 mg/g of Cry1Ac concentration. Therefore, our results suggest that using Cry1Ac toxin instead of MVPII is a more appropriate and realistic option for developing a table and highly resistant CBW colony.