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# SURVIVORSHIP OF HELIOTHINES ON SELECTED REPRODUCTIVE STRUCTURES OF VIPCOT COTTON LINES

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## Abstract

A laboratory study quantified heliothine survivorship on selected reproductive structures of a VipCot cotton line. Heliothine larvae were allowed to feed on selected reproductive structures of a non-Bt variety or a VipCot line for 96 h. Heliothine mortality was nearly 100% on VipCot plant terminals and flower petals. Tobacco budworm, *Heliothis virescens* (F.), larval mortality was significantly lower on whole squares, square bracts, and bolls of VipCot compared to that for bollworm, *Helicoverpa zea* (Boddie) larvae.

## Introduction

Cotton (*Gossypium hirsutum* L.) is an important crop in the United States with 11.9 million acres producing a mean yield of 704 lb/acre in 2004 (Williams 2005). Louisiana is one of 14 states that produce cotton in this country. During 2004, a total of 510,000 acres of cotton were harvested in Louisiana with a mean yield of 955 lb/acre. The bollworm, *Helicoverpa zea* (Boddie) and tobacco budworm, *Heliothis virescens* (F.), commonly known as the heliothine complex, are common pests of cotton across the Southern United States. Bollworm and tobacco budworm are annual pests in Louisiana cotton fields (Leonard et al. 2001). Until the late 1990's, insecticides were the primary strategy used to control all cotton Lepidopteran pests, including bollworm and tobacco budworm (Jenkins et al. 1993, Gore 2002). Populations of bollworm and tobacco budworm have historically developed resistance to the major classes of insecticides used for their control. The severity of bollworm and tobacco budworm infestations and subsequent control failures due to insecticide resistance supported the development of alternative management strategies.

Genetic engineering technologies have successfully produced transgenic cotton that expresses an insecticidal protein from the soil bacterium, *Bacillus thuringiensis* Berliner var. *kurstaki* (Bt). Even after the introduction of transgenic cotton, bollworm and other Lepidoptera remain as economic pests. Bollgard®, with a single insecticidal protein provides excellent control of tobacco budworm. However, bollworm control has not been consistently satisfactory, and supplemental applications of foliar insecticides are required for control (Leonard et al. 2001). As a result, transgenic cottons that express multiple proteins were commercialized to improve control of a range of cotton Lepidopteran pests.

Scientists at Syngenta Crop Protection have used similar GE technologies to develop a novel transgenic cotton that expresses an insecticidal protein. VipCot cotton lines express a slightly different Bt protein compared to the other commercial products (Bollgard, Bollgard 2, and WideStrike). Considerable research has documented heliothine biology and ecology on Bt cottons that express crystal (Cry) proteins. Currently, no information is available on the bioactivity of the VipCot technology among cotton fruiting structures. This information is important because of variations in Bt Cry protein expression among plant parts. In addition, bollworms are more often found in white flowers than on other plant parts of Bt cottons (Smith 1998, Pietrantonio and Heinz 1999). The objective of the study was to quantify heliothine survivorship on selected reproductive structures of a VipCot cotton line.

## Materials and Methods

The study was conducted at the Macon Ridge Research Station near Winnsboro, Louisiana during 2005. Plots of genetically transformed VipCot (COT 202) and conventional non-transgenic (Coker 312) cotton lines were planted on multiple planting dates to ensure sufficient numbers of plants and fruiting structures at proper stages were available throughout the test period. Fertilization rates and general agronomic practices followed the recommended Louisiana Cooperative Extension Service guidelines.

A colony of bollworm and tobacco budworm was established from sweet corn; *Zea mays* L., and garbanzo beans; *Cicer arietinum* L., respectively during June, 2005. Insects were reared in the laboratory for a minimum of one generation to eliminate parasitoids and pathogens and to obtain sufficient numbers of larvae.

Selected plant tissues were harvested from plots of Coker 312 and COT 202 and were immediately transported to the laboratory. The treatments (plant structures) included: 1) terminal leaves (first fully expanded), 2) whole squares with bracts removed, 3) square bracts , 4) flower petals, 5) flower anthers, and 6) small bolls (2 to 3–d--old). Structures were placed into 29.5 ml plastic cups. Three bollworm or tobacco budworm (2-d-old; L2 stage) larvae were transferred to each cup and allowed to feed for 96 h.

Treatments were arranged in a randomized block design with four blocks. Each date of infestation represented a block. Twenty cups were infested for treatment and block combination. Percent survival data at 96 h after infestation was analyzed using analysis of variance (PROC MIXED, Littell et al. 1996). Species comparisons for each structure were made using paired t-tests. The data presented are not corrected for control mortality on the non-Bt line.

## Results and Discussion

Heliothine mortality varied (61.4 to 100.0%) among plant structures. (Fig. 1). Heliothine mortality was highest on plant terminals and flower petals. Larval mortality was near 100% when larvae were exposed to VipCot terminal leaves and flower petals. The lowest level of mortality for both species was observed on square bracts. Vip3A protein expression varies among structures. Previous work also indicated differences in Cry1Ac protein expression among different plant parts (Adamczyk et al. 2000).

There were no significant difference between mortality levels of bollworm and tobacco budworm on plant terminals, flower petals, and flower anthers. However, tobacco budworm survival was significantly lower on whole squares, bracts, and bolls compared to that for bollworm larvae.

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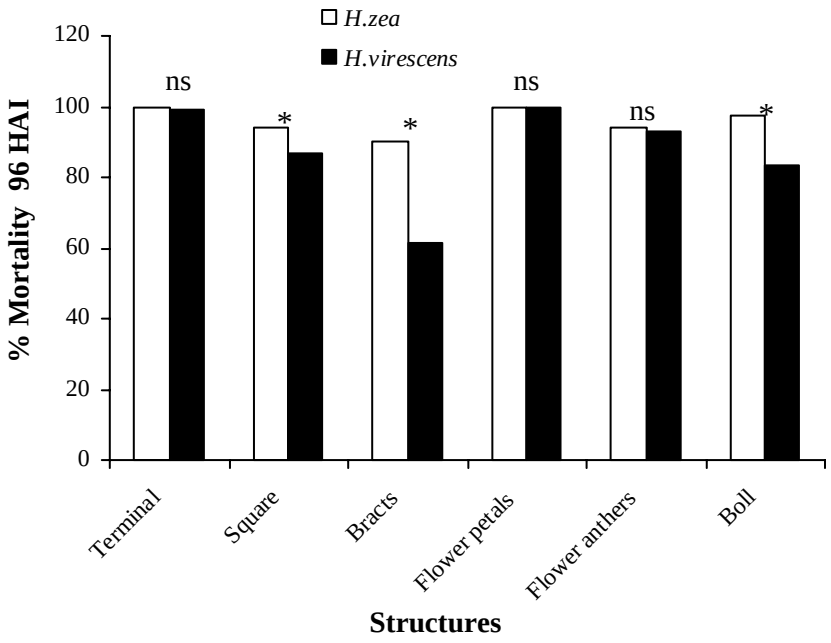


Figure 1. *Helicoverpa zea* and *Heliothis virescens* mortality on VipCot reproductive structures. *, significant differences in mortality between species ($P$ <0.05).