# COMPARATIVE PERFORMANCE OF TWINLINK® AND BOLLGARD II® ON THE CONTROL OF CATERPILLAR PESTS ACROSS MULTIPLE LOCATIONS IN THE COTTON BELT, 2011

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## Abstract

In 2011, researchers in the southern U.S. established similar tests to compare the efficacy of TwinLink and Bollgard II cotton varieties on caterpillar pests. This paper summarizes data collected across the seven trials that experienced moderate to high infestations of bollworm, *Helicoverpa zea*, or tobacco budworm, *Heliothis virescens*. A summary of square and boll damage showed that TwinLink performed similarly to Bollgard II.

## Introduction

Transgenic Bt cottons expressing insecticidal proteins from *Bacillus thuringiensis* were commercially introduced in 1996 and have been widely adopted throughout the U.S. Cotton Belt. The original Bollgard® technology provided nearly complete protection from tobacco budworm and partial control of bollworm infestations. Since then, second-generation Bt cottons have been introduced with the intent of improving performance against bollworm and other caterpillar pests. Pending regulatory approvals, TwinLink® cotton varieties expressing Cry1Ab and Cry2Ae Bt

toxins will be introduced commercially in 2013. This product will compete with current Bt technologies including Bollgard II®, expressing Cry1Ac and Cry2Ab, and WideStrike®, expressing Cry1Ac and Cry1F. Thus, it is important to understand the relative performance of these technologies in controlling common caterpillar pests that infest cotton.

## Materials and Methods

In 2011, field trials developed by Bayer CropSciences were implemented by researchers at multiple locations in the mid-southern and southeastern U.S. The goal of these tests was to contrast the performance of TwinLink and Bollgard II varieties in controlling caterpillar pests. The tests were planted relatively late to increase the likelihood of infestation. Substantial bollworm and/or tobacco budworm infestations occurred at seven locations including Tennessee (Jackson and Memphis areas), Mississippi (Starkville and Stoneville areas), Arkansas (Pine Bluff area), and South Carolina (two locations in Barnwell County). Two TwinLink varieties and two Bollgard II varieties were common to all locations. Each test also included a non-Bt cotton variety which varied but was identical (BCSX 1518GT) in four of seven locations. At all locations, plots were laid out in a randomized complete block design with four replications of each variety. Individual plots were a minimum of four rows wide by 35-50 ft long, with rows planted on 38 or 40 inch centers. Other, non-caterpillar pests were controlled as needed, avoiding the use of lepidopteran-active insecticides. Insecticide applications were also made in some locations to disrupt populations of beneficial arthropods.

Methods of data collection varied, but boll damage ratings were routinely made at all locations, and square damage ratings were made at all but one location in South Carolina. Thus, square and boll damage data were selected to compare the relative efficacy of TwinLink and Bollgard II varieties. To standardize the data, we calculated the cumulative number of damaged squares or bolls observed across all rating dates for each variety and at each location. We then determined the percent of damage observed in Bt varieties relative to the non-Bt entry, again for each location. Thus, regardless of pest pressure, square or boll damage was represented as a percent of the damage observed in non-Bt plots. Statistical analyses were done with cumulative square or boll damage percentages, using location averages for each variety as replicates. In this way, no one location would have too much influence on the overall data set. Means were separated using GLM procedures and a Fisher's Protected LSD ($\alpha = 0.05$). An arcsine transformation of boll damage data was done prior to analysis because of heterogeneous variances among treatments.

## Results

Significant infestations of bollworm and/or tobacco budworm occurred at all locations. Bollworm was the predominant caterpillar pest at most locations. However, tobacco budworm predominated at the Stoneville location, and the location in Arkansas was a mixture of bollworm and tobacco budworm. Few other boll-feeding caterpillars were observed. The maximum, average boll damage observed on any one date in non-Bt cotton plots ranged from 31-100%, depending upon the test location (Fig. 1). However, most infestations were sustained over a period of several weeks, resulting in substantial cumulative injury.

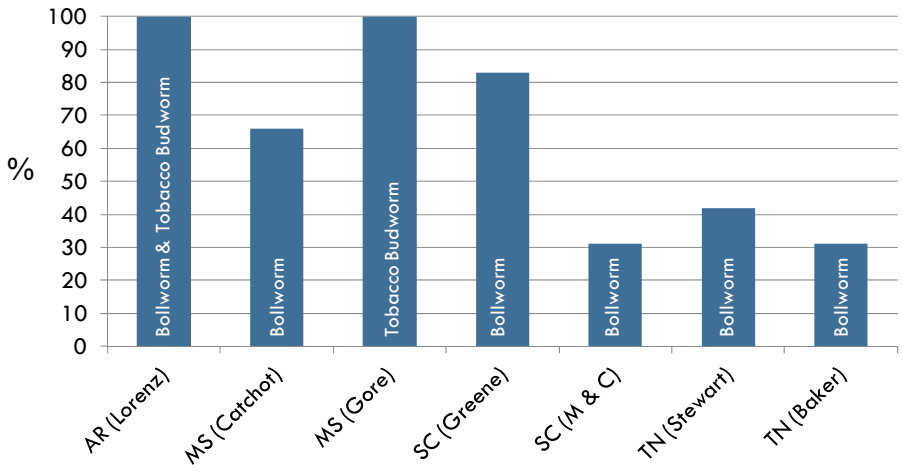

Figure 1. Average maximum percent boll damage observed in non-Bt plots on any one date. The predominant species observed, bollworm or tobacco budworm, is indicated on the bars.

Cumulative square damage among Bt varieties ranged from 3.6-11.5% of that observed in non-Bt cotton (Fig. 2). All varieties provided a similar level of protection except that FM1740 B2F had higher square damage than that observed in the two TwinLink varieties and ST4554 B2F ($F = 4.60$; df = 8, 15; $P = 0.0179$). Similarly, boll damage also varied among Bt varieties from 3.5-9.65% of that in non-Bt cotton (Fig. 3). FM1740 B2F had higher boll damage than other varieties except for the second TwinLink entry ($F = 6.86$; df = 9, 18; $P = 0.0028$).

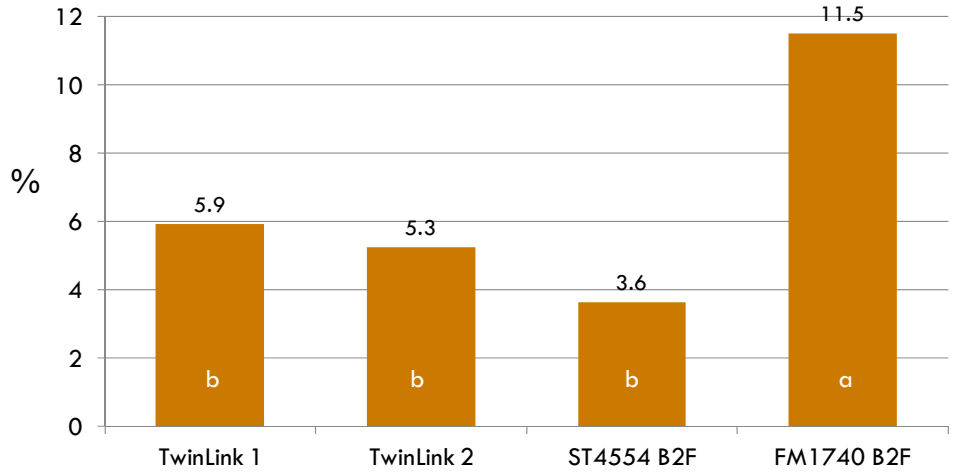


Figure 2. Average square damage for Bt cotton varieties as a percent of that observed in non-Bt cotton. Bars not labeled with a common letter are significantly different (Fisher's Protected LSD, $P < 0.05$).

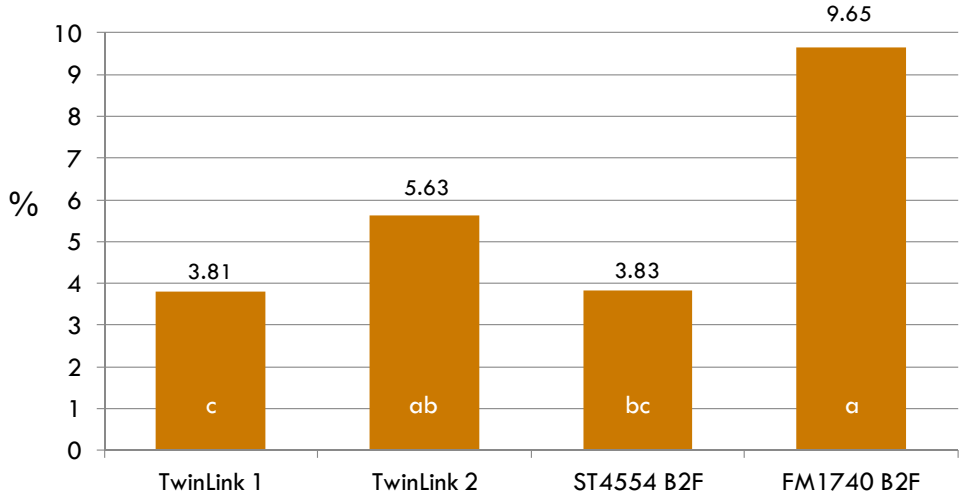


Figure 3. Average boll damage for Bt cotton varieties as a percent of that observed in non-Bt cotton. Bars not labeled with a common letter are significantly different (Fisher's Protected LSD, $P < 0.05$).

## Discussion

Both TwinLink and Bollgard II provided substantial protection against bollworm and tobacco budworm in these trials, providing 88-96% reduction in square and boll damage compared with non-Bt cotton. Although there were differences in square and boll damage among Bt varieties, specifically with FM1740 B2F providing less protection than the others, these differences were relatively small. All Bt technologies are expected to provide nearly complete protection against tobacco budworm, so the differences that we observed among Bt varieties can mostly be attributed to performance against bollworm. However, significant differences between the two Bollgard II varieties in this test indicates that performance of Bt technologies against bollworm may be influenced by other factors such as toxin expression levels, differences in maturity or other varietal characteristics. Assay work in Louisiana indicated that TwinLink and Bollgard II will also provide similar control of beet armyworm, fall armyworm and soybean looper (data not shown).

## Acknowledgements and Disclaimer

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