EVALUATION OF EFFICACY AND ECONOMIC POTENTIAL OF MULTI-GENE COTTON PRODUCTION SYSTEMS FOR CONTROL OF CORN EARWORM, *HELICOVERPA ZEA*, IN COTTON PRODUCTION IN ARKANSAS

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Abstract

Cotton bollworm is considered to be one of the most destructive pests in cotton production. Resistance has recently been documented in cotton bollworm to two gene cotton cultivars and frequently, supplemental foliar applications must be made to protect cotton yield. Currently, three gene cotton cultivars control bollworm, but past studies have shown these to have less yield potential than two gene cultivars. Because of this growers could potentially stay more profitable using two gene cultivars, even with costly foliar applications. Research was conducted in 2019 in Craighead and Desha counties, Arkansas to evaluate the efficacy of *Bt* technology and the economical differences between Bollgard II and Bollgard III. Data indicates that unsprayed three gene cotton had similar levels of damage as two gene cotton when sprayed with Prevathon at 20 oz/a. Three gene cotton yielded greater than two gene cotton, which resulted in greater net returns.

Introduction

Among row crops planted in Arkansas, cotton ranks fourth in terms of area planted, with a total of 485,000 acres in 2019. Cotton bollworm (*Helicoverpa zea)* is one of the most important yield limiting pests in cotton production. In 2018, just under 85,000 bales of cotton were lost due to bollworm in Arkansas, even though 98% of the cotton acres were planted in Bt cotton, with 84% being two gene cotton and 14% being three gene cotton. That year higher yields were seen in two gene cotton with an additional insecticide application when compared to three gene cotton. The objective of this study was to determine if two or three gene cotton would be more cost effective for growers to plant, with the understanding that the two gene cotton may need supplemental foliar applications to control bollworm.

Materials and Methods

Small Plot Efficacy Trials

A study was conducted in Tillar, AR in 2019. Plots were planted on 16 May, using DP 1822 XF (Non-*Bt*), PHY330 W3FE (Widestrike III), ST 5471 GLTP (Twinlink Plus), ST 1518 B2XF (Bollgard II), DP 1835 B3XF (Bollgard III) cultivars. Plot sizes were 12.5 ft (4 rows) by 40 ft. Each cultivar had a plot that either remained unsprayed or was sprayed with 20 oz/a Prevathon. Prevathon applications were made on 24 Jul. Data collection occurred at 6, 12, and 20 days after application (DAA). In each plot 25 terminals, 25 squares, 25 blooms, and 25 bolls were sampled, and the number damaged for each was recorded. The two center rows of each plot were harvested on 24 Oct. The data was analyzed by ARM with an $\alpha = 0.05$.

OVT Yield Analysis

Yields were compared between the two and three gene cultivars from data generated by the On-Farm Variety Trials (OVT) conducted in Arkansas. Two trial locations, one in Craighead county and one in Desha county, were selected in order to represent the major cotton production areas of Arkansas. The On-Farm variety trial at the Craighead County location was planted on 14 May and the Desha County location was planted 1 May. Three each of the highest yielding Bollgard II and Bollgard III cultivars were selected for yield analysis. Three gene cultivars consisted of NexGen 4936 B3XF, Deltapine 2012 B3XF, and Croplan 9210 B3XF and two gene cotton cultivars consisted of Deltapine 1646

B2XF, Deltapine 1518 B2XF, Stoneville 5600 B2XF. Harvest at Craighead County was 5 Oct and Desha County was 3 Oct.

Results

Small Plot Trials

At 6 DAA, the unsprayed non-*Bt* plots had the greatest amount of damaged fruit at 15 percent (Figure 1). Both the unsprayed Bollgard II and Bollgard III plots had similar amounts of damage but were greater than all other treatments except the unsprayed non-*Bt*. At 12 DAA, the percent damaged fruit was greatest in unsprayed non-*Bt* (Figure 2). Sprayed and unsprayed three gene cultivars and the sprayed Bollgard II had lesser amounts of damage than all other plots. At 20 DAA, only the non-Bt and Bollgard II plots benefited from the Prevathon application. Three gene cultivars and sprayed Bollgard II plots contained the least amount of damage (Figure 3).

Yield Analysis

A yield difference between the three gene and two gene cultivars of 103 lb/a and 169 lb/a was observed at the Craighead and Desha county locations, respectively. Using the current market value of 70 cents per pound, three gene cultivars could have potential profit of $72 and $118 per acre greater than two gene cultivars. This is not including a $20- $25/a Prevathon application which would further increase the potential profit a three gene cultivar would have over a two gene. (Table 1). One Prevathon application cost between 20 and 25 dollars per acre. In the case of an additional application, there would need to be a 28.6 lb/ acre increase in lint yield to offset the cost of the application. If the highest yielding two gene cotton cultivar and the lowest yielding three gene cotton cultivar are compared, there is a $27 advantage towards the three gene cotton cultivar (Figure 4). The reduction of additional insecticide applications and increased yields provided a $150 average net return when implementing Bollgard III over Bollgard II (Figure 5).

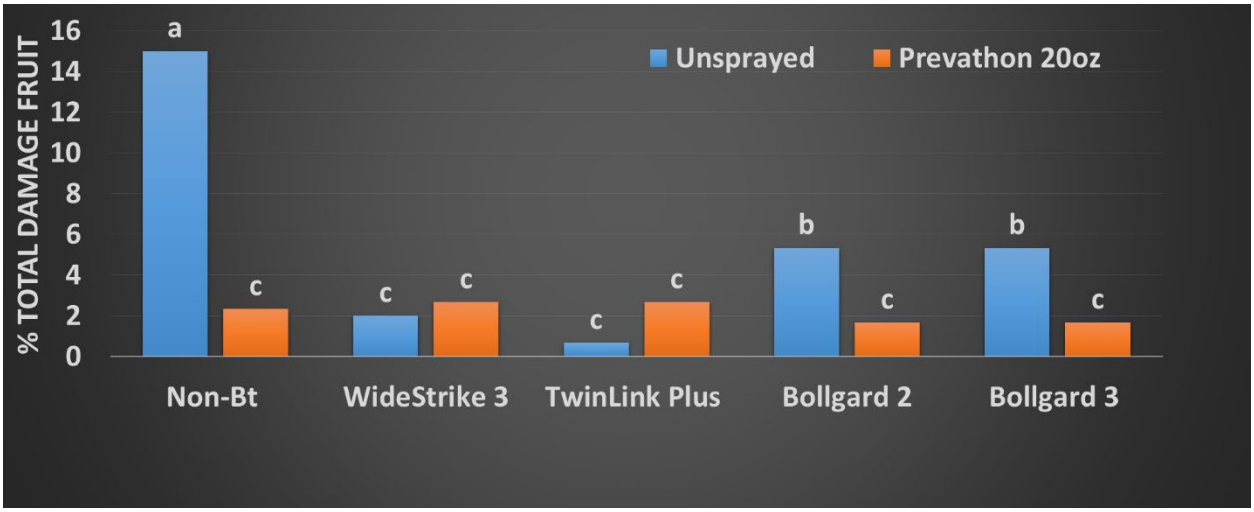

Figure 1. *Bt* Technology Sprayed vs. Unsprayed results from Tillar,AR. Cotton technologies were sprayed on the 24 Jul. 6 DAA on 30 Jul each plot was analyzed for fruiting structure damage.

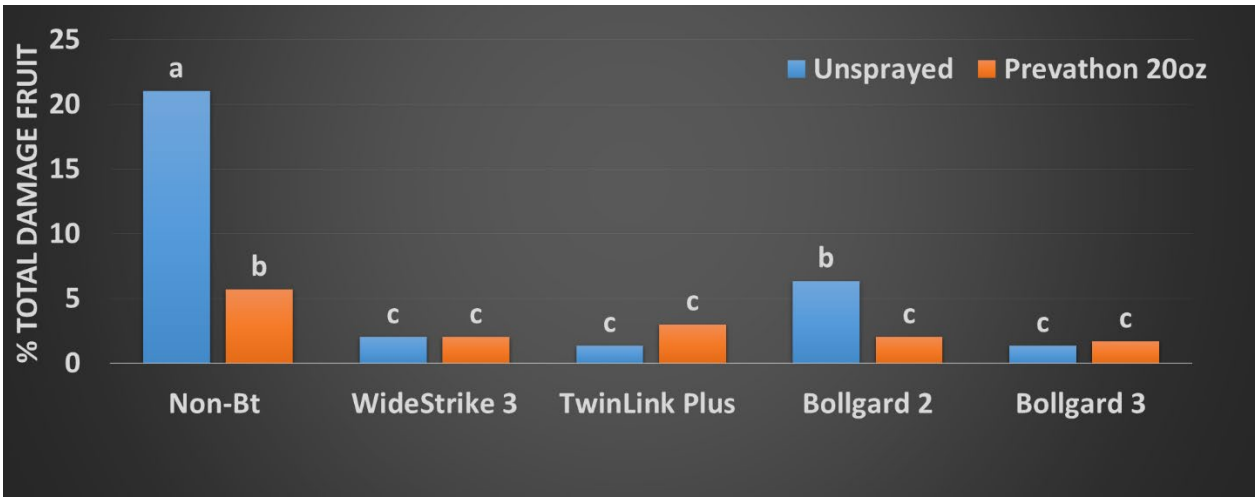

Figure 2. *Bt* Technology Sprayed vs. Unsprayed results from Tillar, AR. Cotton technologies were sprayed on the 24 of Jul. 12 DAA on 5 of Aug, each plot was analyzed for fruiting structure damage.

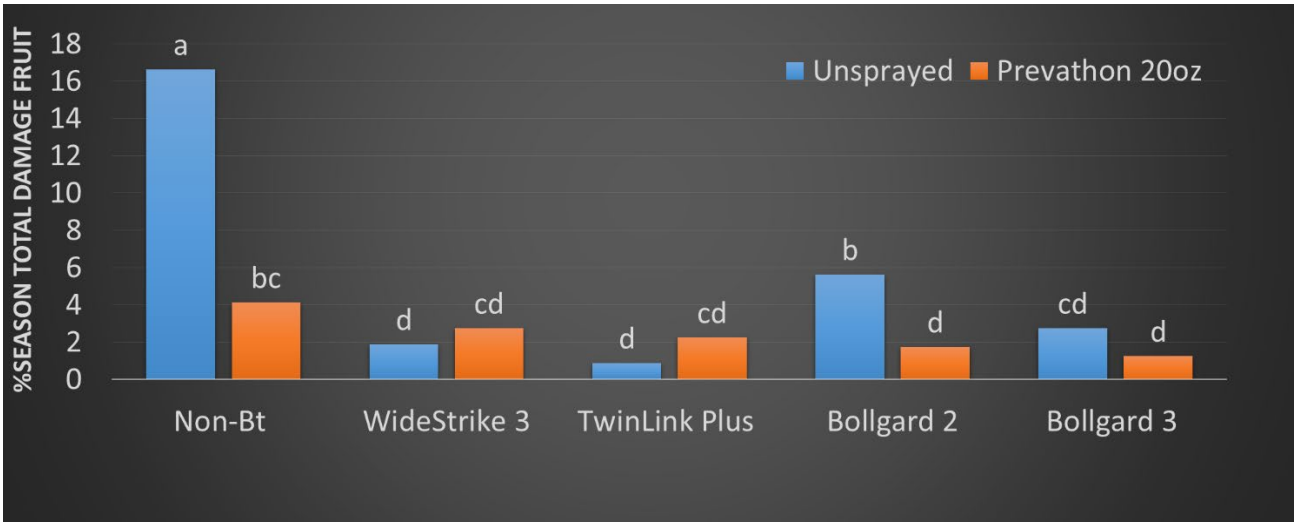

Figure 3. *Bt* Technology Sprayed vs. Unsprayed results from Tillar, AR. Cotton technologies were sprayed on 24 Jul. 20 DAA on 13 of Aug, each plot was analyzed for fruiting structure damage.

Table 1. Yield results for two gene and three gene cotton in Craighead County, Arkansas and Desha County,Arkansas in 2019

Two Gene	**Craighead County, AR (lbs/acre)**	**Desha County,AR (lbs/acre)**
DP 1646 B2Xf	**1,758**	**1,807**
DP 1518 B2XF	**1,673**	**1,565**
ST 5600 B2XF	**1,564**	**1,672**
Average:	**1,665**	**1,681**
Three Gene		
NG 4936 B3XF	**1,737**	**1,897**
DP 1916 B3XF	**1,817**	**1,852**
DG 3427 B3XF	**1,749**	**1,800**
Average:	**1,768**	**1,850**

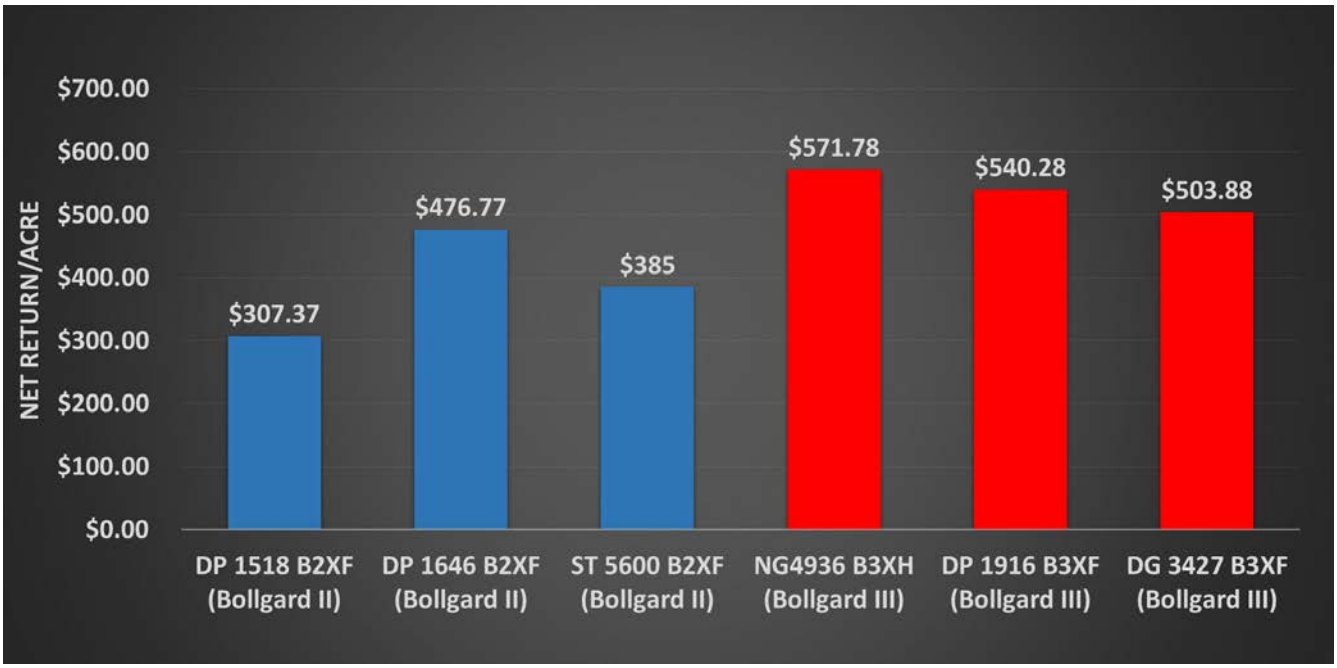

Figure 4. Cotton cultivar net return based upon Desha County, AR location. Evaluation of net return per acre for each cotton cultivar in 2019

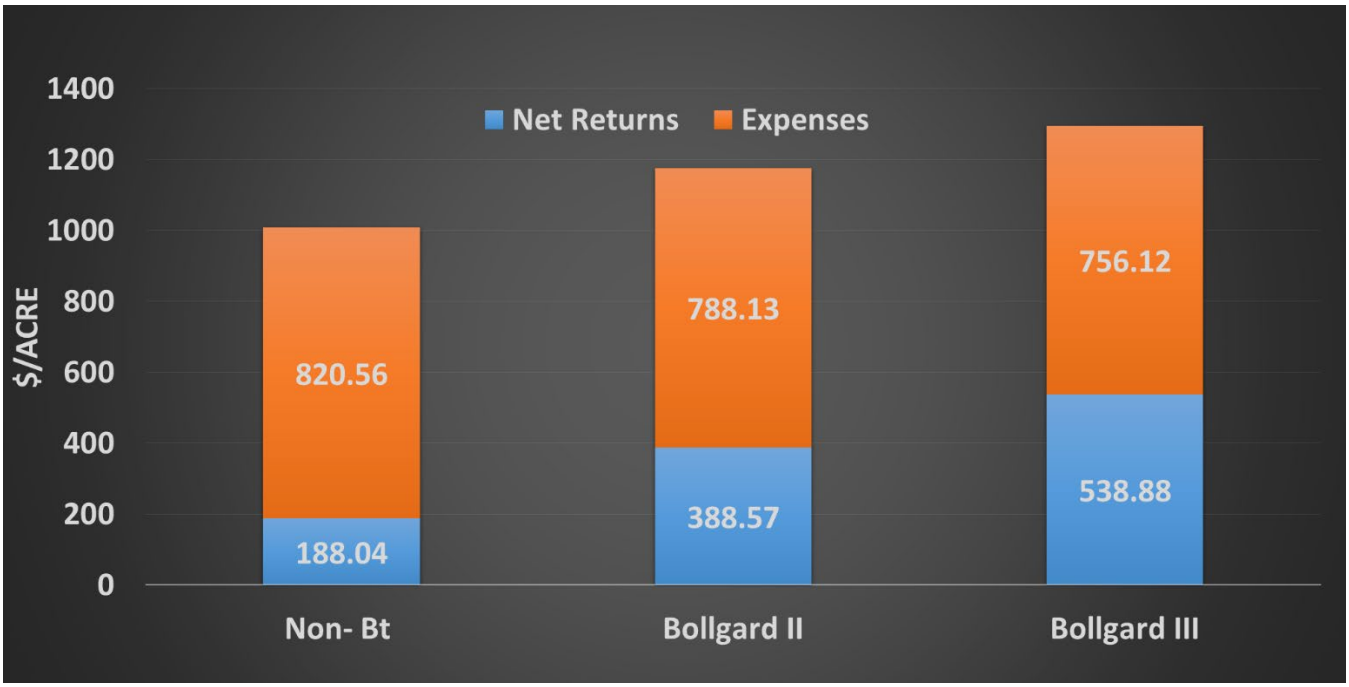

Figure 5. Net return comparison between each *Bt* technology based on yield results obtained from Desha County, AR location in 2019

Summary

Bollgard II when sprayed with Prevathon at 20 oz/a has similar damage as unsprayed Bollgard III. Bollgard III cultivars yielded greater than Bollgard II and did not require a supplemental insecticide application to control bollworm. The increased yield coupled with reduced insecticide applications resulted in a greater profit margin for Bollgard III cultivars over Bollgard II.

Acknowledgements

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