EVALUATION OF VIPCOT AND WIDESTRIKE FOR HELIOTHINE MANAGEMENT IN MISSISSIPPI COTTON

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Abstract

The bollworm, *Helicoverpa zea* (Boddie), and tobacco budworm, *Heliothis virescens* (F.) have historically been major pests of cotton in Mississippi. Studies were conducted during 2007 to evaluate the performance of the VipCot and WideStrike technologies against bollworm and tobacco budworm infestations in Mississippi. The VipCot technology reduced damaged squares and bolls compared to non-treated conventional cotton. WideStrike provided protection against heliothine injury similar to Bollgard II and conventional cotton that received three foliar insecticide applications.

Introduction

The first transgenic *Bt* (*Bacillus thuringiensis* Berliner var. *kurstaki*) cotton cultivars (Bollgard®) received federal registration in 1996. Bollgard® cotton cultivars express the Cry1Ac protein which is toxic to larvae of many lepidopteran cotton pests (Perlak et al. 1990). Recent advances in genetic engineering technologies have produced a second generation of caterpillar resistant cottons. These contain two separate *Bt* proteins to improve efficacy against several lepidopteran pests. Monsanto's newest transgenic *Bt* cotton (Bollgard II) was derived by incorporating the Cry2Ab protein from *Bt* into Bollgard cotton varieties (Greenplate et al. 2000a, 2000b). WideStrike cotton varieties from Dow Agroscience express the Cry1Ac and Cry1F Bt proteins (Pellow et al. 2002). Syngenta's experimental VipCot cotton lines express the Vip3A protein that is different in structure and mode of action than proteins expressed by other transgenic cottons (Estruch et al. 1996). Newer VipCot cotton lines express the Cry1Ab protein in addition to Vip3A. The objective of these studies was to evaluate the performance of the VipCot and WideStrike technologies against heliothine and foliage-feeding pests of cotton.

Materials and Methods

The VipCot studies were conducted at the North Mississippi Research and Extension Center, near Verona, MS (Test 1) and at the USDA-ARS SIMRU, near Stoneville, MS (Test 2) during 2007. WideStrike trials were conducted at Mississippi State University North Farm, near Starkville, MS. The experimental design in all trials was a randomized complete block design with treatments replicated four times. The treatments in the VipCot trials included conventional cotton (Coker 312) and VipCot transgenic cotton (Vip3A + Cry1Ab proteins) without supplemental insecticide applications. The treatments in Test 3 included two WideStrike varieties (Phy 375WRF and Phy 485WRF), two non-*Bt* varieties (Phy 315RF and Phy 425RF) and a Bollgard II variety (St 4554B2RF) without supplemental insecticide applications. Test 4 included three varieties (Phy 425RF, Phy 485WRF, and St 4554B2RF) with and without supplemental heliothine control. The studies were planted on 11 Jun (Test 1), 6 Jun (Test 2), and 27 Apr (Test 3 and 4). Treatment efficacy was determined by examining 25 squares per plot for evidence of heliothine feeding on 1, 8, and 16 Aug (Test 1); 16, 24, 30 Aug, and 6 Sep (Test 2); 3, 11 16, 27 Jul, and 2 Aug (Test 3); and 11, 16 , 27 Jul, and 3 Aug (Test 4). Numbers of heliothine damaged bolls were determined by examining 25 bolls per plot on 8, 16, 23, and 30 Aug (Test 1); 16, 24, 30 Aug, 6, 13, and 20 Sep (Test 2); 3, 11, 16, 27 Jul, and 2 Aug (Test 3); and 11, 16, 27 Jul, and 3 Aug (Test 4). Densities of soybean looper, *Pseudoplusia* *includens* (Walker), larvae were determined in Test 2 by sampling 6 feet of row with a shake cloth on 20 Sep. In Test 4, insecticide treatments (Karate Z 2.08CS 0.03 lb AI/A plus Tracer 4SC 0.067 lb AI/A) were applied on 16, 27 Jul, and 3 Aug with a high clearance sprayer calibrated to deliver 10 GPA. Data for Tests 1 and 2 are expressed as cumulative numbers of damaged squares and bolls. Data were subjected to ANOVA and means separated according to Fisher's Protected Least Significant Difference.

Results

In Tests 1 and 2, plots planted to VipCot cotton had significantly lower cumulative numbers of heliothine damaged squares compared to plots planted to conventional cotton on all sample dates (Figures 1 and 2). Also, plots planted to VipCot cotton had significantly lower cumulative numbers of heliothine damaged bolls compared to plots planted to conventional cotton on all sample dates (Figures 3 and 4). In Test 2, the VipCot plots had significantly lower densities of soybean looper larvae compared to the conventional cotton plots (Figure 5).

In Test 3, plots planted to varieties expressing the WideStrike or Bollgard II technologies had significantly fewer damaged squares compared to plots planted to PHY 315RF or PHY 425RF (no insecticidal traits) on the 27 Jul and 2 Aug sample dates and across all sample dates (Table 1). Also, plots planted to varieties expressing the WideStrike and Bollgard II technologies had significantly fewer damaged bolls compared to plots planted to PHY 425RF (no insecticidal traits) on the 2 Aug sample date (Table 2).

On the 27 Jul sample date, plots planted to ST 4554B2RF (Bollgard II) had significantly fewer damaged squares compared to plots planted to PHY 425RF (no insecticidal traits) that received supplemental insecticide applications in Test 4 (Table 3). Plots planted to PHY 485WRF (WideStrike) or ST 4554B2RF (Bollgard II), with and without supplemental insecticide applications, had significantly fewer damaged squares compared to plots planted to PHY 425RF (no insecticidal traits) with and without supplemental insecticide applications, on the 3 Aug sample date and across all sample dates. On the 3 Aug sample date and across sample dates, plots planted to PHY 425RF (no insecticidal traits) that did not receive supplemental insecticide applications had significantly more damaged bolls compared to plots that received any of the other treatments (Table 4).

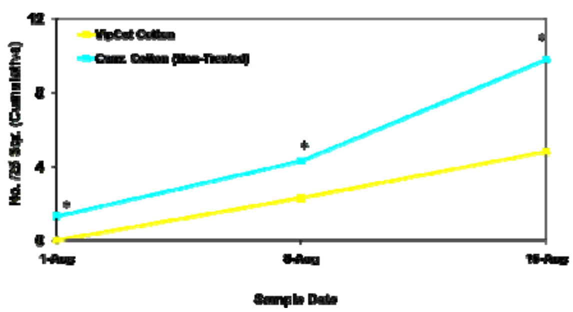

Figure 1. Cumulative number of heliothine damaged squares in VipCot and non-treated conventional cotton plots at NMREC, Verona, MS during 2007 (Test 1). An asterisk indicates significant differences at *P*=0.05.

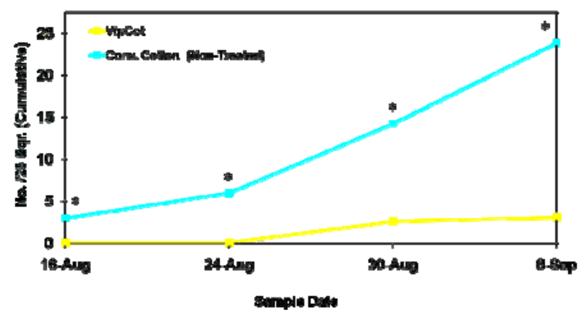

Figure 2. Cumulative number of heliothine damaged squares in VipCot and non-treated conventional cotton plots at USDA-ARS SIMRU, Stoneville, MS during 2007 (Test 2). An asterisk indicates significant differences at *P*=0.05.

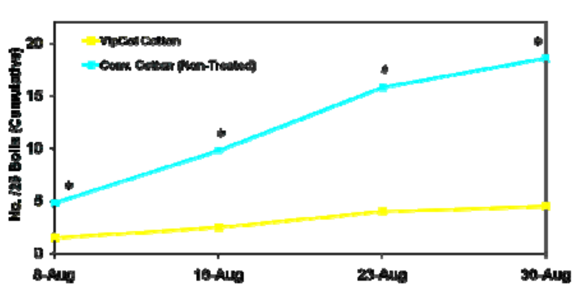

Figure 3. Cumulative number of heliothine damaged bolls in VipCot and non-treated conventional cotton plots at NMREC, Verona, MS during 2007 (Test 1). An asterisk indicates significant differences at *P*=0.05.

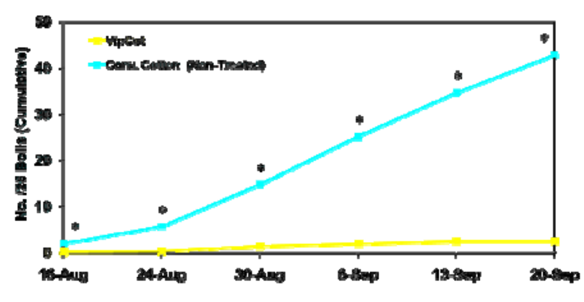

Figure 4. Cumulative number of heliothine damaged bolls in VipCot and non-treated conventional cotton plots at USDA-ARS SIMRU, Stoneville, MS during 2007 (Test 2). An asterisk indicates significant differences at *P*=0.05.

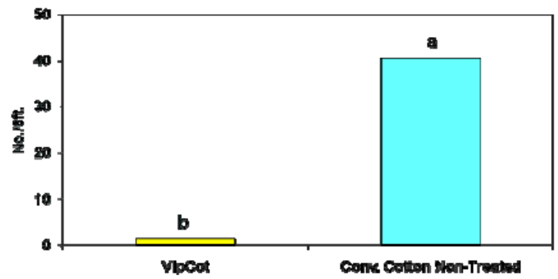

Figure 5. Densities of soybean looper larvae in VipCot and non-treated conventional cotton plots at USDA-ARS SIMRU, Stoneville, MS during 2007 (Test 2).

Table 1. Impact of WideStrike and Bollgard II technologies on number of heliothine damaged squares (Test 3).

	Damaged squares (no./25)					
Treatment	3 Jul	11 Jul	16 Jul	27 Jul	2 Aug	Seasonal Mean[1]
PHY 375WRF	0.5	0.0	0.0	0.3b	0.8b	0.3b
PHY 485WRF	0.9	0.0	0.0	0.1b	0.8b	0.3b
PHY 315RF	0.9	0.3	0.3	3.7a	6.1a	2.3a
PHY 425RF	0.8	0.0	0.0	5.0a	7.0a	2.6a
ST 4554B2RF	1.0	0.0	0.0	0.3b	0.0b	0.3b
P>F	0.94	0.23	0.23	<0.01	<0.01	<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, $P \leq 0.05$).
[1]Means across all sample dates.

Table 2. Impact of WideStrike and Bollgard II technologies on number of heliothine damaged bolls (Test 3).

	Damaged bolls (no./25)					
Treatment	3 Jul	11 Jul	16 Jul	27 Jul	2 Aug	Seasonal Mean[1]
PHY 375WRF	0.0	0.0	0.0	0.0	0.3b	0.1
PHY 485WRF	0.0	0.0	0.0	0.3	0.3b	0.1
PHY 315RF	0.0	0.0	0.3	2.3	0.3b	0.6
PHY 425RF	0.0	0.0	0.0	2.0	1.5a	0.7
ST 4554B2RF	0.0	0.0	0.0	0.3	0.0b	0.1
P>F	1.0	1.0	0.23	0.08	0.04	0.09

Means within columns followed by a common letter are not significantly different (FPLSD, $P \leq 0.05$).
[1]Means across all sample dates.

Table 3. Impact of WideStrike and Bollgard II technologies with and without supplemental insecticide applications on number of heliothine damaged squares (Test 4).

	Damaged squares (no./25)				
Treatment	11 Jul	16 Jul	27 Jul	3 Aug	Seasonal Mean[2]
PHY 425RF	0.5	0.3	1.5ab	8.0a	2.6a
PHY 485WRF	0.0	0.0	0.8bc	0.3b	0.3b
ST 4554B2RF	0.0	0.0	0.5bc	0.3b	0.2b
PHY 425RF (TRTD)[1]	0.0	0.5	2.3a	6.3a	2.4a
PHY 485WRF (TRTD)[1]	0.0	0.3	1.0abc	0.8b	0.5b
ST 4554B2RF (TRTD)[1]	0.0	0.0	0.0c	0.0b	0.0b
P>F	0.45	0.62	0.03	<0.01	<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, $P \leq 0.05$).
[1]Karate Z 2.08CS (0.03 lb AI/A) plus Tracer 4SC (0.067 lb AI/A) applied on 16, 27 Jul, and 3 Aug.
[2]Means across all sample dates.

Table 4. Impact of WideStrike and Bollgard II technologies with and without supplemental insecticide applications on number of heliothine damaged bolls (Test 4).

	Damaged bolls (no./25)				
Treatment	11 Jul	16 Jul	27 Jul	3 Aug	Seasonal Mean[2]
PHY 425RF	0.5	1.3	0.0	2.8a	1.1a
PHY 485WRF	0.0	0.0	0.0	0.0b	0.0c
ST 4554B2RF	0.0	0.0	0.0	0.0b	0.0c
PHY 425RF (TRTD)[1]	0.3	0.5	0.3	1.3b	0.6b
PHY 485WRF (TRTD)[1]	0.0	0.8	0.0	0.0b	0.2bc
ST 4554B2RF (TRTD)[1]	0.0	0.0	0.0	0.0b	0.0c
P>F	0.57	0.06	0.45	<0.01	<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, $P \leq 0.05$).
[1]Karate Z 2.08CS (0.03 lb AI/A) plus Tracer 4SC (0.067 lb AI/A) applied on 16, 27 Jul, and 3 Aug.
[2]Means across all sample dates.

Results from these trials are similar to those of Mascarenhas et al. (2003), Cook et al. (2004), Byrd et al. (2005), Leonard et al. (2005), Mascarenhas et al. (2005), and Micinski et al. (2005), and further demonstrate that the VipCot technology does provide satisfactory control of bollworm and tobacco budworm. In the WideStrike trials heliothine infestations were relatively low. However, the WideStrike technology did provide significant protection from heliothine injury similar to results reported by Huckaba et al. (2005), Jackson et al. (2005), Leonard et al. (2005), Lorenz et al. (2005), Micinski et al. (2006), and Willrich Siebert et al. (2007).

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