VARIATION IN PLANT INJURY AND YIELD BY LEPIDOPTEROUS PESTS IN SELECTED CULTIVARS OF BT COTTONS IN NEW MEXICO

Jane Breen Pierce
Patricia E Monk
New Mexico State University
Las Cruces, NM
Stephen Biles
Texas A&M University
Email:japierce@nmsu.edu

Abstract

As part of a regional collaborative project with Cotton Incorporated and Texas A & M University, seven varieties of Bt +/- cotton were planted in a field trial in Artesia, NM. Damage to squares and bolls was compared weekly. Yields were picked from two 50ft center rows. Plants were also removed for yield partitioning comparisons by position and node. Square damage to conventional cotton was significantly higher than cultivars with 2-3 Bt genes with 9% square damage in non Bt squares vs 3% in the Bt varieties. Boll damage was high ranging from 16-40% boll damage with the more notable differences among Bt products. Non Bt cotton had 38% boll damage comparable to the 36-40% damage in Widestrike and Widestrike 3. Twinlink and Twinlink Plus had 21-26% boll damage. Bollgard 2 and 3 had the least damage with 16-17% boll damage. There were no significant differences in yield. Raw cotton yields ranged from 1412 lb/A in the non Bt cotton variety and 1557 to 1993 lb/A in the Bt cotton varieties.

Introduction

High input costs for insect control including technology fees and insecticide applications make it difficult for growers to produce profitable cotton in much of the cotton belt including New Mexico and Texas. Cotton bollworm, *Helicoverpa zea* (Boddie), is the most important insect pest of cotton in New Mexico. It is found in every cotton field in New Mexico and is one of the reasons Bt cotton is prevalent in New Mexico. Recently, there have been increasing concerns about bollworm resistance to dual and triple gene Bt cotton varieties (Kerns et. al. 2018 and Taillon et. al. 2018). The objective of this study was to evaluate efficacy of dual and triple gene Bt cottons to determine if the use of these cotton varieties is currently cost effective in New Mexico.

Material and Methods

Seven varieties of cotton with 0-3 Bt genes were planted in 4 row, 100 ft plots in Artesia, NM. The Bt cotton technologies evaluated included: PHY 333WFE (WideStrike®), DP1522B2XF (Bollgard II®), ST 5122GLT (TwinLink™), ST5471GLTP (TwinLink Plus™), DP1845B3XF (Bollgard® 3), PHY 330W3FE (WideStrike 3®) and FM2322GL, a non-Bt variety was included as a check. Squares and bolls were sampled for damage from the middle two rows weekly. The outer two rows were mechanically harvested and weighed. Ten feet of plants of one outer row were cut and brought to the lab to record lint weight by position and node.

Results

There was significantly higher square damage in cotton varieties with 2-3 Bt genes compared to non Bt check variety cultivars until late July (Figure 1-2). Although squares were collected until mid-August the only differences between Bt and non Bt cotton were in the first two dates July 7 and 23. In those first two dates there was 9.2% damaged squares in non Bt cotton compared to 2.8 and 2.6% damaged squares in varieties with 2 and 3 genes respectively (df 2,53 F=8.3 $P<0.0007$). There were some interesting numerical trends among products as opposed to number of genes. Widestrike and Widestrike 3 had 4.1 and 3.3% damage, Bollgard 3 and Bollgard 2 had 2.8% and 2.2% damage respectively. Twinlink and Twinlink Plus had 2.1and 1.8% damage respectively. (Table 2) Bollgard 2, Twinlink and Twinlink Plus had significantly less square damage then the check.

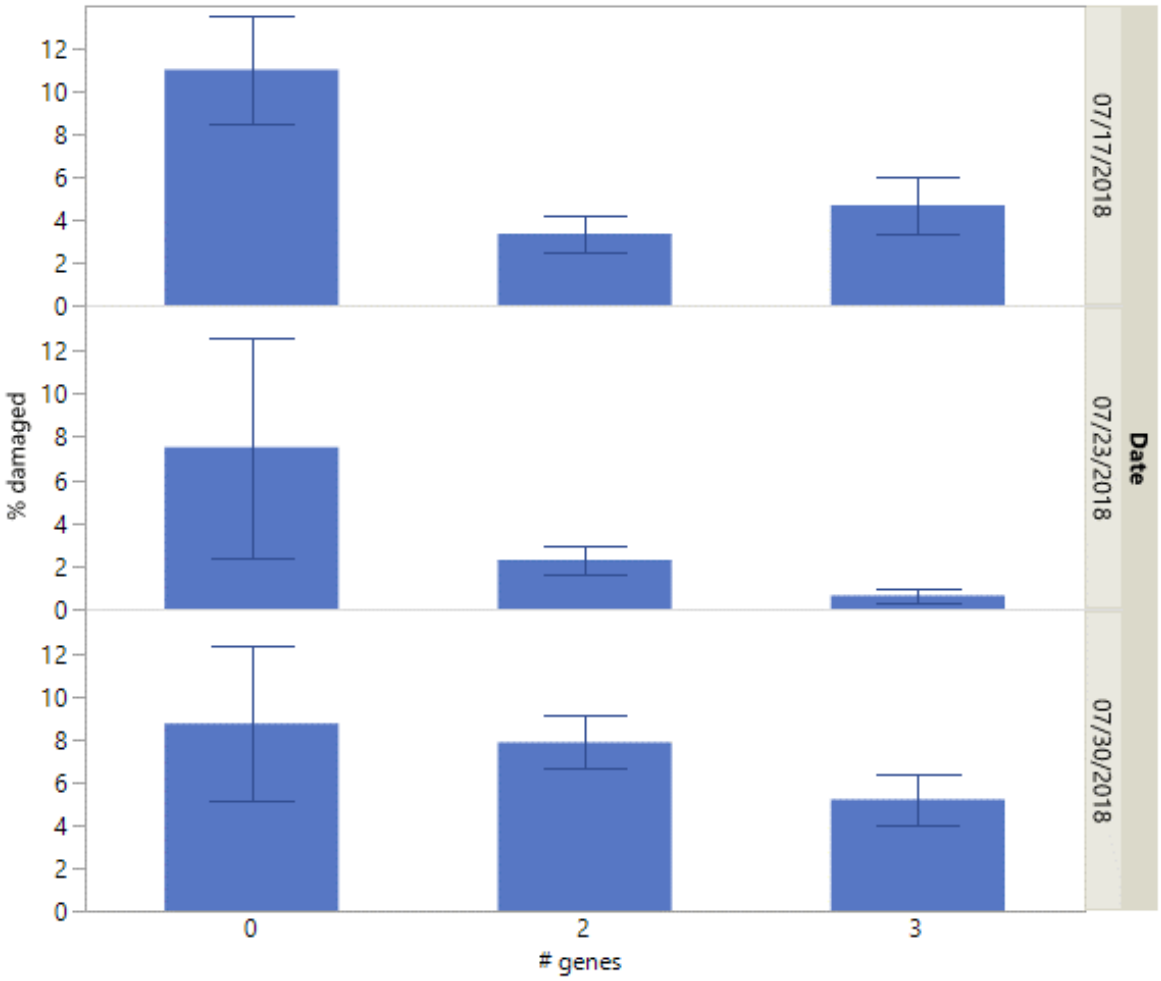

Figure 1. Square damage in July from 7 Bt+/- varieties with 0 or 2-3 genes

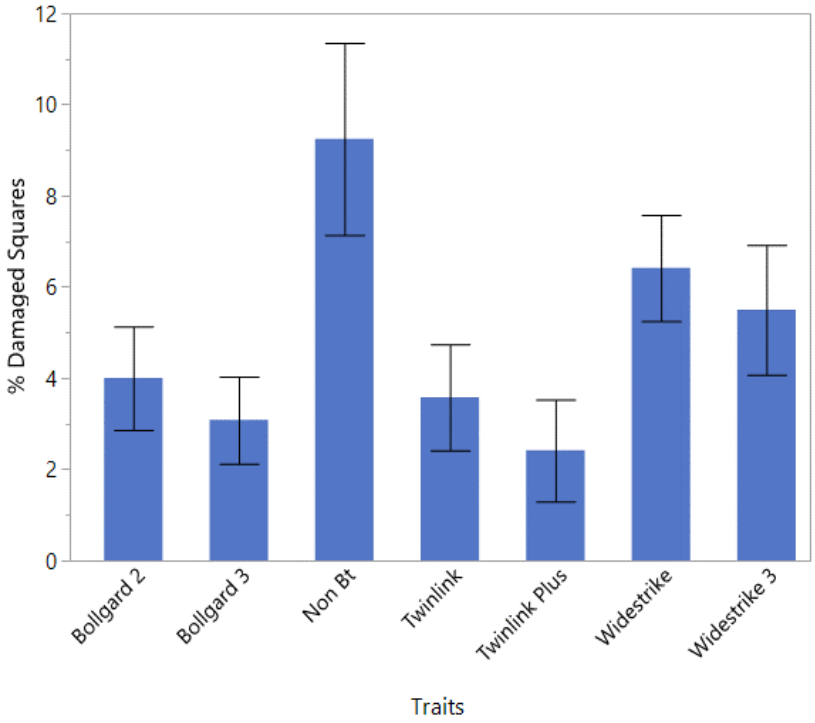

Figure 2. Season long mean percent damaged squares in 7 varieties of Bt +/- cotton Artesia, NM

Table 2. Mean percent damaged squares on 7/17/18 and 7/23/18 in 7 varieties of 2-3 gene Bt products and one non-Bt variety, Artesia, NM

Variety	Mean % damaged squares	(standard error)	Product
FM2322 GL	9.2a	2.7	Non-Bt
Phy333 WFE	4.1ab	0.8	Widestrike
Phy330 W3FE	3.3 ab	1.6	Widestrike 3
DP 1845 B3XF	2.8 ab	1.2	Bollgard 3
DP1522 B2XF	2.2 b	0.7	Bollgard 2
ST5122 GLT	2.1 b	1.1	Twinlink
ST5471 GLTP	1.8 b	1.5	Twinlink Plus

Means within a column followed by the same letters are not significantly different ($P < 0.05$) by Tukey's Multiple Comparison.

Boll Damage

There was a difference in boll damage between non Bt and Bt cotton varieties, but there was no difference between the dual and triple gene cottons varieties (Table 3). Instead, surprisingly, there were larger differences among the products. Non Bt cotton had 38% boll damage comparable to the 36-40% damage in Widestrike and Widestrike 3. Twinlink and Twinlink Plus had 21-26% boll damage. Bollgard 2 and 3 had the least damage with 16-17% boll damage.

Table 3. Mean percent boll damage in Bt +/- 2018 field trial Artesia, NM

	8/6/18		7/30/18	
Product	% Boll Damage	s.e.	% Boll Damage	s.e.
Non-Bt	38.1a	7.0	25.6a	6.8
Widestrike	36.2a	6.8	11.2b	6.1
Widestike 3	40.0a	6.6	19.3b	4.5
Twinlink	21.2a	4.8	26.5b	5.4
Twinlink +	25.6a	4.8	30.6b	3.3
Bollgard 2	16.2a	4.9	11.8b	6.1
Bollgard 3	17.5a	4.2	16.2b	2.4

Means within a column followed by the same letters are not significantly different ($P < 0.05$) by Tukey's Multiple Comparison.

Yield from Bt Cotton Field Trial

There was no significant difference in yield in any of the varieties. (Figure 3) There was a trend with numerically lower yield in the non Bt cotton compared to the Bt cotton varieties. With 1412 lb/A in the non Bt seed cotton variety and 1557 to 1993 lb /A in the Bt seed cotton varieties.

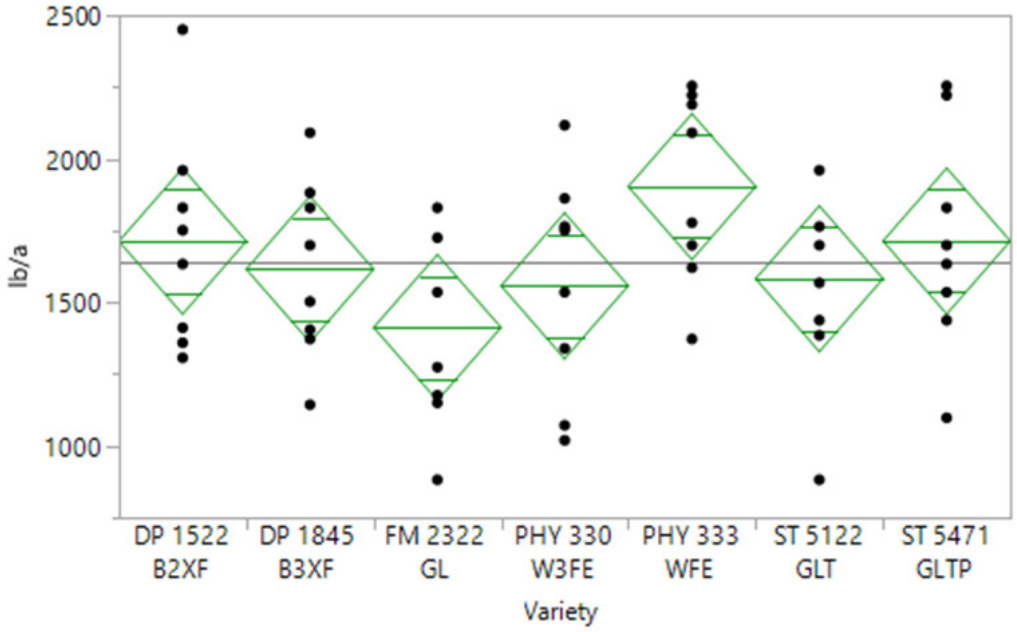

Figure 3. Field weight of seed cotton in seven varieties of Bt +/- cotton in Artesia 2018 Bt trial.

Conclusions

Results from 2018 indicated bollworm damage in conventional cotton resulted in higher damage and likely yield losses compared to some Bt cottons. Although yield losses could not be demonstrated statistically from field plots picked mechanically, numerically the yield of the non Bt cotton was 10-34% less than the Bt cotton varieties. Based on previous work we did on yield partitioning and compensation with Cotton Incorporated we would not expect significant yield losses from 3% square damage to Bt cotton. However 40% loss of bolls even late season, August 8, should produce significant yield losses late season since it is difficult for cotton to compensate for boll losses (Pierce and Monk 2008, Pierce et.al. 2001). Yield partitioning comparisons are in progress.

Typically, bollworm damage is not extremely high in NM. The last year that had bollworm damage as high was 20 years ago in 1998. However, the degree of damage noted here and the likelihood of some yield losses demonstrates the need to monitor bollworm in both transgenic and conventional cotton cultivars.

Acknowledgements

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References

Kerns, D.L., F. Yang,,G. M. Lorenz, J. Gore, A. L. Catchot, S. D. Stewart, S. A. Brown, D. R. Cook and N. Seiter. 2018. Value of Bt technology for bollworm management. *In,* Preceedings 71st Beltwide cotton Conferences, National Cotton Council. San Antonio, TX. pp. 805-809.

Pierce, J. and P. Monk. 2008. Yield compensation for simulated bollworm injury in New Mexico. Lubbock World Cotton Research Conference-4. Refereed Proceedings: Omnipress, Madison, WI p1826.

Pierce, J. Breen, R. Flynn, C. Ellers-Kirk and C. French. 2001. Variation in plant resistance to cotton bollworm *Helicoverpa zea* in selected Bt cotton varieties. Southwestern Entomologist. 26: 353- 363.

Taillon, N., G. Lorenz, A. Plummer, N. Bateman, B. Thrash, K. McPherson, A. Cato and J. Black. 2018. Comparison of Bt cultivars for control of cotton bollworm with and without a foliar application in Arkansas, 2017. *In* Proceedings 71st Beltwide Cotton Conferences, National Cotton Council, San Antonio, TX. pp. 240-243.