BOLLGARD III® EFFICACY ACROSS THE COTTON BELT, 2014

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Abstract

Bollgard III® (BG3) was evaluated at eleven locations across the cotton belt in 2014. Efficacy data show consistent and in numerous scenarios significant improvement in plant protection over Bollgard II® (BG2). Incremental protection was observed in low pressure environments while significant increase in protection was detected in high pressure environments. Germplasm yield of the new traited lines was not significantly different than the currently marketed premium BG2 germplasm lines.

Introduction

Bollgard III® will be comprised of Cry1Ac, Cry2Ab and Vip3A. The complementary efficacy and multiple modes of action provided by this collection of traits provide significant control of caterpillar pests in cotton. There is literature support for the existence of discrete and specific binding sites for all three of the components of Bollgard III [1]. These data, in addition to evidence of substantial amino acid sequence differences, divergent binding properties, and lack of cross resistance in resistant colony testing all suggest a lower probability of resistance development with this product.

Methods

Eleven sites designated to evaluate regulated BG3 lines were strategically located with extension, academic and 3rd party contract researchers across the cotton belt to facilitate trial exposure to varying levels of insect pressure. These small plot / replicated sites were all exposed to native *Helicoverpa zea* populations with one location manually infested with *Spodoptera frugiperda*. At 9 locations, a duplicate set of treatments were kept free of caterpillar infestations with insecticidal over sprays as needed.

Two different BG3 lines were utilized and compared with BG2 commercial lines with a similar germplasm background.
The two lines of BG3 germplasm included:

- 14R335 B3XF, a RRF x glufosinate x dicamba tolerant line was paired with the commercial line DP 1133 B2RF
- 14R440 B3XF, a RRF x glufosinate x dicamba tolerant line was paired with the commercial line DP 1137 B2RF
- DP 174 RF (non-Bt) was used as non-Bt standard in all the trials

Evaluations were taken during the peak fruiting period at each location and counts normalized to represent 25 individual plant parts per plot for each sample date and converted to % damage of that structure. Observations utilized for this study include percent damaged terminals, squares, and bolls and well as seed cotton yields.

Trials were separated into High (6) and Low (5) pressure locations to better understand trait as well as germplasm influence on product performance. Pressure status was determined by seasonal damage level attained in unsprayed DP174 RF plots.

Means within each data cluster followed by the same letter do not differ significantly at the 0.05 level of probability.

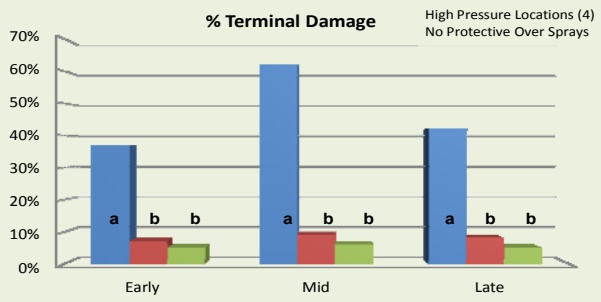
%Terminal Damage

To best evaluate true insect protection provided by the traits, lepidopteran efficacy data from the non-over sprayed sets are emphasized here.

Four high pressure locations were analyzed for terminal feeding damage.

Both BG2 and BG3 (Table 1) significantly reduced terminal damage from that of the non Bt line. Although there were no significant differences between in the traits, BG3 consistently provided greater protection than BG2.

Table 1.

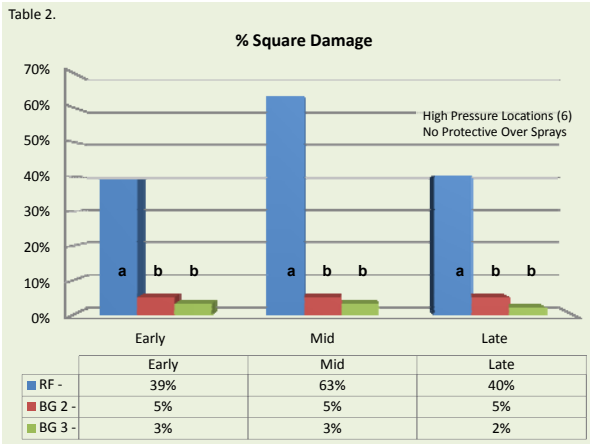


	Early	Mid	Late
RR -	37%	62%	42%
BG 2 -	7%	9%	8%
BG 3 -	5%	6%	5%

% Square Damage

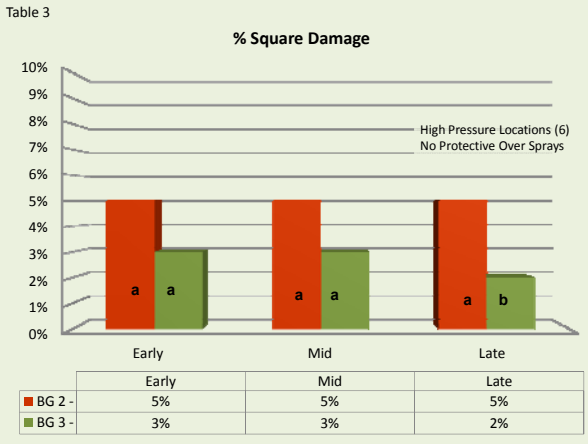
Both BG2 and BG3 significantly reduced damage square percentage (Table 2) at each sample timing. Analysis of the two traited lines in absence of non-traited lines (Table 3) show significant reduction in square damage provided by BG3 over BG2 in late season evaluations.

Table 2.



	Early	Mid	Late
RF -	39%	63%	40%
BG 2 -	5%	5%	5%
BG 3 -	3%	3%	2%

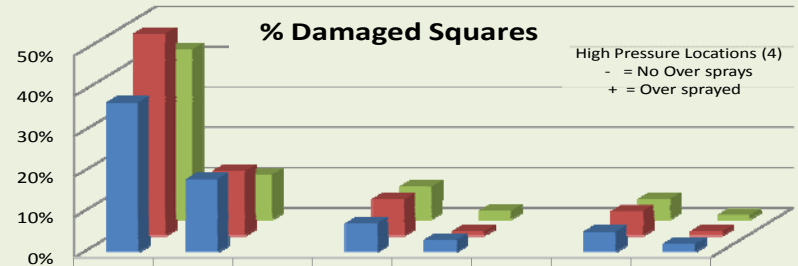
Table 3



	Early	Mid	Late
BG 2 -	5%	5%	5%
BG 3 -	3%	3%	2%

Comparing the protective overspray component of these high pressure trials showed that increased protection can be observed in the two traited lines with protective over sprays (Table 4). This indicates there can be environments where supplemental over sprays are advantageous. Looking then at DP 174 RF, while foliar applications can provide some level of protection, a crop management plan solely dependent on foliar control may represent a higher risk to growers in high pressure environments.

Table 4



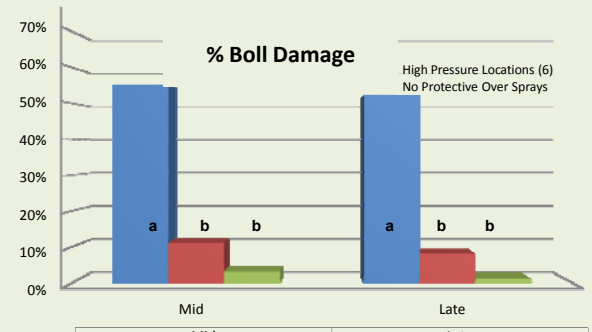
	RF -	RF +		BG 2 -	BG 2 +		BG 3 -	BG 3 +
Early	37%	18%		7%	3%		5%	2%
Mid	62%	16%		9%	1%		6%	1%
Late	42%	11%		8%	2%		5%	1%

% Boll Damage

In trials that sustained substantially higher levels of boll damage, BG3 (Table 5) consistently provided superior boll protection throughout the season.

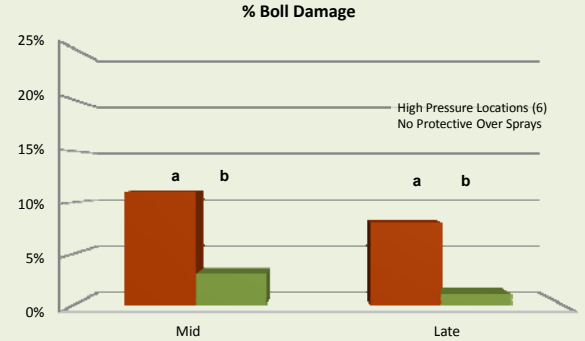
BG3 was significantly more protective than BG2 when analyzed head to head (DP 174 RF removed from the analysis) (Table 6).

Table 5



	Mid	Late
RF -	55%	52%
BG 2 -	11%	8%
BG 3 -	3%	1%

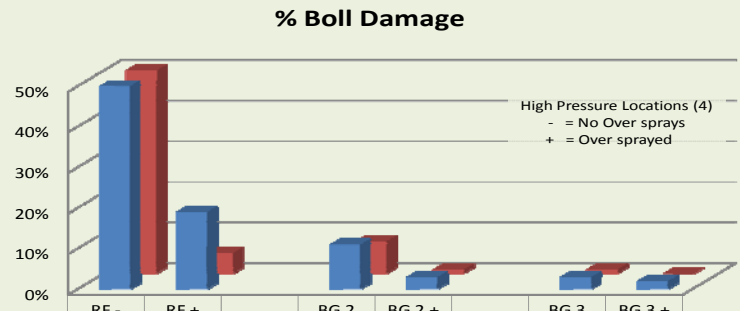
Table 6



	Mid	Late
BG 2 -	11%	8%
BG 3 -	3%	1%

Similar to square evaluation comparing impact of protective over sprays, the non-Bt DP 174 RF plots received greatest benefit, but did not attain the level of protection provided by BG2 or BG3 alone (Table 7). Incremental increase in protection can be observed in both traits in a protected spray environment. BG3 consistently provided greatest boll protection even in over sprayed environments.

Table 7

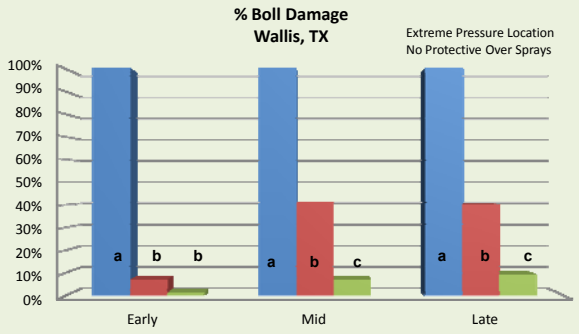


	RF -	RF +		BG 2	BG 2 +		BG 3	BG 3 +
Mid	55%	19%		11%	3%		3%	2%
Late	52%	5%		8%	1%		1%	0%

One trial location in Wallis, TX sustained the greatest pressure from any site (Table 8).
While BG2 at this site sustained heavier boll damage than had been previously experience, damage in the unprotected DP 174 RF plots was 100% season long. Although BG3 did sustain some level of damage, it provided significant and acceptable boll protection from *Helicoverpa zea* even under this intense pressure.

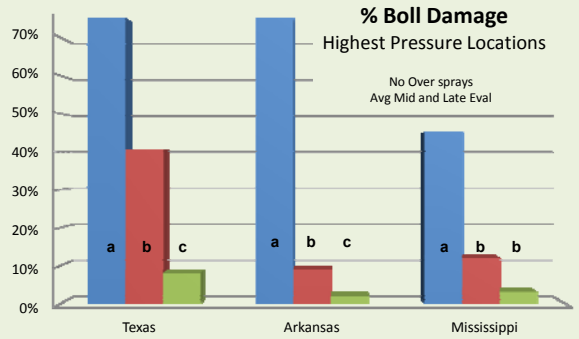
Evaluating the three locations with greatest pressure (Table 9), BG3 allowed less boll damage than BG2, with statistical significance at 2 of the 3 sites.

Table 8



	Early	Mid	Late
RF -	100%	100%	100%
BG 2 -	7%	41%	40%
BG 3 -	1%	7%	9%

Table 9

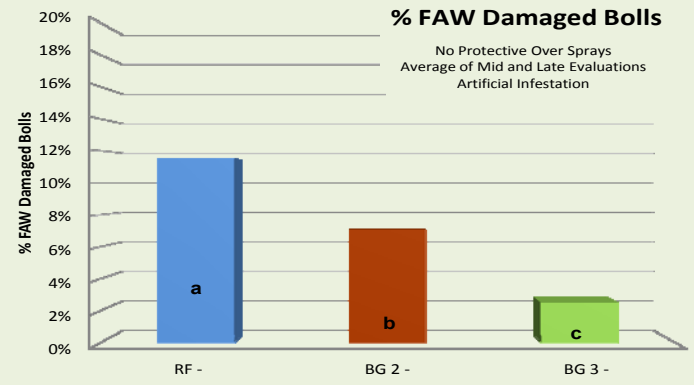


	Texas	Arkansas	Mississippi
RF -	100%	90%	45%
BG 2 -	41%	9%	12%
BG 3 -	8%	2%	3%

Fall Armyworm

At one site with a manually infested *Spodoptera frugiperda* population (Table 10), BG3 exhibited significantly reduced damage compared to BG2.

Table 10

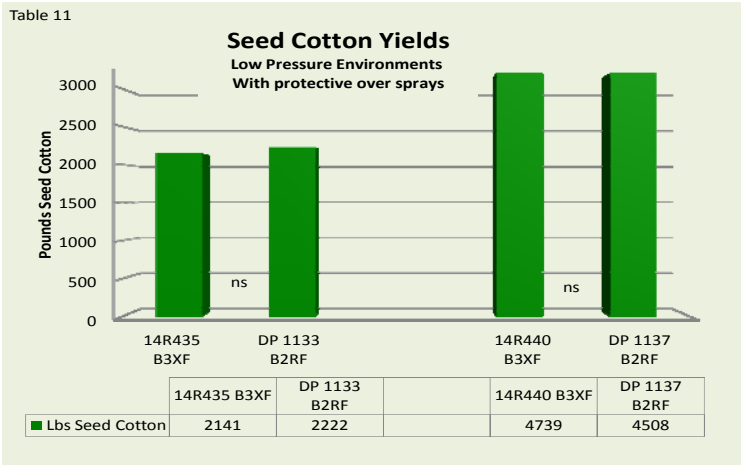


	RF -	BG 2 -	BG 3 -
% Damage	12%	7%	3%

Seed Cotton Yield

Seed cotton yield evaluations in low pressure trials in protected oversprayed environments show the germplasm performance of BG3 (Table 11) lines to be statistically similar to that of BG2 lines. This demonstrates no loss of germplasm yield performance in the presence of the additional genes for insect and weed control.

Table 11



	14R435 B3XF	DP 1133 B2RF		14R440 B3XF	DP 1137 B2RF
Lbs Seed Cotton	2141	2222		4739	4508

Summary

BG3 will be comprised of three distinct Bt proteins (Cry1Ac, Cry2Ab and Vip3A) with distinct modes of action offering expanded lepidopteran pest spectrum and enhanced product durability.

Introduced lines will also carry the traits that confer tolerance to glyphosate, glufosinate and dicamba.

Plant protection data consistently showed the incremental increase in protection provided by Bollgard 3 in low pressure environments and significant improvement in plant protection under higher pressure environments

Yield parity of the new lines was demonstrated relative to current successful lines in the marketplace.

References

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