PERFORMANCE OF BOLLGARD II COTTON AGAINST LEPIDOPTEROUS PESTS IN THE LOWER RIO GRANDE VALLEY OF TEXAS

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Abstract

The Bollgard II variety, which has not been licensed for use by commercial agriculture as of this report date was tested against several lepidopterous pest species. Results indicated that as the cotton leaf aged, increased larval mortality was recorded. The results show promise for improved control of the various tested species with Bollgard II compared to a currently registered Bollgard variety, DPL 50 B and a non-Bollgard variety, DPL 50.

Introduction

The introduction of genetically altered cotton varieties throughout the U.S. cotton belt in 1995 has resulted in some significant changes in insect management. Growers have had to change their decision making process about insect management since the now-insect resistant varieties provide some, but not 100 percent, control of various pests. As new versions of the genetically altered varieties come into the market, growers need current research data to assist them in making variety choices. The objective of this study was to evaluate the relative efficacy of Bollgard II against lepidopterous pests compared to it parental Bollgard line.

Methods and Materials

A small plot trial was planted at the Texas A&M Research and Extension Center Hiler Farm to evaluate the efficacy of Bollgard II against lepidopterous caterpillars. In conjunction with this field trial, a series of laboratory bioassays were conducted to evaluate the efficacy of Bollgard II against the beat armyworm (*Spodoptera exigua)* (BAW) and the cotton bollworm (*Helicoverpa zea)*, also known as the corn earworm (CEW). These bioassays also included evaluation of the effects of leaf age on efficacy.

The field portion of this test consisted of a randomized complete block design with four replications of six treatments. The treatments were three cotton varieties, with two plots of each variety; one designated for treatment with an insecticide as needed and the other designated for non-treatment evaluated included DPL 50, DPL 50B (Bollgard), and DPL 15985 (Bollgard II). Plot size was 8 rows (40 inch centers) by 30 feet.. The data presented in this study was collected from non-treated plots only.

The laboratory bioassays were conducted with larvae (CEW and BAW) provided by the USDA-ARS laboratory in Weslaco, Texas. For each bioassay, leaves were collected from each plot and transported to the laboratory. Leaf disks (7/8 inch diameter) were cut with a cork borer and placed in a 3/4 ounce diet cup which contained a 7/8 inch disk of filter paper moistened with RO water. A single larva was placed on each leaf disk, with ten larvae per treatment per replication. Mortality was checked every two days for 10 days, and leaf disks were replaced with freshly cut disks every two days. At 10 days after initial exposure, any surviving larvae were counted and weighed.

Bioassays were initiated on three dates: On May 22, bioassays were conducted against BAW and CEW using the third leaf from the terminal of each plant. Plants at this time consisted of approximately 12 nodes. These bioassays were initiated with neonate larvae of both species.

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On May 23, a single bioassay was conducted against BAW. This bioassay was initiated with 1 day old larvae. This bioassay included evaluation of the third and sixth leaf from the terminal. Plants at this point contained approximately 12 nodes.

On June 5, both species of caterpillar were bioassayed against the third, sixth, and ninth leaf of each variety. Neonate larvae were used to initiate the bioassays. Plants contained 14 to 15 nodes at this point in the season.

Field populations of lepidopteran larvae remained low until fairly late in the season. Insecticidal treatments were applied to the wrong plots shortly after larvae first appeared, resulting in a single date of field larval counts for this study. On July 3, drop cloth samples were taken in the field plots to determine the number of lepidopterous larvae present in 6 feet of row. Larvae were identified and counted by species.

Seed cotton was harvested for fiber quality analysis and ginned in a 10 saw portable gin. Fiber quality was determined by collecting seed cotton, ginning same and sending it to the International Textile Center in Lubbock, Texas for analysis.

All data were analyzed with the PROC GLM procedure of PC-SAS. Where significant differences were indicated ($P<0.05$), means were separated with DMRT ($P=0.05$).

Results and Discussion

Bollgard provided increased mortality and decreased larval weights in surviving larvae of CEW as compared to DPL 50 (Tables1, 3 and 5), but generally showed minor impact on BAW (Table 2, 3, and 6.). Bollgard II generally showed increased activity on both species as compared to Bollgard, with increased mortality and greatly decreased survivor weights (Tables 1 - 6). All three bioassays on leaf age generally showed decreased survival on older leaves (Tables 4 - 6).

Bioassays were also conducted with square bracts (data not presented). These bioassays showed near 100% mortality of CEW on all three varieties, while BAW data closely resembled the leaf bioassay data.

Bollworm, beet armyworm, cabbage looper (*Tricoplusia ni)* and fall armyworm (*Spodoptera frugiperda)* (*FAW)* appeared in the test field very late in the season. Larval feeding was primarily confined to leaves due to severe loss of fruit from prior boll weevil damage. Field counts of larvae in this test indicated that Bollgard II was superior in protection from the various species encountered since all counts in the Bollgard II were zero and statistically different from Bollgard and DPL 50 (Table 7). Previous research conducted by the authors (unpublished data) indicated that tobacco budworm were significantly reduced by Bollgard II compared to the standard non-Bollgard variety DPL 50 and equal to DPL 50B.

Yield data were not taken because boll weevil damage was so severe as to make harvest non economic. No significant differences in fiber quality were detected among the varieties (Table 8).

Table 1. Bollgard test mortality of neonate CEW larvae reared on leaf disks of selected cotton varieties. Leaf disks were cut from the third leaf from the terminal of plants with 12 nodes. Initiated May 22, 2000.

	Percent mortality at specified days after exposure				
Variety	**2 DAE**	**4 DAE**	**6 DAE**	**8 DAE**	**10 DAE**
BG II	21.7 a	73.3 a	75.0 a	80.0 a	81.7 a
DPL	5.0 b	16.7 b	18.3 b	18.3 b	20.0 b
DPL 50	1.7 b	1.7 b	1.7 b	1.7 c	1.7 c

Numbers within a column followed by the same letter are not significantly different (DMRT).

Table 2. Bollgard test mortality of neonate BAW larvae reared on leaf disks of selected cotton varieties. Leaf disks were cut from the third leaf from the terminal of plants with 12 nodes. Initiated May 22, 2000.

	Percent mortality at specified days after exposure				
Variety	**2 DAE**	**4 DAE**	**6 DAE**	**8 DAE**	**10 DAE**
BG II	11.7 a	46.7 a	60.0 a	68.3 a	73.3 a
DPL 50B	0.0 b	0.0 b	0.0 b	0.0 b	8.3 b
DPL 50	0.0 b	0.0 b	0.0 b	0.0 b	0.0 c

Numbers within a column followed by the same letter are not significantly different (DMRT).

Table 3. Bollgard test surviving larvae weights of neonate CEW and BAW larvae reared for 10 days on leaf disks of selected cotton varieties. Leaf disks were cut from the third leaf from the terminal of plants with 12 nodes. Initiated May 22, 2000.

	Mean Larval Weights	
Variety	**CEW**	**BAW**
BG II	0.003 c	0.001 c
DPL 50B	0.008 b	0.016 b
DPL 50	0.054 a	0.027 a

Numbers within a column followed by the same letter are not significantly different (DMRT).

Table 4. Bollgard test mortality of one day old BAW larvae reared on leaf disks of selected cotton varieties. Leaf disks were cut from the third and sixth leaf from the terminal of plants with 12 nodes. Initiated May 23, 2000.

	Percent mortality at specified days after exposure			
	2 DAE		**4 DAE**	
Variety	**Leaf 3**	**Leaf 6**	**Leaf 3**	**Leaf 6**
BG II	45.0 a	97.5 a*	72.5 a	100.0 a
DPL 50B	5.0 b	37.5 b*	7.5 b	45.0 b*
DPL 50	2.5 b	15.0 b	7.5 b	27.5 b
	6 DAE		**8 DAE**	
	Leaf 3	**Leaf 6**	**Leaf 3**	**Leaf 6**
BG II	85.0 a	100.0 a	92.5 a	100.0 a
DPL 50B	7.5 b	47.5 b*	7.5 b	47.5 b*
DPL 50	7.5 b	27.5 b	7.5 b	27.5 b
	10 DAE		**Mean Larval Weight (g)**	
	Leaf 3	**Leaf 6**	**Leaf 3**	**Leaf 6**
BG II	95.0 a	100.0 a	----	----
DPL 50B	10.0 b	47.5 b*	0.008 b	0.007 b
DPL 50	7.5 b	27.5 b	0.010 a	0.010 a

Numbers within a column followed by the same letter are not significantly different (DMRT).

* following a value indicates that the mortalities on the 3rd versus 6th leaf were significantly different for the indicated DAE and variety.

Table 5. Bollgard test mortality and surviving larvae weights and sizes of neonate CEW larvae reared for 10 days on leaf disks of selected cotton varieties. Leaf disks were cut from the third, sixth and ninth leaf from the terminal of plants with 14 to 15 nodes. Initiated June 5, 2000.

	Percent mortality at specified days after exposure		
Variety	**2 DAE**		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	17.5 Aa	17.5 Aa	10.0 Aa
DPL 50B	7.5 Aa	12.5 Aa	20.0 Aa
DPL 50	5.0 Aa	0.0 Aa	2.5 Aa
	4 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	72.5 Ab	87.5 Aa	97.5 Aa
DPL 50B	30.0 Ba	25.0 Ba	42.5 Ba
DPL 50	7.5 Ba	2.5 Ca	2.5 Ca
	6 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	80.0 Aa	97.5 Aa	100.0 Aa
DPL 50B	52.5 Ba	52.5 Ba	57.5 Ba
DPL 50	20.0 Ca	5.0 Ca	10.0 Ca
	8 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	90.0 Aa	100.0 Aa	100.0 Aa
DPL 50B	67.5 Ba	82.5 Ba	90.0 Aa
DPL 50	45.0 Ca	27.5 Ca	22.5 Ba
	10 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	100.0 Aa	100.0 Aa	100.0 Aa
DPL 50B	87.5 Aa	97.5 Aa	95.0 Aa
DPL 50	52.5 Ba	50.0 Ba	37.5 Ba
	Mean larval weights (g) at 10 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	-----	-----	----
DPL 50B	0.001 B	0.001	0.003
DPL 50	0.010 Aa	0.009 a	0.007 a

Numbers within a data category and leaf age (column) followed by the same UPPER CASE letter are not significantly different (DMRT).
Numbers within a data category and variety (row) followed by the same LOWER CASE letter are not significantly different (DMRT).

Table 6. Bollgard test mortality and surviving larvae weights and sizes of neonate BAW larvae reared for 10 days on leaf disks of selected cotton varieties. Leaf disks were cut from the third, sixth and ninth leaf from the terminal of plants with 14 to 15 nodes. Initiated June 5, 2000.

	Percent mortality at specified days after exposure		
	2 DAE		
Variety	**Leaf 3**	**Leaf 6**	**Leaf 9**
BG II	35.0 Aa	42.5 Aa	82.5 Aa
DPL 50B	0.0 Ba	0.0 Ba	0.0 Ba
DPL 50	0.0 Ba	0.0 Ba	0.0 Ba
	4 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	40.0 Ac	67.5 Ab	95.0 Aa
DPL 50B	0.0 Ba	0.0 Ba	2.5 Ba
DPL 50	2.5 Ba	5.0 Ba	0.0 Ba
	6 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	47.5 Ac	72.5 Ab	100.0 Aa
DPL 50B	0.0 Ba	0.0 Ba	2.5 Ba
DPL 50	2.5 Ba	5.0 Ba	2.5 Ba
	8 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	57.5 Ab	72.5 Ab	100.0 Aa
DPL 50B	0.0 Ba	2.5 Ba	2.5 Ba
DPL 50	2.5 Ba	5.0 Ba	7.5 Ba
	10 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	60.0 Ab	75.0 Ab	100.0 Aa
DPL 50B	0.0 Ba	2.5 Ba	7.5 Ba
DPL 50	2.5 Ba	7.5 Ba	7.5 Ba
	Mean Larval Weights (g) at 10 DAE		
	Leaf 3	**Leaf 6**	**Leaf 9**
BG II	0.001 Ca	0.001 Ca	----
DPL 50B	0.012 Bb	0.017 Ba	0.008 Ac
DPL 50	0.014 Ab	0.020 Aa	0.008 Ac

Numbers within a data category and leaf age (column) followed by the same UPPER CASE letter are not significantly different (DMRT).
Numbers within a data category and variety (row) followed by the same LOWER CASE letter are not significantly different (DMRT).

Table 7. Lepidopterous larval counts in Bollgard test cotton varieties, TAMU "Hiler" farm annex, Weslaco, Texas, July 3, 2000.

	Number of Larvae/6 feet row				
Variety	**Loopers**	**BAW**	**CEW**	**FAW**	**Total Leps**
DPL 50	54.6 a	2.3 a	3.3 a	4.3 a	64.5 a
DP 50B	63.3 a	1.6 a	4.4 a	4.4 a	73.6 a
DP BG II	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b

Table 8. Bollgard test cotton variety fiber quality results, TAMU "Hiler" annex farm, Weslaco, Texas 2000.

Variety	**Micronaire**	**Staple**	**Strength**
BGII	3.7	1.20	31.0
DPL 50	3.5	1.18	31.5
DPL 50B	3.5	1.22	33.4
BGII	3.9	1.22	30.6
DPL 50	3.5	1.17	31.3
DPL 50 B	3.4	1.20	32.8