EFFECTIVENESS OF BOLLGARD II COTTON VARIETIES AGAINST FOLIAGE AND FRUIT FEEDING CATERPILLARS IN ARKANSAS

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RESEARCH PROBLEM

The Bollgard II technology has been recently developed by Monsanto. Since two *Bacillus thuringiensis* (Bt) toxins are present in Bollgard II cottons, improved activity of these cotton varieties is expected against the primary and occasional worm pests of cotton. Yields and agronomic characteristics of Bollgard varieties have not been as consistent as hoped since their release in 1996. Early availability of information on the yield and agronomic characteristics of Bollgard II varieties may help avoid some of the problems that accompanied their release.

BACKGROUND INFORMATION

Bollgard cotton varieties became commercially available in 1996. They have provided cotton growers an alternative to foliar insecticides for controlling some of the caterpillar pests of cotton. They have also removed some of the natural selection for resistance to foliar insecticides. Since their release in 1996, however, cotton losses from caterpillar pests have not declined in the United States or in Arkansas (Williams, 1994-9). Nationally, losses to caterpillars 1996 and 1997 were about the same as in the previous 3 years—4.5 and 4.4%, respectively. In Arkansas, losses were higher from 1996-1998 than from 1993-1995—5.4% and 2.5%, respectively. Certainly, there is room for improvement in the management of caterpillars in cotton. We expect the two Bt toxins in Bollgard II cotton plants will provide improved control of primary caterpillar pests, broader spectrum caterpillar control, and slower development of resistance in caterpillar pests to Bt toxins. This study was conducted to gain a better understanding of the effectiveness of the Bollgard II technology against caterpillar pests and to investigate the agronomic characteristics and yield potential of these varieties.

RESEARCH DESCRIPTION

The study was conducted at the Southeast Branch Experiment Station at Rohwer. Eight replications of four treatments were planted in four row x 40 ft plots on 21 May 1999. Standard production practices were used except that no insecticides for caterpillar control were used. Treatments were the cotton varieties 15813 (Bollgard II), 15985

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(Bollgard II), DPL 50B, and DPL 50.

Seedling vigor data were collected by rating seedlings on 1 June 1999 (1-5 with 1 = very high and 5 = poor). Stand counts were taken on six row feet per plot on 3 June 1999. The plots were sampled weekly for caterpillar pests from mid-July to mid-August by counting the plant bugs, boll weevils, and boll weevil damage, and bollworm/budworm larvae and damage on 25 terminals, 25 squares, and 25 small bolls per plot. On 5 August 1999, eight beet armyworm egg masses were stapled to lower canopy leaves in each plot. On 16 August, whole plots were searched for beet armyworm "hits" (hatching egg masses) and larvae. Soybean and cabbage looper populations increased in the plots in September. Six-foot beet sheet counts were taken in each plot on 15 September. A bollworm/budworm infestation occurred on late-season small bolls. Fifty uppermost small bolls were inspected for the presence of worm damage and larvae on 24 September. Larvae found were collected and identified under a dissecting microscope. Plots were visually assessed for earliness on 25 September and were harvested with a mechanical picker on 21 October. The middle two rows of each plot were harvested, the seed cotton weighed, and lint yields determined using the farm average gin turnout. The data collected were processed using Agriculture Research Manager and CoStat Statistical Software, and analyzed using analysis of variance and least significant difference ($P<.05$).

RESULTS

Bollworm and tobacco budworm populations were low in July and August; therefore, no useable bollworm/budworm data were collected mid-season. Beet armyworm data were collected after the introduction of egg masses on 5 September (Table 1). Fewer beet armyworm hits and larvae were seen in the Bollgard II plots than were seen in the Bollgard (DPL 50 B) or conventional (DPL 50) plots. No beet armyworm larvae were found in either of the Bollgard II varieties. Late season, the bollworm/budworm larvae collected from bolls were 94% tobacco budworm. Significantly fewer tobacco budworm larvae or tobacco budworm damaged bolls were seen in the Bollgard II and Bollgard plots as compared with the conventional cotton. Low level boll damage from tobacco budworm was observed in the DPL 50 B (Bollgard) and 15813 (Bollgard II) plots, but no tobacco budworm damage was seen in the 15985 (Bollgard II) plots.

Late season looper infestations and damage are shown in Table 2. Fewer cabbage and soybean looper larvae were found in the Bollgard II varieties than in the Bollgard or conventional varieties. Presence of cabbage and soybean looper larvae was very low in the Bollgard II varieties. Looper damage was significantly lower in the Bollgard II cotton than in the Bollgard or conventional cotton. Also, Bollgard cotton was less damaged by loopers than was the conventional cotton.

Seedling vigor was higher for the 15985 and DPL 50 Bt varieties than for 15813 (Table 3). Vigor for DPL 50 was intermediate and not significantly different from any of the varieties tested. Average stand counts were higher in plots planted with 15813 than those planted with 15985 or DPL 50 Bt. The average stand count in the DPL 50 plots was intermediate and not significantly different from the other varieties. The

Bollgard II varieties were visually slower to mature than the DPL 50 Bt and DPL 50 cultivars. Lint yields were higher in the DPL 50 Bt and DPL 50 plots than in the 15813 plots but were not significantly higher than in the 15985 plots.

PRACTICAL APPLICATION

The Bollgard II varieties in this test showed good promise in protecting cotton from caterpillar larvae. Bollgard II provided protection from beet armyworm, tobacco budworm, soybean looper, and cabbage looper. No data were collected on the efficacy of Bollgard II against bollworm. The agronomic characteristics of these varieties are still questionable. In summary, more study is needed on the effectiveness of Bollgard II varieties against caterpillar pests in cotton. In particular, data on their effectiveness against bollworm are needed. More work also needs to be done to get Bollgard II varieties agronomically ready for release to growers.

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LITERATURE CITED

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Table 1. Beet armyworm and late season tobacco budworm larvae and damage on Bollgard II, Bollgard, and conventional cotton varieties. Rohwer, AR. 1999.

	Beet Armyworm		Tobacco Budworm	
	Hits	Larvae	Larvae	Damaged Bolls
	--------- #/plot[z] ----------		#/100 small bolls[y]	%
15985	0.0 a[x]	0.0 a	0.0 a	0.0 a
15813	0.0 a	0.0 a	0.0 a	0.5 a
DPL 50 Bt	5.8 b	6.6 b	0.0 a	0.8 a
DPL 50	6.5 b	8.1 b	2.2 b	10.2 b

[z] Plots were 4 rows x 40 feet (160 row feet).
[y] Fifty small bolls per plot were counted, but data are presented on a 100 small boll basis.
[x] Means followed by the same letter are not significantly different (P<.05).

Table 2. Cabbage and soybean looper counts and damage on Bollgard II, Bollgard and conventional varieties. Rohwer, AR, 1999.

	Cabbage Loopers[z]	Soybean Loopers	Looper Damage Rating[y]
	---------- #/6 row ft. ----------		
15985	0.1 a	0.0 a	0.0 a
15813	0.4 a	0.1 a	0.0 a
DPL 50 Bt	27.4 b	40.5 b	2.3 b
DPL 50	23.9 b	47.9 b	3.4 c

[z] 6 ft beat sheet sample.
[y] Rating 0-5; 0 = no damage, 5 = severe defoliation.
[x] Means followed by the same letter are not significantly different (P<0.05).

Table 3. Agronomic characteristics and yield of Bollgard II, Bollgard, and conventional varieties. Rohwer, AR. 1999.

	Stand Counts[z]	Seedling Vigor Rating[y]	Yield
	plants/acre	/6 row ft	lb lint/acre
15985	54,736 b[x]	2.3 b	747 ab
15813	67,346 a	1.6 a	668 b
DPL 50 Bt	55,023 b	2.3 b	847 a
DPL 50	60,755 ab	1.9 ab	785 a

[z] Counts made on 6 row feet/plot on 3 June 1999.
[y] Rating 1-5; 1 = very good, 5 = poor.
[x] Means followed by the same letter are not significantly different (P<0.05).