BOLLGARD™ - IMPACT AND VALUE TO OKLAHOMA'S COTTON INDUSTRY 1996 – 1999

Miles Karner, A.L. Hutson and Jerry Goodson
Oklahoma Cooperative Extension Service

Abtract

Bollgard ™ cotton was the best yielder and increased profits (return per acre) during this four year period. The Bollgard™ profit margin varied between $40.06 per acre in 1999 to $83.53 per acre in 1996. This research indicates the value of investing in Bollgard™ technology throughout these 4 years was $37.57 per acre or $ 2,877,110 dollars (Bollgard™ acreage = 76,580 acres for 4 years).

Bollgard ™ cotton's popularity continues to grow and its future looks bright in Oklahoma. Introduction of stripper varieties and basing rental fees on seeding rate makes it enticing and affordable for dryland production. With its increased popularity, cotton producers must follow and adhere to Monasanto's Bollgard™ resistance management guidelines. Bollgard™ technology will play an integral part of the IPM program after eradication of the boll weevil in Oklahoma.

Introduction

Cotton producers are known as innovators always eager to try new products or technology. However total adoption or reliance is slow until producers see and determine if the new technology is worth the cost or effort required to change -- which was the case with Bollgard™ cotton in Oklahoma.

Today Bollgard™ technology is at the top of breakthrough products (Pyrethroids, Pix, and Prep to name a few) that have revolutionized cotton production in Oklahoma. However several factors or events occurred that slowed its acceptance in Oklahoma. In 1996, Oklahoma producers were excited to see if this highly advertised technological breakthrough could help produce a cheaper crop. However, unlike other new products that were thoroughly tested and evaluated under Oklahoma conditions before releasing, OSU cotton specialists and researchers had little or no experience with Bollgard™ cotton. OSU was hesitant to endorse Bollgard™ technology without any prior field experience and could only speculate about its performance.

To help speed up the learning process, several projects were started and continue today. This research focused on IPM issues that were not answered before Bollgard™ was released i.e., influence of Bollgard™ on insect pests, beneficial insects, scouting methods, economic thresholds, variety adaptation, and impact of supplemental insecticide applications on Bollgard™ yields.

The damage inflicted by the boll weevil in the last five years forced many producers to switch to other crops in 1996. Sorghum and corn replaced cotton on thousands of acres across Southwest Oklahoma. This large tract of sorghum and corn enhanced bollworm development in June resulting in the heaviest July moth flight in cotton in 15 years (Karner, 1996). Producers and consultants spent many a restless night in July resisting the urge to spray eggs and 1st instar larvae in Bollgard™ fields. Bollgard™ performed as advertised with no fields requiring insecticidal control for bollworms. Constant bollworm pressure and rumors of Bollgard™ failures for part of the Cotton belt kept producers and consultants on "edge". Their attention focused on flowers and bolls to detect bollworms trying to prevent a similar horror in their fields. As bollworm numbers increased and damage became obvious, producers and consultants started to doubt Bollgard™ performance. Panic spraying spread as word of bollworm failures surfaced across in Oklahoma.

Economic thresholds changed throughout the season in an attempt to allow Bollgard™ a chance to regulate bollworm infestations but prevent economic loss. At the start of the season, the economic threshold for Bollgard™ cotton was:

> ***Spray only if 10 or more worms are found per 100 plants and are nearing 3/8 inch long***. If worms are less than 3/8 inch long, recheck field in 2 to 3 days to see if worms are killed by consuming the ***Bollgard™ gene.***

By August, the threshold had been amended to reflect the discovery of larvae surviving in flowers.

> In addition to the above mentioned threshold, producers were urged ***to consider spraying when 8 or more larvae ¼ inch or larger were found in 100 flowers pulled at random*** (like sampling for boll weevils).

Neither of these thresholds were ever reached or exceeded in research or extension demonstration plots of Bollgard™ cotton during 1996, 1997, 1998, or 1999. In fact, no larvae greater ¼ inch has ever been found alive in tagged studies conducted annually since 1996.

Oklahoma cotton producers planted approximately 30,000 acres of Bollgard™ cotton varieties, but stormy weather in June reduced the acreage to less than 11,772 acres or 14.72% of the irrigated acres planted in 1996. Producers agreed that Bollgard™ cotton produced as good or better yields than conventional varieties regardless of its insect management scheme. However the extra cost for seed, rental, and other

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1289-1293 (2000)
National Cotton Council, Memphis TN

contract requirements reduced the acres planted to Bollgard™ cotton in 1997 (7,100 acres) and 1998 (8,052 acres). Most producers switching back to conventional varieties stated they did not see a reduction in the number of insecticide sprays in Bollgard™ cotton fields. Adoption of Bollgard™ technology into current cotton IPM practices was slow until resistant bollworm/ tobacco budworm and beet armyworm problems surfaced during the 1998 growing season.

In Oklahoma,1998 will be remembered as the year of the worm. Intense pressure from Heliothines and beet armyworms throughout the summer caused insecticide inputs to skyrocket. Not to be outdone, boll weevil and cotton aphid infestations caused the 1998 crop to be the most expensive since 1982. It was easy to spot producers that invested in Bollgard™ technology in 1998 by the smiles on their faces in September. Bollgard™ varieties (as a group) offer the greatest yield potential compared to conventional varieties with less insect control input (including the rental fee). Finally Oklahoma producers saw the benefits of Bollgard™ cotton and realized the need for this technology as they enter into the first, full year of boll weevil eradication. This renewed confidence and support of the Bollgard™ technology in 1998 was reflected by the jump in planted acres in 1999. A total of 49,656 acres were planted and this upward trend should continue as more stripper varieties hit the market in the future.

Cotton consultants across Oklahoma were mailed a survey to get their opinion on Bollgard™ and its impact on their business (Table 1a, 1b, & 1c). In 1996, consultants threatened to raise their fees because of the number of repeated visits required to monitor bollworm development on Bollgard™ cotton. Much of their apprehensiveness centered around proper scouting techniques to locate larval survivors within the plant and lack of confidence to trust a unproven technology. This skepticism was expected since most consultants tend to modify worm thresholds during bloom and time insecticide applications to coincide with egg hatch. However survey results show consultants adapted quickly learning that some fruit damage did not reduce yields as expected. This attitude is reflected in personal thresholds and insecticide usage used for Bollgard™ cotton. Eighty percent of the consultants triggered insecticide protection on worm counts only and all surveyed agreed amount of fruit damage also influences spray decisions. Bollgard™ cotton insecticide usage was less than conventional cotton saving between 2.3 applications in 1999 to 6.5 applications in 1998.

To help determine the impact of Bollgard™ economically on Oklahoma's cotton industry, budgets and cost analysis was prepared for each year (Table 2a, 2b, 2c, 2d, & 2e). This information is based on four years of replicated data collected from 51 irrigated cotton trials. These comparisons lumped varieties into two groups (Bollgard™ and conventional) regardless of maturity, variety type, or spray regime. Regardless of the management scheme or insect pressure, Bollgard™ cotton was the best yielder and increased profits (return per acre) for all four years. The Bollgard™ profit margin varied between $40.06 per acre in 1999 to $83.53 per acre in 1996. This research indicates the value of investing in Bollgard™ technology throughout these 4 years was $37.57 per acre or $ 2,877,110 dollars (Bollgard™ acreage = 76,580 acres for 4 years).

Bollgard ™ cotton's popularity continues to grow and its future looks bright in Oklahoma. Introduction of stripper varieties and basing rental fees on seeding rate makes it enticing and affordable for dryland production. With its increased popularity, cotton producers must follow and adhere to Monasanto's Bollgard™ resistance management guidelines. Bollgard™ technology will play an integral part of the IPM program after eradication of the boll weevil in Oklahoma.

References

Karner, M.A., J.R. Goodson, and A.L. Hutson. 1997. Growing Pains Associated with Adoption of Bollgard Technology into Standard IPM Practices in Oklahoma. Proc of Beltwide Conf. 1271 – 1277.

Acknowledgements

This research was funded by Cotton Incorporated State Support Funds. We appreciated the help and support by Dr. Pat O'Leary and all the cotton producers of Oklahoma.

Table 1a. Cotton consultants' survey results – cotton insect pests 1996 – 1999.

Conventional Cotton	Bollgard™ Cotton
List in order of importance	
1996	
Boll weevil	
Bollworm	
Cotton Aphid	
1997	
Boll weevill	Boll weevil
Bollworm	Bollworm
Cotton Aphid	Cotton Aphid
1998	
Beet armyworm	Beet armyworm
Bollworms	Boll weevil
Boll weevil	Cotton Aphid
1999	
Bollworm	Cotton Fleahopper
Cotton Fleahopper	Beet armyworm
Beet armyworm	Bollworm

Table 1b. Cotton consultants' survey results – comparison of insecticide usage 1996 - 1999.

Total Insecticide Applications Number of applications for each Insects			
Conventional Cotton		**Bollgard™ Cotton**	
1996			
Total 11.5			
Pest	**(appl #)**		
Boll weevil	5.5		na
Bollworm	3.0		na
Cotton Aphid	1.5		na
Cotton Fleahopper	1.5		na
1997			
Total 10.5		**Total 8.0**	
Pest	**(appl #)**		**(appl #)**
Boll weevil	5.0		4.0
Bollworm	3.5		1.0
Cotton Aphid	1.0		2.0
Beet armyworm	1.0		1.0
1998			
Total 12.5		**Total 6.0**	
Pest	**(appl #)**		**(appl #)**
Boll weevil	4.0		2.0
Bollworm	3.0		0.0
Beet armyworm	2.5		1.0
Cotton Aphid	1.0		1.0
Cotton Fleahopper	2.5		2.0
1999			
Total 5.8		**Total 3.5**	
Pest	**(appl #)**		**(appl #)**
Boll weevil	1.0		1.0
Bollworm	1.5		0.0
Cotton Fleahopper	2.3		1.5
Cotton Aphid	1.0		1.0
Thrips	0.0		1.0

Table 1c. Cotton consultants' survey results – action thresholds, impact on business and value to clients.

List parameters used to trigger bollworm protection for Bollgard™ cotton

- All consultants responding agreed that Bollgard™ cotton required different thresholds than those used for conventional cotton.
- TWENTY PERCENT of the consultants triggered sprays based on eggs (25 or more/100 terminals) and worms (5 or more/100 terminals)
- EIGHTY PERCENT of the consultants triggered spray based solely on worms (8 or more/100 terminals)
- ALL RESPONDENTS indicated that spray decisions arebase on ¼ to ½ inch larvae and amount of fruit damage influences their opinion greatly

Why do your producers grow Bollgard™ cotton?

Rank 1= most important, to 4 least important)

Reduced insecticide usage	1.3
Increased profits	2.3
Reduced inputs	3.3
Increased yields	3.3

Has consulting Bollgard™ cotton made your job easier or harder?

- SIXTY SIX PERCENT of the consultants responded easier
- SEVENTEEN PERCENT of the consultants responded harder and
- SEVENTEEN PERCENT of the consultants said it was not a factor and had no opinion

Table 2a. Cotton budget and analysis – 1996.

Return		Bollgard™		Conventional
Cotton	775 lbs	$465.00	572 lbs	$343.20
Operating Inputs				
Seed	14lbs @ .70	$ 9.80		$9.80
Bt Cost		32.00		---
Hoeing		15.00		15.00
Herbicide		6.40		6.40
Nitrogen		16.00		16.00
Phosphorous		5.40		5.40
Ginning		23.25		17.16
Spraying		34.70		53.45
Crop Insurance		18.00		18.00
Custom Harvest		69.75		51.48
Labor		22.75		22.75
Fuel, Lube & Repair		22.00		22.00
Irrigation		40.00		40.00
Operating Interest		10.20		9.54
Total Operating Cost		$325.25		$286.98
Return to Land, Overhead, Risk & Management		$139.75		$56.22
			$83.53	

[1] Based on 5 replicated tests

[2] Average spraying .80/acre for Bollgard™ and 2.30/acre for conventional bollworm and 3.80 sprays/acre for other sprays on Bollgard™ and 3.80 sprays/acre for conventional. Bollworm cost @ $12.50/spray and other sprays @ $6.50.

Table 2b. Cotton budget and analysis – 1997.

Return		Bollgard™		Conventional
Cotton	1,473 lbs	$883.80	1,350 lbs	$810.00
Operating Inputs				
Seed	14lbs @ .70	$ 9.80		$9.80
Bt Cost		32.00		---
Hoeing		15.00		15.00
Herbicide		6.40		6.40
Nitrogen		16.00		16.00
Phosphorous		5.40		5.40
Ginning		44.19		40.51
Spraying		20.81		20.81
Crop Insurance		18.00		18.00
Custom Harvest		132.57		121.51
Labor		22.75		22.75
Fuel, Lube & Repair		22.00		22.00
Irrigation		40.00		40.00
Operating Interest		5.51		7.91
Total Operating Cost		$394.43		$346.08
Return to Land, Overhead, Risk & Management		$489.37		$442.92
			$46.45	

[1] Based on 16 replicated tests

[2] Average spraying .625/acre for Bollgard™ and .625/acre for conventional bollworm and 2.0 sprays/acre for other sprays on Bollgard™ and 2.0 sprays/acre for conventional. Bollworm cost @ $12.50/spray and other sprays @ $6.50.

Table 2c. Cotton budget and analysis – 1998.

Return		Bollgard™		Conventional
Cotton	1,050 lbs	$630.00	859 lbs	$515.40
Operating Inputs				
Seed	14lbs @ .70	$ 9.80		$9.80
Bt Cost		32.00		---
Hoeing		15.00		15.00
Herbicide		6.40		6.40
Nitrogen		16.00		16.00
Phosphorous		5.40		5.40
Ginning		31.50		27.77
Spraying		22.74		28.40
Crop Insurance		18.00		18.00
Custom Harvest		94.50		77.31
Labor		22.75		22.75
Fuel, Lube & Repair		22.00		22.00
Boll weevil Erdication		18.00		16.09
Irrigation		40.00		40.00
Operating Interest		9.60		8.29
Total Operating Cost		$363.69		$313.21
Return to Land, Overhead, Risk & Management		$266.31		$202.19
			$64.12	

[1] Based on 12 replicated tests

[2] Average spraying .17/acre for Bollgard™ and .67/acre for conventional bollworm and 3.17 sprays/acre for other sprays on Bollgard™ and 3.08 sprays/acre for conventional. Bollworm cost @ $12.50/spray and other sprays @ $6.50.

Table 2d. Cotton budget and analysis – 1999.

Return		Bollgard™		Conventional
Cotton	969 lbs	$484.50	814 lbs	$407.00
Operating Inputs				
Seed	14lbs @ .70	$ 9.80		$9.80
Bt Cost		16.47		---
Hoeing		15.00		15.00
Herbicide		6.40		6.40
Nitrogen		16.00		16.00
Phosphorous		5.40		5.40
Ginning		29.07		24.42
Spraying		14.75		14.75
Crop Insurance		18.00		18.00
Custom Harvest		87.21		73.26
Labor		22.75		22.75
Fuel, Lube & Repair		22.00		22.00
Boll weevil Eradication		17.19		15.64
Irrigation		40.00		40.00
Operating Interest		8.43		7.61
Total Operating Cost		$328.47		$291.03
Return to Land, Overhead, Risk & Management		$156.03		$115.97
			$40.06	

[1] Based on 14 replicated tests

[2] Average spraying .14/acre for Bollgard™ and .14/acre for conventional bollworm and 2.0 sprays/acre for other sprays on Bollgard™ and 2.0 sprays/acre for conventional. Bollworm cost @ $12.50/spray and other sprays @ $6.50.

Table 2e. Cotton budget and analysis – 1996 - 1999.

Return		Bollgard™		Conventional
Cotton	1,038 lbs	$596.85	899 lbs	$516.93
Operating Inputs				
Seed	14lbs @ .70	$ 9.80		$9.80
Bt Cost		28.12		---
Hoeing		15.00		15.00
Herbicide		6.40		6.40
Nitrogen		16.00		16.00
Phosphorous		5.40		5.40
Ginning		31.14		26.97
Spraying		22.28		27.28
Crop Insurance		18.00		18.00
Custom Harvest		93.42		80.91
Labor		22.75		22.75
Fuel, Lube & Repair		22.00		22.00
Boll weevil Eradication		17.88		16.49
Irrigation		40.00		40.00
Operating Interest		9.39		8.23
Total Operating Cost		$357.58		$315.23
Return to Land, Overhead, Risk & Management		$239.27		$201.70
			$37.57	

[1] Based on 4 years of replicated data for 52 trials.

[2] Average spraying .42/acre for Bollgard™ and .83/acre for conventional bollworm and 2.62 sprays/acre for other sprays on Bollgard™ and 2.60 sprays/acre for conventional. Bollworm cost @ $12.50/spray and other sprays @ $6.50.