ECONOMIC ANALYSIS OF THE EXPIRATION OF SINGLE-GENE BOLLGARD® TECHNOLOGY ON GEORGIA COTTON FARMS AND GINS

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Cotton is Georgia's number one row crop in acreage and farm income. Georgia ranks second in the US in cotton acres planted and typically 3rd in total cotton production. In 2007, Georgia accounted for 9.5% of US acres harvested and 8.7% of US production. In 2007, Georgia and US cotton acres decreased due to high prices and relatively high net returns from corn and soybeans but cotton still remains the state's largest crop in acreage and value by a significant margin.

Georgia farmers planted 1.03 million acres of cotton in 2007. Cotton acres reached a high of 1.5 million acres in 1995 and again in 2000. The 2007 Georgia crop is valued at approximately $500 million (lint and cottonseed).

Situation

Almost 100% of Georgia's cotton acreage is planted to transgenic varieties (seed that produces plants that are insect and/or herbicide resistant). Over 92% of Georgia acres are planted to single-gene Bollgard® varieties. Newer two-gene Bt varieties (Bollgard II® and Widestrike®) have not yet gained widespread acceptance.

Of the over 92% of Georgia acres planted to single-gene Bollgard (referred to in this analysis as "B1") varieties, this acreage is almost exclusively Delta and Pine Land (DPL) varieties (Table 1). Over 83% of the state's cotton acreage is planted to one variety-- DPL555BR. DPL555BR has proven to be a consistent high-yielding variety in University of Georgia Official Variety Trials (OVT's) and in practice on the farm.

Given the wide array of available cotton technologies (as illustrated in Table 1), University of Georgia research has shown that the most significant factors in profitability are yield and choice of variety within a technology. Research has shown that while there are differences in inputs and production costs among technologies, such differences in costs are relatively small and thus may be easily offset by difference in yield per acre. Georgia cotton farmers find both profitability and convenience in using transgenic technologies.

The registration on single-gene Bollgard technology (B1) will expire September 30, 2009. Available seed stocks will be phased out but use of carryover seed will be allowed in 2010. Monsanto will not pursue re-registration of the B1 technology and will transition to Bollgard II (B2) technologies for insect resistant management purposes.

Without B1 technology, cotton producers will plant non-B1 varieties. Non-B1 technologies would include B2, Widestrike (W), conventional or non-transgenic, or other varieties with herbicide resistance but without insect resistance traits such as Roundup Ready®, Roundup Ready Flex®, and Liberty Link®. The economic implications of such a change will depend on differences in lint yield per acre, differences in gin turn-out (T/O) as this impacts cottonseed yield, differences in seed and technology fees, and differences in production practices and other production costs if applicable.

Economic Factors

Yield Considerations

In University of Georgia Official Variety Trials (OVT's) at 4 irrigated locations from 2004 to 2007, the top-yielding non-B1 varieties averaged 13.1% less than DPL555BR and 7% less than other B1 varieties (Table 2). The top yielding B2 varieties averaged 15.3% less than DPL555BR and 9% less than other B1 varieties.

In non-irrigated OVT's at 3 locations (Table 3), the top-yielding non-B1 varieties averaged 5.2% less than DPL555BR and 4.3% less than other B1 varieties. The top yielding B2 varieties averaged 7.4% less than DPL555BR and 6.6% less than other B1 varieties.

DPL555BR is a full-season, late maturity variety. Because DPL555BR comprises the majority of acres in the state, the OVT results used for this analysis were for full-season, later maturing varieties only. Some Widestrike® varieties were included in these OVT's but others were in separate early-mid season tests and thus not considered in this analysis.

Georgia cotton yields have improved due to higher yielding varieties like DPL555BR, improved management of newer varieties, improved control of pests such as stink bugs, and favorable harvest conditions. For the 5 years 2003 to 2007, the "Olympic average yield" per acre harvested was 800 lbs per acre (dropping the high and low years and averaging the remaining 3 years) and the Olympic average yield per acre planted was 783 lbs per acre.

It is estimated that approximately 40% of Georgia's cotton production is irrigated (based on an average of UGA and Farm Service Agency estimates). Assuming irrigated yield has averaged 1,000 lbs per acre (which would be considered low on some farms), to achieve the state average yield of 800 pounds per acre, the average non-irrigated yield would be estimated at 667 lbs per acre.

Assuming 1,000 lbs per acre irrigated weighted average yield for B1 varieties, the estimated average yield for DPL555BR (83.6% of state acres and 90.5% of B1 acres) would be 1,007 lbs per acre and other B1 varieties (8.8% of state acres and 9.6% of B1 acres) would be 937 lbs per acre—7% less than DPL555BR yield.

Likewise, assuming 667 lbs per acre non-irrigated weighted average yield for B1 varieties, the estimated average yield for DPL555BR would be 668 lbs per acre and other B1 varieties would be 662 lbs per acre—1% less than DPL555BR yield.

Cottonseed and Gin Turn-Out

Gin turn-out (T/O) is the ratio of lbs of lint after ginning to lbs of seed cotton (picked cotton in the module or trailer) prior to ginning expressed as a percentage. Seed cotton includes not only lint but also seed, trash, and moisture. A T/O of 40%, for example, would mean that for every 1000 lbs of seed cotton there were 400 lbs of lint after ginning and 600 lbs of seed, trash, and moisture removed at ginning.

The lower the T/O, the higher the seed weight per lb of lint assuming no difference in trash and moisture content. Conversely, the higher the T/O the lower the seed weight per pound of lint. DPL555BR is known to have a high gin turn-out compared to other varieties due in-part to its relatively small seed size.

In the irrigated OVT's, the T/O for DPL555BR averaged 43.53% and T/O of other B1 varieties averaged 42.8%. This compares to 41.65% for non-B1 varieties and 40.4% for B2 varieties (Table 4). In the non-irrigated OVT's, the T/O for DPL555BR averaged 43.55% and T/O of other B1 varieties averaged 42.8%. This compares to 42.13% for non-B1 varieties and 41.5% for B2 varieties (Table 5).

Cotton producers depend on income from cottonseed to help offset the cost of ginning, warehousing, classing, and promotion fees. Total income from cotton production includes both lint and seed—the value of seed being used to offset these charges. For this analysis, the impact of change in seed technology includes change in cottonseed production in addition to lint yield.

The total effect of a change in yield on the farmer's income must also consider any change in cottonseed production due to a change in lint yield and/or T/O. An income loss associated with less lint yield, for example, could be offset slightly by any difference (increase) in seed weight and value due to a lower T/O. If the difference in lint yield is high (if the yield of another variety/technology is significantly lower, for example) a lower T/O (higher seed weight per pound of lint) may still also result in a loss of cottonseed weight and value.

Seed Cost and Technology Fees

For 2008, the suggested retail price for Deltapine (DPL) seed is $125.95 or $121.95 per 250,000-seed bag depending on the variety. DPL555BR is $125.95 per bag. Deltapine varieties comprise over 93% of cotton acres in Georgia. Therefore, for the purpose of this analysis, the cost of seed from other manufacturers was not considered.

Technology fees are in addition to the cost of seed. For BR (Bollgard with Roundup Ready) varieties with 250,000 seed per bag, the technology fee for 2008 is $291.70 per bag. The total cost for DPL555BR would be $417.65 per bag.

For Bollgard II technology (B2), the fee is $333.30 per bag if B2R and $381.00 per bag if B2RF. At present, very little B2 cotton is grown in Georgia (only .25%, see Table 1) but the acreage that is planted is packaged with Roundup-Ready Flex (RF) or Liberty Link (LL) technology.

Therefore, for the purpose of this analysis, it is assumed that all B1 acres upon loss of B1 seed availability would be planted to B2RF technology.

Other Costs and Considerations

For the purpose of this analysis, it is assumed there are no changes in production practices and other inputs such as insecticide sprays, herbicide sprays, plant growth regulator (PGR), defoliation, fertilizer, etc.

It is also assumed that harvesting costs do not change with a change in yield. Theoretically, if change in seed technology resulted in lower yield this could result in a slight savings in machinery and labor costs. But harvesting would be done at essentially the same rate or at the very least, any savings would not be directly proportional to yield. Therefore, for the purpose of this study no change in harvesting cost is assumed.

Results

Economic Loss On Cotton Farms

This analysis assumes 1.0 million acres of Georgia cotton of which 92.4% is B1 technology (83.6% DPL555BR and 8.8% other B1). Thus, 924,000 acres are used for the analysis and it is assumed that 40% is irrigated (369,600 acres) and 60% non-irrigated (554,400 acres).

The weighted average yield for all B1 irrigated cotton is assumed to be 1,000 lbs per acre. Using the percentage yield differences from UGA OVT's, the yield for DPL555BR is assumed to be 1,007 lbs per acre and the yield for all other B1 varieties 937 lbs per acre (7% less). The yield for B2 varieties is assumed to be 856 lbs per acre (15% less).

The weighted average yield for all B1 non-irrigated cotton is assumed to be 667 lbs per acre. Using the percentage yield differences from UGA OVT's, the yield for DPL555BR is assumed to be 668 lbs per acre and the yield for all other B1 varieties 661 lbs per acre (1% less). The yield for B2 varieties is assumed to be 618 lbs per acre (7.5% less).

The loss in the farmer's net income due to elimination of B1 technology is estimated at $59.44 million. This is considered to be a conservative estimate due to the assumptions used for this analysis.

Cotton was valued at 70 cents per pound and cottonseed at $150 per ton. At this price for cotton, there would be no Loan Deficiency Payment to consider. DCP (Direct and Countercyclical Payment) program payments are made on base acres and thus do not need to be considered. Ginning and warehouse charges are assumed to be 10.5 cents per pound which includes 8.5 cents for ginning and 2.0 cents (approximately $10 per bale) for warehousing and storage. Classing and state and national boards/promotions are assumed to be 1.0 cents per pound or approximately $5 per bale.

For this analysis, the net change in farm income due to the elimination of single-gene Bollgard technology (B1) was calculated as:

Change in the value of lint production + Change in the cost of ginning, warehousing, classing, and marketing + Change in the value of cottonseed production + Change in the cost of seed and technology fees. Cottonseed production was calculated using the gin T/O from UGA OVT's and assuming 10% of the seedcotton weight removed during ginning as trash, motes, moisture, etc.

Net Loss in farm income on 369,600 irrigated acres is estimated at $36.55 million or approximately $98.89 per acre (Table 6). Cotton production would decline by 111,136 bales for a loss in value of $37.34 million at 70 cents per pound. Lower yield would reduce ginning and warehouse charges resulting in a savings of $6.13 million but lower cottonseed production would result in a net savings on ginning of only $5.58 million. Seed and technology cost would increase by $4.79 million or $12.95 per acre ($89.30 per bag and 6.9 acres per bag). Lower lint income, minus the net savings on ginning charges, plus increased seed and technology costs result in a net farm income loss of $36.55 million on irrigated acres.

Net Loss in farm income on 554,400 non-irrigated acres is estimated at $22.89 million or approximately $41.29 per acre (Table 7). Cotton production would decline by 56,980 bales for a value of $19.15 million at 70 cents per pound. Lower yield would reduce ginning and warehouse charges resulting in a savings of $3.15 million. Although yield would decline, cottonseed weight would actually increase resulting in a total net savings on ginning of $3.44 million. Seed and technology cost would increase by $7.18 million or $12.95 per acre ($89.30 per bag and 6.9 acres per bag. Lower lint income, minus the net savings on ginning charges, plus increased seed and technology costs result in a net farm income loss of $22.89 million on non-irrigated acres.

Economic Loss to Gins

Savings to the cotton producer in ginning, warehouse, and storage charges due to less lint production represents an income loss to the cotton gin. Cotton production is

estimated to decline 168,116 480-lb bales or 80.696 million pounds. At the 10.5 cents per pound assumed for ginning and warehouse/storage charges, this would be an income loss of approximately $8.47 million to Georgia cotton gins—approximately $134,000 annually on average per gin. This is a very conservative estimate since this assumes only 1 month of storage per bale.

If less cottonseed is produced, the gin also loses income on the "margin" when cottonseed from the farmer is later sold to an oil mill, for livestock feed, etc. On balance between irrigated and non-irrigated production and yield differences, cottonseed production is estimated to decline by 1,749 tons. Assuming $20 per ton average margin between the farmer price and mill/feed price, cottonseed margin would decline by a relatively small amount-- $34,980.

Losses in ginning, warehouse, storage, and cottonseed income is estimated to total $8.51 million.

Producers also pay classing fees and state and national boards/promotions. These fees total an estimated $5 per bale or an additional 1 cent per pound. This loss is not shown in the analysis but would total approximately $807,000.

Other Factors

Acreage Considerations

This analysis does not consider the income impacts of changes in acreage—acreage that could potentially shift out of cotton and into other crops due to the loss of B1 technology and change in income. US and Georgia cotton acreage has already declined due to competition with high-priced corn and soybeans. Loss in income due to yield differences when losing B1 technology could further reduce cotton's competitiveness.

When acres shift among crops, there is a multiplier effect on local economies and the state economy. Income impacts at the farm level and changes in production and inputs used have impact on input suppliers and infrastructure supporting production, processing, and marketing. Should the loss of B1 technology result in additional shift of acres out of cotton and into other crops, there would be a multiplier effect associated with that change in addition to the multiplier effect of the income loss estimated in this analysis.

While cotton producers have the flexibility of responding to economic signals and planting other crops if profitable, the cotton gin is only in the business of ginning cotton. The economic impacts of acreage and yield change are severely felt by gins.

Development of Higher Yielding Varieties

Currently there are no consistently high-yielding substitutes for DPL555BR on Georgia cotton farms. Non-B1 technologies including Bollgard II and Widestrike are currently available but not yet widely accepted and planted in Georgia. Widestrike varieties were planted on 2.3% of Georgia acres in 2007 and Bollgard II varieties on .25% of acres. This analysis assumed B1 acres would be planted to B2RF varieties.

The impact of the loss of B1 technology depends largely on differences in yield and production costs—specifically the seed cost and technology fee associated with non-B1 varieties. This analysis is based on comparative yields of currently available varieties and technologies. The eventual impacts of the elimination of B1 technology can be minimized by improved yield in available non-B1 varieties. Impact may also be minimized by reduced difference in seed and technology cost or savings in other production costs.

Summary

Assuming 1 million acres of Georgia cotton, 40% irrigated and 60% non-irrigated, and approximately 92.4% of acres in B1 varieties (83.6% in DPL555BR)—farm income loss is estimated to be $59.44 million. This further assumes that acres in B1 varieties would be planted in B2RF upon expiration of the B1 registration.

Income losses at the gin level due to lower cotton lint yield would include less income from ginning and warehouse/storage fees and less income on the resale margin for cottonseed. Gin losses are estimated at $8.51 million.

Total loss is estimated at $67.95 million (Table 8). This excludes multiplier effects and other losses not considered.

The cotton industry must move to two-gene technology in an effort to manage pest resistance. Technologies such as Bollgard II and Widestrike offer alternatives to single-gene technology. Varieties with these technologies, however, have not to-date consistently yielded as high as DPL555BR and other B1 varieties. DPL555BR comprised 83.6% of Georgia cotton acres planted in 2007.

UGA research has shown that yield and choice of variety within a technology are more important to profit than the technology itself. As the industry and state adjusts to the elimination of B1 technology, the eventual impact on farmer income and gins will depend on the yield potential of varieties available in 2010 and beyond and the seed and technology costs and production practices associated with those varieties.

The impact of the loss of B1 technology on Georgia farms could be minimized by a longer period of transition while newer/higher yielding varieties are developed to replace DPL555BR and/or lower seed cost and technology fees on two-gene varieties.

Table 1. Percent of Georgia Acreage Planted in 2007, By Variety and Technology Type

	Variety					
Technology	**Fibermax**	**DPL**	**Phytogen**	**Stoneville**	**Others**	**Total**
Conventional	0.10	0.52				0.62
RR	0.86	1.50				2.36
RF		0.11		0.10		0.21
B		0.07				0.07
BR [1]	1.01	90.85		0.43		92.29
B2R						0.00
B2RF		0.15				0.15
LL	0.07					0.07
B2LL	0.10					0.10
WR			2.30			2.30
Not Specified	0.05	0.02	0.06	0.01	1.69	1.83
TOTAL	**2.19**	**93.22**	**2.36**	**0.54**	1.69	**100.00**

SOURCE: USDA-AMS
[1]83.58% DPL555BR

Table 2. Yield Per Acre, UGA OVT, Irrigated, 4 Locations [1]

	2004	**2005**	**2006**	**2007**	**Average**
DPL555BR	1,687	1,613	2,105	1,825	1,808
Other B1 Varieties [2]	1,611	1,652	1,786	1,689	1,685
Non-B1 Varieties [3]	1,569	1,474	1,685	1,556	1,571
Top B2 Varieties [4]	1,538	1,458	1,619	1,512	1,532
Yield vs. 555					
Other B1	-76	+39	-319	-136	-123
Non-B1	-118	-139	-420	-269	-237
Top B2	-149	-155	-486	-313	-276
Difference vs. 555					
Other B1					-6.8%
Non-B1					-13.1%
Top B2					-15.3%
Difference vs. Other B1					
Non-B1					-6.8%
Top B2					-9.1%

1/ Tifton, Midville, Plains, and Bainbridge.
2/ Top 5 yielding other single-gene varieties. Excludes experimental cultivars.
3/ Top 5 yielding B2, non-Bt (conventional, RR, RF) and Widestrike. Excludes experimental cultivars.
4/ Average of all B2's if in "Non-B1" or the single top B2 if not in top-5 Non-B1. Excludes experimental cultivars.

Table 3. Yield Per Acre, UGA OVT, Non-Irrigated, 3 Locations [1]

	2004	2005	2006	2007	Average
DPL555BR	1,120	1,438	1,329	906	1,198
Other B1 Varieties [2]	1,030	1,541	1,217	961	1,187
Non-B1 Varieties [3]	1,011	1,443	1,150	938	1,136
Top B2 Varieties [4]	936	1,428	1,107	965	1,109
Yield vs. 555					
Other B1	-90	+103	-112	+55	-11
Non-B1	-109	+5	-179	+32	-63
Top B2	-184	-10	-222	+59	-89
Difference vs. 555					
Other B1					-0.9%
Non-B1					-5.2%
Top B2					-7.4%
Difference vs. Other B1					
Non-B1					-4.3%
Top B2					-6.6%

1/ Tifton, Midville, and Plains. Excludes Athens--DPL555BR not adapted for that location.
2/ Top 5 yielding other single-gene varieties. Excludes experimental cultivars.
3/ Top 5 yielding B2, non-B1 (conventional, RR, RF) and Widestrike. Excludes experimental cultivars.
4/ Average of all B2's in "Non-B1" or the single top B2 if not in top-5 Non-B1. Excludes experimental cultivars.

Table 4. Gin Turnout (Lint Lbs as a Percent of Seed Cotton), 4 Locations, Irrigated [1]

	2004	2005	2006	2007	Average
DPL555BR	43.60	42.50	43.5	44.50	43.53
Other B1 Varieties [2]	42.52	40.80	43.3	44.50	42.78
Non-B1 Varieties [3]	42.70	39.60	41.5	42.78	41.65
Top B2 Varieties [4]	40.90	39.13	39.63	41.90	40.39
Gin T/O vs. 555					
Other B1	-1.08	-1.70	-0.20	0.00	-0.75
Non-B1	-0.90	-2.90	-2.00	-1.72	-1.88
Top B2	-2.70	-3.37	-3.87	-2.60	-3.13

1/ Tifton, Midville, Plains, and Bainbridge.
2/ Top 5 yielding other single-gene varieties. Excludes experimental cultivars.
3/ Top 5 yielding B2, non-B1 (conventional, RR, RF) and Widestrike. Excludes experimental cultivars.
4/ Average of all B2's in "Non-B1" or the single top B2 if not in top-5 Non-B1. Excludes experimental cultivars.

Table 5. Gin Turnout (Lint Lbs as a Percent of Seed Cotton), 3 Locations, Non-Irrigated [1]

	2004	2005	2006	2007	Average
DPL555BR	43.50	42.00	44.40	44.30	43.55
Other B1 Varieties [2]	41.95	41.24	43.72	44.30	42.80
Non-B1 Varieties [3]	41.78	40.60	41.98	44.14	42.13
Top B2 Varieties [4]	40.90	39.70	41.00	44.40	41.50
Gin T/O vs. 555					
Other B1	-1.55	-0.76	-0.68	0.00	-0.75
Non-B1	-1.72	-1.40	-2.42	-0.16	-1.43
Top B2	-2.60	-2.30	-3.40	0.10	-2.05

1/ Tifton, Midville, and Plains. Excludes Athens-- DPL555BR not adapted for that location.
2/ Top 5 yielding other single-gene varieties. Excludes experimental cultivars.
3/ Top 5 yielding B2, non-B1 (conventional, RR, RF) and Widestrike. Excludes experimental cultivars.
4/ Average of all B2's in "Non-B1" or the single top B2 if not in top-5 Non-B1. Excludes experimental cultivars.

Table 6. Irrigated Acres, Estimated Change in Farm Income Due to Loss of Single-Gene Technology [1]

	Acres Currently Planted To		If Acres Planted To	Difference
	DPL555BR	Other B1	B2	
Irrigated Acres (40% of State)	334,400 (83.6%)	35,200 (8.8%)	369,600	
Assumed Yield	1,007	937 (7% Less)	856 (15% Less)	
Production (480-lb bales)	701,543	68,713	659,120	-111,136
Loss In Lint Income				$37.34 million
Ginning/Warehouse Fees Saved On Yield Difference				$6.13 million
Cottonseed Production	180,156 tons	18,140 tons	194,572 tons	-3,724 tons
Loss In Cottonseed Value				$558,600
Net Change (Savings) in Ginning [2]				$5.58 million
Increase In Seed and Tech Fees	$60.56/acre	$60.56/acre	$73.51/acre	$4.79 million
Net Income Change (Loss) [3]				**$36.55 million**
Loss Per Acre				**$98.89**

1/ One million acres planted, 40% irrigated, 92.4% to single-gene Bollgard (B1). B2 acres assumed yield of 15% less than DPL555BR.
2/ Savings on ginning and warehouse charges minus loss in cottonseed income.
3/ Loss in lint income minus net savings in ginning and warehousing charges plus increase in seed cost and technology fees

Table 7. Non-Irrigated Acres, Estimated Change in Farm Income Due to Loss of Single-Gene Technology [1]

	Acres Currently Planted To		If Acres Planted To	Difference
	DPL555BR	Other B1	B2	
Non-Irrigated Acres (60% of State)	501,600 (83.6%)	52,800 (8.8%)	554,400	
Assumed Yield	668	661 (1% Less)	618 (7.5% Less)	
Production (480-lb bales)	698,060	72,710	713,790	-56,980
Loss In Lint Income				$19.15 million
Ginning/Warehouse Fees Saved On Yield Difference				$3.15 million
Cottonseed Production	179,262 tons	19,195 tons	200,432 tons	+1,975 tons
Increase In Cottonseed Value				$296,250
Net Change (Savings) in Ginning [2]				$3.44 million
Increase In Seed and Tech Fees	$60.56/acre	$60.56/acre	$73.51/acre	$7.18 million
Net Income Change (Loss) [3]				**$22.89 million**
Loss Per Acre				**$41.29**

1/ One million acres planted, 60% non-irrigated, 92.4% to single-gene Bollgard (B1). B2 acres assumed yield of 7.5% less than DPL555BR.
2/ Savings on ginning and warehouse charges plus increase in cottonseed income.
3/ Loss in lint income minus net savings in ginning and warehousing charges plus increase in seed cost and technology fees

Table 8. Summary of Farm and Gin Income Losses

	Dollars Loss
Farm Income Loss- Irrigated Acres	$36.55 million
Farm Income Loss- Non-Irrigated Acres	$22.89 million
Loss In Ginning, Warehouse, Storage, Cottonseed	$8.51 million
Total	**$67.95 million**