Quantification of the Impacts on US Agriculture of Biotechnology-Derived Crops Planted in 2005

Executive Summary

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Sujatha Sankula Ph.D

National Center for Food and Agricultural Policy
1616 P-street, NW
Washington, DC 20036
Phone: 202-328-5048
Fax: 202-328-5133
Email: ncfap@ncfap.org
Website: www.ncfap.org

Key Findings

The current report, an update to the 2005 released "Biotechnology-Derived Crops Planted in 2004 – Impacts on US Agriculture", confirms that American growers continued to choose biotechnology-derived crops in 2005, the tenth year of their commercial planting, because they realized significant benefits from planting these crops. This report evaluated the reasons behind the adoption of biotechnology-derived crops on 123 million acres in the United States in their tenth year of commercial planting (2005) and analyzed the producer and crop production impacts that resulted from this widespread adoption.

American growers planted eight biotechnology-derived crops (alfalfa, canola, corn, cotton, papaya, soybean, squash, and sweet corn) in 2005. Planted acreage was mainly concentrated in 13 different applications (herbicide-resistant alfalfa, canola, corn, cotton, and soybean; virus-resistant squash and papaya; three applications of insect-resistant corn, two applications of insect-resistant cotton, and insect-resistant sweet corn). Though the number of planted traits remained the same at three in 2005, similar to 2004, expanded acreage of 4 percent has led to overall increase in crop yield and farm income and further reduction in pesticide use.

Production and economic impacts

The planting of biotechnology-derived crops in 2005 has led to improved crop production of 8.3 billion pounds, lowered crop production costs of $1.4 billion dollars, and reduced pesticide use of 69.7 million pounds (Table 1). Increased revenue from higher yields and reduced production costs improved net returns to growers by $2.0 billion in 2005. Enhanced, season-long, and effective control of key pest problems translated to improved crop/pest management and yields thereby leading to the above-listed positive impacts. Compared with 2004, crop production improved by 26 percent and pesticide use reduced by an additional 12 percent in 2005. Net economic impact was slightly lower in 2005 compared with 2004 and was due to an increase in the adoption/technology fee cost for the herbicide-resistant crops (corn, cotton, and soybean) and lower selling prices for corn and cotton. In reality, it is not accurate to compare 2005 with 2004 in view of the significant year-to-year changes in pest management recommendations, pesticide prices, crop prices, production costs, and technology access costs. Furthermore, unlike the previous report, impacts were not analyzed in this report for Herculex I corn.

Table 1	**Overall impact on U.S. agriculture of biotechnology-derived crops**				
Year	**Planted acreage**	**Yield increase**	**Reduction in production costs**	**Net economic impact**	**Pesticide use reduction[1]**
	Million acres	Billion pounds	Billion dollars	Billion dollars	Million pounds
2005	123	8.34	1.4	2.0	69.7
2004	118	6.61	1.7	2.3	62.0
2003	106	5.34	1.5	1.9	46.4
2001	80	3.79	1.2	1.5	45.7

[1] Refers to active ingredients.

Pesticide use impacts
Herbicide-resistant crops accounted for 87 percent of the overall pesticide use reduction in 2005 while insect-resistant corn and cotton contributed for the rest. Whereas herbicide-resistant corn accounted for 31 percent of the overall reduction, herbicide-resistant soybean and cotton contributed 29 and 26 percent, respectively. About 13 percent reduction in pesticide use was due to insect-resistant crops. Altogether, the 10 applications of biotechnology-derived crops included in this report (glyphosate-resistant alfalfa, Herculex I corn, and Attribute sweet corn are not included in the analysis) reduced the use of pesticides in crop production by 69.7 million pounds. This represents a further 12 percent decrease in pesticide usage compared with 2004.

Crop impacts
Biotechnology-derived insect-resistant corn and cotton and virus-resistant papaya and squash have led to significant gains in crop production in 2005, similar to years before. Yield improvements were not noted with any of the herbicide-resistant crops as weed management efficacy in these crops is equivalent to that obtained in conventional crops and thus no impacts on crop production. Except for virus-resistant crops, all other crops contributed to reduced pesticide use in 2005. As in 2003 and 2004, yield improvement and pesticide use reduction was greatest in biotechnology-derived field corn while planting of soybean led to largest reduction in production costs and greatest net economic impact.

Biotechnology-derived varieties improved corn production by 7.6 billion pounds in 2005. Cotton ranked second in yield improvement, with an additional 671 million pounds produced due to biotechnology-derived varieties. Biotechnology-derived soybean reduced production costs by $1.17 billion, and therefore increased growers' net returns by the same amount. Overall reduction in pesticide use due to biotechnology-derived varieties was greatest in corn (28.5 million pounds) followed by soybean (20.5 million pounds) and cotton (20.0 million pounds).

State impacts
All the 42 states of the United States where biotechnology-derived crops were planted in 2005 reaped considerable benefits from planting these crops. In view of large acreage of corn and soybean, midwestern states of the United States experienced greater benefits in 2005, as in 2003 and 2004.

Crop production gains were greatest in Iowa (1.46 billion pounds) followed by Nebraska (0.99 billion pounds) and Minnesota (0.95 billion pounds). Estimates indicate that largest reduction in production costs and greatest net economic impact occurred in Minnesota ($179 million and $212 million, respectively). Planting of biotechnology-derived crops led to reduction in crop production costs of at least $100 million or more in four states (Minnesota, Illinois, Indiana, and Iowa) in 2005. While pesticide use reduction was greatest in Minnesota (8.5 million pounds), Illinois and Indiana ranked second and third, respectively, in the same category (7.7 and 7.3 million pounds, respectively). Overall, Minnesota received the largest returns from the planting of biotechnology-derived crops in 2005.

Study Background and Purpose

American growers planted biotechnology-derived crops on 123 million acres in 2005, a year which is considered remarkable in the history of agriculture and biotechnology, as it represented two significant milestones. First, it marked the first decade of the planting of biotechnology-derived crops. Second, it denoted the historic event of the planting of the cumulative first billionth acre to biotechnology-derived crops. American growers' confidence in biotechnology-derived crops, as reflected in surging adoption each year, is due to the positive impacts provided by these crops.

American growers planted 5 million more acres to biotechnology-derived crops in 2005 (123 million acres) compared to 2004 (118 million acres). Planted acreage of biotechnology-derived crops in 2005, as in 2004, was concentrated in three traits (herbicide-resistance, insect-resistance, and virus-resistance). However, with the commercial debut of herbicide-resistant alfalfa in 2005, the total number of biotechnology-derived crops planted in 2005 increased to eight (alfalfa, corn, canola, cotton, papaya, soybean, squash, sweet corn) from seven in 2004.

Three earlier reports by the National Center for Food and Agricultural Policy entitled "Plant Biotechnology: Current and Potential Impact for Improving Pest Management in US Agriculture", "Impact on US Agriculture of Biotechnology-Derived Crops Planted in 2003", and "Biotechnology-Derived Crops Planted in 2004 – Impacts on US Agriculture" documented clear-cut benefits to growers in terms of improved crop yields, reduced production costs, and reduced pesticide use due to the planting of biotechnology-derived crops. This study, a follow-up to the earlier one, analyzed the impacts (agronomic, economic, and environmental) on American growers and agriculture of biotechnology-derived crops planted in 2005.

Since the last study, the number of acres planted to biotechnology-derived varieties increased by 4 percent. Other noteworthy changes for 2005 crop season include the commercial debut of Roundup Ready alfalfa, Roundup Ready Flex cotton, and insect-resistant WideStrike cotton. Alfalfa is the first perennial crop that was approved for commercial planting in the United States. Roundup Ready Flex cotton is the second generation cotton which offers expanded window for over-the-top application of Roundup herbicide whereas WideStrike cotton provides enhanced control of worm pests such as cotton bollworm, tobacco budworm, beet armyworm, fall armyworm, soybean loopers, cabbage loopers, and pink bollworm.

The current study, therefore, focuses on calculating the impacts of these crops based on the changes in planted acreage and applications in 2005. Similar to the previous report, the current study identified and quantified impacts on production volume, production value, production costs and pesticide use. Impacts of biotechnology-derived crops on other production practices such as tillage also were included.

Changes in production volume were measured based on yield changes that have occurred when biotechnology-derived crops replaced conventional crops. Change in production

value was calculated based on the yield changes and crop prices. Changes in production costs were calculated by determining which current practices would be affected. Adoption costs associated with the use of the technology (either as technology/royalty fee or seed premium or both) were considered in the calculations. Finally, changes in pesticide use were quantified when the biotechnology-derived crop cultivar has replaced or substituted the current use of the target pesticides leading to either an increased or reduced usage. The impacts were calculated using the 2005 acreage and crop production data, for which the U.S. Department of Agriculture's National Agricultural Statistics Service served as a valuable resource.

University researchers and university extension crop specialists were surveyed to obtain first hand information on the existing pest management approaches in conventional crops and to help determine how biotechnology-derived crops replaced or substituted current practices. Updated estimates, contained within 10 case studies, were sent to relevant external reviewers for comment and their comments were integrated into the final report. In total, 19 agriculture, pest management, and plant biotechnology experts from 14 academic and government institutions reviewed the report.

The full report containing all 10 case studies can be accessed at www.ncfap.org/whatwedo

Adoption of Biotechnology-Derived Crops in 2005

Information on the adoption of biotechnology-derived crops planted in 2005 is presented in Table 2. Similar to years in the past, herbicide-resistant crops were planted on a large scale in 2005 compared with insect/virus-resistant crops. The rapid and widespread adoption of herbicide-resistant crops is mainly due to the enhanced flexibility and simplicity of weed management in these crops. The adoption of insect/virus-resistant crops varied each year based on the anticipated level of target pest infestation. Adoption of these crops, Bt crops in particular, will continue to increase in future, as new varieties such as VipCot cotton are commercialized and as more seed supplies are available for YieldGard Rootworm corn and WideStrike and Bollgard II cotton.

In 2005, adoption of herbicide-resistant canola was highest at 93 percent followed by herbicide-resistant soybean (88 percent), and herbicide-resistant cotton (80 percent). Increased adoption of biotechnology-derived canola in 2005 is attributed to the surging popularity of herbicide-resistant varieties and also the overall increase in planted canola acreage in North Dakota, the primary canola producing state in the United States. Percent change in planted acreage in 2005 is greatest for herbicide-resistant corn and is due to the European Unions' October 2004 approval of glyphosate-resistant corn for use in food products in addition to feed ingredients. Adoption of the new Bt varieties of corn (YieldGard RW) and cotton (Bollgard II), which were introduced in 2003, was still low in 2004, at 4 and 2 percent, respectively, due to limited seed supplies. Adoption of these new crop traits will increase significantly in the next few years once seed supply is abundant.

Table 2	Adoption of biotechnology-derived crops in the United States					
Case study	Crop	Trait	Percentage adoption			
			2005	2004	2003	2001
1	Papaya	Virus-resistant	55	56	46	37
2	Squash	Virus-resistant	12	10	3	17
3	Canola	Herbicide-resistant	93	75	75	70
4	Corn	Herbicide-resistant	35	18	14	8
5	Cotton	Herbicide-resistant	80	77	74	59
6	Soybean	Herbicide-resistant	88	85	82	69
7	Corn	Insect-resistant (IR-I)[a]	34	28	30	21
8	Corn	Insect-resistant (IR-II)[b]	4	2	0.5	-
9	Cotton	Insect-resistant (IR-III)[c]	55	51	46	42
10	Cotton	Insect-resistant (IR-IV)[d]	2	1	0.2	-

[a] European corn borer/southwestern corn borer/corn earworm-resistant corn (YieldGard Corn Borer).
[b] Rootworm-resistant corn (YieldGard RW).
[c] Bollworm and budworm-resistant cotton (Bollgard).
[d] Bollworm/budworm/looper/armyworm-resistant cotton (Bollgard II).

Results

American growers' confidence in biotechnology-derived crops, as reflected in the increased planting of these crops each year, is due to the positive benefits generated by these crops. Benefits were realized in the form of enhanced crop yields, improved insurance against pest problems, reduced pest management costs, decreased pesticide use, and overall increase in grower returns (Table 3). While control of key insect pests that resulted in increased yields and reduced insecticide use were the reasons for the success of Bt crops, simplicity and flexibility of weed management afforded by herbicide-resistant crops enhanced their adoption.

Similar to the preceding years, yield impacts in 2005 were greatest for insect-resistant crops, due to season-long protection from key pest problems. Economic impacts, on the other hand, were greatest from herbicide-resistant crops. Herbicide-resistant crops provided effective weed control with fewer herbicides and fewer applications. Costs associated with tillage and handweeding were reduced in crops such as cotton. All these impacts translated to reduced production costs and improved returns. Moreover, pesticide use in 2005 was 69.7 million pounds lower than it would have been without the use of biotechnology-derived crops.

Table 3	Impact of biotechnology-derived crops planted in 2005							
Case Study	**Crop**	**Trait[1]**	**Production**			**Total net value**	**Reduction in pesticide use**	**Acreage[2]**
			Volume Million lbs.	**Value** Million $	**Costs** Million $	Million $	Million lbs. ai[3]	Million acres
1	Papaya	VR	4.5	1.7	0.08	1.62	0	0.0013
2	Squash	VR	72.2	23.3	1.03	22.2	0	0.007
3	Canola	HR	0	0	-14.4	14.4	0.69	1.06
4	Corn	HR	0	0	-268.5	268.5	21.8	27.93
5	Cotton	HR	0	0	-38.7	38.7	17.8	11.13
6	Soybean	HR	0	0	-1,169	1,169	20.5	64.63
7	Corn	IR - I	6123.2	213.2	16.7	196.7	4.85	27.91
8	Corn	IR - II	1470	51.5	-3.1	55.0	1.82	3.51
9	Cotton	IR – III	630.0	270.9	37.0	233.9	1.95	7.78
10	Cotton	IR - IV	41.4	17.8	0.99	16.8	0.24	0.322
Total			**8,341.3**	**578.4**	**-1,438**	**2,017**	**69.7**	

[1]Trait: VR, virus-resistance; HR, herbicide-resistance; IR, insect-resistance.
[2]Acreage is not totaled because, in some cases, cultivars with multiple traits could be planted on the same acre.
[3]ai refers to active ingredients.

Impacts by trait

Crop production was further increased by 26 percent in 2005 compared with 2004 due to the planting of biotechnology-derived varieties. As in 2004, insect-resistant crops had the greatest impact on crop yields, contributing to about 99 percent of this increased production. Crop production gains were greatest due to YieldGard RW corn compared to other applications. Gained production from Bt crops was valued at $553 million in 2005.

Table 4	Impact of biotechnology-derived crops by pest management trait in 2005				
Trait	**Production**			**Total net value**	**Reduction in pesticide use**
	Volume Million lbs.	**Value** Million $	**Costs** Million $	Million $	Million lbs. ai[1]
Herbicide-resistance	0	0	-1,490.6	1,490.6	60.79
Insect-resistance	8264.6	553.4	51.59	502.4	8.86
Virus-resistance	76.7	25.0	1.11	23.82	0
Total	**8341**	**578**	**-1,438**	**2,017**	**69.7**

[1]ai refers to active ingredients.

Among all the traits planted in 2005, herbicide-resistant crops led to greatest reduction in crop production costs and greatest increase in net economic impacts. Herbicide-resistant crops reduced production costs by $1.5 billion dollars in 2005. Reduction in crop production costs due to herbicide-resistant soybean alone was $1.2 billion. Herbicide-resistant crops have also contributed to significant reductions in pesticide use. For example, herbicide-resistant crops reduced pesticide use by 60.8 million pounds while insect-resistant crops accounted for 8.86 million pounds. Though pesticide use has remained unchanged with the virus-resistant crops, significant production gains have been noted with these crops (77 million pounds).

Impacts by crop

Similar to that noted in 2004, biotechnology-derived field corn accounted for 91 percent production increase in 2005 while Bt cotton and virus-resistant crops (papaya and squash together) contributed to 8 and 1 percent of the production gain, respectively. Unlike insect-resistant and virus-resistant crops, herbicide-resistant crops did not have any impact on crop yields. Herbicide-resistant crops did not affect crop yields as weed control offered by herbicides used in these crops was similar to that provided by herbicides used in conventional crops.

Biotechnology-derived soybean resulted in largest net returns to growers ($1.2 billion) followed by corn ($520 million) and cotton ($289 million). The impacts of papaya, squash, and canola were small compared to soybean, corn, and cotton, mainly due to their minor acreage. Together, the net economic impact of papaya, squash, and canola was only 1.9 percent of the total. Similar to 2004, reduction in pesticide use in 2005 was greatest in corn (29 million pounds) followed by soybean (21 million pounds), and cotton (20 million pounds).

Table 5	**Impact of agricultural biotechnology by crop in 2005**						
#	**Crop**	**Production**			**Total net value**	**Reduction in pesticide use**	**Acreage**
		Volume Million lbs.	**Value** Million $	**Costs** Million $	Million $	Million lbs. ai	Million acres
1	Papaya	4.5	1.7	0.08	1.62	0	0.0013
2	Squash	72.2	23.3	1.03	22.2	0	0.007
3	Canola	0	0	-14.4	14.4	0.69	1.06
4	Soybean	0	0	-1,169	1,169	20.5	64.6
5	Corn	7593.2	264.7	-255	520.2	28.47	59.28
6	Cotton	671.4	288.7	-0.7	289.4	19.99	19.20
Total		**8,341**	**578**	**-1,438**	**2,017**	**69.7**	

[1]ai refers to active ingredients.

Impacts by state
The 42 states that planted biotechnology-derived crops in 2005 realized significant benefits (Table 6). Similar to 2004 and 2003, the midwestern states experienced greatest impacts in all categories in 2005 also. Crop production gains were greatest in Iowa (1.5 billion pounds) followed by Nebraska (0.99 billion pounds) and Minnesota (0.95 billion pounds). While reduction in crop production costs in 2005 were highest in Minnesota ($179 million) followed by Illinois ($177 million) and Indiana ($171 million), net returns to growers were highest in Minnesota ($212 million) followed by Illinois ($208 million) and Iowa ($203 million). Reduction in pesticide use due to biotechnology-derived crops was greatest in Minnesota (8.5 million pounds) followed by Illinois (7.7 million pounds), and Indiana (7.3 million pounds).

Aggregate impacts
The six biotechnology-derived crops planted in 2005 improved crop production by 8.3 billion pounds, reduced production costs by $1.4 billion, and increased revenue by $2.0 billion. Furthermore, American growers used 69.7 million fewer pounds of pesticides in 2005 due to the planting of these crops.

Compared with 2004, crop production was increased by 26 percent in 2005. This is due to an overall increase in the adoption of insect-resistant corn and cotton varieties and also due to significant yield improvements offered by YieldGard RW corn. Production costs, however, increased in 2005 compared with 2004. Increase in technology fee costs (ranging from 7 to 100 percent) for herbicide-resistant crops (corn, cotton, and soybean) contributed to the increased crop production costs in 2005. Net economic impact, therefore, was lower in 2005 compared to 2004. Lower crop prices in 2005 for both corn and cotton and exclusion of the case study on Herculex I corn further reduced the economic impact in 2005.

Biotechnology-derived crops and no-tillage
The adoption of biotechnology-derived crops has led to significant positive environmental impacts in addition to agronomic and economic benefits. Conservation tillage practices, no-till in particular, have increased significantly since the adoption of biotechnology-derived herbicide-resistant crops. Grower surveys and expert polls strongly indicate that the adoption of herbicide-resistant crops correlated positively with increase in no-till acreage since 1996, the year when herbicide-resistant crops were first planted on a commercial scale.

Weed control is a major concern in no-till fields when poor weather conditions hamper the effectiveness of herbicides. Herbicide-resistant crops increased growers' confidence in their ability to control weeds without relying on tillage because herbicides used in biotechnology-derived crops are more effective than those used before. With that increased confidence, American growers planted 64, 20, and 371 percent more acres to no-till in soybean, corn, and cotton, respectively, in 2004 (the most recent year for which the data is available), compared with years before their introduction.

Table 6	Aggregate impacts of biotechnology-derived crops by state in 2005				
State	Production			Total net value	Pesticide use
	Volume 000 lbs.	Value 000 $	Costs 000 $	000 $	000 lbs. ai[1]
Alabama	34805	14966	1268	13699	-725
Arizona	26407	6397	-816	7348	-381
Arkansas	90146	32699	-65118	97817	-3506
California	3078	1324	-30649	31973	-710
Colorado	108669	3785	-6637	10422	-590
Delaware	17276	602	-5188	5790	-204
Florida	29208	13050	2594	10456	-155
Georgia	126223	45904	2255	43946	-3203
Hawaii	4488	1661	79	1582	0
Idaho	168	5	-1444	1449	-112
Illinois	884038	30840	-176696	207536	-7723
Indiana	284312	9928	-170831	180759	-7328
Iowa	1455040	50729	-152660	203389	-2325
Kansas	640502	23781	-62503	86284	-3136
Kentucky	57340	1998	-10001	11999	184
Louisiana	70941	20657	-25886	46543	-2192
Maryland	91504	3187	-9259	12446	-409
Massachusetts	0	0	-51	51	-5
Michigan	133980	5327	-37433	42760	-1671
Minnesota	951944	33182	-179146	212248	-8544
Mississippi	92822	37280	-20278	57558	-3913
Missouri	411262	26588	-62246	88834	-3402
Nebraska	989744	34484	-58589	93073	-4407
New Jersey	7000	1981	-2716	4697	-95
New Mexico	34084	3457	598	2859	-147
New York	32076	1118	-5364	6482	-379
North Carolina	98685	27817	-45305	73123	-3163
North Dakota	126448	4405	-60398	64733	466
Ohio	60522	2110	-58220	60330	3348
Oklahoma	52926	8586	483	8101	-456
Pennsylvania	70129	2444	-10438	12882	-560
South Carolina	20441	8479	-9035	17514	-560
South Dakota	616368	21482	-97678	119460	-5184
Tennessee	109135	23475	-24137	47613	-1343
Texas	355518	63184	-14456	77640	-5837
Utah	0	0	-389	389	-30
Vermont	0	0	-201	201	-16
Virginia	39189	3862	-8786	12648	-704
Washington	7504	261	90	171	-4
West Virginia	0	0	-505	505	-37
Wisconsin	207520	7238	-31926	39164	-404
Wyoming	0	0	-569	569	-44

[1] ai refers to active ingredients

The Conservation Technology Information Center (CTIC) reported in 2002 that increased use of conservation tillage practices such as no-tillage reduced soil erosion by nearly 1 billion tons and saved $3.5 billion in sedimentation treatment costs. Other benefits from no-tillage included significant fuel savings (3.9 gallons of fuel per acre), reduced machinery wear and tear, reduction of pesticide run-off (70 percent) and less water runoff (69 percent), reduction in greenhouse gases due to improved carbon sequestration, and improved habitat for birds and animals. Some experts have credited herbicide-resistant crops for transforming American agriculture from a carbon intensive operation to a potential carbon sink. By providing more assured weed control, biotechnology-derived herbicide-resistant crops facilitated the increase in no-till production practices and the associated environmental and economic benefits.

Biotechnology and biofuels

A major question that underlines the recent debate on biofuels, ethanol in particular, is whether the United States would be able to meet the demands for both food and fuel. The current report suggests that biotechnology provides a key solution to this question. The report indicates that improved corn production achieved through biotechnology will help meet the demand for both food and fuel and aid in alleviating the stress on land use.

With the energy crunch and surge in gas prices that loomed in the United States in recent years, interest in alternative fuels such as ethanol increased tremendously. Primarily used as a blend with gasoline, ethanol is produced from starch in corn kernels.

Escalating demand for ethanol, increased investments in ethanol production, and the establishment of numerous new distilleries in the United States led to predictions of insufficient corn supply to meet the increased demand from the growing number of ethanol plants, the need to increase corn acreage to satisfy robust growth in demand, bringing the land now idled under the Conservation Reserve Program to corn production, possible shift in acres from soybean to corn, and possible increase in corn prices. The U.S. Agriculture Department's chief economist Keith Collins predicts that growers would need to plant 90 million acres of corn or 10 million more acres than those planted in 2006 by 2010 to fill the projected ethanol demand and maintain existing levels of exports and livestock-feed usage. The increase of 10 million acres almost equals the total corn acreage in Iowa, where growers planted 12.7 million acres of corn in 2006.

American growers were able to improve corn production by 39 billion pounds during the first decade of planting biotechnology-derived crops. This enhanced production is equivalent to 1.9 billion gallons of ethanol (Table 7). With just a third of total corn acreage planted to biotechnology-derived varieties in 2005, corn production was improved by 7.6 billion pounds (equivalent to 366 million gallons of ethanol) (Table 7). Adoption trends for 2006 and predictions for years ahead indicate that production (for both and food and fuel use) will increase substantially in the coming years due to biotechnology-derived corn.

Table 7. Impact of biotechnology-derived Bt corn on grain and ethanol production						
Year	**Planted corn acreage**	**Bt corn adoption[1]**	**Bt corn acres**	**Average US corn production**	**Yield gain due to Bt corn[2]**	**Ethanol production from gained production due to Bt corn[4]**
	000 acres	percent	000 acres	Lbs./acre	Million lbs.	Million gallons
1996	79487	1	795	7118	170	8.2
1997	80227	8	6418	7045	1356	65.4
1998	80187	18	14434	7515	3254	156.8
1999	77431	26	20132	7403	4471	215.5
2000	79545	19	15114	7678	3481	167.8
2001	75702	19	14383	7739	3541[3]	170.7
2002	78894	24	18935	7241	4113	198.2
2003	78603	31	24367	7963	4941[3]	238.2
2004	80929	32	25897	8982	5944[3]	286.5
2005	81759	35	28616	8282	7593[3]	366.0
Total					**38,864**	**1,873**

[1]Includes YieldGard Corn Borer only for 1996 – 2002; Includes YieldGard Corn Borer, YieldGard Rootworm, and Herculex corn for 2003, 2004, and 2005.
[2]A 3 percent yield gain was assumed due to Bt corn.
[3]Based on calculations from the previous reports by the National Center for Food and Agricultural Policy.
[4]Based on the assumption that 1 bushel (56 lb) of corn yields 2.7 gallons of ethanol.

Conclusion

Every crop management decision has consequences, and the decision to plant biotechnology-derived crops is no exception. American growers have made the decision to choose biotechnology-derived crops because they realized clear and positive benefits from planting these crops. In addition to revolutionizing the way crops are produced, biotechnology provided best hope to growers by providing enhanced pest protection thereby improving yields with the use of minimal inputs. With that increased hope and confidence, American growers have increased planting of biotechnology-derived crops from 5 million acres in 1996 to 123 million acres in 2005. The fact that adoption of biotechnology-derived crops has continued to grow each year since their first introduction is a testimony to the ability of these crops to deliver tangible positive impacts and to the optimistic future they hold.