



Genetically Modified Crops in the United States

Genetically modified food and agricultural biotechnology have generated considerable interest and controversy in the United States and around the world. Some tout the technology's benefits while others raise questions about environmental and food safety issues. This paper provides background information regarding the adoption of genetically modified plants among domestic and international farms and is one in a series that the Pew Initiative on Food and Biotechnology has developed to address common questions that are frequently asked about genetically modified food and agricultural biotechnology.

Crop varieties developed by genetic engineering were first introduced for commercial production in 1996. Today, these crops are planted on more than 167 million acres worldwide. U.S. farmers are by far the largest producers of genetically modified (GM) crops. In addition to summarizing the extent to which GM crops have been adopted in the United States compared to other countries, this factsheet also shows which GM crops U.S. farmers grow and which states plant the most GM varieties.

Recent innovations in biotechnology allow scientists to select specific genes from one organism and introduce them into another to confer a desired trait. This technology can be used to produce new varieties of plants or animals more quickly than conventional breeding methods and to introduce traits not possible through traditional techniques. The principal agricultural biotechnology products marketed to date have been genetically modified crops engineered to tolerate herbicides and/or resist pests. Crops carrying herbicide-tolerant genes were developed so that farmers could spray their fields to eliminate weeds without damaging the crop. Likewise, pest-resistant crops have been engineered to contain a gene for a protein from the soil bacterium, *Bacillus thuringiensis* (Bt), which is toxic to certain pests. This protein, referred to as Bt, is produced by the plant, thereby making it resistant to insect pests like the European Corn Borer or Cotton Boll Worm. Other pest-resistant GM crops on the market today have been engineered to contain genes that confer resistance to specific plant viruses.

The United States is the World Leader in Production of Biotechnology Crops

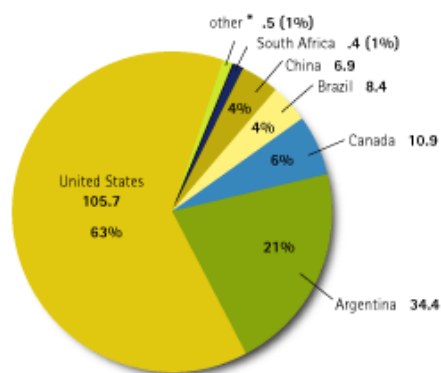
The United States accounts for nearly two-thirds of all biotechnology crops planted globally. GM food crops grown by U.S. farmers include corn, cotton, soybeans, canola, squash, and papaya. Other major producers of GM crops are Argentina, which plants primarily biotech soybeans; Canada, whose principal biotech crop is canola; Brazil, which has recently legalized the planting of GM soybeans; China, where the acreage of GM cotton continues to increase; and South Africa, where cotton is also the principle biotech crop.

Worldwide, about 672 million acres of land are under cultivation, of which 25 percent or 167.2 million acres – an area greater than

twice the size of the United Kingdom – consisted of GM crops in 2003. Since 1996, the United States has consistently planted more GM crops than any other country, with 105.7 million acres supporting GM crops in 2003. Argentina is the next largest producer, with 34.4 million acres, followed by Canada with 10.9 million acres, Brazil with 8.4 million acres, China with 6.9 million acres, and South Africa with 1.0 million acres in 2003. Together, these six countries grew 99 percent of the global GM crop area last year. Australia, Mexico, Romania, Bulgaria, Spain, Germany, Uruguay, Indonesia, the Philippines, India, Columbia, and Honduras also planted significant acreage in GM crops in 2003.

PERCENT OF GLOBAL LAND AREA PLANTED IN BIOTECHNOLOGY VARIETIES BY COUNTRY

(2003 total global land area: 167.2 million acres)



Acreage in Millions

* The following countries planted genetically modified crops totaling one percent of global GM crop production: Australia, Mexico, Romania, Bulgaria, Spain, Germany, Uruguay, Indonesia, India, Columbia, Honduras, and the Philippines. Differences between values shown and those calculated (from percent and total global acreage) are a likely consequence of rounding.

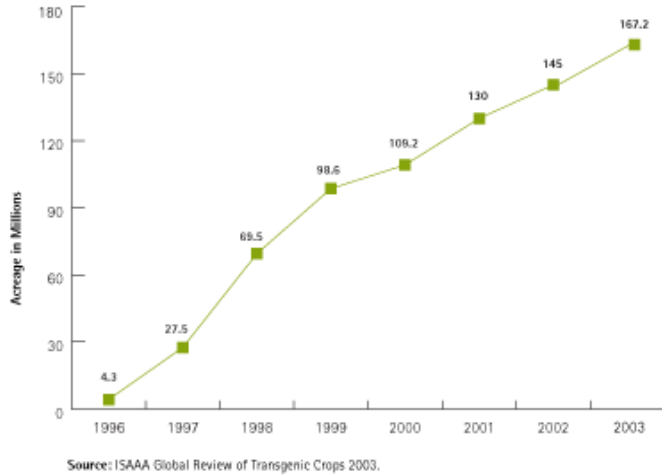
Source: International Service for the Acquisition of Agri-biotech Applications (ISAAA) Global Review of Transgenic Crops 2003.

The number of farmers planting GM crops has also increased over the past three years. In 2000, 3.5 million farmers planted GM crops. That number has nearly doubled, to an estimated total of seven million farmers planting GM crops in 2003. More than 85 percent of the farmers who planted GM crops in 2003 were resource-poor, including Chinese and South African Bt cotton growers.

U.S. Farmers Continue to Increase GM Crop

In 1996, 4.2 million acres in six countries were planted with GM crops. By 2003, the numbers had grown to 167.2 million acres in 18 countries on six continents – a 40-fold increase in eight years. The adoption of GM crops has been the most rapid in the United States, where there has been a 27-fold increase in the area of GM crops planted during the same eight year period (3.7 million acres in 1996 to 105.7 million acres in 2003).

INCREASE IN GLOBAL AREA OF BIOTECHNOLOGY CROPS – 1996 TO 2003



Top GM Crops Produced in the United States

In the United States the three main GM crops under cultivation are varieties of corn, soybeans, and cotton.

In 2001, 68 percent of U.S. soybeans were genetically engineered, covering 50.4 million acres. Biotechnology varieties (which included herbicide and insect resistant types) accounted for about 26 percent (19.7 million acres) of the corn and 69 percent (10.9 million acres) of the upland cotton planted in the U.S. during 2001.

In 2002, genetically engineered varieties of soybeans planted in the U.S. rose to 75 percent of the total soybeans sown – an increase of 3.5 million acres which gave a total of 54 million acres. GM corn plantings increased 5.6 million acres to a total of 25.3 million acres – which represented 32 percent of all U.S. corn planted. While GM cotton increased its share of the total cotton crop planted in the U.S. in 2002 to 71 percent, the total acreage of all cotton as well as that of GM cotton planted decreased by six percent and five percent respectively in 2002.

In 2003, U.S. farmers increased GM soy plantings to total 59.7 million acres or 81 percent of all soy planted in the U.S. GM corn plantings also increased to 40 percent (31.6 million acres) of the U.S. crop. As was the case in 2002, acres dedicated to cotton farming as a whole as well as to GM varieties in particular both declined in the U.S. (13.9 million and 10.2 million acres respectively). GM varieties accounted for 73 percent of all cotton grown which is, despite the decline in actual acreage, an increase in the percentage of cotton planted with GM varieties from the previous year.

In 2004, the percentage of U.S. soybeans planted in genetically engineered varieties again grew, accounting for 85 percent of all soy planted. This reflects an increase of 3.9 million acres and a total of 63.6 million acres of GM soy. The percentage of GM corn rose to 45 percent of all U.S. corn planted, with farmers planting 4.9 million acres more than in 2003 giving a total of 36.5 million acres of GM corn. For the first time in three years, total cotton acreage in the U.S. increased. The share of cotton which is GM –

a total of 10.6 million acres – increased three percent from 2003 to 76 percent in 2004.

MAJOR U.S. GM CROPS

Crop	2001 Total Acreage	2002 Total Acreage	2003 Total Acreage	2004 Total Acreage
Corn	75,800 (26%)	79,000 (34%)	79,066(40%)	81,100 (45%)
Soybean	74,105 (68%)	72,993 (75%)	73,853 (81%)	74,724 (85%)
Cotton	15,499 (69%)	14,151 (71%)	13,924 (73%)	13,947 (76%)

Other GM crops currently grown in the U.S. include canola, squash and papaya. An estimated 54 percent of all canola grown in the U.S. in 2001 was genetically modified, according to industry estimates. While more than 50 percent of papayas grown in the U.S. (all in Hawaii) are GM, other commercially available GM crops, such as sugar beets, potatoes, and sweet corn, have yet to be widely adopted by farmers.

*This estimate is based on the report "Papaya Acreage Survey Result August 2002" by the National Agricultural Statistics Service. The estimate does not include the acreage of Sun-Up variety, a GM papaya, which is combined with other unknown varieties in the "Other" Category of this report. The "Other" category accounts for 4 percent of all planted papaya in 2002.

South Dakota Stakes Claim as Top GM Corn and Soybean Producer, Mississippi Farmers Embrace GM Cotton

Corn

Data collected by the United States Department of Agriculture (USDA) in June 2001 showed that farmers in every state in the continental U.S. planted some GM corn in 2001. However, 11 states were responsible for 82 percent of the country's GM corn crop that year. Six of the large GM corn producing states reported that their farmers had planted over 30 percent of their total corn crop with GM corn. South Dakota was the leader, increasing their acreage of GM corn to 47 percent. Kansas plantings increased to 38 percent, followed by 36 percent in Minnesota, 34 percent in Nebraska, and 32 percent in both Missouri and Iowa.

The USDA June 2002 data reported an increase in GM corn plantings for that year. Eighty-five percent of all GM corn grown in 2002 was sown in the same 11 states responsible for the majority of GM corn planting in 2001. Six states – led by South Dakota - reported GM corn acreage exceeding 30 percent of the total acres of corn planted. The proportion of GM corn planted in South Dakota leapt to 66 percent of 2002 corn acreage, while Nebraska increased to 46 percent and Minnesota to 44 percent, followed closely by Kansas with 43 percent. Iowa reported 41 percent GM corn planted and Missouri increased its GM corn holdings slightly to 34 percent of its total corn crop.

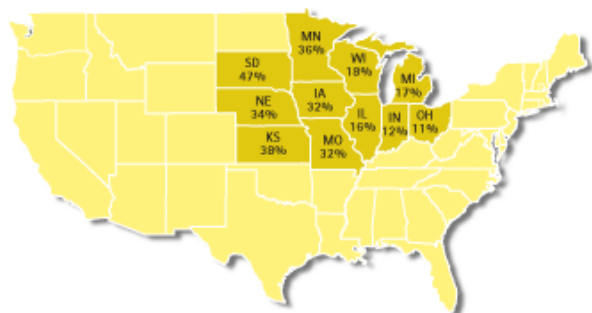
In 2003, 82 percent of GM corn was planted in the same 11 states mentioned in 2001 and 2002. However, in 2003 the number of states reporting over 30 percent of their acreage sown with GM corn increased to eight. South Dakota continued to outpace other states by planting 75 percent of its corn crop with GM varieties. Minnesota planted 53 percent and Nebraska planted

52 percent. Kansas at 47 percent, Iowa at 45 percent, Missouri at 42 percent, Michigan at 35 percent, and Wisconsin at 32 percent completed the list of eight states.

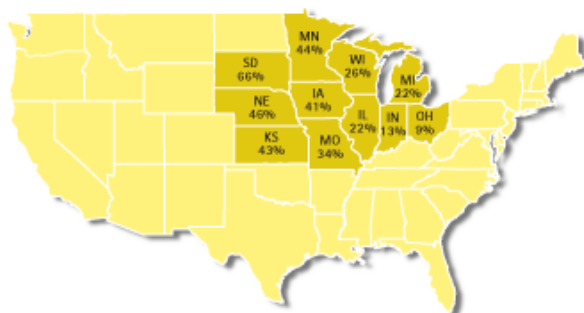
In 2004, the 11 states that have previously dominated GM corn planting account for 81 percent of the U.S. GM corn crop. This year, nine states use GM varieties on over 30 percent of their corn acreage. South Dakota still leads with 79 percent of its corn being a GM variety, followed by Minnesota with 63 percent, Nebraska with 60 percent, Kansas and Iowa with 54 percent each, Missouri with 49 percent, Wisconsin with 38 percent, and Illinois and Michigan with 33 percent each.

PRINCIPAL STATES GROWING GM CORN

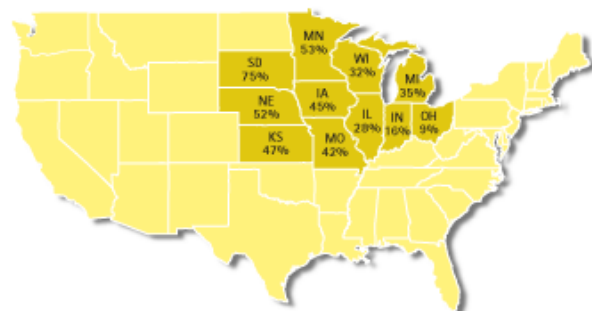
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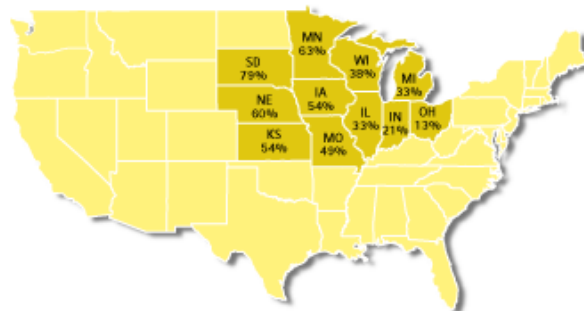
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Source: Figures based on N.A.S.S. Acreage Reports, June 2002, June 2003, and June 2004.

2001-2004 TOTAL ACRES VS. GM ACRES IN TOP GM CORN PRODUCING STATES (in 1,000's)

State	2001 Total Acres	2001 GM Acres	2002 Total Acres	2002 GM Acres	2003 Total Acres	2003 GM Acres	2004 Total Acres	2004 GM Acres
Illinois	11,000	1,760 (16%)	11,600	2,552 (22%)	11,000	3,108(28%)	11,700	3,861(33%)
Indiana	5,800	696 (12%)	5,400	702 (13%)	5,700	912 (16%)	5,500	1,155 (21%)
Iowa	11,700	3,744 (32%)	12,200	5,002 (41%)	12,400	5,580 (45%)	12,600	6,804 (54%)
Kansas	3,450	1,311 (38%)	3,150	1,355 (43%)	2,900	1,363 (47%)	3,250	1,755 (54%)
Michigan	2,200	374 (17%)	2,350	517 (22%)	2,300	805 (35%)	2,200	726 (33%)
Minnesota	6,800	2,448 (36%)	7,400	3,256 (44%)	7,100	3,763 (53%)	7,700	4,851 (63%)
Missouri	2,700	864 (32%)	2,800	952 (34%)	2,950	1,239 (42%)	3,000	1,470 (49%)
Nebraska	8,100	2,754 (34%)	8,400	3,864 (46%)	8,000	4,160 (52%)	8,300	4,980 (60%)
Ohio	3,400	374 (11%)	3,200	288 (9%)	3,450	311 (9%)	3,250	422.5 (13%)
South Dakota	3,800	1,786 (47%)	4,100	2,706 (66%)	4,500	3,375 (75%)	4,500	3,555 (79%)
Wisconsin	3,400	612 (8%)	3,600	832 (26%)	3,700	1,184 (32%)	3,750	1,425 (38%)
U.S. Total	75,800	19,700 (26%)	79,000	26,900 (34%)	79,066	31,626 (40%)	80,968	36,436 (45%)

Source: Figures based on N.A.S.S. Acreage Reports, June 2002, June 2003, and June 2004.

Soybeans

Although soybeans are not as widely planted throughout the United States as corn, GM soybeans have proven to be even more popular than GM corn among farmers in the top producing states.

Fourteen states accounted for 90 percent of GM soybeans planted in the U.S. during 2001. Five of those states reported that over 70 percent of their farmers planted GM soy in 2001. Michigan and South Dakota indicated 80 percent of the soybean crop planted was a GM variety, while Indiana and Nebraska were not far behind with 78 percent and 76 percent, respectively. Kansas reported 73 percent of their crop was GM soy in 2001.

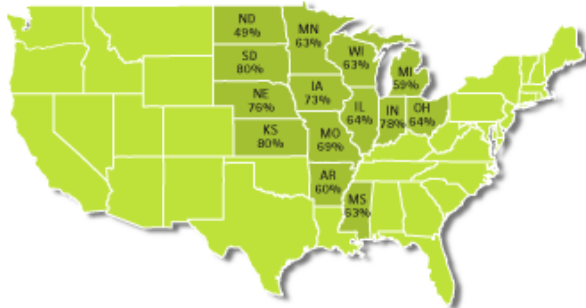
In 2002, the same 14 largest producers of GM soy accounted for 91 percent of all GM soy planted. Seven states joined the ranks of those reporting over 70 percent of their soybean crop as GM in 2002, bringing the total to 12 states. South Dakota sprang to 89 percent use, followed by Nebraska with 85 percent and Indiana and Kansas at 83 percent. Mississippi reported 80 percent of the crop was GM soy, Wisconsin reported 78 percent, Iowa reported 75 percent, Ohio 73 percent, and Michigan and Missouri 72 percent each. At 71 percent, Illinois and Minnesota completed the list of 12 states.

The figures for 2003 once again showed an increase in the planting of GM soy in the U.S. While in previous years only a subset of the 14 top GM soy-planting states reported planting over 70 percent of their crop with a GM variety, in 2003, each of the 14 top producers indicated doing so. Nine of these states reported over 80 percent GM soy planted and South Dakota led, reporting 91 percent of their soy crop as GM varieties. Eighty-nine percent of the Mississippi plantings, 88 percent of Indiana plantings, 87 percent of Kansas plantings, and 86 percent of Nebraska plantings were GM soy. Arkansas, Iowa and Wisconsin each planted 84 percent GM soy, while Missouri planted 83 percent. These states along with Illinois, Michigan, Minnesota, North Dakota, and Ohio accounted for 90 percent of the GM soy acreage in the U.S. for 2003.

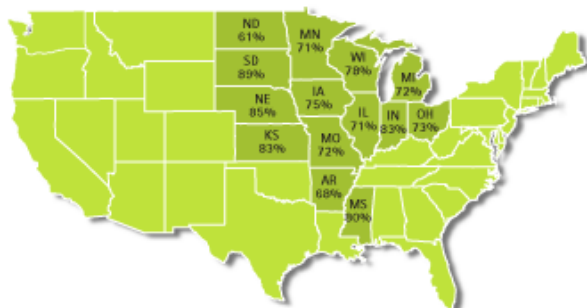
Of the 31 states that report planting GM soybeans in 2004, the 14 top GM soy-planting states account for 89 percent of the national total. In 2004, as in 2003, all 14 of the top GM soy producing states planted over 70 percent of their crop with GM varieties and 12 of the 14 states planted over 80 percent. South Dakota, once again, tops the list at 95 percent GM soy, followed closely by Mississippi at 93 percent GM soy and Nebraska and Arkansas at 92 percent each. Iowa farmers report 89 percent of their soy crop as GM; Missouri, Kansas, and Indiana each report 87 percent; and Wisconsin, Minnesota, and North Dakota all report 82 percent. Illinois reports 81 percent GM soy, and Michigan and Ohio, at 75 and 76 percent respectively, complete the list of the 14 largest producers.

PRINCIPAL STATES GROWING GM SOYBEANS

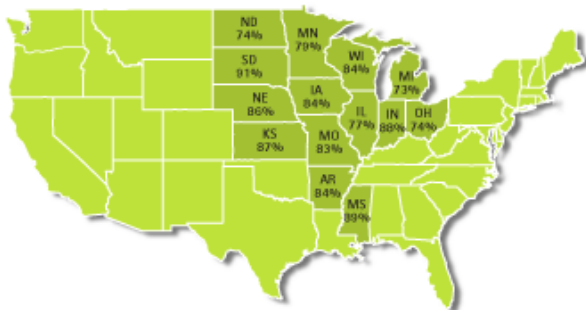
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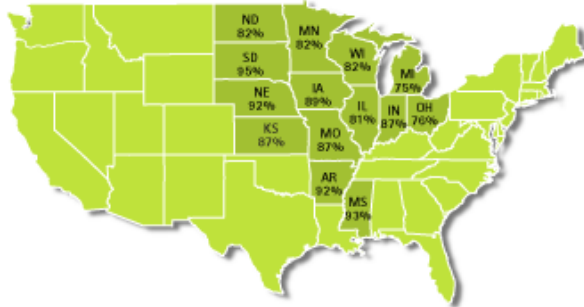
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Source: Figures based on N.A.S.S. Acreage Reports, June 2002, June 2003, and June 2004.

2001-2004 TOTAL ACRES VS. GM ACRES IN TOP GM SOYBEAN PRODUCING STATES (in 1,000's)

State	2001 Total Acres	2001 GM Acres	2002 Total Acres	2001 GM Acres	2003 Total Acres	2003 GM Acres	2004 Total Acres	2004 GM Acres
Arkansas	2,900	1,740 (60%)	2,950	2,006 (68%)	2,900	2,436 (84%)	3,100	2,852 (92%)
Illinois	10,700	6,848 (64%)	10,300	7,313 (71%)	10,600	8,162 (77%)	9,900	8,019 (81%)
Indiana	5,600	4,368 (78%)	5,700	4,731 (83%)	5,400	4,752 (88%)	5,500	4,785 (87%)
Iowa	11,000	8,030 (73%)	10,700	8,025 (75%)	10,400	8,736 (84%)	10,400	9,256 (89%)
Kansas	2,850	2,280 (80%)	2,800	2,324 (83%)	2,700	2,349 (87%)	2,700	2,349 (87%)
Michigan	2,150	1,269 (59%)	1,950	1,404 (72%)	2,100	1,533 (73%)	2,000	1,500 (75%)
Minnesota	7,300	4,599 (63%)	7,000	4,970 (71%)	7,600	6,004 (79%)	7,400	6,068 (82%)
Mississippi	1,160	731 (63%)	1,470	1,176 (80%)	1,360	1,210 (89%)	1,670	1,553 (93%)
Missouri	4,950	3,416 (69%)	4,700	3,384 (72%)	4,950	4,109 (83%)	5,000	4,350 (87%)
Nebraska	4,950	3,762 (76%)	4,900	4,165 (85%)	4,700	4,042 (86%)	4,750	4,370 (92%)
North Dakota	2,150	1,054 (49%)	2,450	1,495 (61%)	3,100	2,294 (74%)	3,700	3,034 (82%)
Ohio	4,600	2,944 (64%)	4,700	3,431 (73%)	4,400	3,256 (74%)	4,450	3,382 (76%)
South Dakota	4,500	3,600 (80%)	4,200	3,738 (89%)	4,100	3,731 (91%)	4,200	3,990 (95%)
Wisconsin	1,600	1,008 (63%)	1,450	1,131 (78%)	1,600	1,344 (84%)	1,700	1,394 (82%)
U.S. Total	74,105	50,391 (68%)	72,993	54,745 (75%)	73,653	59,659 (81%)	74,809	63,588 (85%)

Source: Figures based on N.A.S.S. Acreage Reports, June 2002, June 2003, and June 2004.

Cotton

The main producers of upland cotton (all of which are in the southern United States) have embraced GM cotton. In 2001, the seven top producing states reported that over 75 percent of cotton grown was a GM variety. Louisiana led the list in 2001, planting 91 percent of its cotton crop with GM varieties, followed by 86 percent in Mississippi, 85 percent in Georgia, 84 percent in North Carolina, and 78 percent in Arkansas. These five states, together with California and Texas, accounted for 78 percent of GM upland cotton cultivation in 2001.

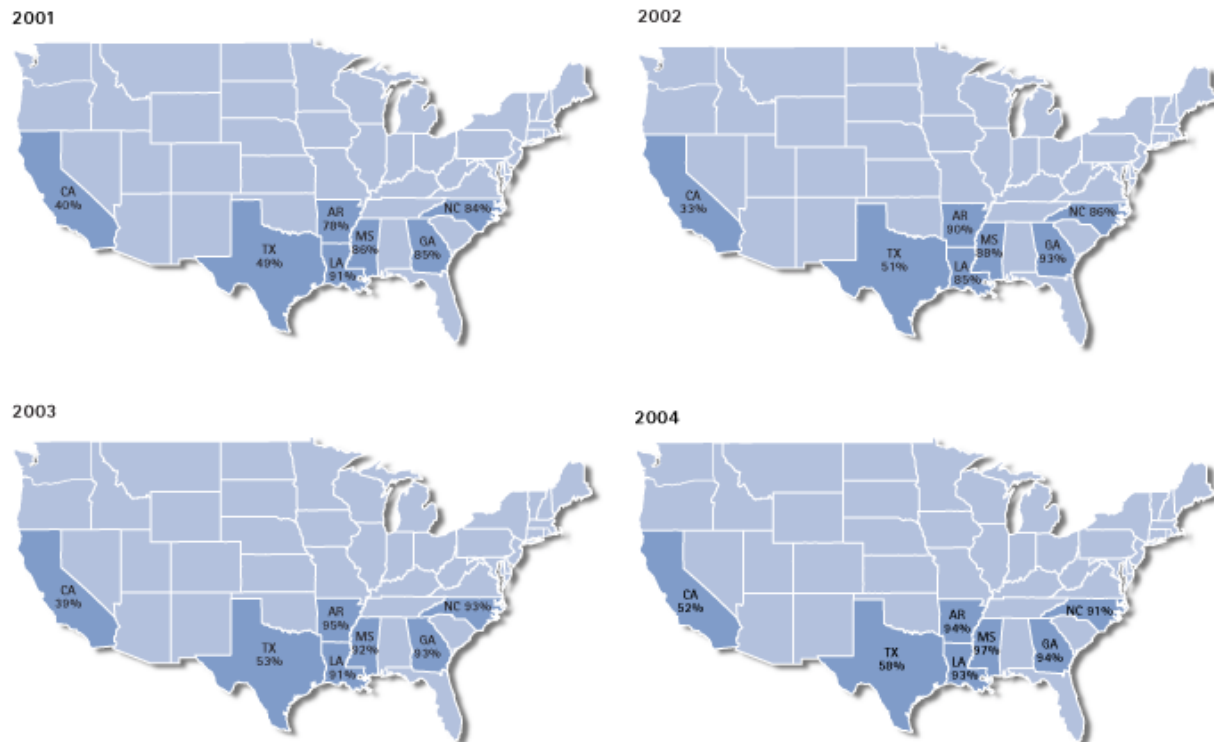
The USDA reported similar statistics for 2002, and the top seven producing states remained the same. However, in 2002, of the five states that reported over 75 percent of their cotton crop as GM, the lead spot shifted to Georgia with 93 percent sown GM followed by Arkansas with 90 percent, and Mississippi with 88 percent. Louisiana fell to 85 percent, and North Carolina dropped to 82 percent. The GM cotton grown in California, Texas, and the preceding five states accounted for 76 percent of all GM upland cotton cultivation in 2002.

In 2003, five of the seven top GM cotton producing states reported planting over 90 percent of their cotton acreage with GM varieties. Of the five states reporting their farmers to have planted over 90 percent of GM cotton, Arkansas led the nation with 95 percent sown as a GM variety, followed by Georgia and North Carolina, each with 93 percent. Mississippi was close behind with 92 percent, and Louisiana reported 91 percent. The GM cotton grown in California, Texas, and the preceding five states accounted for 82 percent of all GM upland cotton cultivation in 2003.

The 2004 USDA report again shows that GM cotton continues to increase as a percent of the total cotton crop with the top seven producers accounting for 81 percent of the GM cotton grown in the U.S. Five of the seven states report over 90 percent of their cotton acreage is a GM variety. Mississippi is now the state

reporting the greatest percentage of GM cotton acreage (97 percent), while Georgia and Arkansas trail closely behind (94 percent each). Louisiana plants 93 percent GM varieties, and North Carolina plants 91 percent. Texas and California finish off the list of top seven producers, planting 58 and 52 percent of their cotton with GM varieties respectively.

PRINCIPAL STATES GROWING GM COTTON



Source: Figures based on N.A.S.S. Acreage Reports, June 2002, June 2003, and June 2004.

2001-2004 TOTAL ACRES VS. GM ACRES IN TOP GM COTTON PRODUCING STATES (in 1,000's)

State	2001 Total Acres	2001 GM Acres	2002 Total Acres	2002 GM Acres	2003 Total Acres	2003 GM Acres	2004 Total Acres	2004 GM Acres
Arkansas	1,080	842 (78%)	1,000	900 (90%)	950	903 (95%)	950	893 (94%)
California	630	252 (40%)	460	152 (33%)	550	215 (39%)	560	291 (52%)
Georgia	1,490	1,267 (85%)	1,500	1,395 (93%)	1,400	1,302 (93%)	1,330	1,241 (94%)
Louisiana	870	792 (91%)	580	493 (85%)	550	501 (91%)	500	465 (93%)
Mississippi	1,620	1,393 (86%)	1,180	1,038 (88%)	1,120	1,030 (92%)	1,100	1,067 (97%)
North Carolina	970	815 (84%)	980	843 (86%)	850	791 (93%)	720	655 (91%)
Texas	6,000	2,940 (49%)	5,800	2,958 (51%)	5,800	3,074 (53%)	6,000	3,480 (58%)
U.S. Total	15,499	10,694 (69%)	14,151	10,047 (71%)	13,924	10,165 (73%)	13,700	10,412 (76%)

Source: Figures based on N.A.S.S. Acreage Reports, June 2002, June 2003, and June 2004.

This fact sheet was produced by the Pew Initiative on Food and Biotechnology, a nonprofit, nonpartisan research project whose goal is to inform the public and policymakers on issues about genetically modified food and agricultural biotechnology, including its importance, as well as concerns about it and its regulation. It is supported by a grant from the Pew Charitable Trusts to the University of Richmond. The information presented

in this fact sheet was obtained from the United States Department of Agriculture and two nongovernmental, nonprofit organizations: the International Service for the Acquisition of Agri-biotech Applications and the National Center for Food and Agricultural Policy.

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