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Availability and Market Penetration of GMO Corn Soybeans

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This new generation of corn and soybean seed that enables farmers to better control pest damage could be the leading edge of a technological revolution that changes the way farmers produce crops and changes the characteristics of those crops. The uncertainty about whether these crops are the leading edge or simply a trial run that goes nowhere arises not because of scientific uncertainty—scientists are certain that many new seeds will become available—but rather because of uncertainty about the extent of consumer acceptance of food produced using genetically engineered seed.

For corn, there are four main products that express Bt, a protein that is toxic to lepidopteran insects (moths and butterflies whose larvae are caterpillars).

1. **KnockOut and NatureGard.** Bt toxin gene: CryIAb. Genetic event name: 176. Developed and marketed by CIBA Seeds (now Novartis), and Mycogen. Approved for sale in August 1995. Commercial sales started in 1996.
2. **Bt-Xtra.** Bt-toxin gene: CryIAb. Genetic event names: DeKalBt and DBT418. Developed and marketed by DeKalb (now part of Monsanto). It was approved for sale in March 1997 and commercial sales started in 1997.
3. **YieldGard.** Bt toxin gene: CryIIAc. Genetic event names: Mon810 and Bt11. YieldGard was developed by Monsanto and Northrup King (now Novartis) and is marketed by Pioneer Hi-Bred, Cargill, DeKalb, and Golden Harvest. The Monsanto event was

approved for sale in December 1996, the Novartis event in October 1996, and commercial sales started in 1997.

4. **StarLink.** Bt toxin gene: Cry9C. Genetic event name: CBH-351. StarLink was developed by AgrEvo. The event was approved for sale in May 1998. Sales started in 1998.

There are two corn products that are resistant to herbicides. The benefit of a herbicide-resistant crop is that a broad spectrum herbicide can be sprayed as a post-emergent herbicide without stunting the crop.

1. **Liberty Link** corn resistant to glufosinate-ammonium. Developed and marketed by AgrEvo. Approved in January 1997. First year of commercialization 1997.
2. **RoundReady corn** resistant to glyphosate. Developed and marketed by Monsanto. First year marketed was 1998.

There is one soybean product that is resistant to herbicides.

1. **Roundup Ready soybeans** resistant to glyphosate. Developed by Monsanto. First year of commercial production was 1996.

USDA's Economic Research Service conducts surveys of seed use by region. This table shows USDA estimates of adoption rates from 1996 to 1998.

Adoption Rates for GMO Seeds in the United States and Central Cornbelt

	Corn Belt 1996	United States 1996	Corn Belt 1997	United States 1997	Corn Belt 1998	United States 1998
Corn						
% acres planted with Bt seed	1.5	1.4	8.1	7.6	19.4	19.1
% acres planted with herbicide resistant seed*				0.01		0.03
Soybeans						
% acres planted with herbicide resistant seed**	6.9	7.4	14.7	17.0	44.3	44.2

*Excludes acreage planted to herbicide resistant corn obtained by traditional breeding but developed using biotechnology techniques that helped to identify the genes.

**Estimates reported for Roundup Ready soybeans in 1996 are much higher than estimates from Monsanto.

No reliable estimates are available for 1999, although press reports citing industry sources commonly use 55 percent of soybeans planted to Roundup Ready seed and 35% of all corn planted to Bt corn, Roundup Ready corn, or Bt-Roundup Ready corn.

Data from a 1998 USDA cost-of-production survey were used to examine the economic impact of GMO crops at the farm level. This survey was a cross-section of randomly selected corn and soybean fields in Iowa. In 1998 more than 40 percent of Iowa soybean acres were planted with GMO soybeans. Of the farmers surveyed, 52 percent said they planted GMO beans to increase yields through improved pest control. Twenty-seven percent said they used GMO soybeans to decrease pesticide costs, and another 12 percent cited increased planting flexibility. The average yield reported for the GMO soybeans was 49.3 bushels per acre. The non-GMO soybeans averaged 51.2 bushel per acre.

There are more genetic modification options available in corn. In 1998, 24 percent of the Iowa corn acres were planted to Bt corn, 14 percent had some other genetically modified seed, and the remaining 62 percent used conventional seed. More than three-fourths of the farmers using Bt corn said they did so to increase yields. Another 7 percent said they used it to reduce pesticide costs, and the remaining 16 percent gave some other reason. Increased yields with Bt corn did occur in 1998 in Iowa. Bt corn averaged 160.4 bushels per acre whereas the non-Bt corn averaged only 147.7 bushels per acre.

Even though reports indicate that about 35 percent of the 1999 U.S. corn crop was planted to GMO varieties, the usable percent of the crop that is non-GMO is uncertain. Some observers say that many fields were planted with alternating strips of Bt and non-Bt corn to provide a refuge for corn borers so that Bt resistance would not develop. The alternating strips would have cross-

pollinated and would be co-mingled during harvest. Others in the industry indicate that a significant part of the refuge corn was planted in adjoining fields (maximum of one-fourth mile away, and equal to a minimum of 20 percent of the Bt acreage), which would result in less co-mingling. Either way, the effective supply of GMO corn (including old-crop co-mingled grain) may be considerably above 35 percent of the total.

For soybeans, the situation is slightly less complex. Cross-pollination is not a concern for soybeans, and refuge strips are not a problem. Reports indicate that 55 percent of this year's soybean acreage was planted to GMO varieties. Allowing for co-mingling of the old-crop carryover (which is about 12 percent of the total supply), perhaps 30 to 35 percent of the total U.S. soybean supply is non-GMO.