

GAO

Report to the Chairman, Subcommittee  
on Risk Management, Research, and  
Specialty Crops, Committee on  
Agriculture, House of Representatives

January 2000

# BIOTECHNOLOGY

## Information on Prices of Genetically Modified Seeds in the United States and Argentina



G A O

Accountability \* Integrity \* Reliability



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# Contents

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<b>Letter</b>		3
<b>Appendixes</b>	Appendix I: Scope and Methodology	22
	Appendix II: GAO Contacts and Staff Acknowledgments	25
<b>Tables</b>	Table 1: Price Ranges for Roundup Ready Soybean and Bt Corn Seeds in the United States (Illinois and Iowa) and Argentina, 1998	4
	Table 2: Soybean Seed Price Ranges, 1998	10
	Table 3: Corn Seed Price Ranges, 1998	11
	Table 4: Sources of Soybean Seeds	15
<b>Figures</b>	Figure 1: Estimated Percentage of Soybean Acreage Planted in Roundup Ready Soybeans in the United States and Argentina, 1996 Through 1999	8
	Figure 2: Estimated Percentage of Corn Acreage Planted in Bt Corn in the United States and Argentina, 1996 Through 1999	9
	Figure 3: Average Prices of Soybean Seeds in Argentina, 1997 Through 1999, per 50 lb. bag	17
	Figure 4: Average Prices of Soybean Seeds in the United States, 1997 Through 1999, per 50 lb. bag	18

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United States General Accounting Office  
Washington, D.C. 20548

Resources, Community, and Economic  
Development Division

B-284201

January 21, 2000

The Honorable Thomas W. Ewing  
Chairman, Subcommittee on Risk Management,  
Research, and Specialty Crops  
Committee on Agriculture  
House of Representatives

Dear Mr. Chairman:

Biotechnology is changing the face of agriculture, with farmers adopting genetically modified seeds at unprecedented rates. From 1996 through 1998, the global area planted with these seeds increased more than fifteenfold. While genetically modified seeds are available for many crops, the ones most widely grown are herbicide-tolerant soybean and insect-resistant corn seeds—specifically, Roundup Ready soybeans<sup>1</sup> and *Bacillus thuringiensis* (Bt) corn. Roundup Ready soybeans contain a gene that enables soybeans to withstand applications of Roundup—an herbicide effective on many kinds of weeds. Bt corn is genetically modified with a gene from a soil bacterium that makes the corn resistant to certain insects, including the European corn borer—a damaging insect pest of corn in the United States.

Farmers in the United States and Argentina—two countries that are major producers of soybeans and corn—have been in the forefront of adopting this new seed technology. In 1999, an estimated 80 percent of the soybean acreage in Argentina and 51 percent of the soybean acreage in the United States were planted with Roundup Ready soybeans. However, while genetically modified seeds can be a powerful weapon in a farmer's arsenal of weed control and insect protection tools, these seeds have typically sold for a premium over conventional varieties.

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<sup>1</sup>Roundup Ready is a brand name owned by the Monsanto Company.

In response to farmers' concerns about the pricing of genetically modified seeds, you asked us to provide you with information on the (1) prices of Roundup Ready soybean seeds and Bt corn seeds in the United States and Argentina and (2) major reasons for the price differences, if any, between the two countries for these seeds. As agreed, we obtained price ranges for popular varieties of these seeds—rather than average prices—and focused on prices paid by farmers in Argentina and in Illinois and Iowa—the two states with the largest soybean and corn acreage in the United States. The price ranges include technology fees (fees paid by farmers and others for the use of patented Roundup Ready soybean and Bt corn seeds) but do not include taxes.<sup>2</sup>

## Results in Brief

In 1998, available data indicate that the ranges of commercial prices for popular varieties of Roundup Ready soybean seeds were higher in the United States than in Argentina. However, as shown in table 1, for popular varieties of Bt corn seeds there were no clear differences in prices.<sup>3</sup>

**Table 1: Price Ranges for Roundup Ready Soybean and Bt Corn Seeds in the United States (Illinois and Iowa) and Argentina, 1998**

	Roundup Ready soybean seeds per 50 lb. bag	Bt corn seeds per 80,000 seed bag
United States	\$20 - \$23	\$83 - \$122
Argentina	\$12 - \$15	\$75 - \$117 <sup>a</sup>

<sup>a</sup>Price ranges for Bt corn seeds in Argentina are for 1999, the first year that well-documented price data were available for this product. Reliable 1998 price data were not available because Bt corn seeds were first marketed in 1998 and accounted for less than 1 percent of Argentina's corn acreage.

Sources: GAO based its estimates on data from Doane Marketing Research, Inc., and Argentine industry sources.

<sup>2</sup>Argentine farmers pay taxes on commercial seed; farmers in Illinois and Iowa do not.

<sup>3</sup>Soybean and corn seed prices in the United States and Argentina are not entirely comparable for a variety of reasons. For example, seed prices are from different times of the year to correspond with the different growing seasons in the United States and Argentina (the second quarter in the United States and the fourth quarter in Argentina). Other issues associated with seed prices are discussed in app. I and in a section on seed prices later in this report.

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Since we found price differences for Roundup Ready soybean seeds and not for Bt corn seeds, we focused our analysis of reasons for price differences on Roundup Ready soybean seeds.<sup>4</sup> We identified two primary reasons for price differences: (1) greater control over patented seed technology in the United States and (2) extensive black market sales of soybean seeds in Argentina.<sup>5</sup> Roundup Ready soybean seeds are patented in the United States; they are not patented in Argentina. Among other things, patents give a company more control in setting prices and restricting a product's use. For example, farmers in the United States are required to pay technology fees for the use of Roundup Ready soybean seeds and are not allowed to replant the seeds; this is not the case in Argentina. A strong black market for seeds in Argentina has also contributed to lower prices in that country: An estimated 25 to 50 percent of the soybean seeds grown in Argentina are sold in violation of Argentina's seed law. The law was designed, among other things, to protect plant breeders' intellectual property rights by requiring that all seeds be certified prior to sale.

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## Background

For many years, scientists have used traditional plant-breeding techniques to develop improved plant varieties with higher yields and greater resistance to pests, diseases, and environmental stresses. However, traditional plant-breeding techniques can be very time-consuming—it sometimes takes up to 15 years or more before a new plant variety reaches the market. Furthermore, in traditional breeding, generally only closely related plant species can be used in cross breeding for the development of new varieties and hybrids. Biotechnology—and, more specifically, genetic engineering—enables scientists to breach the reproductive barriers between species. Through the use of genetic engineering techniques, genes from one plant, animal, or microorganism can be incorporated into an unrelated species, thus increasing the range of traits available for developing new plants.

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<sup>4</sup>As discussed elsewhere in this report, other factors—such as farmers' willingness to pay for the product and the costs of developing and marketing new varieties—also affect seed prices.

<sup>5</sup>The term “black market” refers to trade in goods or commodities in violation of laws and regulations. For this report, it refers to the sale of soybean seeds in violation of Argentina's seed law (Act No. 20247; 1973). In addition, taxes are not collected on these sales, nor are royalties paid to the seed companies.

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In the United States, the first genetically modified food product—a delayed-ripening tomato—was marketed in 1994. Since then, genetically modified seeds have become available for many crops, with Roundup Ready soybeans and Bt corn being the ones most commonly grown. Roundup Ready soybean seeds contain a gene that enables the plant to withstand applications of Roundup—an herbicide that is effective against many types of weeds. Roundup Ready soybean seeds completed the U.S. regulatory process in 1995 and were marketed in the United States (as well as in Argentina) in 1996. The Monsanto Company holds U.S. patents for Roundup Ready soybean seeds that enable it to restrict the use of the seeds in the United States.<sup>6</sup> Monsanto licenses the Roundup Ready technology to seed companies, which incorporate it into their conventional soybean varieties and sell the genetically modified seeds to farmers. While Roundup Ready soybean seeds are marketed in Argentina by several seed companies, Roundup Ready soybean technology is not patented there.<sup>7</sup>

Bt corn provides resistance to several types of insects, including the European corn borer in the United States and a related pest—the sugar cane borer—in Argentina. These borers are major insect pests of corn, with the European corn borer historically costing U.S. farmers an estimated \$1 billion annually in crop yield losses and pest control expenditures. Bt corn is produced by modifying hybrid corn with a gene from *Bacillus thuringiensis*, a bacterium that occurs naturally in the soil. The gene produces a protein that causes European corn borer larvae to die after they feed on the plant.

Bt corn was first marketed in the United States in 1996 and in Argentina in 1998. Several companies, including the Monsanto Company, Mycogen Seeds, and Novartis Seeds, hold patents for various types of Bt corn in the United States and Argentina. However, in terms of restricting the product's use, patents are not as important for corn seeds as they are for soybean seeds—hybrid corn seeds have an inherent biological protection because

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<sup>6</sup>For example, U.S. purchasers are not allowed to save seeds for replanting in the following year.

<sup>7</sup>Monsanto's 1995 application for a patent for Roundup Ready soybeans in Argentina was rejected. Monsanto appealed the decision, and an Argentine court overturned the rejection. Monsanto has petitioned for reconsideration of the patent application; as of December 1999, the application was pending.

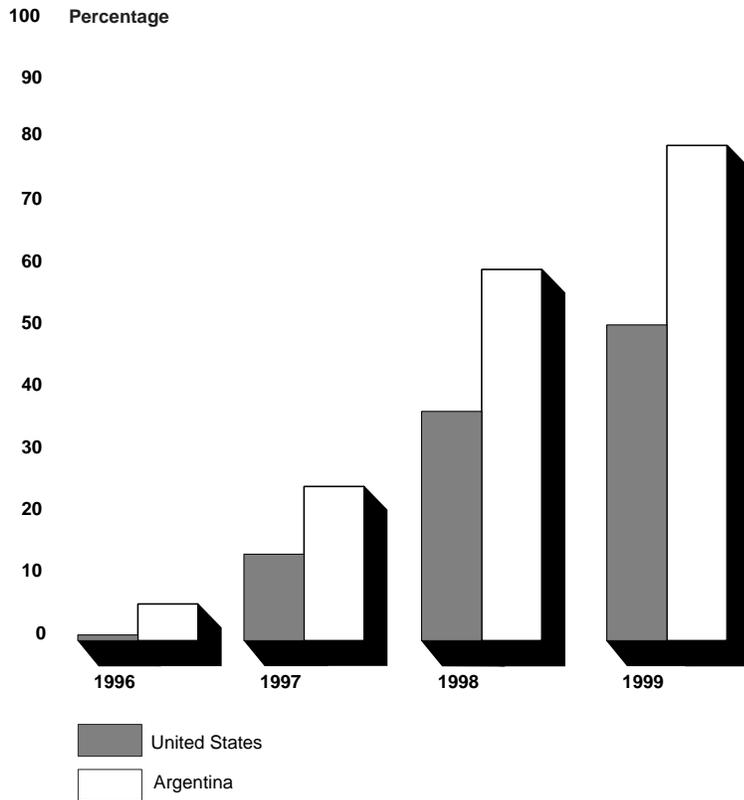
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of how they are reproduced. Specifically, when hybrid corn seeds are replanted, the resulting offspring do not have the same traits as the parent plant (e.g., they have lower yields). In contrast, succeeding generations of soybean plants are essentially identical to the parent plant. Thus, farmers do not save and replant hybrid corn seeds, whereas soybean seeds are traditionally saved and replanted in the following crop year. Seeds planted in this manner are called “farmer-saved” seeds.

U.S. and Argentine farmers have readily adopted Roundup Ready soybean and Bt corn seeds since their market introductions—with adoption rates for Roundup Ready soybean seeds particularly high. Farmers adopt these products for the perceived benefits they offer, including increased yields, more flexibility in crop management, reduced herbicide usage, and decreased pest management costs. According to a study by the U.S. Department of Agriculture’s Economic Research Service, the benefits and performance of these crops are expected to vary greatly by region, pest infestation levels, seed and technology costs, irrigation, and other factors.

Although Roundup Ready soybean seeds were first marketed in the United States and Argentina in 1996, by 1999—just 3 years later—they accounted for an estimated 51 percent and 80 percent of the total soybean acreage in the United States and Argentina, respectively. (See fig. 1.)

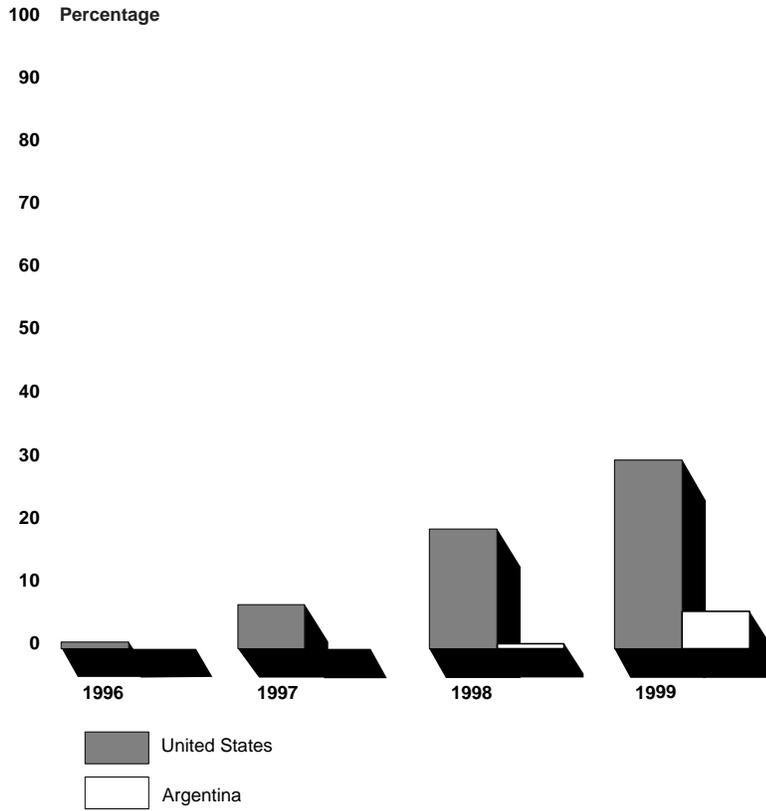
**Figure 1: Estimated Percentage of Soybean Acreage Planted in Roundup Ready Soybeans in the United States and Argentina, 1996 Through 1999**



Sources: U.S. and Argentine government and industry sources. (See app. I for specifics on these sources.)

Bt corn was marketed in small amounts in the United States starting in 1996 and in Argentina starting in 1998. As shown in figure 2, in 1999, U.S. and Argentine farmers planted an estimated 30 percent and 6 percent, respectively, of their corn acreage in Bt corn.

**Figure 2: Estimated Percentage of Corn Acreage Planted in Bt Corn in the United States and Argentina, 1996 Through 1999**



Sources: U.S. and Argentine government and industry sources.

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## Roundup Ready Soybean Seed Prices Were Higher in The United States Than in Argentina; Bt Corn Seed Prices Were Similar

In 1998, the ranges of commercial prices farmers paid for popular varieties of Roundup Ready soybean seeds were higher in the United States (specifically, Illinois and Iowa) than in Argentina. There were no clear differences in the price ranges of popular varieties of Bt corn in the two countries.<sup>8</sup> Several issues, however, should be considered to add perspective in interpreting our price comparisons. For example, the seed varieties used in the two countries generally differ.

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## Roundup Ready Soybean Seed Prices Are Higher in the United States

In 1998, the ranges of commercial prices paid by farmers for popular varieties of Roundup Ready and conventional soybean seeds were higher in the United States than in Argentina. In addition, as shown in table 2, Roundup Ready soybean seeds sold for a premium over conventional soybean seeds in both countries.

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**Table 2: Soybean Seed Price Ranges, 1998**

Per 50 lb. bag

	Conventional soybean seeds	Roundup Ready soybean seeds
United States	\$13 - \$17	\$20 - \$23
Argentina	\$8 - \$10	\$12 - \$15

Sources: GAO based its estimates on data from Doane Marketing Research, Inc., and Argentine industry sources.

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<sup>8</sup>See app. I for details on the methodology we used to develop the price ranges. The comparison of price ranges reflects how the prices of popular selling seeds in the two countries are affected by market conditions but does not permit a precise measurement of price differences.

**Price Ranges for Bt Corn Seeds Were Similar**

There were no clear differences in the ranges of commercial prices paid by farmers for popular varieties of Bt corn in the United States and Argentina. Generally, there is a premium for Bt corn seeds; however, this is not always the case. For example, as shown in table 3, some Bt corn seed prices are lower than those of conventional corn seeds.<sup>9</sup>

**Table 3: Corn Seed Price Ranges, 1998**

Per 80,000 seed bag

	Conventional corn seeds	Bt corn seeds
United States	\$72 - \$101	\$83 - \$122
Argentina	\$52 - \$105	\$75 - \$117 <sup>a</sup>

<sup>a</sup>The price range for Bt corn seeds in Argentina is for 1999, the first year that well-documented price data were available for this product. Reliable 1998 price data were not available because Bt corn seeds were first marketed in 1998 and accounted for less than 1 percent of Argentina's corn acreage.

Sources: GAO based its estimates on data from Doane Marketing Research, Inc., and Argentine industry sources.

**Issues Related to Our Price Comparisons**

For added perspective in interpreting the price ranges we identified, several issues should be considered. First, the agronomic conditions in the United States and Argentina generally differ, as do the seed varieties used in these countries, thus preventing a "one-to-one" comparison of seeds and seed prices. Second, because of data limitations, we used different methodologies in constructing price ranges for the two countries. As a result, prices are not strictly comparable, and a precise measurement of price differences is not possible. Third, lower seed prices do not necessarily mean greater profitability in crop production. While seeds are an important part of a farmer's production expenditures, other production costs, as well as the economic environment in which the farmer operates, also affect a farmer's profitability.

<sup>9</sup>The value of genetically modified seeds is derived from the quality of their germplasm, that is, the material in seeds that controls heredity (e.g., the ability to tolerate drought is a hereditary trait) as well as the technology component (e.g., Bt). Thus, conventional corn seeds with top-quality germplasm may be priced higher than Bt corn seeds with less desirable germplasm.

Finally, the data we present reflect past conditions. However, the increasing controversy over genetically modified food may affect seed prices in the future. In response to consumer concerns about the safety of genetically modified foods, several countries, including the United States, are considering labeling requirements that would identify foods containing genetically modified ingredients. In addition, some companies are offering price premiums for conventional commodities to meet potential consumer demand for products that are not genetically altered. Lower demand for genetically modified products along with higher prices for conventional commodities could lower the prices of Roundup Ready soybean and Bt corn seeds.

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## Major Reasons for Price Differences

Greater control over the patented seed technology in the United States and extensive black market sales of soybean seeds in Argentina are the two primary reasons we identified for the difference in price ranges of Roundup Ready soybean seeds in the two countries. Monsanto's U.S. patents for Roundup Ready soybean seeds have given it and the companies to whom it has licensed the technology greater control over seed prices and has enabled them to restrict the availability and use of seeds. Extensive illegal seed sales in Argentina have depressed prices in the legal Roundup Ready soybean seed market. These factors do not have the same impact on Bt corn seed prices. Bt corn is genetically modified hybrid corn, and hybrid corn cannot be easily reproduced from seed. Thus, farmers and others cannot readily reproduce Bt corn seed for use on their farms or in the black market.

In addition to the two primary reasons we identified as contributing to price differences in Roundup Ready soybean seeds, other factors—relating to farmers' willingness to pay for seeds and seed companies' production costs and marketing strategies—also affect seed prices.

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## Greater Control Over Patented Seed Technology Gives Companies More Control Over Roundup Ready Soybean Seed Prices in the United States

Seed companies have greater control over Roundup Ready soybean seed prices in the United States as a result of Monsanto's patents on the Roundup Ready soybean technology.<sup>10</sup> Thus far, Monsanto has not obtained patent rights for this product in Argentina. Seed breeders and companies usually seek intellectual property protection for their new plants and processes. This protection provides incentives for further private plant-breeding research by allowing the companies to control the use and availability of the new technology. Plant variety protection<sup>11</sup> and patents—two forms of intellectual property protection—are available in the United States and Argentina. Patent laws in the United States and Argentina, although different, enable seed companies to obtain greater control and protection than plant variety protection laws.<sup>12</sup>

Monsanto applies patent protection restrictions through licensing agreements with seed companies in the United States that use Roundup Ready technology in their soybean varieties. This patent protection has enabled Monsanto, and its licensees, to require U.S. farmers to pay technology fees for each bag of seed purchased—the current technology fee is \$6.50 a bag—and to sign agreements restricting their use.<sup>13</sup> For example, farmers may not save Roundup Ready soybean seeds for replanting. Farmer-saved seeds, the use of which is a traditional practice throughout the world, are still used in the United States for conventional soybeans and other nonhybrid crops. The technology agreement also

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<sup>10</sup>The patents on the Roundup Ready soybean technology expire on July 10, 2007.

<sup>11</sup>Plant variety protection laws in each country allow plant breeders to exclude others from producing or commercializing material of a specific plant variety for a period of time. In the United States, see the Plant Variety Protection Act, as amended, codified generally at 7 U.S.C. 2321 et seq. (1970). In Argentina, see "The Approval of the International Convention for the Protection of New Varieties of Plants," codified in Act No. 24.376 (1994).

<sup>12</sup>In the United States, companies can obtain patents on, among other things, plants, genetic alteration processes, or genetic sequences. In Argentina, companies can generally obtain patents on genetic alteration processes or genetic sequences that do not currently exist in nature. U.S. and Argentine industry representatives agreed that U.S. patent law is well established and defined, whereas the Argentine patent law is relatively new and untested for plants.

<sup>13</sup>Monsanto charges a fee for using the Roundup Ready soybean seed technology as part of a purchase agreement. Some seed companies list the technology fee separately on seed invoices; others incorporate it into the seed price. Also, although Roundup Ready soybean seeds are not patented in Argentina, Monsanto has agreements with other seed firms in Argentina allowing them to use the Roundup Ready technology in their seeds.

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stipulates that the purchaser may not supply saved seeds to anyone else for replanting.

Monsanto has not yet received a patent in Argentina for the Roundup Ready soybean seed technology, although seed companies have sold Roundup Ready soybean seeds since 1996. Thus, Monsanto does not require Argentine farmers to sign purchase agreement, nor does it charge a technology fee on Roundup Ready soybean seed purchases. Similarly, Argentine farmers can legally save and replant Roundup Ready soybean seeds. According to Monsanto, it is not feasible to charge a technology fee on soybean seeds in Argentina without patent protection. In contrast, Monsanto does charge a technology fee to farmers for its Bt corn in Argentina, for which it holds a patent.<sup>14</sup>

The patent-related restrictions that protect Roundup Ready soybean seeds in the United States from being saved and replanted are not as relevant for Bt corn seeds. Hybrid corn is produced by using two unrelated parent lines (plants). The hybrid traits of the resulting plant are diminished if its seed is replanted. Plant breeders guard the parent lines of hybrid corn as trade secrets and, thus, control the availability of the hybrid seed. As a result, although Monsanto and several other companies hold patents for various types of Bt corn seeds in both countries, patent restrictions on saving and replanting seeds are not necessary for Bt corn, while they are for Roundup Ready soybean seeds.

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### Black Market Sales of Soybean Seeds in Argentina Have Depressed Seed Prices

Extensive black market sales of soybean seeds (primarily Roundup Ready soybean seeds) in Argentina—ranging from 25 to 50 percent of all soybean acreage—have depressed the prices of legally sold seeds.<sup>15</sup> According to Argentine government and industry officials, seed companies have lowered the prices of Roundup Ready soybean seeds to enable them to better

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<sup>14</sup>In 1999, the technology fee for Monsanto's Bt corn was \$30 a bag in Argentina and \$24 a bag in the United States. According to Monsanto officials, the technology fee was higher in Argentina because Bt corn generally provides greater benefits to Argentine farmers. Argentine seed dealers and farmers said that Bt corn provided protection against two types of pests and provided greater stalk strength—a particularly important benefit in Argentina's climate.

<sup>15</sup>According to Argentine industry officials, black market seed is sold principally by seed multipliers (local firms that produce seed for the major seed companies and pay royalties to the companies), grain elevator operators, and farmers who sell their saved seed to other farmers.

compete for sales and market share. As shown in table 4, the market for illegal seed sales is significantly higher in Argentina than in the United States. While farmer-saved soybean seeds are also used in Argentina in large numbers, these seeds are at least one generation old. Black market seeds, on the other hand, are sometimes the same varieties as those sold commercially and thus may have newer, more desirable traits than farmer-saved seeds.

**Table 4: Sources of Soybean Seeds**

Source of seeds	Estimated percentage of total soybeans planted	
	United States	Argentina
Commercial sales	80-85	28-50
Farmer-saved <sup>a</sup>	15-20	25-35
Black market sales	0-2	25-50

<sup>a</sup>While Monsanto's patents enable it to restrict U.S. farmers from saving and replanting Roundup Ready soybean seeds, conventional soybean seeds can be legally replanted. In Argentina, all saving of seed—Roundup Ready and conventional—is legal as long as the seed is replanted only on the farm where it was originally grown.

Sources: U.S. and Argentine government and industry officials.

Argentina's seed law prohibits the sale of all uncertified seeds, conventional and genetically modified.<sup>16</sup> The certification program was designed in part to protect the intellectual property rights of plant breeders—thus, it serves as a form of plant variety protection. This protection provides a legal basis for seeking prosecution of anyone involved in the unapproved reproduction and sale of the plant breeders' discoveries. A group of Argentine seed companies and breeders, called the Argentine Association for the Protection of Plant Varieties, in cooperation with the government, have had an effort under way since 1990 to enforce the law and limit the sale of uncertified seed on the black market. The effort helped reduce black market sales from about three-quarters of all soybean seed sales in 1992 to about half in 1994. However, according to

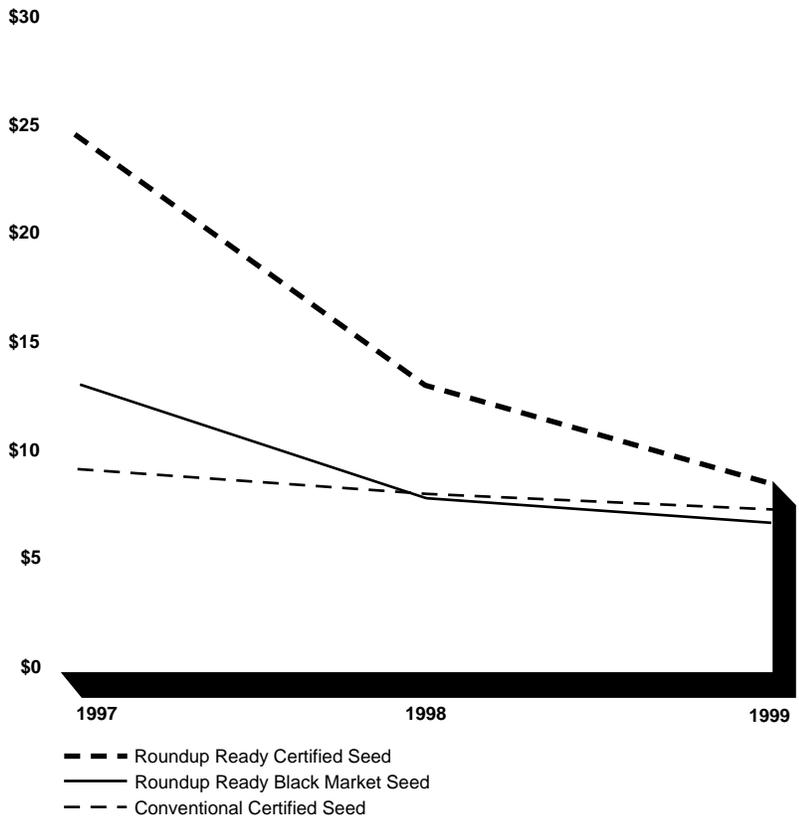
<sup>16</sup>Act No. 20247, section 9, requires, among other things, that seed bags contain a label with unique identification and certification information. Sales of seed without this information are prohibited.

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Argentine industry officials, black market sales subsequently increased in response to higher prices for commercial seeds following the initial marketing of Roundup Ready soybean seeds in 1996.

To compete with black market sales, seed companies lowered the commercial price of Roundup Ready soybean seeds from 1997 through 1999. According to an Argentine seed dealer, the commercial price reductions have led to recent decreases in sales of black market Roundup Ready soybean seeds. Prices for commercially sold conventional soybean seeds were also eroded by the falling price of Roundup Ready soybean seeds. As shown in figure 3, since 1997, the average commercial price paid for Roundup Ready soybean seeds dropped significantly in Argentina—from about \$25 for a 50-pound bag in 1997 to about \$9 in 1999. As a result, the average commercial price of Roundup Ready soybean seeds has moved closer to the average prices of black market Roundup Ready and commercial conventional soybean seeds.

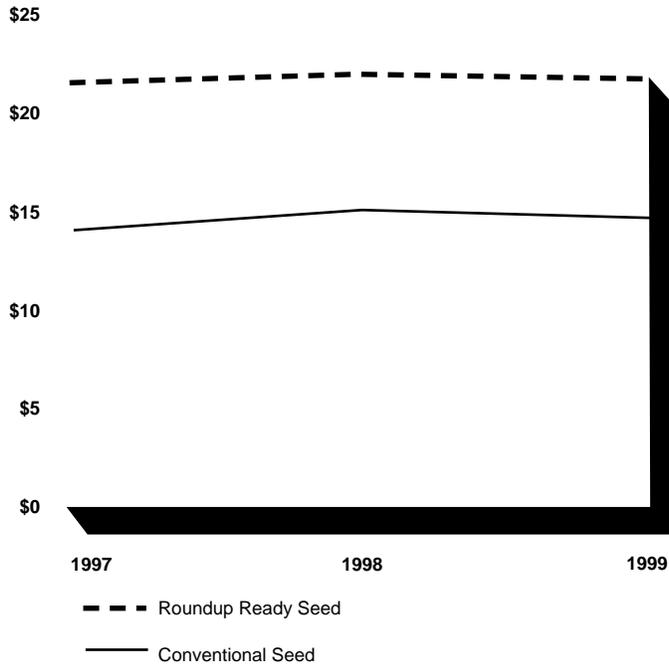
**Figure 3: Average Prices of Soybean Seeds in Argentina, 1997 Through 1999, per 50 lb. bag**



Sources: GAO based its estimates on data from Argentine industry sources.

As shown in figure 4, U.S. prices were relatively flat over the same period.

Figure 4: Average Prices of Soybean Seeds in the United States, 1997 Through 1999, per 50 lb. bag



Sources: GAO estimates based on data from Doane Marketing Research, Inc., and other industry sources.

The black market for hybrid corn seed is negligible. Hybrid corn is produced by using parent lines that are usually maintained as trade secrets by seed companies or organizations associated with plant breeders. The offspring of hybrid corn do not demonstrate the same traits as the parent plant and, thus, hybrid corn seed cannot be readily reproduced for illegal sale. Similarly, for all practical purposes, hybrid corn seed cannot be saved and replanted by farmers—thus, making less important the need for patent-related restrictions on replanting saved seeds.

### Other Factors Contribute to Price Differences

In addition to the primary reasons we identified for seed price differences in the United States and Argentina, other factors relating to farmers' willingness to pay for seeds and companies' marketing strategies and production costs contribute to price variations.

The amount a farmer is willing to pay for seeds depends on factors such as crop yields, commodity prices, and the costs of other agricultural inputs. For example, higher commodity prices may increase a farmer's willingness to pay more for seeds. The economic environment in which a farmer operates (including taxes, subsidies, and credit conditions) also affects how much a farmer will pay for seeds. In Argentina, the sales tax on seeds may make farmers less willing to pay higher prices for soybean seeds,<sup>17</sup> which may partially explain why conventional soybean seed prices are lower there than in the United States.<sup>18</sup> In the United States, subsidies (e.g., subsidized crop insurance and loan deficiency payments) and lower interest rates for credit may increase a farmer's willingness to pay and, thus, contribute to higher seed prices. Prices may also vary in response to seed companies costs of producing seeds and operating in different market environments. In addition, seed firms that are closely affiliated with pesticide companies may make seed pricing and marketing decisions that complement their pesticide products. Thus, in determining the price structure for its seeds and pesticides, a company would consider the prices that competitors in the local market charge for these products.

## Scope and Methodology

To determine the price of seeds in Argentina and the United States, we purchased market research data; obtained price information from seed companies, dealers, and farmers; and interviewed government and industry officials in the United States and Argentina. With these data, we developed price ranges for popular seed varieties for 1998 (1999 for Bt corn seeds) and trends in seed prices from 1997 through 1999. To identify the major reasons for price differences, we interviewed government and industry officials and university researchers and farmers in both countries. We also reviewed literature on intellectual property rights and pricing issues. We confirmed the seed price data in this report with government and seed industry officials in the United States and Argentina and other experts. We performed our review from July through December 1999 in accordance with generally accepted government auditing standards. Appendix I provides details on our scope and methodology.

<sup>17</sup>In Argentina, farmers pay a 21-percent value-added tax on seed purchases. The farmers recover a portion of this tax when they sell the commodity at harvest—thus, their net tax burden is about 12 percent. There is no sales tax on seed purchases in Illinois and Iowa.

<sup>18</sup>Argentine corn producers, on the other hand, cannot avoid the sales tax because hybrid corn seeds cannot be readily replanted by farmers or reproduced for sale on the black market.

As arranged with your office, unless you publicly announce the contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time, we will provide copies to interested congressional committees and the Honorable Dan Glickman, Secretary of Agriculture. We will also make copies available to others upon request.

If you have any questions regarding this report, please contact us—Robert Robertson at (202) 512-5138 or Susan Westin at (202) 512-3655. The key contributors to this report are listed in appendix II.

Sincerely yours,



Robert E. Robertson,  
Associate Director, Food and  
Agriculture Issues



Susan S. Westin,  
Associate Director, International  
Relations and Trade Issues



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# Scope and Methodology

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The Chairman, Subcommittee on Risk Management, Research, and Specialty Crops, House Committee on Agriculture, asked us to provide information on the (1) prices of Roundup Ready soybean seeds and Bt corn seeds in the United States and Argentina and (2) major reasons, if any, for price differences between the two countries for these seeds.

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## Prices for Seeds in the United States and Argentina

To determine the price ranges for popular varieties of these seeds in the United States, we used the results of a survey of Illinois and Iowa farmers from Doane Marketing Research, Inc. Questionnaires were sent to a panel of over 900 farmers—a representative sample of the total population of farmers with \$2,500 or more gross annual agricultural income in Illinois and Iowa.<sup>1</sup> Prices paid by the survey respondents were calculated to include discounts (e.g., volume discounts) and technology fees, but did not include promotional seed given to farmers. We used Doane's survey results to identify the 10 best-selling corn hybrids (Bt and conventional) and soybean varieties (Roundup Ready and conventional) in Iowa and Illinois. The varieties with the highest and lowest average price per unit within the group of top sellers formed the price ranges. Several seed company officials and other experts generally confirmed the U.S. price ranges that we report.

We used a different methodology to construct the price ranges in Argentina because different types of data were available from different sources. For the Argentine prices, we constructed the price ranges for popular seed varieties using government and industry (e.g., seed companies and distributors) retail prices and farmer discount data. Argentine government and industry officials also identified the popular varieties of Roundup Ready and conventional soybean seeds and Bt and conventional corn seeds. We used 1998 prices for Roundup Ready and conventional soybean seeds and conventional corn seeds. Because less than 1 percent of Argentina's corn acreage was planted with Bt corn in 1998 and well-documented price information was not available, we used prices from

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<sup>1</sup>We did not verify the validity of all of the price data provided by Doane Marketing Research. We obtained survey instruments and other documents in order to review the survey methodology, wording of questions, sampling, and mode of administration. Although about one-third of the over 900 Illinois and Iowa farmers returned the survey, Doane did not analyze the differences between responders and non-responders. However, analyses for prior surveys showed no statistical differences between the two groups. We also checked for consistency within the data set and for outliers. Doane's data are considered reliable by many seed companies that purchase the data to complement their marketing information.

Argentina's 1999 growing season when an estimated 6 percent of its corn acreage was planted with Bt corn. Argentine government and seed industry officials generally confirmed the seed price ranges that we report.

To calculate the average prices paid for soybean seeds from 1997 through 1999 (shown in figs. 3 and 4), we used different data sources and methodologies than we used to determine price ranges. The average prices are useful for showing price trends but are less reliable for comparing price differences between the two countries. The data on average commercial Argentine soybean seed prices are based on (1) estimates of several seed industry officials for 1997 and (2) published seed price lists for 1998 and 1999.

The average prices for the United States were constructed using (1) estimated farmer adoption rates for Roundup Ready soybeans and (2) Doane's survey data for Roundup Ready and all soybean seed prices. Seed industry officials in the United States and Argentina generally confirmed the price trends observed in both figures.

All prices in our report are reported in nominal U.S. dollars. Since 1991, the Argentine peso has been pegged to the U.S. dollar, with one peso being equal to one dollar.

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## **Reasons for Price Differences in the United States and Argentina**

To determine the reasons for soybean seed price differences in the United States and Argentina, we analyzed documents and other information obtained in interviews with officials from industry (seed companies, associations, seed dealers, and farmer organizations); government; university researchers; and farmers in Illinois, Iowa, and Argentina. We interviewed officials in the United States and Argentina from a number of seed companies, including the Monsanto Company; Pioneer Hi-Bred International, Inc.; Novartis Seeds, a division of Novartis Corporation; Nidera S.A.; Asociados Don Mario; and Morgan Seeds and Mycogen Seeds, subsidiaries of Dow AgroSciences. We interviewed officials from Argentine seed distribution companies, including: Desab S.A., Agronort, Centro Agropecuario Modelo, 3-El Semillas, and Francisco Celeart, S.A. In Illinois and Iowa, we interviewed seed dealers for Pioneer Hi-Bred Seeds, as well as seed marketing officials from agricultural supply firms.

We discussed the role of intellectual property rights and black markets with seed company officials, government officials, associations, patent attorneys, and economists in both countries. We examined statements and

policies of the World Trade Organization's Agreement on Trade-Related Aspects of Intellectual Property Rights, the International Association of Plant Breeders for the Protection of Plant Varieties, the International Union for the Protection of New Varieties of Plants, and the Convention on Biological Diversity. We also reviewed literature on the economic impact of intellectual property rights and seed piracy.

We interviewed Argentine government officials from the National Institute of Industrial Property, the National Service of Agrifood Health and Quality, the National Institute of Agricultural Technology, the National Advisory Committee on Agricultural Biotechnology, and the National Seed Institute. Argentine associations providing information included the Argentine Seed Association and the Society of Rural Argentina (a farmer organization).

We also interviewed and collected information from officials from the U.S. Department of Agriculture's Foreign Agricultural Service, National Agricultural Statistics Service, Agricultural Marketing Service, Economic Research Service, the Office of the U.S. Trade Representative, the U.S. Plant Variety Protection Office, and the U.S. Patent and Trademark Office. Associations in the United States that provided interviews and documents included the National Corn Growers Association, Illinois Corn Growers Association, United Soybean Board, and the American Seed Trade Association. Finally, we interviewed extension agents in Illinois and Iowa, state seed control officers, and officials from the Illinois and Iowa State Departments of Agriculture and the Illinois and Iowa Farm Bureaus.

We used seed prices from 1997 through 1999 to study price trends for genetically modified and conventional seeds in the two countries. The anecdotal information on prices provided by industry and government experts in the seed industry in Argentina and the United States was supported by the trends we observed in the data.

# GAO Contacts and Staff Acknowledgments

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