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THE PUBLIC DEBATE ON AGROBIOTECHNOLOGY: A BIOTECH COMPANY'S PERSPECTIVE

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Since the first commercial release of a bioengineered crop in 1996, planted acres of enhanced crops have increased steadily each year. Yet, public perceptions and knowledge of the benefits of this technology have not kept pace with grower demands for the new tools. Additionally, global regulatory infrastructure and capacity to evaluate and approve the release and import of these products has been uneven and slow. As the global population continues to grow and more people demand a higher standard of living, few solutions offer the promise of genetic modification, namely, to increase agricultural productivity while decreasing its impact on the environment. Monsanto will continue to use the tools of genetic modification for crop improvement, combining germplasm, biotech traits, and agronomic solutions to offer products and systems that will not only benefit producers, but also offer benefits to processors and consumers. As the true, scientifically-based benefits of these products become clearly articulated, support and acceptance of this new tool will lead to the next generation of added value products and consumers will be able to make informed decisions on cost, benefits, and alternative solutions to meeting their demands.

Key words: bioengineered crop; regulatory; Roundup Ready® soybeans; Bt corn; Bt cotton; public acceptance; biotechnology; consumers; science; stakeholders; scientific outreach.

Farm level adoption rates of bioengineered crops have surpassed the expectations of even the optimists among biotechnology proponents. Worldwide acreage sown to bioengineered crops continues to increase (figure 1) despite some predictions of reductions in farmer plantings. In 2001, some 130 million acres were planted to biotech crops worldwide, an increase of 19% over 2000 (James, 2001).[1] And crops such as *Bacillus thuringiensis* corn (Bt-corn), Roundup Ready® soybeans, and Bt-cotton have exhibited significantly faster adoption rates in the United States (US) than previous fundamental agricultural innovations, such as hybrid corn (Kalaitzandonakes, 1999).

Despite such success, bioengineered crops face a mixed regulatory and public acceptance environment in certain parts of the world. Argentina, Australia, Canada, China, India, Japan, Russia, South Africa, and the US have all approved bioengineered crops for commercial production and sale. In contrast, most of Europe and Brazil have delayed commercialization of biotech foods. Other parts of the world, such as Mexico, Indonesia and Turkey, are at the pre-commercialization stage, conducting field trials. In the absence of broad global participation in

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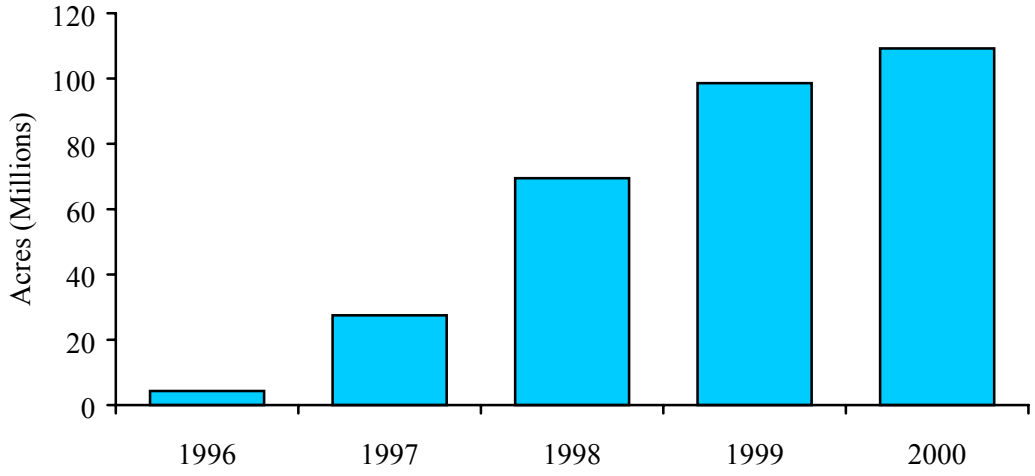
the production of biotech crops, US farmers can face restricted access to key export markets. Table 1 illustrates the degree of freedom to operate by country on the basis of regulatory approvals. Clearly, North America and Japan have had a more continuous and longer standing approval process, allowing market introduction of new traits and trade.

Figure 1. Worldwide Biotech Acres And Hectares, 1996-2000.



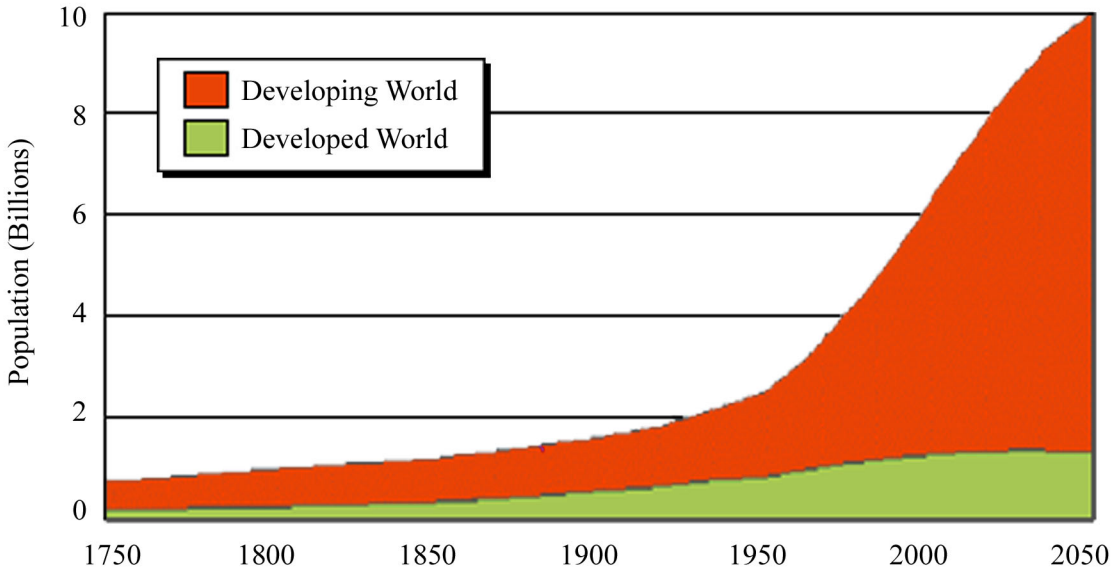
Note. From "Global Review of Commercialized Transgenic Crops: 2000," by C. James, 2001, ISAAA Briefs No. 23-2001.

Table 1: Worldwide Approvals For Biotech Crops, 2000.

Country	Number of Approvals
United States	51+
Canada	38+
Japan	30+
European Union	12
Mexico	3
Argentina	3
Australia	3
Brazil	1
CIS	1
India	1

The fragmented regulatory environment mirrors the public support of biotechnology in different parts of the world. Yet development of biotechnology crops has never been more needed. Some 6 million square miles of the earth are currently farmed. Without continuing yield increases, 15 million square miles could be needed by 2050, given current population projections (figure 2) (Borlaug, 2000). The most productive and sustainable farmland is already under cultivation. We at Monsanto believe that biotechnology provides an important tool for agricultural sustainability. Other interested voices have taken quite a different view of the technology. How did we get to where we are today? The next section reflects on the first five years of the commercial introduction of biotech crops.

Figure 2: Population Projections For Year 2050.



Note. From United Nations Population Division and Population Reference Bureau, 1993.

The Introduction Of Biotech Crops: Reactions, Changes And Influencing Factors

Part of the explanation for the differing responses and regulation of agrobiotechnology around the world lies in events that occurred concurrently during its commercial introduction. What follows is a brief overview of how specific events affected key markets in the US, Europe, Latin America, and the rest of the world.

United States (mid-1990s)

During the mid-1990s, Monsanto focused on developing biotechnology products that would provide greater weed control for farmers—especially in soybeans, but also in canola, corn and cotton. Those crops remain the main focus of biotechnology research at the company. Farmers needed new weed control technologies as a result of increased weed resistance. Against this background, farmers also faced declining world grain prices. United States farmers were therefore looking for a technology that would reduce production costs and increase yields. At the same time that the technology was rapidly developing, the United States had established a strong regulatory system for biotech approvals, through the efforts of the US Department of Agriculture

(USDA), the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA). The US was ahead of the rest of the world in this respect. There was a strong belief within the biotech industry that sound science would drive consumer acceptance of products that provided benefits to farmers as well as to the environment. In fact, environmental activist groups, although not expressing support for plant biotechnology, had not raised it as a major issue in the United States.

Europe (1995-1996)

In Europe, the process of regulating biotechnology was not nearly as well defined as it was in the United States. The European Union regulatory process was in a state of flux; as a result there was no one focal point for establishing trust and credibility about the safety of biotechnology. Before a solid regulatory process for biotechnology could be established, several critical events occurred in Europe. In March 1996, the "mad cow" crisis erupted, during which all exports of British beef were banned as a result of a link between BSE and its human version (new variant Creutzfeldt Jacob Disease). As a result, Europeans became increasingly skeptical that food regulatory authorities could adequately monitor and regulate the food supply. Also during 1996, Europe-based nongovernmental organizations (NGOs), which had been silent during the development phase of the first biotech products, began to champion an anti-biotech movement in Europe, forming collaborative efforts to link and coordinate their activities. Working against biotech crops was the perception that the first generation products delivered limited, if any, benefits to consumers. Monsanto, an American-based company, which had received import approval of some products before concerns were elevated, was particularly singled out. The company responded by launching an advertising campaign to discuss the potential benefits of biotechnology. Rather than easing concerns, the campaign created the perception among many Europeans that the industry, and Monsanto in particular, was trying to impose America's food and production systems on the European way of life.

Such events and cultural differences were not factored into the European launch of biotech crops by the biotechnology industry.

Latin America and the Rest of the World (mid-1990s)

While Europe was less receptive to biotech crops, Latin America's response was varied. Countries such as Argentina and Brazil were rapidly developing their agricultural systems, increasing production acreage devoted to soybeans and corn. The economic situation was also generally improving in the region during the 1990s. Latin America was in the early stages of developing a regulatory structure for the approval of biotech crops. As it turned out, Argentina rapidly adopted Roundup Ready soybeans, while Brazil chose a "wait-and-see" approach.

In the rest of the world (developing countries in Asia and Africa), there was little capacity to independently approve biotech crops in the mid-1990s. Initiatives such as the Convention on Biological Diversity and the Biosafety Protocol were gaining momentum, in an effort on the part of developing countries to protect their biological diversity from what they perceived to be the potential risks posed by living modified organisms. As a result, Monsanto and other biotechnology companies did not launch biotech crops into these markets during the initial commercialization stage.

The Late 1990s: Factors Influencing Monsanto's Continued Launch

The coincidence of the introduction of biotech crops in the mid-1990s with these developments around the world can account for some of the consumer backlash against biotech crops in Europe. However, other events in the late 1990s, particularly in the United States, also contributed to additional suspicion towards biotech crops. In March 1998, the US Patent Office granted the USDA and the cottonseed company Delta Pine Land a patent for a system that could protect intellectual property contained in each genetically modified seed. The USDA was interested in the technology, which would produce sterile seeds, as a way to offer U.S. crops and biotech traits to other countries without concern that the technology would be pirated. Anti-biotech groups dubbed it "terminator technology" and implied that farmers in the developing world, who save seed from year to year, would be forced to buy new seeds every year. Even though that would be true only for farmers who chose to plant biotech seeds for the benefits they provide, the technology proved very controversial. Monsanto become embroiled in the controversy because the company had made a bid to acquire the seed company in order to facilitate distribution of its biotech cotton products. Even though others held the patent, Monsanto was falsely accused in media reports of seeking to develop the technology protection system (which has yet to be proven workable). As a result, in 1998 Monsanto declared that it would not use any such technology should it become available. The issue left a lasting impression—especially in developing countries—that biotechnology companies, rather than bringing much-needed technology, had potential to exercise undue control over farmers.[2]

Following closely on the technology protection controversy came a laboratory experiment by Losey, Raylor, and Carter (1999) indicating the possibility of harmful effects to the Monarch butterfly from biotech corn. Publication of this research drew immediate media attention around the world. Activist groups in the United States, who had gradually begun to adopt tactics used by European activists, seized the Monarch issue.[3]

Such events reinforced an already negative climate in Europe. As a result, Europe imposed a moratorium on any new product approvals, which resulted in even more reluctance among developing countries. In Europe, the public debate shifted its focus to the labeling of biotech foods, as European consumers demanded the "right to know" and the "right to choose." Some leading food companies began demanding non-biotech grains, and in September 1999, Archer Daniels Midland Co., a large US grain handler, announced that it wanted farmers to segregate biotech from non-biotech crops.

Given such a negative climate in 1999, US and Canadian farmers were understandably concerned about whether they would be able to gain access to domestic and export markets in the 2000 planting season. Biotech acreage was predicted to decline in 2000. Such concerns resulted in a change in strategy on the part of Monsanto in 1999, focusing on effectively addressing the needs of its biggest market—North America—while better understanding consumer attitudes in domestic and international markets.

The Situation Since 2000

Market research in 2000 and 2001 continued to indicate that US consumers were not concerned about biotech foods (Pew Initiative, 2001; IFIC, 2001). Even the issue regarding an unapproved corn product (StarLink) in the food supply, which received intensive media coverage during late 2000 and early 2001, caused little change in public attitude (KRC, 2001). Moreover, in six out of seven countries sampled by the market research company Environics for Monsanto, pesticide and agrochemical residues were considered the greatest threat to food safety (table 2). Although

some European consumers did express concern regarding GM foods, the safety of GM foods was not the primary concern (table 2). In addition to such survey results, no change in purchasing behavior on the part of US consumers could be observed since the introduction of biotech crops. And despite forecasts, farmers held firm in their commitment to biotech crops, increasing their total acreage to 75 million acres (Monsanto, 2001). At the same time, a large portion of the public was either unaware or undecided about the technology. However, findings indicated that the more US consumers knew about the benefits of biotechnology, the more likely they were to support it.

Table 2: Food Safety Concerns For Selected Countries, 2000.

	US	Canada	Brazil	UK	Germany	France	Japan
Food handling/storage	39	25	34	15	17	7	4
Pesticides/agrochemicals	37	37	69	32	42	34	27
Bacterial contamination	21	18	25	11	23	10	5
Artificial ingredients	7	12	21	10	17	10	25
GM foods	2	9	1	21	15	19	11
Disease from animals	2	3	13	9	30	18	1

Note. Unaided voluntary responses to the following question, "What, if anything, do you feel are the greatest threats to the safety of the food you eat?" Figures are expressed as a percentage of respondents. From Environics GM Food Tracking for Monsanto, 2000.

This market research led Monsanto and other biotech firms to a key strategic conclusion—that there was an immediate need to inform US consumers about the benefits of biotechnology. In April 2000, Monsanto, along with eight other biotechnology companies, launched the Council for Biotechnology Information (CBI) in order to provide information about biotech foods to US and Canadian consumers. The industry had been criticized for not providing information to consumers and responding to NGO claims about biotech food products during the mid-1990s. At about the same time, US media shifted from negative to more positive/neutral coverage in 2000.

The food and feed industry, represented by organizations such as the Grocery Manufacturers of America (GMA, 2001) and the International Food Information Council (IFIC, 2000), also came out in support of biotech foods. Most food making companies received shareholder resolutions calling for a ban on GM ingredients in 2000, and all failed (Dorfman, 2000). Processors and traders, such as Cargill, ADM, and Conagra, expressed vocal support for biotech crops, while not engaging in discounting GM crops relative to non-GMOs. The government (US EPA, 2001) and scientific communities (AgBioWorld, 2002) have also lent their support to biotech crops. The regulatory framework set out by the US FDA was also strengthened (US FDA, 2001), as has the explicit inclusion of voluntary labeling that has industry support.

Strategies To Improve Public Acceptance Of Biotech Foods

Over these turbulent five years of commercial introduction Monsanto learned some key lessons:

- Impeccable science and grower demand are only the first steps in selling our products.
- Information about biotech products must be clear and delivered by credible authorities.
- There are many stakeholders with strong interests in the issue of agricultural biotechnology. Hence, a "go-it-alone" strategy is not always advisable.
- Carefully listening and responding to legitimate issues and concerns of consumers and other societal groups is paramount to the effective introduction of biotechnology products.

These lessons have been put to work as Monsanto continues its efforts to improve public acceptance of agricultural biotechnology. In November 2001, the new Monsanto company, solely devoted to agriculture, announced a new Monsanto Pledge comprised of five key elements: dialogue, transparency, respect, sharing and delivering benefits (Monsanto, 2002).

The company has endeavored to put the pledge into action. First, we have held a series of "listening sessions" in order to better understand public concerns and solicit feedback for improvement. Second, we have engaged credible messengers through scientific outreach efforts to objectively discuss the risks and benefits of biotechnology. Third, we are more effectively communicating the benefits of biotechnology to different stakeholders. Fourth, through initiatives such as the CBI, we are building critical coalitions and improving public awareness. And of course we remain committed to developing products that help North American farmers while sharing technologies with scientists in the developing world. For example, we have shared our rice genome information and have assisted in the development of subsistence crops such as sweet potato and cassava.

Listening Sessions

Monsanto participated in listening sessions with key stakeholder groups globally. These sessions were designed to help us directly understand and address legitimate public concerns about biotechnology. We focused on building relationships and networks with stakeholders, in order to develop a broader base of support and trust in the technology and to gain critical feedback.

Our initial conclusions from these sessions are that stakeholders are generally supportive of agricultural biotechnology. Concerns are often linked to larger issues such as consolidation, multinational corporate control, the future of agriculture, consumer choice, and a lack of trust in regulatory systems. These sessions have also revealed constructive suggestions to address stakeholder concerns and reduce conflict.

Scientific Outreach Efforts

Since 1999, Monsanto has actively promoted involvement of the scientific community in the biotech debate. We have promoted the dissemination of scientific information about biotech issues and products. We have conducted safety and benefit briefings for key stakeholder groups, such as regulatory agencies, food industry associations and retailers, members of the animal feed chain, and university and scientific organizations. We have developed an information source for scientists and communicators (http://www.agsymbion.com), and we supported the development of an extensive compendium of scientific research on biotechnology, which was compiled by ISAAA and Agbios (http://www.agbios.com).

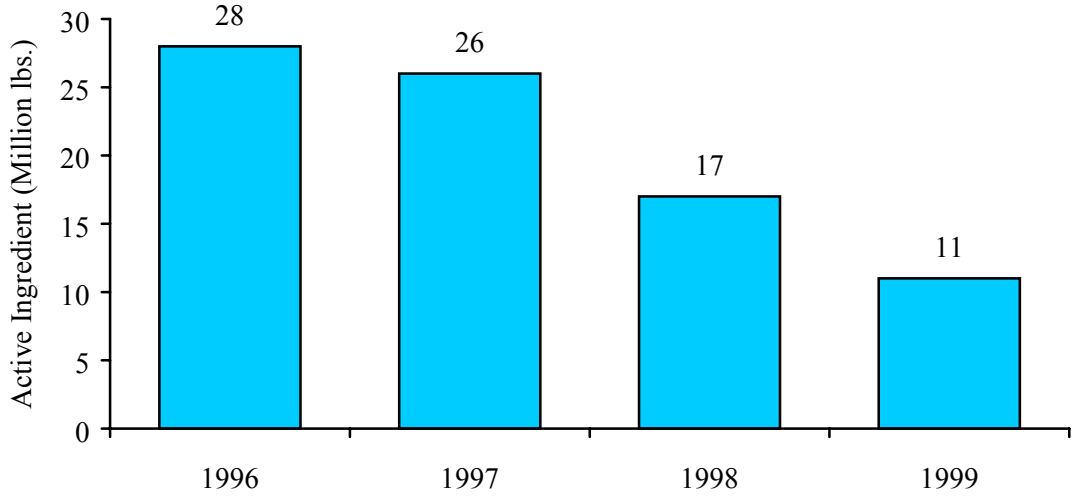
Advertising Program

In North America, the biotech industry's advertising program has also been very different in its approach, style, and content, compared to the European campaign initiated during the summer of 1998. The North American program is sponsored by an industry coalition, whereas a single company—Monsanto—sponsored the European campaign. The North American campaign has been a multi-faceted public information program, whereas the European initiative consisted of a series of less comprehensive advertisements. The North American program emphasizes biotechnology benefits and is more emotive, rather than the straightforward "debate approach" that we engaged in within Europe.

Where To From Here?

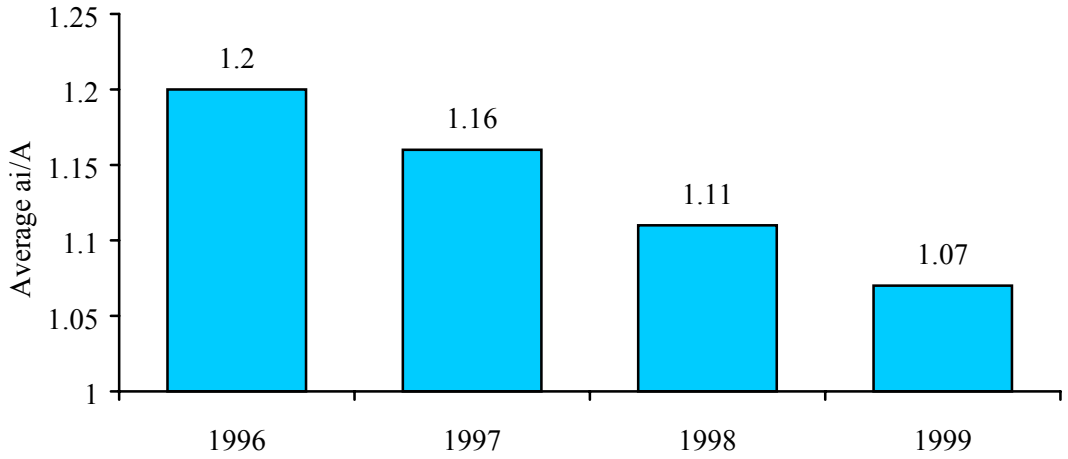
Monsanto strives to provide agricultural system solutions through crop protection products, seed, and biotech products. Today's biotech products are already providing tangible benefits to producers and the environment. Our long-term goal is to achieve more sustainable production systems by producing more food on less land with fewer inputs. We believe that biotechnology has an important role to play in world food security and sustainability. Since their introduction in 1996, Roundup Ready soybeans have given farmers greater choice in the herbicides that they use. The amount of soybean herbicides requiring EPA ground water advisory labeling has been reduced by 60% or 17 million pounds of active ingredient (figure 3). Likewise, farmers have reduced the amount of herbicides used in soybean production by 10% since the introduction of Roundup Ready soybeans in 1996 (figure 4). Similar results are found in relation to crop protectants. Our integrated solution of chemicals, seeds, and biotech traits has reduced pesticide pressure across the six major cotton producing states (figure 5). An average of 1.4 spray treatments are used for insect-protected cotton, compared to an average of 5.3 spray treatments for conventional cotton. The net result is that over 5 million acre-treatments have been eliminated with a resultant 2.0 million pounds of insecticide reductions.

Figure 3: Reduction In Herbicide Usage With EPA Ground Water Advisory Labeling Resulting From The Use Of Roundup Ready Soybeans.



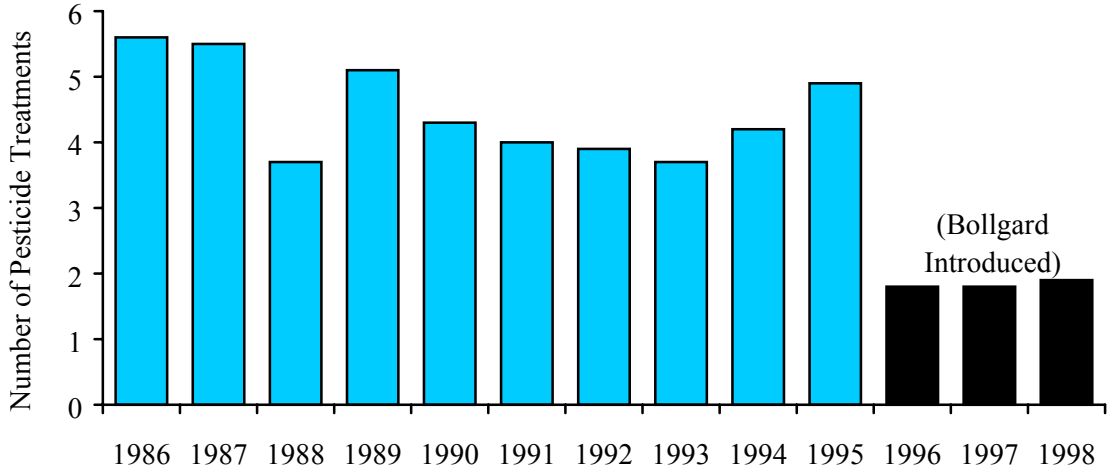
Note. Herbicides used in soybeans with ground water advisory labeling include acifluorfen, alachlor, bentazon, dimethenamid, metolachlor, s-metolachlor, metribuzin, flumetsulam, and fomesafen. From Doane Market Research, 2000.

Figure 4: Reduction In Soybean Herbicide Use, 1996-1999.



Note. Roundup Ready soybeans have grown to account for 50% of US market since their introduction in 1996. ai = active ingredient; A = per acre basis. Soybean herbicide use has decreased by 10% over the same period. From Doane Market Research, 2000

Figure 5: Reduction In Pesticide Use In Major Cotton States, 1996-1998.



Note. From Agricultural Biotechnology: Insect Control Benefits, by L.P. Ginanessi and J.E. Carpenter, 1999.

Monsanto is also developing new crops with traits that have more direct benefits to consumers. Several crops are under development and field testing to produce the following desirable traits: modified oils, carbohydrates, and amino acids; protein improvements; fiber modifications; enhanced vitamin content; increased yields (resulting in lower prices); the production of pharmaceutical proteins; and biopolymers.

For instance, consider high beta-carotene oilseeds (canola and mustard) that will help prevent vitamin A deficiency and that are nearing commercialization (table 3). Vitamin A deficiency affects some 800 million people worldwide, leading to night blindness or in some cases complete

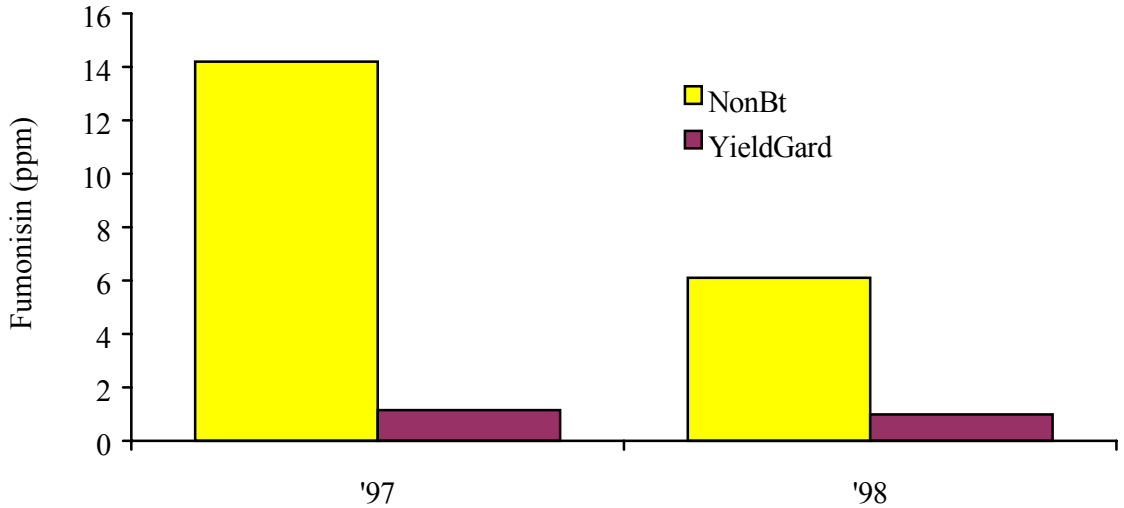
blindness. Adults, on average, need a dose of 750 µg of Vitamin A per day. Modified oilseed crops will conveniently deliver the required daily amount. Consumers can also benefit from biotech crops that result in lower levels of food contaminants. YieldGard® Bt-corn has improved the overall quality of the corn grain, resulting in higher quality animal feed and reducing the risks from certain mycotoxins, such as fumonisin (figure 6), in the food supply.

Although we believe that such benefits will speak for themselves, ultimately consumer acceptance of agricultural biotechnology will take more than the initiatives of our company alone. Rather, as we have learned, acceptance is predicated on a two-way dialogue and engagement with the public through a broad coalition of stakeholders.

Table 3: High Beta-Carotene Oilseeds.

Source (mg/g)	Beta-Carotene
Carrots	30-110 (60 avg.)
Pumpkin	16
Tomato	3-6
Melon	17
Apricots	20
Red palm oil	250-350
High carotenoid canola oil	1,000 – 1,200

Figure 6: Improved Grain Quality From Bt-Corn.



Note. From "Occurrence of fusaproliferin and beauvericin in Fusarium-contaminated livestock feed in Iowa," by G. Munkvold, H.M. Starh, A. Logrieco, A. Moretti, and A. Ritieni, 1998, Applied and Environmental Microbiology, 64(10), pp. 3923-3926.

Endnotes

[1] According to Clive James, Chairman of the ISAAA, the International Service for the Acquisition of Agri-biotech Applications, an estimated 3.5 million farmers from industrial and developing countries grew and significantly benefited from planting 44.2 million hectares (109.2 million acres) of biotech crops in 2000. ISAAA concluded that in 2000, biotech acres grew by 11% or 4.3 million hectares to 44.2 million hectares, from 39.9 million hectares in 1999. ISAAA also predicts more than 10% growth in biotech crop acreage in 2001, with the number of farmers benefiting from biotech crops in 2001 growing to over 5 million (James, 2001).

[2] It should be noted that in December 2000, Monsanto abandoned its plan to acquire Delta Pine Land, due to difficulties that arose during the relevant Federal Trade Commission review of the proposed acquisition.

[3] Extensive field research conducted in 1999 and 2000 by several independent researchers resulted in a consensus conclusion that Bt corn poses negligible risk to the Monarch population (Sears *et al*., 2001).

References

AgBioWorld. (2002). Scientists in support of biotechnology. Available on the World Wide Web: http://www.agbioworld.org/declaration/declaration_index.html.

Borlaug, N.E. (2000). Ending world hunger: The Promise of biotechnology and the threat of antiscience zealotry. Plant Physiology, 124, pp. 487-490.

Dorfman, B. (2000, November 3). Many Americans say stop planting gene-altered crops. Reuters.

Grocery Manufacturers Association (GMA). (2001). In support of biotechnology (white paper). Available on the World Wide Web: http://www.gmabrands.com/news/docs/WhitePaper.cfm?docid=429

International Food Information Council (IFIC). (2001). More US consumers see potential benefits to food biotechnology. Many oblivious to labeling debate. Available on the World Wide Web: http://www.ific.org/proactive/newsroom/release.vtml?id=19241

International Food Information Council (IFIC).(2000). Background on food biotechnology. Available on the World Wide Web: http://ific.org/proactive/newsroom/release.vtml?id=18620

James, C. (2001). Global review of commercialized transgenic crops: 2000 (ISAAA Brief No. 23-2001). Available on the World Wide Web: http://www.isaaa.org.

Kalaitzandonakes, N. (1999). A farm level perspective on agrobiotechnology: How much value and for whom? AgBioForum, 2(1), pp. 61-64. Available on the World Wide Web: http://www.agbioforum.org/.

KRC Research and Consulting. (2001, November). U.S. tracking results.

Losey, J.E., Rayor, L.S., and Carter, M.E. (1999). Transgenic pollen harms monarch larvae. Nature, 399, p. 214.

Monsanto Co. (2002). The new pledge. Available on the World Wide Web: http://www.monsanto.com/monsanto/about_us/monsanto_pledge/default.htm.

Monsanto Co. (2001). Achievements in biotechnology, 2000. Available on the World Wide Web: http://www.biotechbasics.com/biotech01/index.html.

Munkvold, G., Starh, H.M., Logrieco, A., Moretti, A., and Ritieni, A. (1998). Occurrence of fusaproliferin and beauvericin in Fusarium-contaminated livestock feed in Iowa. Applied and Environmental Microbiology, 64(10), pp. 3923-3926.

Pew Initiative on Food and Biotechnology. (2001, March 26). Pew initiative on food and biotechnology finds public opinion about genetically modified foods 'up for grabs.' (news release). Available on the World Wide Web: http://pewagbiotech.org/newsroom/releases/032601.php3

Sears, M.K., Hellmich, R.L., Stanley-Horn, D.E., Oberhauser, K.S., Pleasants, J.M., Mattila, H.R., Siegfried, B.D., and Dively, G.P. (2001). Impact of Bt corn pollen on monarch butterfly populations: A Risk assessment. Proceedings of the National Academy of Science, USA , 98(21), pp. 11937-11942.

United States Environmental Protection Agency (US EPA). (2001). Biopesticides registration action document. Available on the World Wide Web: http://www.epa.gov/pesticides/biopesticides/reds/brad_bt_pip2.htm.

United States Food and Drug Administration (US FDA). (2001, January 17). FDA announces proposal and draft guidance for food developed through biotechnology (press release). Available on the World Wide Web: http://www.cfsan.fda.gov/~lrd/hhbioen3.html.