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MONSANTO



P l a n t B i o t e c h n o l o g y

2001



"It is notable that the global area of GM crops exceeded the historical milestone of 50 million hectares (in 2001)."

Clive James, Ph.D., Chairman, International Service for the Acquisition of Agri-biotech Applications (ISAAA), 2001

Worldwide Progress

Agricultural crops enhanced through biotechnology were planted worldwide in 2001 by large and small farmers in both developed and developing countries. Enhanced crops were grown on 52.6 million hectares (130 million acres), which was the first time in their six-year history that acreage exceeded the 50 million mark. The area devoted to enhanced crops in 2001 rose by 19 percent over 2000 – an increase of 8.4 million hectares (20.8 million acres).

The United States remained the world leader in the production of enhanced crops in 2001 with 68 percent of the total acreage planted, or 35.7 million hectares (88.2 million acres). After the U.S., the three principal countries that grew enhanced crops were Argentina (11.8 million hectares; 29 million acres), Canada (3.2 million hectares; 7.9 million acres), and China (1.5 million hectares; 3.7 million acres).

According to the International Service for the Acquisition of Agri-biotech Applications (ISAAA), the world's farmers chose to plant enhanced crops because of their significant environmental and economic benefits. Enhanced crops enable farmers to employ more sustainable, resource-efficient crop management practices, such as no-till or low-till techniques; use fewer applications of conventional insecticides; and provide both growers and society with more efficient and higher crop productivity. According to ISAAA's 2001 report, more than three-quarters of the growers who benefited from these crops were resource poor, developing country farmers.

Monsanto Highlights – 2001

In 2001, Monsanto continued to offer the world's growers the most advanced agricultural technologies, the widest coverage in both crops and geography, and a portfolio of products unmatched in the industry. Through the development of plant biotechnology, Monsanto is helping its customers manage the financial challenges of farming by improving their yields and reducing their input costs. With the assistance of these crops, farming is also becoming more environmentally sustainable.



"In many cases, biotechnology may even save an entire industry in a state or region, such as the papaya industry in Hawaii or the citrus industry in Texas."

Leonard Gianessi, Senior Research Associate,
National Center on Food and Agricultural
Policy, October 2001

In 2001:

- Acres planted with Monsanto traits increased about 14 percent over 2000, and seeds with Monsanto traits accounted for just over 90 percent of the acres planted with herbicide-tolerant or insect-protected crops.
- Monsanto received full commercial approval for *Roundup Ready* cotton in Argentina.
- South Africa approved commercialization of *Roundup Ready* soybeans, and farmers planted that country's first commercial food crop enhanced through biotechnology.
- Indonesia approved the commercialization of *Bollgard* cotton.
- Monsanto received field trial approval for *Roundup Ready* corn in Indonesia and *YieldGard* corn in the Philippines for the first time, and approval for large-scale field trials of *Bollgard* cotton in India.
- The U.S. Environmental Protection Agency (EPA) renewed Monsanto's registrations for *YieldGard Corn Borer* insect-protected corn (seven years) and *Bollgard* insect-protected cotton (five years).
- Monsanto President and CEO Hendrik A. Verfaillie announced a new Monsanto Pledge commitment to develop plant biotechnology and advanced breeding techniques to improve the quantity and quality of bioenergy.
- Monsanto donated a key soybean genetic marker to the United Soybean Board's Technology Utilization Center to help accelerate the Better Bean Initiative's goal to develop a high yielding soybean that is lower in saturated fat.
- Monsanto scientists published the entire genetic sequence of an *Agrobacterium tumefaciens* strain of bacteria used to transfer DNA into plant cells. The publication of the bacterial genome will assist other researchers in understanding how it interacts with plants.
- Monsanto acquired 100 percent equity in Limagrain Canada Seeds, Inc. – a major canola seed research, production and marketing company, based in Saskatchewan.
- Monsanto conducted regulatory field trials in 26 countries throughout North America, Latin America, Asia, Africa, Eastern Europe and the Middle East.



"Biotechnology gave farmers another tool to control weeds...while at the same time, helping us improve our stewardship of the environment."

*Bart Ruth, Grower & President, American Soybean Association, Rising City, Nebraska
Soybean Digest, American Soybean Association, January 2002*

Since their introduction in 1996, *Roundup Ready* soybean plantings have increased from just over one million acres in the United States to more than 78 million acres in seven countries. *Roundup Ready* soybeans, which contain in-plant tolerance to *Roundup* brand herbicides, were the dominant biotech crop grown in 2001.

United States

Roundup Ready soybeans, which were planted on over 54 million U.S. acres in 2001, continue to provide environmental and economic benefits. According to the American Soybean Association (ASA), U.S. soybean growers credit the introduction of *Roundup Ready* soybeans for helping them adopt conservation tillage (CT). In fact, a 2001 ASA survey found that 53 percent of surveyed U.S. farmers are now making fewer tillage passes in the field and 48 percent have eliminated tillage altogether. CT is an important technique for increased agricultural sustainability. ASA data indicates CT saved 247 million tons of topsoil and 234 million gallons of fuel in 2000 alone.

Roundup Ready soybean growers enjoyed economic benefits as well. According to another 2001 U.S. study conducted by the National Center on Food and Agricultural Policy, herbicide tolerant soybeans decreased growers' cost by a total of \$735 million in 2001.

As a result of economic and environmental advantages like these, 97 percent of U.S. *Roundup Ready* soybean growers surveyed by Monsanto in 2001 rated the product a very good, good or fair value. Overall, 97 percent of U.S. growers surveyed were very or somewhat satisfied with the product, while 91 percent of U.S. growers surveyed were very or somewhat satisfied with the yield potential of *Roundup Ready* soybeans.

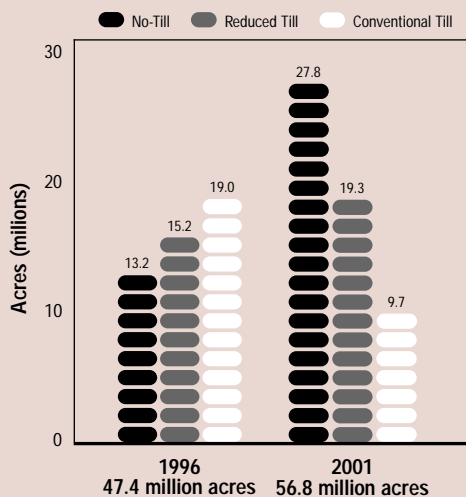
Word about the value of *Roundup Ready* soybeans continues to spread. In fact, 44 percent of surveyed U.S. growers who did not plant *Roundup Ready* soybeans in 2001 plan to plant them on at least some of their soybean acres this year.

Argentina

Growers in Argentina planted over 27 million acres, or 95 percent of the country's total soybean acres, with *Roundup Ready* soybeans in 2001. This is an increase of several hundred thousand acres over the previous year. According to the International Service for the Acquisition of Agri-biotech Applications (ISAAA), growers who planted *Roundup Ready* soybeans in Argentina were able to decrease their agrochemical expenses and stabilize their yields.

Roundup Ready soybeans are also approved and grown commercially in Uruguay and will be grown for seed bulk-up in Paraguay this year. Field trials are on-going in Bolivia.

**Soybean Acres By Tillage Type (U.S.)
1996 vs. 2001**



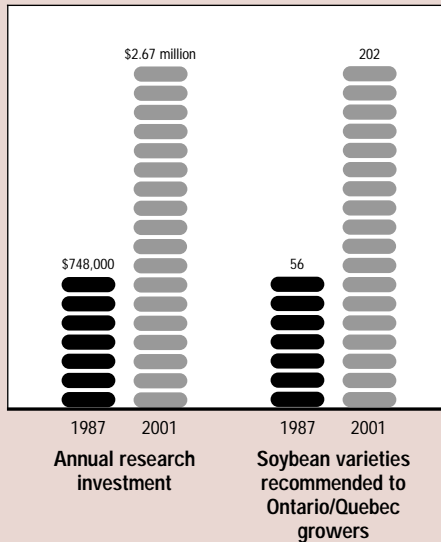
Source: American Soybean Association, 2002



"We've never had to use the 'too' excuses since we started using Roundup Ready soybeans – too windy, too wet, too cold, too dusty."

Bev Hill, Grower, Hill & Hill Farms, Varna, Ontario, 2001

Soybean Research Investment Has Sent Variety Choices Skyrocketing (Canada)



Source: Ontario Soybean Variety Trial Reports, 2002

Canada

Roundup Ready soybeans enjoyed a 50 percent market growth in 2001 over 2000 among Canadian farmers who planted the crop on more than 590,000 acres. Overall, *Roundup Ready* soybeans captured 28 percent of Canadian soybean plantings, an increase over the 18 percent share the previous year.

Roundup Ready soybeans are gaining popularity in Canada primarily due to their enhanced weed control and economic and yield advantages over conventional varieties – benefits that have convinced many farmers that the *Roundup Ready* system is a better value than saving seed. In fact, in 126 side-by-side field trials, conducted over three years on grower land in Ontario and Quebec, *Roundup Ready* soybeans out yielded conventional soybean programs by an average of 2.2 bu/acre.

Further, 75 percent of Canadian growers surveyed by Monsanto Canada agree that Technology Use Agreement checks are fair, and a survey by the Canadian Seed Trade Association (CSTA) found that improved intellectual property protection for soybeans has supported a 257 percent increase in new soybean variety research since 1987.

Romania

In Romania, about 44,000 acres of *Roundup Ready* soybeans were planted by growers in 2001, a 45 percent decrease from 2000 plantings largely due to severe drought conditions. Certified seed acres increased by 25 percent over the previous year.

South Africa

South African growers planted *Roundup Ready* soybeans for the first time in November 2001 on about 20,000 acres, following government approval to commercialize the product earlier in the year. Monsanto South Africa reports that nearly all the *Roundup Ready* seed imported into the country was sold. At the time of this report, South Africa's soybean crop was in mid-season growth.

Mexico

In 2001, *Roundup Ready* soybeans were grown on a semi-commercial basis in Mexico. Growers in the Northeast and Southeast planted more than 4,000 acres of *Solución Faena Soya*, the Mexican trade name for Monsanto's product. With the *Roundup Ready* system, Mexican growers enjoyed an average 20 to 30 percent cost reduction and four to 10 percent higher net income than with conventional varieties. Those who grew the biotech soybeans using minimum tillage realized 112 percent more income from the *Roundup Ready* system.



"[Biotechnology] can contribute to growing high quality food in ways that are environmentally attractive to growers and consumers alike..."

Leonard Gianessi, Senior Research Associate, National Center for Food and Agriculture Policy, American Medical Association Media Briefing, October 12, 2001

YieldGard vs. Conventional Hybrids (Canada)

Hybrid	Maturity	Yield (bu/acre)	YieldGard Advantage (bu/acre)
DK325 DK334BtY	2575 CHU 2600 CHU	120.0 125.2	5.2
DK427 DKC42-22	2850 CHU 2850 CHU	137.4 142.2	4.8
DK595 DK595BtY	3350 CHU 3350 CHU	118.9 137.2	18.3

YieldGard consistently delivers protection from European corn borer.

Source: Monsanto Company, 2002

Since the 1997 introduction of *YieldGard Corn Borer* insect-protected corn and the 1998 introduction of *Roundup Ready* herbicide tolerant corn in the U.S., acres planted with these modified crops have continually increased. In 2001 alone, over 21 million acres of *YieldGard Corn Borer* corn, *Roundup Ready* corn and *Roundup Ready/YieldGard Corn Borer* stacked-trait corn were planted worldwide.

YieldGard Corn Borer Corn

In 2001, *YieldGard Corn Borer* was grown in the U.S., Canada, Argentina and South Africa on more than 18 million acres. The first genetically-improved corn that offers full-plant, full-season protection against corn borers, *YieldGard Corn Borer* delivers maximum yield potential by consistently producing more bushels per acre than conventional corn.

Benefits and Satisfaction

Hundreds of Monsanto-branded and non-branded *YieldGard Corn Borer* hybrids were available to U.S. farmers in 2001 from all major seed companies. Ninety-nine percent of all surveyed users said they were very or somewhat satisfied with the product's effectiveness in controlling first and second generations of the pest.

The majority (75 percent) of U.S. growers surveyed believe *YieldGard Corn Borer* provides them with greater value than non-Bt corn, reporting an average added value of \$9.80 per acre. When they were asked to compare the performance of *YieldGard* to non-Bt corn, 60 percent of surveyed growers rated *YieldGard* as a much or somewhat better value than conventional hybrids.

In Canada, 59.6 percent of all corn growers planted *YieldGard Corn Borer* on about 900,000 acres in 2001 – an increase of 150,000 acres over 2000. Corn crops, particularly in Ontario, were severely affected by European corn borer in 2001, yet DEKALB market development plots planted across the province showed a 5.2 to 18.3 bu/acre yield advantage with *YieldGard* over non-Bt hybrids.

In Argentina, where the brand name is *Maizgard*, growers planted Monsanto's modified corn on 13 percent of the country's total corn acres last year. Forty-one percent of the growers who planted *Maizgard* were small holders, 36 percent were medium-size holders and 23 percent were large holders.

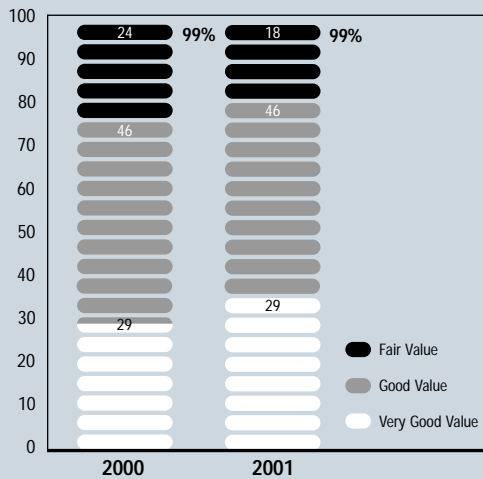
2001 marked the third commercial year for yellow *YieldGard* hybrids in South Africa where the product was planted on over 200,000 acres – a 33 percent increase over 2000. White *YieldGard* maize – used for human food in South Africa – was introduced for the first time in 2001. Both crops were in mid-season growth at the time this report was compiled.



"We find the evidence to date supports the appropriate use of Bt corn as one component in the economically sound management of lepidopteran corn pests."

Excerpted from letter to BioScience from 22 plant science experts, November 2001

Nearly 100% of Roundup Ready Corn Users Believe Roundup Ready Corn is a Fair to Very Good Value



Q: Considering all aspects of *Roundup Ready* corn, including seed costs and your herbicide program, would you consider *Roundup Ready* corn to be:

Source: *Roundup Ready Corn Satisfaction Study, Marketing Horizons, 2000 & 2001*

Roundup Ready Corn

Roundup Ready corn contains in-plant tolerance to *Roundup UltraMAX* herbicide. *Roundup UltraMAX*, which is a broad spectrum herbicide, reduces the total amount of herbicides growers use to control weeds in the crop – an environmental and economic advantage.

Benefits and Satisfaction

Nearly all surveyed users (99 percent) said *Roundup Ready* corn provided them with a very good to average value, while 92 percent of those surveyed said they will definitely or probably plant the product again in 2002. *Roundup Ready* corn was planted on about 4.8 million acres in the U.S. last year.

In a U.S. study conducted by Monsanto, *Roundup Ready* corn treated with *Roundup UltraMAX* herbicide consistently out-yielded *Roundup Ready* corn treated with a competitive herbicide and conventional corn treated with a competitive herbicide. In 22 field trials on farmer land, the *Roundup Ready* system yielded 13.1 bushels per acre more than the conventional corn system, and 4.7 bushels per acre more than the competitive herbicide program.

Canadian growers planted over 140,000 acres of *Roundup Ready* corn in 2001, an increase of about 38,000 acres over 2000. In Ontario alone, growers planted 50 percent more acres of *Roundup Ready* corn in 2001 than 2000 – the largest one-year percentage increase of any seed corn technology.

Bulgaria grew *Roundup Ready* corn on more than 50,000 acres in 2001, and Indonesia approved field trials of the product for the first time.

Stacked Trait Corn

Monsanto's *Roundup Ready/YieldGard Corn Borer* stacked trait corn – offering *Roundup UltraMAX* tolerance and corn borer protection in a single plant – was grown on 1.2 million U.S. acres last year, an increase of more than one million acres over the 2000 planting season.

Also in 2001, Monsanto conducted over 200 field trials in 80 U.S. locations to evaluate the efficacy of a *YieldGard* product that provides corn rootworm and corn borer control in a single plant. In field tests, the new stacked trait corn showed superior rootworm control compared to both conventional insecticide sprays and chemical seed treatments. Trade named *YieldGard Plus*, the product is expected to be commercially available for planting in the 2003 growing season.

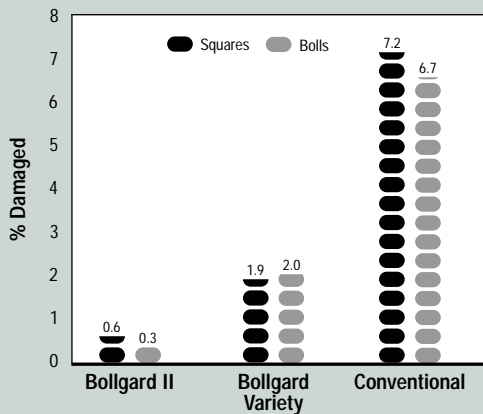


C O T T O N

"There is a trend emerging that shows biotech crops, especially cotton, significantly reduce the amount of chemical insecticides that must be sprayed to control insect pests."

*Nicholas Kalaitzandonakes, Ph.D.,
Associate Professor, Agribusiness,
University of Missouri*

Southeast U.S. Seasonal Average in 12 Locations System Damaged Fruit: *Bollgard* & *Bollgard II* vs. Conventional Cotton, 2001



Source: Monsanto Company, 2002

Monsanto offers three types of genetically enhanced cotton: *Bollgard* single-trait insect-protected cotton, which provides season-long protection against cotton bollworm, pink bollworm and tobacco budworm; *Roundup Ready* single-trait herbicide tolerant cotton, which enables growers to apply *Roundup* herbicide over-the-top of growing crops; and *Bollgard/Roundup Ready* stacked-trait cotton, which provides both insect protection and *Roundup* tolerance in a single plant.

Monsanto's enhanced cotton varieties were planted on about 12 million acres in seven countries in 2001.

United States

In 2001, U.S. farmers grew over five million acres each of *Roundup Ready* single-trait cotton and *Bollgard/Roundup Ready* stacked-trait cotton, and about 500,000 acres of *Bollgard* single-trait cotton. According to the U.S. Department of Agriculture, genetically enhanced cotton comprised 75 percent of U.S. cotton acres in 2001, an 18 percent increase over the previous year.

Studies conducted in 2001 confirm that all three biotech cotton crops provide growers with significant economic and environmental benefits. According to the National Center on Food and Agricultural Policy, American growers have increased their annual net revenue by \$99 million since the introduction of insect protected cotton primarily by eliminating the use of 2.7 million pounds of insecticide. And a recent survey conducted by the Conservation Technology Information Center (CTIC) indicates that herbicide tolerant cotton has significantly increased the use of conservation tillage (CT). CTIC estimates that CT has saved U.S. cotton farmers about \$2.6 billion to date.

Satisfaction with *Bollgard* and *Roundup Ready* single-trait cotton and *Bollgard/Roundup Ready* stacked-trait cotton continued to be high in 2001. Ninety-five percent of surveyed *Roundup Ready* growers said they were very satisfied (59 percent) or somewhat satisfied (36 percent) with the technology, while 89 percent of *Bollgard/Roundup Ready* stacked-trait users said they were very satisfied (54 percent) or somewhat satisfied (35 percent).

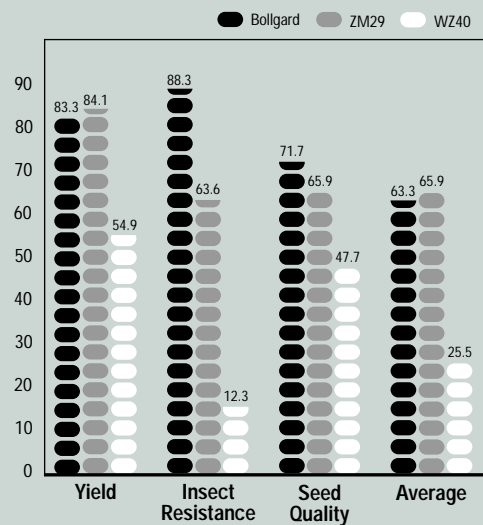
Field trials with Monsanto's new *Bollgard II* cotton continued in 2001 with positive results. Hundreds of trials in the U.S., Argentina, Australia, Mexico and South Africa continued to confirm the product's effective control of target insects with added control of beet armyworm, fall armyworm and soybean loopers. *Bollgard II* contains two insect control proteins in a single plant – a strategy that may reduce the likelihood of insect resistance. The new product is expected to receive U.S. registration in 2002, with commercial approval in Australia, Mexico and South Africa anticipated in 2003.



"This poor [cotton] yield can be increased... through the cultivation of genetically modified cotton seeds."

R. Jaipura, Chairman, India Cotton Mills Federation (ICMF), Business Standard, December 2001

**Bollgard Satisfaction Survey in Anhui Province, China
1,000 households**



*Bollgard - Average of DP32B & PM1560B
ZM29 - A local Bt F1 hybrid.
WZ40 - A local conventional F2 hybrid.*

Source: Monsanto Company, 2002

Australia

Cotton production was in mid-season in Australia as of the writing of this report. However, growers planted about 251,000 acres of *Ingard* single-trait cotton, 104,000 acres of *Roundup Ready* single-trait cotton, and 86,000 acres of *Ingard/Roundup Ready* stacked-trait cotton in September/October 2001. Grower surveys following the 2000/2001 season indicated a high level of satisfaction with all three products.

China

Farmers in three Chinese provinces (Hebei, Shandong and Anhui) planted over 600,000 acres of *Bollgard* single-trait cotton in 2001. Growers continued to receive yield and economic benefits from *Bollgard* as compared to conventional cotton. As a result, 66.7 to 83.3 percent of the growers across the three provinces reported they were very or somewhat satisfied with the product.

Mexico

Bollgard single-trait cotton and *Bollgard/Roundup Ready* stacked-trait cotton were grown on about 74,000 acres, with Monsanto gaining market share even as total cotton acres in Mexico continued to decrease. *Bollgard* and *Bollgard/Roundup Ready* cotton continued to provide an economic advantage to growers who reported an average cost benefit of US\$26.50 per acre with *Bollgard/Roundup Ready* stacked-trait cotton. In addition, insecticide applications in some areas have been reduced from an average of eight sprays a season in 1996 to zero sprays in 2001.

Argentina

Roundup Ready single-trait cotton received full commercial approval in Argentina in 2001 and was launched on a small scale, while *Bollgard* single-trait cotton, now in its fourth commercial year, was planted on approximately 99,000 acres. Studies performed by Argentina's National Institute of Agricultural Technology found there were 64 percent fewer insecticide sprays in *Bollgard* than in conventional cotton, a significant reduction with positive environmental ramifications. Also according to the study, Argentine growers received an average economic advantage of US\$26 per acre with *Bollgard* cotton as compared to conventional cotton.

South Africa

South African farmers planted about 8,000 acres of *Roundup Ready* single-trait cotton and about 50,000 acres of *Bollgard* single-trait cotton in 2001. Here, cotton fiber yields for smallholder farmers using *Bollgard* cotton in the Makhatini Flat area increased to 920 kilograms per hectare from a previous high of 680 kilograms per hectare, or about a US\$54 profit increase per hectare over previous years. In addition, smallholders sprayed for insects in *Bollgard* cotton about five fewer times than farmers who grew conventional varieties.

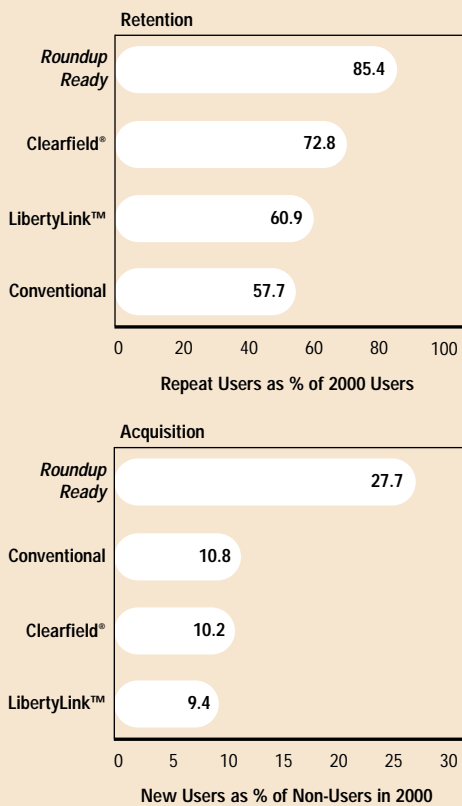


C A N O L A

"It's a weed control system. I think that is what is enticing producers."

*Ray Wilfing, Canola Grower,
Meadow Lake, Saskatchewan, Canada, 2001*

Roundup Ready Customer Retention/Acquisition (Canada)



Source: Stratus Agri-Marketing Survey, 2001

LibertyLink™ is a registered trademark of AgrEvo/PGS.

Clearfield® is a registered tradename of BASF Corporation.

Roundup Ready canola turned in another outstanding performance in 2001, with significant economic and weed control benefits for U.S. and Canadian growers. The enhanced canola contains the Roundup Ready trait, which enables growers to apply Roundup brand herbicides directly over the top of the crop. Grown in Canada since 1996 and in the U.S. since 1999, Roundup Ready canola was planted on more than 4.6 million total acres in North America last year.

Roundup Ready canola provides growers with unsurpassed control of 145 labeled annual and perennial weeds. Before the commercialization of Roundup Ready canola, canola growers had limited herbicide options, which reduced their ability to effectively control many weeds. With Monsanto's Roundup Ready technology, canola growers have the simple, yet flexible weed management tool they need to control yield-robbing weeds and to improve the economics of the crop.

With Roundup Ready canola, growers can plant earlier in the season and reduce the risk of losing yield due to early frost – a significant advantage in shorter season areas. Early planting is possible with the Roundup Ready system because the use of tillage to control weeds and herbicide soil incorporation are eliminated.

Canada

Canada is the world's leading producer and exporter of canola. Since its introduction in 1996, Roundup Ready canola has steadily increased its share of the canola market, particularly in Western Canada where the majority of the crop is grown. In 2001, Canadian growers planted nearly four million acres of canola with Monsanto's herbicide tolerant canola trait. About 61 percent of Canada's 10 million canola acres were planted using biotech-enhanced varieties in 2001.

According to a 2001 Canola Council of Canada (CCC) survey of 650 biotech canola growers, participating users reported significant economic benefit from biotech-enhanced canola. On average, surveyed Canadian users gained an additional CAN\$5.80 per acre with biotech varieties over conventional varieties – a total economic benefit that CCC estimates at CAN\$144 million to CAN\$249 million.

Also based on the CCC survey, participating growers prefer biotech-enhanced canola over conventional canola because it allows for easier weed control, increased yield, reduced chemical applications, and increased use of environmentally sustainable agronomic techniques, such as conservation tillage (CT). Increased use of CT substantially reduces soil erosion and moisture loss while it saves fuel and time.



"...when you weigh the costs versus more herbicides, more fuel, doing less work, and higher yields, farmers will tell you this [transgenic] canola makes sense."

JoAnne Buth, Vice President, Canola Council of Canada, 2001

Herbicide Use is Lower with Transgenic Canola

	Per Acre
Transgenic	\$16.22
Conventional	\$21.72

- 40% reduction in herbicide costs
- Reduced herbicide use - 6,000 tonnes LESS in 2000 than in 1997

Source: Canola Council of Canada, 2001

Monsanto surveys show that 91 percent of surveyed Canadian farmers said the *Roundup Ready* system for canola provides improved weed control over conventional systems. Seventy-seven percent said their fields were cleaner the following year, and almost 69 percent said they grow *Roundup Ready* canola because it's easier and more convenient. Customer satisfaction with Monsanto's biotech-enhanced canola is further evidenced by the company's rate of retention of previous customers (85.5 percent) and its acquisition of new ones (27.7 percent), as compared to other herbicide tolerant trait technologies.

United States

Grown on over 850,000 acres in the U.S. in 2001, *Roundup Ready* canola provided the greatest economic return per acre to farmers of any system including conventional canola, according to studies conducted by North Dakota State University and Monsanto researchers. Results indicate that *Roundup Ready* canola continues to show increased yields and decreased production costs over conventional hybrids.

Since its introduction in the U.S. in 1999, *Roundup Ready* canola has captured about 63 percent of the total canola market, with a 10 percent market share increase in 2001 over 2000. The *Roundup Ready* system is conducive to reduced tillage techniques and adds a needed broadleaf rotational crop for farmers.

In 2000, Monsanto introduced its first branded canola seed through DEKALB. This new higher yielding hybrid (DKL223), launched for planting in 2002, was enthusiastically received by U.S. growers who already have purchased the entire 2002 seed supply.

Australia

2001 was the fifth year of Monsanto *Roundup Ready* canola field trials in Australia. Monsanto is developing *Roundup Ready* canola in Australia in collaboration with a number of private and public sector partners. The company's product development efforts focused on breeding of enhanced varieties appropriate to Australia, studies to determine optimum *Roundup* herbicide application rates and timing in the field, *Roundup* herbicide formulation development and compatibility testing, field trials to examine the use of *Roundup Ready* canola in integrated weed control systems, and the rotational effects of *Roundup Ready* canola on subsequent crops.