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# Monsanto & Genetic Engineering: Risks for Investors

## Analysis of company performance on intangible investment risk factors and value drivers

### Key Issues for Strategic Investors:

**Significant risks to financial performance remain un-examined in Monsanto's business plan and are not properly reflected in current stock market valuations:**

- Potential costs of "adventitious presence", or contamination of conventional seed with biotechnology traits, are not delineated properly for investors by management.
- Lack of regulatory oversight is not acknowledged as a business risk since liability remains with Monsanto once GE crops are commercialized.
- Regular appearance of "Extraordinary Charges" on the balance sheet as a result of environmental litigation costs and restructuring charges imply that such costs will likely continue to be burdensome.
- Ambitious profit targets do not reflect political and economic realities facing GE crops with respect to consumer acceptance and commercialization.
- Reliance on litigation to "capture value" and fend off competitors is not fully acknowledged in the business plan, or accounted for in SEC filings.
- Traditional chemical company risks remain a burden despite the shift to Ag biotech.


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"*Traditional* financial measures fail on many fronts. They are not well designed to capture the quality of the company's relationships with such crucial constituencies as customers, employees, and suppliers. They shed little light on the key source of future revenue and profit in the firm: the state of product innovation. And they provide scant evidence of the effectiveness of the board and top management – that is, the efficacy of governance and management processes.

The need for boards of directors, top executives, and the investing community to understand the vital signs of companies beyond those measured in monetary terms – call them the *non-financial performance measures*, if you will – is paramount."

Monsanto's Auditors: Deloitte Touche Tohmatsu on Corporate Governance

– From: "In the Dark: What Boards and Executives Don't Know About the Health of Their Businesses" 2004

# 1. EXECUTIVE SUMMARY

## Innovest Strategic Value Advisors & This Report

Innovest Strategic Value Advisors, a financial services firm based in New York, London, Paris and Toronto, analyzed investor risks related to Monsanto's genetic engineering (GE)[1] business strategy. Partly owned by State Street Global Advisors and the Dutch pension fund ABP, Innovest is a leader in analyzing the financial impacts of environmental, social and corporate governance issues. Investors use Innovest's best-in-class ratings, ranging from AAA to CCC, to minimize risk and maximize return potential. In nearly every industry sector, companies with above average scores, taken as a group, outperformed below average firms by 300 to 3000 basis points per year in the stock market.

Innovest has maintained its CCC Intangible Value Assessment™ rating for Monsanto, the lowest rating. This rating has been maintained over the past several years and is based on a regular review of environmental, social and corporate governance risk factors. Monsanto's performance on these factors was compared relative to peer companies in the MSCI index Specialty Chemicals sector. This implies the firm has above average risk exposure and less sophisticated management than peers. As a result, it will likely underperform in the stock market over the mid to long-term.

This report represents an update of a similar report published in April 2003 and covers the business risks and profit potential of Monsanto's genetic engineering (GE) businesses. It aims to uncover for investors and stakeholders the following: What is the current state of Monsanto's GE businesses? How profitable are they? Where is the value for investors? And what risks remain under-reported or undefined that might impact that value in the future?

This executive summary is intended to provide an overview of the report contents and it is recommended that readers seeking more in-depth analysis consult the chapters below for more detail.

## Monsanto & Genetic Engineering

Monsanto is the global leader in developing and marketing GE seeds (in 2003, 90% of GE hectares world-wide were planted with Monsanto seeds). The company also makes the world's largest selling herbicide, Roundup/Glyphosate. Its strategy includes selling GE seeds intended to be used with Roundup (73% of GE seeds planted worldwide in 2003 were designed to be herbicide resistant) and developing new seeds which produce food. In 2004 Monsanto consisted of two divisions, Agricultural Productivity and Seeds & Traits. The former represents Monsanto's agricultural chemicals operations, whose main product is Roundup (Glyphosate) herbicide – the world's best-selling product of its kind. The latter represents the company's genetic engineering research and development arm which has become the world's leader in developing genetically engineered crops for commercial production.

Monsanto has developed two main products through its GE program over the past twenty years, insect resistance using the *Bacillus thuringiensis*, or Bt bacteria genes, and

[1] In this report "GE" refers specifically to genetic engineering techniques and "GM" refers to the broader category of any type of genetic modification of organisms.

herbicide resistance – specifically to Glyphosate or "Roundup", as the product is known commercially. These genetically engineered traits have been commercialized in various forms in soy beans, corn, cotton and canola.

## Monsanto's Share Price (Year end 2004) and Long Term Value

Wall Street has been somewhat overly optimistic with respect to Monsanto's valuation over the latter half of 2004. In April of 2003 Innovest estimated a 2004 EPS of $1.26 and the Wall Street consensus at that time was a more bullish $1.43. Actual EPS (ttm) at year end 2004 was $0.99, corrected from $1.61. Yet a sound balance sheet, bullish marketing of Ag biotech potential, and the perception that many big risks were behind it (such as the PCB litigation settlement) has pushed Monsanto's share price to all time highs, hitting over $50.00 in mid-December, 2004. However, Wall Street's bullishness is not reflected in actual earnings demonstrated by Monsanto's PE ratio which has shown a share price between 40 to 50 times earnings over the latter part of the year. In addition, 21.9% of the shares held by insiders have been sold in the latter half of 2004. Over the same time period 2.2% of the institutional shares have been sold while no significant purchases have taken place. In addition, extraordinary charges have regularly appeared on the balance sheet, averaging $350 million per year over the past four years. $285 million in reserves have already been set aside by the company to cover continuing costs from the Solutia bankruptcy in 2005.

**This implies that Monsanto is overvalued with respect to current profit potential in the short term. Therefore, long term value is the only *real* value inherent in the stock. Innovest's analysis of Monsanto, detailed in the chapters below, strongly implies that this long term value is at risk**.

As a result investors should seek greater transparency from the company regarding the risks associated with its business model and should be aware of the following outstanding risks to Monsanto's business plan over the next few years, which the company does not fully address in its AR or 10K filing to the SEC.

## LACK OF REGULATORY OVERSIGHT

The scope and impact of developing and commercializing new plants meant for agricultural production and human consumption is significant. Given the central economic position of the agricultural sector and controversies over public acceptance of GE traits into the food chain, Monsanto has been at pains to show that the company's operations have low risk and that its products are thoroughly reviewed by regulators during development and prior to commercialization. This is one of the key fallacies about Monsanto's products that the market has accepted.

Closer examination of the regulatory environment for genetic engineering in the United States shows a significant lack of oversight that places the risks taken by the industry squarely onto shareholders. Currently, the regulatory situation for GE crops in the U.S., the major market for both developers and sales, consists of a patchwork of outdated regulations and voluntary guidelines which have been widely criticized by the scientific community. Regulatory oversight of genetically engineered (GE) crops in the United States is divided between three federal regulatory agencies, the Food & Drug Administration (FDA), the Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA). Since the first introduction of these new crops in the early 1990s, there have been

no new laws passed to regulate GE crops. Instead, all regulation has fallen under pre-existing laws.

The Food & Drug Administration (FDA) only has voluntary requirements for Monsanto's herbicide resistant products. While the Environmental Protection Agency is tasked with regulating Bt crops, the only applicable laws are those for pesticides which do not deal with any of the larger ecosystem impacts, or properly integrate with the FDA's regulations on food. In most cases, regulatory oversight has been limited to voluntary guidelines.

The FDA does have the ability to regulate a GE product as a food additive, which is a fairly rigorous process. However, the way FDA determines whether a new GE product should go through the food additive review process is not apparent as there are no clear guidelines in place to determine when a product might be selected for the food additive review. The only time a GE product has gone through the more rigorous food additive review is when the marketers of the GE Flavr Savr tomato specifically requested that their product go thorough this analysis. Since then, no GE product has gone through a food additive review, all have gone through GRAS review.

In 2003, a committee of the National Academy of Sciences (NAS) and the Institute of Medicine conducted an assessment of the safety of genetically engineered foods[1] in which it made a number of recommendations that implied that proper safety procedures for GE crop development were not currently in place. The nature of the NAS and Institute of Medicine recommendations[2] strongly contradict Monsanto's portrayal to investors of thorough oversight and review by regulatory agencies of its Seeds and Traits operations. The committee recommended that changes that result from genetic engineering undergo an appropriate safety assessment (implying that current assessments were inadequate); that the extent of an appropriate safety assessment should be determined prior to commercialization (implying that current assessment was not extensive enough); that the appropriate federal agencies determine if evaluation of new genetically modified (GM[3]) foods for potential adverse health effects from both intended and unintended compositional changes is warranted by elevated concern (implying that federal agencies were not making such determinations); and for those foods warranting further evaluation, the committee recommended safety assessments be conducted prior to commercialization and that there be continued evaluation postmarket where safety concerns are present (implying that such evaluations were not currently being done and that regulatory capacity was not in place).

Furthermore, the committee recommended four safety assessment actions: that standardized sampling methodologies, validation procedures, and performance-based techniques for targeted analyses and profiling of GM food be developed and employed; that tracking of potential health consequences from commercially available foods that are genetically modified, including those that are genetically engineered, be developed and improved; that a significant research effort should be made to support analytical methods technology, bioinformatics, and epidemiology and dietary survey tools to detect health

[3] GM, or genetically modified refers more broadly here to all methods of genetic modification and not just genetic engineering. Throughout the report, "GM" has this meaning, whereas "GE" refers specifically to the process of genetic engineering.

changes in the population that could result from genetic modification and, specifically, genetic engineering of food; and that research is needed to determine the relevance to human health of dietary constituents that arise from or are altered by genetic modification.

The fact that the "Starlink" corn contamination case, which cost the developer Aventis over $1 billion to remediate, was discovered by a private non-governmental organization rather than government regulators is a strong reminder of how this situation places heightened risks on shareholders.

## MARKET GROWTH

One of the largest structural challenges Monsanto faces for long term growth is an effective strategy for capturing value in the developing world. Outside of the US, Canada and a handful of other developed countries, Monsanto receives little if any revenue from its traits. Company marketers are quick to point to increasing acres planted for its GE crops. However, in-depth analysis of the economic gains in these markets by the industry has been slight and it appears that acres planted in the developing world have not yielded any significant revenue to date. This is particularly true for Argentina despite the almost complete market penetration of Roundup Ready soy there. The problem of "value capture" primarily affects soya and cotton because these plants are non-hybridized, meaning the seeds can be replanted year after year without yield loss. The same cannot be said for corn where yield loss of over 50% on replanted seeds is not uncommon.

Argentina typifies the value capture conundrum. While over 95% of soy planted in that country is Roundup Ready, Monsanto was forced to shut down its operations there in 2004 because it could not earn revenues. The acres planted and penetration numbers touted by the marketing department suggest booming profits. However, the balance sheet reveals a quite different story of political wrangling ending in little, if any, profit.

## MARKET REJECTION

Many GE products have been removed from the market or developed but not commercialized due to market rejection. Examples include GE wheat, tomatoes, flax seed, rice and sugar beets. Monsanto withdrew its GE potatoes from the market in 2001 after companies including McDonald's, Burger King, McCain's and Pringles refused to buy them. North American farmers' concerns over the salability of GE wheat caused Monsanto to abandon that product in 2004. In addition, concern over contamination liability led Monsanto to abandon is pharma-crop R&D pipeline in 2003.

At present, commercially viable GE products provide no proven nutritional benefits to consumers. However, they do pose various environmental and human health risks. As a result, many consumers refuse to buy GE products once labeling makes them aware that GE ingredients are being used. Foreign markets, especially those with labeling requirements, have seen strong market rejection. In the US, where labeling is not required, outright rejection has been minimal so far, although significant support for labeling has developed.

## Foreign Market Rejection

Over 58 countries have enacted or announced laws that restrict GE imports, commercialization of GE products and/or require labeling of foods containing GE ingredients, Europe being the most important of these markets. U.S. corn exports have declined from 52.3 million tons to 47.3 million tons with a drop in value from $8.5 billion to $4.9 billion. GE wheat was withdrawn from world markets in 2004 due to intense pressure from farm groups concerned over export market loss in the EU and beyond. The resulting program stoppage cost Monsanto approximately $60 million in 2004 alone.

The Cartagena Protocol on Biosafety came into force in 2003. This will impose substantially greater documentation and risk assessment costs on GE exporters. The Protocol will also likely hold GE seed manufacturers liable for contamination and other problems caused by GE seed use. In the wake of the $1 billion StarLink loss, it may be difficult or impossible to get insurance for GE-related losses. For example, NFU mutual, the largest UK farm insurer, refuses to insure such losses. These restrictions will make it more difficult for GE products to compete with non-GE varieties in the 103 countries that are signatories to the Protocol. To avoid losing market share, food exporters will likely demand non-GE crops from US farmers. This was the case with GE wheat which reinforced the trend against the commercialization of GE food crops with a sizable portion dedicated to human consumption.

However, a main constituent element in the recent (year end 2004) share price rise for Monsanto was the decision in May of 2004 by the EU to lift a five-year moratorium on new licenses for GE crops. Seventeen Bt corn varieties, all derived from Monsanto's MON 810 maize (trade name "Yieldguard)[2], were listed for the first time in EU seed catalogs in September of 2004. Whether this will result in actual sales to European farmers remains to be seen since 70% or more of EU consumers oppose GE crops and the EU rejected looser labeling for GE content in Sept. of 2004[3]. In addition, farmers may have difficulty insuring their GE crops in the European market since many insurers have stated publicly that they will not insure against risks from GE crops.

Most European food manufacturers and retailers have implemented policies to ensure that no GE ingredients are used in their food products. Companies pursuing such policies include Nestlé, Unilever, Heinz, ASDA (Wal-Mart), Carrefour, Tesco and many others. Beyond Europe, there has been strong opposition to GE crops in Asia, Africa and other developing regions.

## Domestic Market Rejection

The vast majority of US consumers do not realize they are eating GE foods since GE firms have aggressively and successfully lobbied to suppress labeling requirements. Since 1997, over twenty US polls have shown strong support for labeling. Examples include: Pew Center - 92% of Americans surveyed support labeling of GE foods, ABC News – 93% of Americans want GE food labeled, Rutgers University – 90%, Harris Poll – 86%, USA Today – 79%, MSNBC – 81%, Gallup Poll – 68%, Grocery Manufacturers of America – 92%, Time Magazine – 81%, and Novartis – 93%. A 2001 poll by Oxygen/Market-Pulse not only found that 85% of Americans want GE food labeled, but also that only 37% of women would feed GE food to their children.

Several of these polls also found that a significant percentage of Americans would not eat GE foods if they were labeled as such (the Time poll found 58% would not eat them).

If labeling requirements were imposed in the US, it appears highly likely that a significant number of consumers, perhaps as high as 30% or more, would stop eating GE foods and demand non-GE alternatives. As in Europe, many food manufacturers would probably choose to carry only non-GE foods, rather than going to the expense of pushing two separate lines through the same distribution channels.

Many companies in the mainstream food industry and many countries have spent the last 2-4 years implementing non-GE policies to the extent of arranging new contracts with new or existing suppliers, implementing Identity Preservation (IP) systems for their ingredients, and labeling their products as non-GE.

Adding new crops for human consumption to its existing portfolio may be difficult and their failure can be very costly. Monsanto lost $60 million alone in 2004 or 0.24 EPS due to the abandonment of GE wheat. These losses are certainly higher if the R&D costs prior to 2004 for development and testing of GE wheat are considered. The fact that farmers, Monsanto's main customers, successfully organized boycotts[4,5,6] against GE wheat is instructive as to the pressure they were under from global export markets.

A major part of the risk in Monsanto's genetic engineering program is the fact that it is dealing with the genetic structures of the four or five most important food crops for humanity. Risks, even remote ones, have compelling gravity given the obvious importance of food crops. Lack of complete knowledge is a problem for investors. For developers of GE crops it is *the* problem. Monsanto is also exposed to risks taken by competitors such as Aventis CropScience and ProdiGene. Missteps by these companies could seriously impact Monsanto's business in GE seeds.

## ENVIRONMENTAL AND HUMAN HEALTH RISKS

Herbicide tolerance in weeds is fast becoming a common feature of the Roundup system. Tolerance began to appear soon after Roundup Ready crops were introduced. Due to the ease of use of the Roundup system and the falling price of Roundup in the US, farmers are simply applying more of it. Instead of a broader mix of pesticides that would be more resistant to weed adaptation, Glyphosate is used almost exclusively on GE crops. The financial impact of this development is a shortened shelf life for GE traits. The more successful the adoption of a particular trait, the faster that trait will become obsolete as pests adapt. There is a clear trend over time to GE crops requiring more pesticides than conventional crops, not less as the industry has promised[7]. The trend is so strong that in 2004 farmers sprayed an average 4.7% more pesticides on GE crops than they did on the identical conventional crops[8]. It should be noted that a portion of Monsanto's projected future profitability comes from increasing tech fees on existing product lines. Investors should question whether the company will be able to do so if its products become less effective for farmers to use.

### Inevitable Environmental Contamination

GE contamination is inevitable because it is impossible to completely prevent GE pollen and seeds from being carried by wind and other vectors to non-GE fields and natural areas. The inevitability of GE contamination is evidenced by StarLink and other GE contamination cases. In 2000, Aventis' StarLink corn, a GE product not approved for human consumption, was found in many different food products. Following recalls of over 300 corn products, Aventis spun off its CropScience division, and took losses of over $1 billion.

In another contamination case, GE corn designed by ProdiGene to produce pig vaccine recently contaminated corn and soy beans food crops in Iowa and Nebraska. Regulatory leniency limited ProdiGene contamination costs to $3 million and allowed the firm to stay in business. However, further contamination could occur and costs to the firm could rise since GE material from pig vaccine corn may have transferred to food crops. In another case, GE corn contamination has been found in Mexico, where GE corn growing is not allowed. A NAFTA commission has concluded that if left unchecked GE corn threatens to displace native Mexican varieties which have significant value to the corn industry given the genetic diversity of corn in the region. A second commission recommended better regulation of biotech corn.

Monsanto began admitting in 2002 that research and development of GE crops will result in the spreading of GE traits to non-GE crops.[9] This is a major admission for the industry and implies that the risk of contamination and negative impacts is very high going forward. The company's 2002 annual report (as well as subsequent reports) acknowledge concerns about research and development of both traditional biotechnology as well as pharmaceutical proteins appearing in food crops. This implies that the company is aware of the possibility that both approved GE traits as well as unapproved traits still in the development process could end up in the human food supply-chain. The level of environmental and human-health risk, and therefore financial risk, cannot be understated.

The relevance of this admission to shareholders is apparent in the abandonment by the company of bio-pharmaceutical crops from the research and development pipeline due to perceived risks associated with their development and commercialization.

## Human Health Risks

The US National Academy of Science has tried to address the issue of the potential for human health risks associated with the genetic engineering of food crops and has pointed out that most research showing the safety of GE foods was conducted or funded by GE firms. Since these firms have a large financial stake in seeing GE crops commercialized, there is a risk that safety testing done by them is biased. Therefore, many scientific panels have recommended that safety and environmental testing be done by regulators and not the industry.

Other safety concerns include the fact that safety testing is usually not done over the long-term or over multiple generations. As a result, long-term impacts on human health may not be discovered until impacts have already happened. Many scientists are concerned that the GE process can have unintended consequences such as creating new toxins and proteins which could cause allergic reactions and other human health problems.

An example of unintended consequences includes antibiotic resistant marker genes which are used in the production of many GE seeds. Some medical authorities have found that these genes may pass on antibiotic resistance to bacteria in the gut, thus making the bacteria resistant to clinically important antibiotics. As a result, the EU is phasing them out in 2008. The United Nations CODEX Alimentarius Committee has also recommended that they be phased out. In the US however, there appears to be no plan to phase them out.

## HISTORICAL RISK LIABILITIES

Investors should also be aware that despite a move away from a traditional chemical product portfolio, Monsanto retains significant environmental liabilities with respect to past operations. In particular, the previously owned subsidiary, Solutia was forced into bankruptcy in 2003 after it was found liable for PCB contamination in Anniston, Alabama. Monsanto has indemnified former owner Pharmacia for any liabilities relating to Solutia. Monsanto's liability in the PCB case totaled $394 million which wiped out all Agricultural Productivity segment earnings in 2003.[10] As the result of prior agreements, Solutia also has debt obligations, supply obligations and stock options that are due to Monsanto.[11] The current bankruptcy proceedings put the collection of these items into jeopardy. Moreover, Solutia's liquidity problems make it significantly more likely that Monsanto will be required to indemnify the company in future court cases.

Monsanto has the highest risk exposure relative to peers in the specialty chemicals sector (defined by Morgan Stanley's MSCI Index). Significant numbers of organochlorine contaminant (dioxins, furans and PCBs) related liabilities could, as they have in the past, result in burdensome court cases and expensive payouts.

Monsanto has manufactured many high-risk chemicals in the past which still persist in the environment or comprise the significant site liability which Monsanto remains liable for. Currently Monsanto is liable for some 89 hazardous waste sites in the U.S. This does not include site liability outside the U.S. or similar potential liability from Solutia which the company may also be liable for.

The company faces significant and expanding liabilities and reputational risks associated with its historical production of Agent Orange. Tens of thousands of U.S. and foreign national troops who served in Vietnam and were exposed to Agent Orange have filed suits against manufacturers seeking restitution for injuries caused by the chemical (which was contaminated with the most toxic form of dioxin, TCDD). In a possibly even more significant development, Vietnamese citizens have filed a suit in New York seeking damage claims on behalf of those injured by exposure to Agent Orange in that country.

According to Dr. Arthur Galston, Professor Emeritus at the Yale School of Forestry and Environmental Studies, who spoke at a Yale University conference, The Ecological and Health Effects of the Vietnam War, "*the use of Agent Orange as a defoliant and herbicide in Vietnam was the largest chemical warfare operation in history, producing considerable ecological as well as public health damage*."[12] It has been estimated that over a million Vietnamese may have died or were injured due to exposure to Agent Orange.

Monsanto was the largest producer of Agent Orange with 29.5% of production. In previous settlements over Agent Orange liabilities, Monsanto paid a larger portion (45.5%) of damage awards since its product was contaminated to a much greater degree with dioxin then competitors.

## CONCLUSION

In summary, the risks to Monsanto's shareholders from the company's genetic engineering business are substantial. In addition, the company already carries historical risk liabilities well in excess of sector peers. As this report illustrates, the company faces business constraints in the form of market rejection by consumers, producers, and farmers; significant legislative hurdles to commercialization; uncertainty in the face of human health and

environmental impacts stemming from the company's products; and finally, significant risk exposure from potential contamination of the human food chain by both approved and unapproved genetically engineered traits. It should be stressed that even if the company is a good actor with respect to safety and control during product development, problems stemming from actions by a competitor could impact the company's profitability.

In light of these developments, shareholders should seek increased transparency in reporting from the company with respect to these risks and management should develop contingency plans accordingly. It is likely, given the current burdens on Monsanto's balance sheet that EPS guidance from Wall Street is optimistic with respect to future earnings. However, the development of non-GE traits in the R&D pipeline, as well as improved approach to genetic modification (as opposed to genetic engineering) such as "marker assisted breeding" techniques, may provide future value alternatives for shareholders.

This report provides much additional guidance on the topics discussed in this executive summary. This includes an overview of the GE crop market, a detailed description of Monsanto's GE-focused strategy and the large risks it poses to consumers, the environment, food manufacturers and investors.

## 2. MONSANTO STOCK PRICE PROJECTIONS

Wall Street has been somewhat overly optimistic with respect to Monsanto's share price over the past several months (at the time of this writing – year end '04). In April of 2003 Innovest estimated a 2004 EPS of $1.26 and the Wall Street consensus at that time was a more bullish $1.43. Actual EPS (ttm) at year end 2004 was $0.99. Yet a sound balance sheet, bullish marketing of Ag biotech potential, and the perception that many big risks were behind it (such as the PCB litigation settlement) pushed Monsanto's share price to all time highs, hitting over $50.00 in mid-December, 2004. However, Wall Street's bullishness is not reflected in actual earnings demonstrated by Monsanto's PE ratio which has hovered in the high forties throughout the forth quarter of 2004. In addition, 21.9% of the shares held by insiders have been sold in latter half of 2004. Over the same time period 2.2% of the institutional shares have been sold while no significant purchases have taken place.

While the company is relatively free of debt and has a reasonably sound balance sheet, earnings have been lower than projected over the past year and will likely continue to be as new and old issues plaguing the balance sheet continue to be a problem. As Sergey Vasnetsov of Lehman Brothers stated in 2002, "*It's not an issue that the company is financially in trouble. It's strategically in trouble*."[13] And investors should ask if this is still the case. While profit losses in 2002 lead to a change in leadership at the company, they did not lead to a change in strategy. What Monsanto is facing is a lack of possibilities for growth, coupled with increasing risk for the types of financial disasters relating to contamination issues that hit smaller competitors like Aventis CropScience and ProdiGene, nearly bankrupting the latter. That said, some high risk ventures, such as GE wheat and bio-pharmaceutical crops were abandoned in 2004 & 2003 respectively, which now give Monsanto a lower risk profile in the Seeds & Traits side of the business.

Monsanto's main product Roundup is under increasing pressure from competition and the company predicts that its market share will continue to go down, although at a much more reduced rate.[14] At the same time resistance to Roundup is reported to be developing in many of the weeds it is meant to control. Meanwhile, the company has rearranged its strategy for commercializing its genetically engineered crops. With efforts to open up world-wide markets stalled, Monsanto is looking to expand its presence further in the U.S. market, and states that it will sell 75% of its new corn varieties to existing customers. While this has provided new profit avenues in 2004, it does not appear to be the cash cow that Roundup has been, nor has it matched previous levels of product adoption in the early nineties.

Consumer rejection of genetically engineered foods has been considerable and shows no apparent abatement. This market rejection has been moving up the food industry supply chain from consumers to retailers to producers to farmers. If the level of resistance to GE wheat is any example, Monsanto will have to increasingly expend greater and greater amounts of monetary and political capital to commercialize any new genetically engineered crops. The difference between now and the late nineties when many of its existing crop varieties were approved is that there are increasingly large financial interests arrayed against the further commercialization of GE crops. The fact that lawsuits against the company are increasing, as well as its own lawsuits against farmers in an effort to protect its patent rights on GE crops, does not bode well for the relationship between the company and its main constituents, farmers.

Investors should be concerned about the medium to long-term prospects for the company's genetically engineered crops business. At the same time the company should be more forthright with investors about the increasing risks of products in its GE pipeline. Monsanto's GE soya and GE corn are largely sold to feed livestock. The company recently discontinued its bio-pharmaceutical crop program and the commercialization of GE wheat, both of which were to be major revenue sources in the future. Costs for the abandonment of GE wheat were over $60 million in 2004 alone excluding all prior R&D investments. Innovest's analysis shows that going forward the company will continue to suffer from a drop in Roundup sales with adverse weather conditions likely to resume and with increased competition in major market segments. By basing future profitability on the assumption that it can increase technology fees on its products, Monsanto makes the key assumption that its products *gain* value over time. However, as Roundup and Bt resistance grows, farmers may question paying more in tech fees for less effective technology. In addition, a much greater proportion of the company's profits will rely on the riskier strategy of commercializing genetically engineered crops.

Figure 1, Figure 2 and Figure 3 below outline different financial scenarios for Monsanto. The first figure shows the Wall Street consensus view. The second chart shows Innovest's sales projections based on more conservative earnings estimates for GE crops in light of recent experiences in South America and increased competition. It also includes less optimistic SG&A reduction estimates to reflect higher potential costs.

Wall Street Consensus

| | Y2004 | Y2005 E | Y2006 E | Y2007 E |
|---|---|---|---|---|
| **Sales (Millions)** | **$5,457** | **$5,604** | **$6,047** | **$6,341** |
| **Net Income (Millions)** | **$432** | **$564** | **$717** | **$817** |
| **EPS** | $1.61 | $2.10 | $2.85 | $3.45 |
| **Implied P/E Multiple** | 19.6 | 21.4 | 15.7 | 13.0 |
| **Share Price** | $31.56 | $44.94 | $44.75 | $44.85 |
| **Implied Net Profit Margin** | 7.9% | 10.1% | 11.9% | 12.9% |
| **Shares Outstanding** | 258 | 258 | 258 | 258 |

Figure 1. Wall Street Earnings Estimate for Monsanto

Innovest Conservative Case

| | Y2004 | Y2005 E | Y2006 E | Y2007 E |
|---|---|---|---|---|
| **Sales (Millions) (1)** | **$5,457** | **$5,380** | **$5,716** | **$5,873** |
| **Net Income (Millions) (2)** | **$432** | **$541** | **$617** | **$693** |
| **EPS** | $1.61 | $2.10 | $2.39 | $2.69 |
| **P/E Multiple (3)** | 19.6 | 21.4 | 15.7 | 13.0 |
| **Share Price** | $31.56 | $44.91 | $37.56 | $34.93 |
| **Implied Net Profit Margin** | 7.9% | 10.1% | 10.8% | 11.8% |
| **Shares Outstanding** | 258 | 258 | 258 | 258 |

(1) Based on projection revisions which included increased competition on Bt corn (See section in Chpt. 4) and more conservative est. of Indian cotton sales in light of value capture difficulties in Argentina and Brazil.

(2) Based on the net profit margin implied in the Street consensus with adjusted SG&A to reflect higher potential costs.

(3) P/E multiple used in UBS analysis of MON (11/22/04).

Figure 2. Innovest Earnings Estimate (Low Conservative Case)

It is important to note that neither of these estimates includes potential future extraordinary charges which are discussed in Figure 4 below and averaged $350 million per year over the past 4 years. $285 million in reserves have already been set aside by the company to cover continuing costs from the Solutia bankruptcy in 2005.

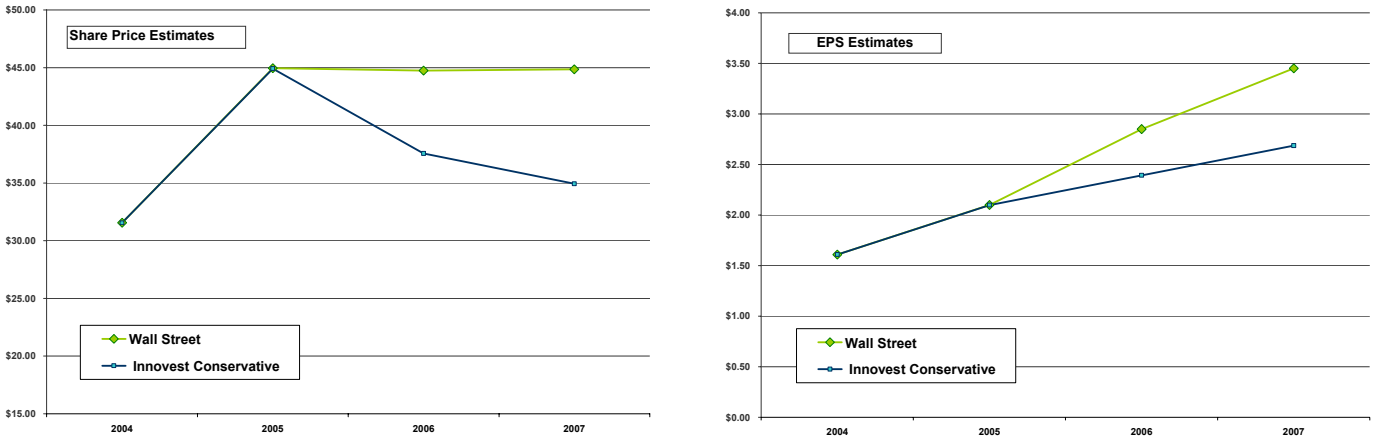



Figure 3. Stock Price & Earnings Per Share Estimates

It is also significant to note that one-time charges, or extraordinary items regularly comprise large impacts to the balance sheet which are not a regular part of business forecasting. However, risk analysis of intangible value drivers such as environmental risk factors or political/social risk factors conducted by Innovest Strategic Value Advisors imply that Monsanto maintains an elevated risk level relative to sector peers. Figure 4 and Figure 5 below show a history of extraordinary charges to the balance sheet and the resulting EPS changes over time. These charges have stemmed directly from the types of business risks outlined in the rest of this report and are comprised of site liability costs, market failure and resulting restructuring costs, as well as the effects of increased competition on core products. Investors should be aware of these consistent impacts to profitability and the regular downward adjustment of EPS as a result. $285 million in reserves have already been set aside by the company to cover continuing costs from the Solutia bankruptcy in 2005.

| | 8/31/2004 | 08/31/03 | 12/31/02 | 12/31/01 |
|---|---|---|---|---|
| Revenue ($M) | 5,457.00 | 5,059.50 | 4,673.00 | 5,462.00 |
| SG&A ($M) | 1,145.00 | 1,043.00 | 1,057.00 | 1,166.00 |
| Ratio of Revenue to SG&A Expenses | 21% | 21% | 23% | 21% |
| **Extraordinary Charge - Pretax ($M)*** | 274 | 594 | 259 | 273 |
| Net Income ($M) | 267.00 | -16.50 | 129.00 | 297.00 |
| PE Ratio | 46.00 | -120.00 | 39.00 | 30.00 |

Figure 4. Earnings Impacted by Regular Appearance of Extraordinary Items
Source: Thompson Financial[4]

[4] The Thompson Financial definition of Extraordinary Charges includes: (1) Major casualties such as earthquakes and floods, if rare in the area; (2) Expropriation of assets by foreign governments ; (3) Effects of a prohibition under a newly enacted law or regulation ; (4) Prior effects of an accounting change ; (5) Reorganization ; (6) Exceptional Items (United Kingdom) ; (7) Write-down or write-off of inventories or other write-downs that are normally a part of operations if they exceed 25% of earnings.

A breakdown of these impacts to 2004 earnings per share is as follows: - 0.36 EPS went to "Monsanto's 2004 Restructuring plant"; - 0.02 EPS went to discontinued operations; - 0.24 went to the discontinuance of GE Wheat; the total of -0.62 in charges against a base EPS of 1.61 results in the actual EPS for 2004 being 0.99 .

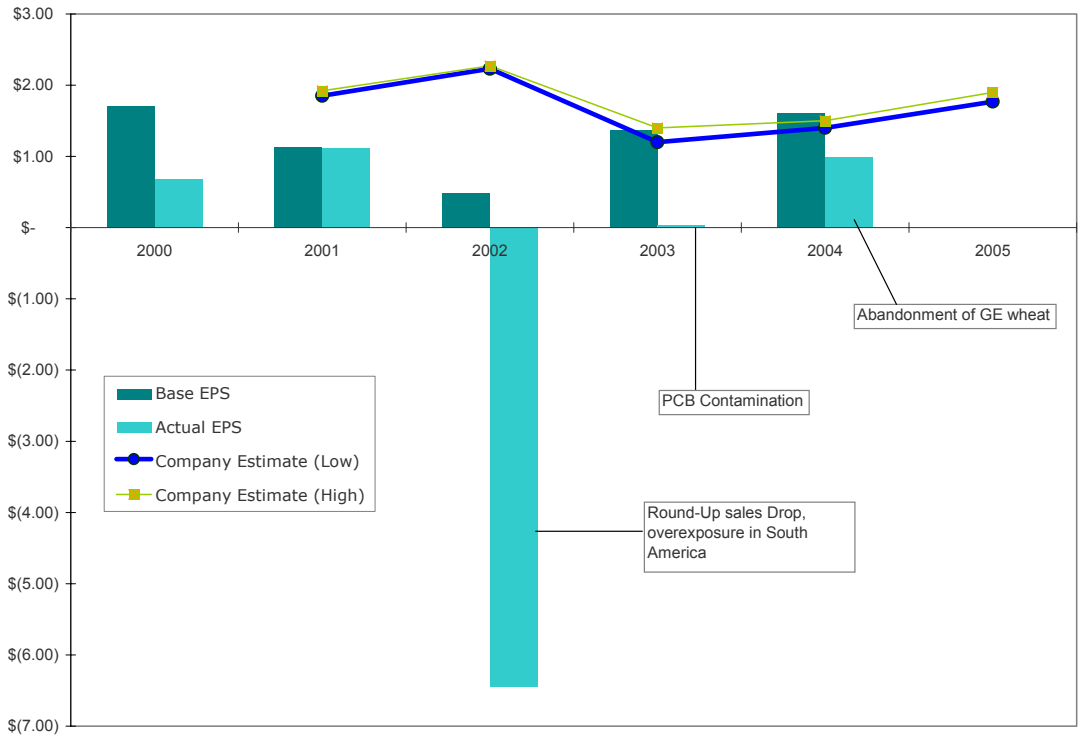



Figure 5. Monsanto's EPS History

Other potential impacts to profitability stem from the possibility of costs relating to GE contamination issues. Figure 6. shows the effect of a liability of $1 billion on the market value and share price of Monsanto. The GE/pharma company Aventis incurred costs of over $1 billion when it withdrew StarLink genetically engineered corn from the marketplace. StarLink was approved only as animal feed but was found in boxes of taco shells and in other products for human consumption in US supermarkets and then found throughout the US corn supply chain. The corn was restricted to use as an animal feed due to the presence of a specific protein, Cry9C, which exhibited many of the known characteristics of an allergen. After a few years of growing, StarLink had spread into processed foods and bulk corn exports. Given Monsanto's product mix and the inevitability of GE contamination, losses in the billion dollar range relating to GE contamination are possible.

| | |
|---|---|
| **Potential Liability (Millions)** | $1,000 |
| **Market. Cap. (Millions)** | $13,193 |
| **Liability as % of Market Cap** | 7.58% |
| **Shares Outstanding (Millions)** | 264 |
| **Liability per share** | $3.79 |

Figure 6. Potential Financial Fallout from Contamination - the "StarLink" Scenario

# 3. GE CROP DEVELOPMENT & ADOPTION

Genetically modified organism (GMO) means an organism in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination. Monsanto has specialized in creating GMOs through genetic engineering.

Genetically engineered crops have been in development for roughly two decades. While the number of acres of GE crops has grown significantly since the mid-nineties, when they were first introduced commercially, the majority of acres of GE crops still reside in only one country – the United States. While major acreage of GE crops exists in Canada (soya, corn, and canola) and Argentina (soya), the U.S. has been both the corporate home of GE leaders like Monsanto & Pioneer Hi-Bred (Du Pont) and the industry's political home with the most aggressive trade policies and lobbying efforts on behalf of the industry. The estimated global area of transgenic crops for 2003 is 67.7 million hectares or 167.3 million acres. (See Figure 7 below) During the seven-year period from 1996 to 2003, the global area of transgenic crops increased by 40 fold, from 1.7 million hectares in 1996 to over 67.7 million hectares in 2003.[15]

| Market Size of GE Crops | % of Total Transgenic Crop Plantings | % of Total Crop Plantings | Transgenic Crop Plantings (Millions of hectares) | Total Acreage by Crop (Millions of hectares) |
|---|---|---|---|---|
| Soya (Herbicide Resistant) | 61% | 54.5% | 41.4 | 76.00 |
| Corn (Bt Pesticide Traits) | 13% | 6.5% | 9.1 | 140.00 |
| Corn (Herbicide Resistant) | 5% | 2.3% | 3.2 | |
| Corn (Stacked Traits for Both) | 5% | 2.3% | 3.2 | |
| Canola (Herbicide Resistant) | 5% | 16.4% | 3.6 | 22.00 |
| Cotton (Bt Pesticide Traits) | 5% | 9.1% | 3.1 | 34.00 |
| Cotton (Stacked Traits for Both) | 4% | 7.6% | 2.6 | |
| Cotton (Herbicide Resistant) | 2% | 4.4% | 1.5 | |

Figure 7. Global Commercialized Transgenic Crop Plantings 2002[16]

The United States and Argentina account for 84% of commercially grown GE crops in the world. The next largest growers are Canada, Brazil and China, with 14%. Two crops (soya and maize/corn) account for 84% of the GE acreage. Together with cotton and rapeseed/canola, they account for over 99% of the GE acreage. Just three companies account for virtually all the GE crops currently commercially grown: Monsanto, Syngenta (formerly Novartis) and Aventis CropScience (recently acquired by Bayer). Monsanto dominates the market of commercial genetically engineered crops. In 2003, Monsanto products alone accounted for over 90% of the total area sown with GE crops.[17]

| Market Size of GE Crops by Transgenic Traits | % of Total Transgenic Plantings by Trait | Acreage of Planting (Millions of Hectares) |
|---|---|---|
| Herbicide Resistance | 73% | 49.7 |
| Insect Resistance | 18% | 12.2 |
| Stacked Genes for Both | 9% | 5.8 |
| Total Area | | 67.7 |

Figure 8. Transgenic Crops by Traits[18]

While estimates for growth of the GE crop market have come down since the halcyon days of the mid-nineties, the market is expected to grow somewhat, and pressure by the industry will remain unabated, despite consumer rejection in most markets. For Monsanto and other GE companies the push is still on to open up new countries to commercially grow GE crops although Monsanto's stated goals for achieving profits in 2004 do not include the opening of new markets. That is a significant change over past years when optimism for opening new markets was higher. Currently, Monsanto is looking to expand its business by selling more to its current customers. It does this by engineering multiple traits into a single crop, such as herbicide resistance and Bt toxin production, for which it can therefore receive a greater share of the farmers' operating expenditure. Since 1996, according to the company, Monsanto has increased its share of US corn farmers' input expenditures from 7% to 20% by 2003, in part by utilizing this method.[19]

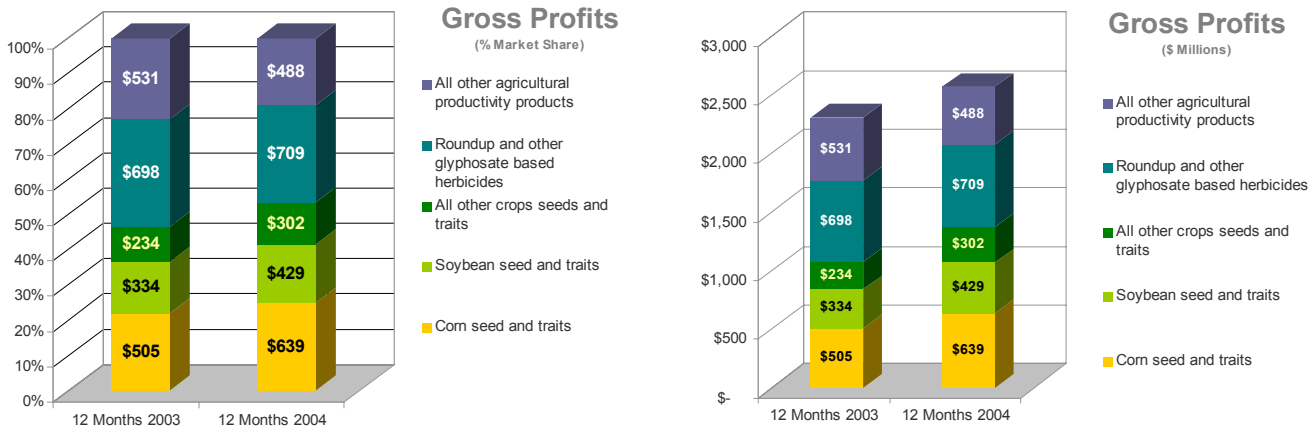



Figure 9. Monsanto's Market Share and & Profits by Product Type

## Where Has Growth Stalled?

According to Congressional testimony[20] by Leon Corzine, Chairman of the Biotechnology Working Group of the National Corn Growers Association, the quantity of U.S. corn exports has declined from 52.3 million tons to 47.3 million tons with a drop in value from $8.5 billion to $4.9 billion. He stated that *"(...)in some markets the influence [of trade problems with biotechnology] has been dramatic, and we anticipate that the next few years may bring increasing pressures on U.S. corn exports as more countries introduce biotechnology labeling and approval systems and more to implement the Cartagena Protocol*

*of Biosafety*." Corzine also noted that in Asia, the number one market for U.S. corn, the Korean market had dropped from $300 million per year to $48 million in 2003 and contamination of supplies by StarLink corn, a GE variety not approved for human consumption, caused "(…)a sharp drop in the Japanese market." The EU corn market of $300 million (as of the mid-1990's) has evaporated, and exports of corn oil to the Middle East have declined by $80 million since the introduction of genetically engineered crops.[21]

Overall, the expansion in existing markets for GE crops appears to be reaching its limits, as consumers continue to resist GE crop technologies and governments and scientists continue to question the safety and risks of these crops.

At present GE soya represents 85% of U.S. and 95% of Argentinean soya crops so there is not much room in either market for further expansion. Current GE corn varieties in the U.S. may expand somewhat based on their perceived value in relation to insect infestations which vary in range, scope, and species. Not all GE varieties are suitable for all regions and expansion of the market will therefore be limited based on those criteria. Argentina despite being pro-GE generally has for many years still banned any GE corn that is not already approved in the EU. They do this in order to protect their current corn export market to Europe. While the EU has started to approve some Monsanto GE corn varieties, difficulty with retaining technology fees in Argentina and consumer rejection combined with non-GE sourcing supply chains already established in Europe, may make earning profits from this development unlikely. In Canada GE soya sits at around 30-35% where it has been for a couple of years. It should be noted that there is a substantial part of the Canadian soya trade that is specifically non-GE food grade beans which attract a premium. So GE soya in Canada is not expected to expand. Seventy percent of canola in Canada is GE, and the rest is already effectively GE contaminated. This has led to growth in legal suits against Monsanto relating to the contamination, and the potential for increased sales is low. GE cotton is already widely grown in the countries where it is authorized and a negative experience in India with GE cotton may make moving forward there more difficult.

Significant markets have also developed and are continuing to develop for certified non-GE crops, and organically grown crops which exclude genetic engineering. This creates a very dangerous situation for the GE industry because it adds a new and powerful opponent with economic interest in preventing GE crop commercialization. Within these economic interest groups are:

- Many companies in the mainstream food industry and many countries have spent the last 2-4 years implementing non-GE policies to the extent of arranging new contracts with new or existing suppliers, implementing Identity Preservation (IP) systems for their ingredients, and labeling their products as non-GE. They did this in response to their customer demands and many of them are already using the non-GE status as a positive marketing tool.
- The organic food industry. Organic production methods and standards exclude the use of GE seeds or ingredients and this market is very much threatened by potential and already realized contamination of organic produce by unwanted GE traits.
- The farmers who are already supplying these often premium markets and the food processors and shippers who have established non-GE and/or organic processing and distribution channels. These farmers, processors and shippers have good reason to seek to avoid GE contamination and to sue for loss of profit if and when GE contamination causes them to lose contracts. A class action suit is under way in Canada demanding lost

organic canola profits due to contamination. The German parliament recently passed a law making farmers who plant GE crops liable in the case of contamination.

The development of these economic interests, opposed to further GE crop commercialization, may prevent new markets in Europe, South America and Asia from materializing. The industry's history of market failures represent a consistent pattern of market rejection that is still working its way up the industry supply chain from consumers to producers to farmers. The next section of the report outlines Monsanto's current strategy and highlights how market rejection and increased risk exposure may hurt the company financially.

# 4. THE RISKS OF MONSANTO'S GE STRATEGY

In the process of developing genetically engineered crops Monsanto appears to have come up against two major problems – lack of market acceptance by consumers and risk exposure stemming from possible genetic contamination of food crops. These comprise the main risks to Monsanto shareholders. There are many possible ways in which market rejection could manifest itself and many of these forces are reinforcing. This dynamic can be seen in several incidences where market rejection in one segment of the economy lead to rejection in another. For example, general consumer rejection of GE foods led food producers to abandon genetically engineered potatoes. Similarly, farmers in North America led a successful campaign against the commercialization of GE wheat due to the potential loss of lucrative markets not just in Europe but globally. Many food producers in Europe have stated that they will not accept GE wheat.

However, a main constituent element in the recent (year end 2004) share price rise for Monsanto was the decision in May of 2004 by the European Union (EU) to lift a five-year moratorium on new licenses for GE crops. Seventeen Bt corn varieties, all derived from Monsanto's MON 810 maize (trade name "Yieldguard)[22], were listed for the first time in EU seed catalogs in September of 2004. Whether this will result in actual sales to European farmers remains to be seen since 70% or more of EU consumers oppose GE crops. The EU rejected looser labeling for GE content in September of 2004.[23] In addition, farmers may have difficulty insuring their GE crops in the European market since many insurers have stated publicly that they will not insure against risks from GE crops.

In its development of genetically engineered crops Monsanto's business has three main constituents – farmers, producers, and consumers, only one of which provides it directly with income. The company's strategy has focused on only one of these constituents for its business: farmers. By linking seeds with pesticides through genetic engineering the company can gain a greater share of farmers' operating budgets. This strategy has forced the company to focus on seeds and chemicals as its products and farmers as its customers. However, when viewed in a larger context, Monsanto's products and customers are actually food and consumers, not farm inputs and farmers. This implies that the company's product development strategy discounts the importance of consumers and food producers to its overall business model. Since the attributes of genetically engineered crops do not have a direct benefit for consumers but rather are aimed at farmers, these crops can be seen to pose a potential and unknown risk and yet provide no direct benefit.

Clearly consumers should have been part of the equation because it was consumer rejection that triggered the food manufacturing and retail sectors in many countries already to keep GE ingredients out of their products. Food companies were also just responding to meet their own interests and sometimes their interests are different. When GE potatoes aren't good enough for McDonald's, it is sending some kind of message.

The record of successes and failures in GE crops is instructive in this regard. Corn & soya – the two most widely grown GE crops - are mostly eaten by livestock (roughly 90%) or enter the human food chain directly mainly as minor ingredients or derivatives (e.g. soya and corn oil, soya flour, soya lecithin, corn starch). Particularly for the human food market outside of North America, there is a solid, fairly well established market for certified non-GE soya and corn. The biggest failures are items like GE wheat, the "Flavr Savr" tomato, "New Leaf" Potato, and Aventis' GE rice. These are crops with significant direct human

consumption. Adding new crops for human consumption to its existing portfolio may be difficult and their failure can be very costly. Monsanto lost $60 million alone in 2004 or 0.24 EPS due to the abandonment of GE wheat. These losses are certainly higher if the R&D costs prior to 2004 for development and testing of GE wheat are considered. The fact that farmers, Monsanto's main direct constituents, successfully organized boycotts[24,25,26] against GE wheat is instructive as to the pressure they were under from global export markets.

The second issue of product development which Monsanto faces in its move to expand its portfolio of genetically engineered crops is risk exposure. A major part of the risk in Monsanto's genetic engineering program is the fact that it is dealing with the genetic structures of the four or five most important food crops for humanity. Risks, even remote ones, have compelling gravity given the obvious importance of food crops. Lack of complete knowledge is a problem for investors. For developers of GE crops it is *the* problem. Monsanto is also exposed to risks taken by competitors such as Aventis CropScience and ProdiGene. Missteps by these companies could seriously impact Monsanto's business in GE seeds.

Informed critics of GE crops have pointed out that scientists do not have enough knowledge about several critical areas of recombinant DNA crop science. In short those include the long term effects of eating GE foods, especially pesticide producing crops; how added genes relate to the rest of the plants' genome; how damage to plant DNA that can result from inserting genes affects plants; how inserted genes will express themselves in future generations; and finally, what ecological impacts GE crops will have over time. The Union of Concerned Scientists in a 2004 report commented that "Heedlessly allowing the contamination of traditional plant varieties with genetically engineered sequences amounts to a huge wager on our ability to understand a complicated technology that manipulates life at the most elemental level."[27]

## U. S. FEDERAL REGULATORY PROCESS FOR GE CROPS

*"It will take years, perhaps decades, to construct a detailed theory that explains how DNA, RNA and the epigenetic machinery all fit into an interlocking, self-regulating system. But there is no longer any doubt that new theory is needed to replace the central dogma that has been the foundation of molecular genetics and biotechnology since the 1950's." ..."I think this will come to be a classic story of orthodoxy de-railing objective analysis of the facts, in this case for a quarter of a century. The failure to recognize the full implications of this…may well go down as one of the biggest mistakes in the history of molecular biology."* - John S. Mattick, Director of the Institute for Molecular Bioscience at the University of Queensland in Brisbane, Australia[28]

*"Although the array of analytical and epidemiological techniques available has increased, there remain sizeable gaps in our ability to identify compositional changes that result from genetic modification of organisms intended for food; to determine the biological relevance of such changes to human health; and to devise appropriate scientific methods to predict and assess unintended adverse effects on human health."* - Committee on Identifying and Assessing Unintended Effects of Genetically Engineered Foods on Human Health; The Institute of Medicine and the National Research Council of the National Academies,[29] 2004

"*If need be, we could even go to the public*" - Rhoda Applebaum, Executive V.P. of Scientific and Regulatory Affairs at the National Food Processors Association. Kilman S. (Nov. 5, 2002) Food, Biotech Industries Feud Over Plans for Bio-Pharming, The Wall Street Journal

Monsanto, in an effort to portray to investors an image of responsibility and rigorous risk management, has consistently maintained to investors that the operations of the Seeds and Traits division are heavily regulated. However, analysis of the actual regulatory system for GE crops shows a patchwork of regulations that are not adapted to address the scope and risks of genetic engineering. In many cases these regulations are merely voluntary regimes for assessing safety and impacts.

Regulatory oversight of GE crops in the United States is divided between three federal regulatory agencies, the Food & Drug Administration (FDA), the Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA). Since the first introduction of these new crops in the early 1990s, there have been no new laws passed to regulate GE crops. Instead, all regulation has fallen under pre-existing laws. The FDA, which is responsible for regulating for food safety, looks to the Federal Food Drug and Cosmetic Act, and the Food Quality Protection Act to determine regulatory guidelines. The EPA, which is responsible for regulating crops that have been genetically engineered to produce pesticides within the cells of the plant (i.e. Bt corn and cotton), regulates under the Federal Insecticide, Fungicide, and Rodenticide Act, the Food Quality Protection Act, and the Toxic Substances Control Act. The USDA, which oversees field tests of genetically engineered crops and is responsible for regulating plant pests and weeds, follows guidelines set out in the Plant Protection Act, the Federal Seed Act, and the National Environmental Policy Act.

The determination that GE crops and foods would be regulated under these pre-existing statutes and that use of novel recombinant DNA techniques—that include many new genes and proteins that have never previously been in the food supply—would not generate new legislative consideration, was made in 1986 during the process of determining an appropriate regulatory framework, and prior to any significant review of potential environmental or health effects stemming from the introduction of these novel GE crops.

In 1992, the FDA declared genetically modified foods to be substantially equivalent to conventional foods, deeming these new organisms "generally regarded as safe" (GRAS). This policy made GE foods exempt from mandatory human and environmental safety tests and meant that GE foods would not require any special labeling. The determination of substantial equivalence was made despite the FDA's knowledge that there was no scientific consensus on the safety of GE foods, and even though some of FDA's own scientists specifically warned that there was reason to believe GE foods might not be safe. Thus, contrary to popular belief, the FDA does not actually formally approve GE crops as safe for human consumption, as the GRAS review process only involves a voluntary consultation.

FDA does have the ability to regulate a GE product as a food additive, which is a fairly rigorous process, however, the way FDA determines whether a new GE product should go through the food additive review process or the GRAS review process is not apparent; there are no clear guidelines in place to determine when a product might be selected for the food additive review. The only time a GE product has gone through the more rigorous food additive review is when the marketers of the GE Flavr Savr tomato specifically requested that their product go through this analysis. Since then, all GE products have only gone through GRAS review.

The GRAS is thoroughly inadequate to determine safety of new GE products. In one study of the inadequacies of the GRAS review, it was discovered that when FDA requested additional information from the developers of a GE crop to conduct a complete and thorough safety assessment, 50 percent of the time the GE-food developer did not comply with that

request. In those cases, FDA had little choice but to complete its evaluation without the desired information. Additionally, submissions did not evaluate some potentially deleterious compounds, such as scientifically recognized toxicants in tomatoes or anti-nutrients in corn. And the FDA did not generate its own safety assessment, but merely summarized for the public the developer's food-safety analysis. [30] Nothing can illustrate the inadequacy of the regulatory process to determine food safety of GE crops better than the letter that the FDA sends to the GE crop developer after completion of the voluntary consultation. Take, for instance, the following typical example.

> ***Based on the safety and nutritional assessment Monsanto and KWS have conducted****, it is our understanding that Monsanto and KWS have concluded that sugar beet brei (processed root) and tops from the new variety are not materially different in composition, safety, and other relevant parameters from sugar beet brei and tops currently on the market, and that the genetically engineered sugar beet does not raise issues that would require premarket review or approval by FDA*[31]. [Emphasis added.]

As this letter implies, the FDA has allowed GE food safety review to be conducted by the companies without regulatory involvement or oversight in the safety testing process.

In the case of insect resistant crops the EPA has jurisdiction over pesticides that have been incorporated into GE crops. However, the EPA review process does not cover the full scope of impacts and risks, as the agency only regulates the gene and gene products, not the GE plant. It explicitly disavows authority over regulation of any potential unintended effects, which are supposedly handled by the FDA. Clearly however, as illustrated above, the FDA regulatory process is not adequate to determine the full range of potential safety impacts and additionally, does not address ecosystem impacts which may cause economic harm to the agriculture industry. The EPA also does not have any regulatory authority over herbicide resistant plants.

In its regulation of the most common type of plant pesticide, Bt, the EPA allowed it to be expressed in the cells of the GE plant in unlimited amounts, save for StarLink corn, which was never approved for food use. Also, the EPA has failed to establish data requirements specific to plant pesticides and recommends only that companies conduct short-term oral toxicity tests in rodents and *in vitro* digestibility tests on the plant pesticide, without any further guidance regarding test conditions.

The USDA oversees GE crop field trials and is responsible for making a "determination of nonregulated status" prior to commercialization for GE crops that are submitted by developers for environmental review. The "determination of nonregulated status" permits the unregulated cultivation and sale of a GE crop. Every petition for non-regulated status submitted to the USDA thus far, has been approved. When a crop is deregulated, the crop and all its progeny are completely removed from the USDA's regulatory authority. Therefore, no monitoring of environmental harm is conducted after deregulation. The main criteria USDA uses to determine deregulation is whether or not the GE crop is invasive or has weedy characteristics. The USDA does not have the authority to evaluate the potential health impacts of the crop, or of conventional crops that become contaminated with experimental traits.

In 2002, a committee of the National Academy of Sciences (NAS) reviewed the USDA's performance at regulating GE crops. It found a lack of transparency, too little external scientific and public review of decision-making, and poorly trained personnel. It also

found that the USDA was allowing companies to make excessive claims of confidential business information (CBI). In fact, the committee itself complained that it was denied access to information it needed to conduct its review due to inaccessible CBI.[32]

In 2003, a committee of the NAS and the Institute of Medicine conducted an assessment of the safety of genetically engineered foods[33] in which it made a number of recommendations that implied that proper safety procedures for GE crop development were not currently in place. The nature of the NAS and Institute of Medicine recommendations[5] strongly contradict Monsanto's portrayal to investors of thorough oversight and review by regulatory agencies of its Seeds and Traits operations. The committee recommended that changes that result from genetic engineering undergo an appropriate safety assessment (implying that current assessments were inadequate); that the extent of an appropriate safety assessment should be determined prior to commercialization (implying that current assessment was not extensive enough); that the appropriate federal agencies determine if evaluation of new GE foods for potential adverse health effects from both intended and unintended compositional changes is warranted by elevated concern (implying that federal agencies were not making such determinations); and for those foods warranting further evaluation, the committee recommended safety assessments be conducted prior to commercialization and that there be continued evaluation post-market where safety concerns are present. (Implying that such evaluations were not currently being done and that regulatory capacity was not in place.)

Furthermore, the committee recommended four safety assessment actions: that standardized sampling methodologies, validation procedures, and performance-based techniques for targeted analyses and profiling of GE food be developed and employed; that tracking of potential health consequences from commercially available foods that are genetically modified, including those that are genetically engineered, be developed and improved; that a significant research effort should be made to support analytical methods technology, bioinformatics, and epidemiology and dietary survey tools to detect health changes in the population that could result from genetic modification and, specifically, genetic engineering of food; and that research is needed to determine the relevance to human health of dietary constituents that arise from or are altered by genetic modification.

Monsanto investors should consider that these recommendations imply that Monsanto has a higher risk profile as a result of the lack of regulatory oversight. Since there is no overarching regulatory system for genetically modified crops, and therefore in many cases, no government agency responsible for controlling unintended impacts, Monsanto is held directly liable for damages relating to its products.

While Monsanto has lowered its risk profile by getting out of genetically engineered bio-pharmaceutical crop development, the company still has risk exposure to any potential market backlash stemming from contamination by pharma-crop development and commercialization programs run by competitors. This implies that the regulation of bio-pharmaceutical crops is still of interest to investors as well. It should also be noted that such risk also extends to the development of genetically engineered animals (such as GE Fish) which are currently regulated as "food additives" by the FDA. Again, while Monsanto is not involved in such activities, market risk still exists for the company. This risk relates to

general distrust by consumers of the technological soundness of genetic engineering processes, with respect to safety and regulatory oversight, should problems occur. So while the USDA and FDA have recently increased their oversight involvement in pharma-crop development, FDA guidelines are **still voluntary**[34] and consumers' response to pharma-crop gene contamination of food is reasonably expected to be one of zero tolerance. Most importantly, since these issues are very complex, consumers are not reasonably likely to distinguish between Monsanto's products and those of a pharma-crop developer.

## MARKETING AND GOALS

The chart below (figure 10) describes the breeding and technology product development, comprising more than 80% of Monsanto's R&D investment. Capabilities in genomics, biotechnology and plant breeding are applied to develop seeds with preferred input and output traits

| | Discovery | Phase 1 | Phase 2 | Phase 3 | Phase 4 |
|---|---|---|---|---|---|
| **Description:** Key Activities and milestones in each phase of product development | **Gene/Trait identification:** Conduct high-throughput screening of genetic database to identify valuable plant traits that can be used in conventional breeding and valuable genes that can be used to improve plants through biotechnology. Apply screens to broad categories of interest, identifying multiple leads that can be investigated | **Proof of Concept:** For conventional breeding, breed plants from parents with desired traits; for biotechnology products, test gene configurations in plants to screen for desired performance. Determining which products leads show the most promise for application to core crop plants. | **Early Product Development:** For conventional breeding, conduct field trials of plants bred from parents with desired traits; for biotechnology products, conduct lab and field testing of genes in plants to select commercial product candidates and to meet regulatory requirements. | **Advanced Development:** Demonstrate performance of hybrid/variety developed through conventional breeding or demonstrate efficacy of biotechnology trait in elite germplasm. Develop regulatory data as appropriate. | **Final Regulatory submission:** Produce build seed for potential sale, develop plans for commercialization/launch, and respond to regulatory process as appropriate |
| Average Duration | 24 to 48 Months | 12 to 24 Months | 12 to 24 months | 12 to 24 Months | 12 to 36 months |
| **Average Probability of Success** (based on all Candidates in each phase) | 5% | 25% | 50% | 75% | 90% |
| **Input Trait Candidates:** Input traits aimed to provide value to farmers by increasing productivity and reducing costs | · **Grain Yield**<br>· **Environmental stress tolerance**<br>· **Insect Control**<br>Corn rootworm II<br>Nematode Control<br>· **Roundup Ready**<br>Enhanced tolerance<br>· **Disease Resistance** | · **Higher Yielding Corn/Soy**<br>· **Drought-tolerant Corn/Soy** | · **YieldGard II insect-protected corn**<br>· **Roundup Ready and insect-protected soybeans** | · **Second-generation Roundup Ready/YieldGard Rootworm corn**<br>· **Roundup Ready Flex Cotton**<br>· **Hybrid Roundup Ready canola** | · **Conservation tillage elite germplasm -- Corn**<br>· **YieldGard Plus Insect protected corn**<br>· **YieldGard Rootworm corn Stacks** |
| **Output trait candidates:** Output traits aimed to provide consumer benefits and create value for manufacturers and processors | · **Protein enhancement**<br>· **Lipid enhancement**<br>· **Carbohydrate enhancement**<br>· **Bioactive compounds** | · **Healthier oil II for food uses**<br>· **Improved-energy corn III for feed**<br>· **Improved-protein corn for feed** | · **Omega-3 soybeans for food uses**<br>· **Improved-protein soybeans for food/feed**<br>· **Improved-oil soybeans for processing** | · **Low linolenic soybeans**<br>· **Improved-energy II corn for feed** | · **High fermentable starch corn for ethanol**<br>· **Processor Preferred elite germplasm in key crops** |

Figure 10. Monsanto Product Pipeline[35]

Monsanto's marketing approach has emphasized that its products will help to feed a growing population and will help farmers ensure higher yields. Its overall business model is to sell chemicals and seeds to farmers. It does so by linking seeds with chemical technologies through recombinant DNA techniques (genetic engineering), as with Roundup Ready seeds, or more directly through licensing agreements on genetically engineered seeds such as its Bt

corn and herbicide-resistant soybeans for which it earns royalty fees from seed producers and ultimately paid for by farmers.

The company has stated in its recent annual report that it intends to increase the percentage of revenues earned from genetic engineering relative to its regular seed and chemicals businesses.[36] This will increase the company's risk exposure to potential problems associated with genetically engineered crops.

Monsanto has been one of the earliest adopters of GE crop development. Its first product was the FlavrSavr tomato, a product it acquired when it bought the original developer, Calgene. Since then it has developed GE soya, GE corn in several varieties, GE canola, GE cotton, a GE potato and GE wheat. A number of other products are in the R&D pipeline. According to the company it is in the process of developing several new genetic traits through recombinant DNA techniques (genetic engineering). These include cold, heat and drought tolerance, disease resistance, and nitrogen efficiency, as well as an "improved energy" corn for pig feed and "improved-oil" soybeans for processing efficiency (see Figure 10 above).

The company also has a number of "stacked gene" crops in its product development pipeline that include its Bt toxin and Roundup Ready traits. This year the company has submitted for final regulatory submission (the final phase of its four phase product development process) a new variety of Bt corn, second generation of Bt cotton, and a feed corn which has improved energy characteristics. It should be noted that the strategy of developing products which have no direct perceived benefits to consumers is evident here and will therefore be likely to amplify the trend of consumer rejection of GE crops. In addition, the focus on crop traits which are not meant for human consumption, and yet could result in contamination of the human food chain appears an especially risky endeavor in light of the StarLink corn problem.

## MARKET RISKS FOR GENETICALLY ENGINEERED CROPS

### Increasing Competition in the Bt Corn Market

Pesticide resistant corn is becoming an increasingly important crop for Monsanto's future growth. The mainstay product, Roundup Ready soy, was quickly adopted in the US and has essentially reached maximum penetration at around 85% of the acres planted in the US. Penetration numbers are similar in Argentina and Brazil. Although soy will continue to return revenue, its growth potential is limited. Corn's penetration in the US is much lower. Bt trait corn makes up approximately 32%[37] of all corn planted in the US.

Monsanto currently has two established corn traits in commercial use. The first is glyphosate tolerance and the second is a Bt corn borer insecticide. Glyphosate tolerance is one of the primary reasons for high adoption rates of soy. The situation is somewhat different for corn. Due to corn's denser planting, as compared to soy or cotton, there is much less opportunity for weeds to root and get sunlight to grow. As such, although moderately useful, herbicide tolerance in corn is not as valuable as it is in soy or cotton.

The second trait in corn is the expression of the Bt bacteria which kills the corn borer pest. In contrast to herbicide tolerance, the Bt corn borer trait is much more valuable to the farmer and has proven largely effective in reducing pesticide use. It produces Bt in what the EPA describes as a "high dose event" or that the dose is at least 25 times the 95% lethality dose. Such a high dosage assures a strong resistance to corn borer infestation.

A third corn trait was introduced last year which Monsanto is promising will lead the way in terms of growth. This third trait kills the rootworm pest via a second type of Bt bacteria. The rootworm insect is an even more virulent pest than the corn borer and it has been nicknamed 'the billion dollar bug' for its efficacy at destroying corn crops in the US. Given the damage that this pest has wrought, there is a demonstrated need for new means of controlling it. *YieldGard Rootworm* is an attempt to capitalize on that need.

However, the landscape is much different for the Bt rootworm than it was for Bt corn borer. In contrast to the Bt corn borer trait, the rootworm variety expresses a "low dose event." In fact the dosage is so low that farmers will still likely need to apply a rootworm insecticide.[38] Monsanto's own 2004 tests show that the yield gain on Bt rootworm corn vs. conventional corn is only 5%.[39]

The advantage of in-plant protection may well still be adopted by farmers. However, both Dupont and Syngenta will introduce their own varieties within 2 years. Pioneer's Bt rootworm trait, in particular, has been shown to have a higher Bt dosage given its more recent development (2001 vs. 1999 for Monsanto).[40] Although the short term first mover advantage is Monsanto's, Dupont has ready access to the seed market. Through its Pioneer brand, Dupont will be able to capitalize quickly on its new trait.

Finally, it must be noted that the rootworm is notoriously efficient at adapting to pesticides. The quick obsolescence of Bt corn can only hurt Monsanto's weaker variety as farmers require a higher dosage from the Pioneer or Syngenta variety for pest control.

## Affects of Roundup Competition

In its 2002 annual report Monsanto estimated that its market share will likely drop from 77% to the low 60's by around 2005. Also, as a result of competition, company officials provided estimates to Wall Street analysts projecting that Roundup prices would drop from $23 per gallon in 2002 to around $14-$16 per gallon by 2005.[41] Given that Roundup prices are now hovering around $13 per gallon in the U.S. and that Monsanto has been able to keep global market share at around 60% it seems that the worst impacts of Roundup competition are over.

The affects of competition for Roundup have been considerable, although not unexpected with an estimated $1.69 billion in lost revenues, and a 14% drop in overall revenues from 2001. In some cases, Monsanto has been driven out of the glyphosate market altogether, as was the case in Australia, where competition from cheap Chinese imports caused the company to close its manufacturing plant there.[42] Based on Monsanto's estimates, losses in the glyphosate business were roughly in the $400 to $500 million range through 2005. The question remains for investors as to how serious the financial impacts of generic glyphosate competition will be and whether Monsanto can replace the lost revenues with new business elsewhere. It will also be important to track the degree to which cheaper glyphosate hastens the biological development of resistance by key weedy species Roundup is meant to control. This development would make the product less valuable to farmers, and therefore less of a profit center for both Monsanto and competitors.

## Problems with "Value Capture" Outside US

One of the largest structural challenges Monsanto faces for long term growth is an effective strategy for capturing value in the developing world. Outside of the US, Canada and a handful of other developed countries, Monsanto receives little if any revenue from its traits. Company marketers are quick to point to increasing acres planted for its GE crops. However, in-depth analysis of the economic gains in these markets by the industry has been slight and it appears that acres planted in the developing world have not yielded any significant revenue to date. This is particularly true for Argentina despite the almost complete market penetration of Roundup Ready soy there. The problem of "value capture" primarily affects soy and cotton because these plants are non-hybridized, meaning the seeds can be replanted year after year without yield loss. The same cannot be said for corn where yield loss of over 50% on replanted seeds is not uncommon.

Argentina typifies the value capture conundrum. While over 95% of soy planted in that country is Roundup Ready, Monsanto was forced to shut down its operations there in 2004 because it could not earn revenues. The acres planted and penetration numbers touted by the marketing department suggest booming profits. However, the balance sheet reveals a quite different story of political wrangling ending in little, if any, profit.

Developing countries often have poor enforcement of intellectual property rights and/or inefficient justice systems making prosecution of trait theft difficult. Moreover, these countries often have laws supporting seed saving, further frustrating value capture attempts. Several value capture models have been tried to date and none has yet to return significant revenue. The latest iteration is in Brazil where Monsanto has allied itself with collection depots. When farmers come to drop off their soy for processing it is tested. If it is found to be Roundup Ready soy, the farmer is charged a percentage of the total value. The Brazilian system managed to break even in 2004 even though a large portion of the soy crop is Roundup Ready. A similar system is under discussion for Argentina which is due for introduction in the next two years. It is unclear at this stage how controversial these developments will be, given the historical prerogative of farmers to save seed and to own outright, their crops.

The structural difficulties with a value capture system of this type should be obvious. First of all it relies on a much broader spectrum of collection agents. These agents have a strong incentive to keep the collection fees for themselves. Thus, enforcement mechanism must be funded either by the government or Monsanto itself. Furthermore, a value capture system not strongly rooted in farmer chosen seed sales tends to breed resentment towards a "Monsanto tax." Given the uncertain property rights situation, political whims can have a strong influence on program size and revenue. Finally, long term profits are based on the ability to significantly raise the collection fee. Although this type of system may have the ability to break even and even return small profits, larger fees may be unpalatable to farmers. A bigger take at collection depots causing farmer dissent mixed with uncertain IP rights makes for a very uncertain revenue picture no matter how many acres are planted.

## Catastrophic Failure Risks

### "Adventitious Presence" [Contamination]

*"The detection of unintended but unavoidable trace amounts (sometimes called "adventitious presence") of commercial biotechnology traits in conventional seed or the grain or products produced from seeds containing these traits, may negatively affect our business or results of operations.."* – From the Monsanto 2003 Annual Report pg. 39.

Monsanto has admitted in the 2002 annual report that research and development of GE crops will result in the spreading of GE traits to non-GE crops.[43] This is a major admission for the industry and implies that the risk of contamination and negative impacts is very high going forward. The report acknowledges concerns about research and development of both traditional biotechnology as well as pharmaceutical proteins appearing in food crops. This implies that the company is aware of the possibility that both approved GE traits as well as unapproved traits still in the development process could end up in the human food supply-chain. The level of environmental and human-health risk, and therefore financial risk, cannot be understated.

Contamination can occur for example through the following paths: cross pollination, so-called "volunteers" – seeds from previous crops that are herbicide resistant, and mix of grain in silos. Even one gene with unapproved characteristics escaping into the general population of food crops could impugn the entire industry, and could result in major business losses for the company as was seen with the StarLink contamination episode. Given that Monsanto has multiple GE crops in the development pipeline that are discussed as being animal feed crops, it will be interesting to see how those are dealt with at the regulatory approval stage. New controversies and negative financial impacts for investors are highly likely. While Monsanto, as a large company with a focused agricultural inputs business, will likely make short term earnings targets, the issue of inevitable contamination implies that a serious contamination problem is a matter of when, not if, investors take note.

The problem of contamination is going to become an increasingly difficult problem for Monsanto going forward. The company has stated that competitive pressure on its flagship product, Roundup, will increase and profits derived from its sale will drop along with market share. The company will be under increasing pressure to bring new products to market in order to fill the gap in terms of profits. A juxtaposition of the company's pipeline for products, which include animal feed crops not intended for human-food consumption, with increased pressure to commercialize its GE crops, implies that the company will be at increasing risk for contamination problems.

### Contamination of the Mexican Crop Cradle

In Mexico, genetic contamination of one of the major staple crops of the world has occurred. In September 2001, Mexican government officials first reported contamination of local varieties of corn with genetically engineered sequences in communities in the states of Oaxaca and Puebla, despite a federal moratorium on the planting of GE corn. Further investigations confirmed these findings.[44]

The most likely source of the contamination is unsegregated U.S. corn, huge quantities of which are imported into Mexico each year. According to the U.S. Department of Agriculture (USDA) more than 5.6 million tonnes of corn with a value of 651 million USD

were exported to Mexico in 2003.[45] In 2004, 45% of the corn grown in the US was genetically engineered.[46]

Upon request of affected communities, the Commission for Environmental Cooperation (CEC), established as an environmental body under the NAFTA, investigated the full magnitude of the genetic contamination and its social and environmental consequences.[47]

Mexico is one of the so-called centers of origin and diversity of corn. Teosintes, the closest wild relatives of cultivated corn, and thousands of landraces of corn are found growing in Mexico. Corn is the most important crop in Mexico in terms of land area devoted to it. Corn is open-pollinated and it is known that gene flow occurs easily among such plants. There is a potential for GE crops to interbreed with wild relatives varieties and the offspring to be viable. The CEC report recommends that all certified GM free corn be labeled. All unlabeled corn should be milled upon import to mitigate the risk of it accidentally mixing with native varieties. In addition, the report supports the current moratorium on GM maize and urges stronger outreach to small farmers concerning the risks of GM maize.

It is instructive for investors to examine the past record of contamination cases involving genetically engineered crops to quantify the real material risks facing Monsanto not only from GE food crops but also from second generation products which have been genetically engineered to be animal supplements. Going forward, the company will be relying much more heavily on profits from its GE seeds business. This will place greater pressure on the company to commercialize products in its pipeline and therefore push the company to greater levels of risk exposure.

## StarLink

*"...year-to-date, US exports of corn, wheat, and soy products were down 65 million bushels. And that was compared with projections by USDA that call for exports to be up by 330 million bushels. So that shows you the order of magnitude of what's happened. And I don't think it's that we've been uncompetitive price wise with other people around the world. I just think South Americans in particular have been able to take advantage of the situation and take some of the business formerly supplied by US farmers and merchandisers on the basis of having GMO free material. That's happened in Europe. That's happened in Korea. It's happened in Japan."* – Larry Cunningham, Senior Vice-President of Corporate Affairs of ADM, commenting on the effects of the Star Link contamination in an April 23, 2001 quarterly analysts' conference call.

In the fall of 2001, independent non-governmental analysis of grocery store food products uncovered wide-spread contamination by a GE corn variety known as "StarLink." The corn contained an insecticidal protein from the *Bacillus thuringiensis* bacterium which had not been approved for human consumption due to potential allergic reactions. While less than 1% of the U.S. corn crop was planted with StarLink corn, upwards of 10% of U.S. corn was contaminated. The recall cost companies along the food chain hundreds of millions of US Dollars as they attempted to find, retrieve and replace products that used the corn.[48] StarLink corn also turned up in Japan - the top foreign buyer of U.S. corn – where GE corn has no approval for use as food or feed. In 2001, Japanese imports of U.S. corn fell by about 1.3 million metric tons due to the StarLink issue.[49] To date this event has cost StarLink's developer, Aventis, an estimated $1 billion. Recently, in February of 2003, Aventis and the StarLink distributor agreed to pay $110 million to farmers who say they were financially hurt by the incident.[50]

## ProdiGene and "Bio-pharmaceutical crops"

*"It is possible that crops transformed to produce pharmaceutical or other industrial compounds might mate with plantations grown for human consumption, with the unanticipated result of novel chemicals in the human food supply."* - Committee on Environmental Impacts Associated with Commercialization of Transgenic Plants of the National Academy of Sciences

In the wake of the StarLink fiasco, a second contamination case has raised serious questions about the safety procedures surrounding the development of genetically engineered crops containing industrial or pharmaceutical proteins which produce medicines or vaccines.

ProdiGene, a small Texas-based genetic engineering firm, was found to have mishandled genetically engineered pharmaceutical corn that produced pig vaccines in Iowa and Nebraska. A test plot of ProdiGene pharmaceutical corn was grown on a Nebraska field in 2001. Ordinary soybeans that were planted in the same field in 2002 got contaminated by the GE corn and mixed with 500,000 bushels of soybeans, worth roughly $2.7 million, at a commercial grain elevator. The company was fined $250,000 and had to spend up to $3 million to destroy the soybeans. The company will also have to post a $1 million bond to guarantee its financial responsibility for future problems.[51] The company's CEO acknowledged that no formal human safety testing had been done on the pig vaccine protein contained in the corn.[52]

In a similar incident, the USDA ordered ProdiGene to destroy several thousand bushels of corn in Pocahontas County, Iowa after the company failed to follow procedures designed to stop the spread of the engineered genes to other fields containing food crops.[53] The seed distributor, Stauffer Seeds (owned by ProdiGene) ran ads in farm journals telling farmers they could grow "*genetically enhanced corn containing industrial and pharmaceutical products*" with "*No change in current farming practices*."

These incidents have galvanized the food industry in opposition to the further development and commercialization of food crops genetically altered to contain industrial or pharmaceutical proteins. Politically powerful trade groups for the $500 billion food sector such as the National Food Processors Association and the National Grocery Manufacturers of America have been pressuring the genetic engineering industry to change its approach to the development of these crops by staying away from food crops and switching to non-food crops such as tobacco. These industries see bio-pharmaceutical crops as a financial threat and don't want to repeat the StarLink fiasco. "*If need be, we could even go to the public*" stated Rhoda Applebaum, Executive V.P. of Scientific and Regulatory Affairs at the National Food Processors Association.[54] This is significant opposition coming from an industry that has previously been supportive of genetic engineering.

The editors of the journal Nature Biotechnology and the U.S. National Academy of Sciences have both stated that cross-pollination with non-GE crop varieties was a potential problem.[55,56]

Pressure from the food sector was eventually successful in forcing Monsanto to abandon its bio-pharmaceutical crops division in 2003. However, potential contamination of food crops by bio-pharmaceutical crops could further galvanize market rejection to its products including the genetically engineered food crops upon which it will increasingly rely for profitability.

# 5. ANALYSIS OF THE BENEFITS

While this report has detailed the risks of Monsanto's GE strategy, there are benefits driving adoption by many farmers. Higher yields, lower costs and pesticide usage, as well as less labor have been the main claims with which GE crops have been marketed. The economic record remains unclear and genetically engineered crops have been a mixed bag for developers and farmers. While Monsanto lost $1.7 billion in 2002 due to droughts and growing competition for its Roundup herbicide, among other things, the financial benefits for farmers are also uncertain with studies showing both positive and negative financial results.

An analysis by the USDA looking at the adoption of genetically engineered crops in the United States found the following conclusions:[57]

- The adoption of herbicide tolerant soybeans did not have a significant impact of net farm returns in 1997 or 1998. This is consistent with other surveys done. [58,59]
- Adoption of Bt cotton had a positive impact on net returns but adoption of Bt corn had a negative impact on net returns among specialized corn farms. Positive return may be due to seed companies setting low premiums for herbicide tolerant varieties in an attempt to expand market share. It is important to note here that a portion of Monsanto's projected future profitability is intended to come from increasing tech fees on existing products.
- The adoption of herbicide tolerant corn improved net returns among specialized corn farms (deriving more than 50% of the value of production from corn.)
- Broader financial analysis used in determining performance measures, such as net farm income and return on assets, did not show GE crops to have a significant impact.

These results imply that positive returns for farmers, where they were found, may only last while the company cuts prices to expand its market share. Monsanto may find its ability to lower prices is curtailed as Roundup competition increases the pressure on the company to achieve higher revenues for its GE seed business. Indeed, the company has been pursuing a strategy of lower system costs. While Glyphosate costs are decreasing, the price of GE seeds is rising so that the overall cost of using the Roundup system is down. However, this strategy will continue to work only as long as Glyphosate costs continue to fall. The dynamic of capturing falling Glyphosate sales with increased seed costs may not produce the levels of profitability that Monsanto projects. This is due to the fact that its GE traits will become less effective over time due to pest resistance and the fact that the company's Roundup strategy partly relies on marketing a more expensive value-added product. These factors combined with increasing market rejection may have a negative effect on the company's profitability.

A report by the Soil Association outlines reasons why many farmers are planting GE crops, that go beyond the explanations of the industry. Some of the agricultural sector dynamics that may explain increased use of genetically engineered crops despite supposed losses include:

- Lack of farmer awareness of differences between GE crops and other crops. Many high yielding hybrids are now available only in GE varieties. Therefore, farmers seeking those advantages had to accept GE traits as well.
- Lack of information provided to farmers stating that they were buying GE crops.
- Lack of awareness of market rejection and agronomic problems associated with GE crops. Government and company information sources frame GMO rejection as a "trade barrier" by competing governments rather than market rejection by consumers.
- Many farmers are "locked in" to GE crop production due to contamination problems from neighboring farms growing GE crops. Lack of access to premium non-GE markets, such as for Canola farmers in Saskatchewan where contamination levels essentially rule out growing non-GE canola.

## Lower Pesticide Use & Increased Yields

*"Farmers are really starting to question the profit-enhancing ability of products that seem to be shutting them out of markets world-wide"* Cory Ollikka, Canada's National Farmers Union current president calling for a moratorium on GE crops, December 2000.

In the U.S., Brazil, Argentina and Canada, farmers have been won over by industry's promises of better yields and lower costs. However, the panacea of low pesticide use is proving to be short lived. The first years of herbicide tolerant crops did indeed lead to decreased use of pesticides on GE as compared to conventional crops. Several years of intense Glyphosate use though have lead to escalating populations of herbicide tolerant weeds. There is a clear trend over time to GE crops requiring more pesticides than conventional crops, not less as the industry has promised.[60] The trend is so strong that in 2004 farmers sprayed an average 4.7% more pesticides on GE crops than they did on the identical conventional crops.[61] It should be noted that Bt crops have lead to slight decreases in insecticide use as compared to conventional crops. However, due to much larger planting of herbicide tolerant crops, overall pesticide use on GE crops is up significantly.

| Glyphosate Resistant | Common Name | Countries | Year |
|---|---|---|---|
| Conyza bonariensis | Hairy Fleabane | South Africa | 2001 |
| | | Spain | 2004 |
| Conyza Canadensis | Horseweed | USA | 2000 |
| Eleusine Indica | Goosegrass | Malaysia | 1997 |
| Lalium multiflorum | Italian Ryegrass | Chile | 2001 |
| | | Brazil | 2003 |
| Lolium Multiflorum | Rigid Ryegrass | Australia | 1996 |
| | | USA | 1998 |
| | | South Africa | 2001 |
| Plantago Lanceolate | Buckhorn Plantain | South Africa | 2003 |

Figure 11. Known Glyphosate Resistant Weeds[62]

Herbicide tolerance in weeds is fast becoming a common feature of the Roundup system. Tolerance began to appear soon after Roundup Ready crops were introduced. Due to the ease of use of the Roundup system and the falling price of Roundup in the US, farmers are simply applying more of it. Instead of a broader mix of pesticides that would be more

resistant to weed adaptation, Glyphosate is used almost exclusively on GE crops. The financial impact of this development is a shortened shelf life for GE traits. The more successful the adoption of a particular trait, the faster that trait will become obsolete as pests adapt.

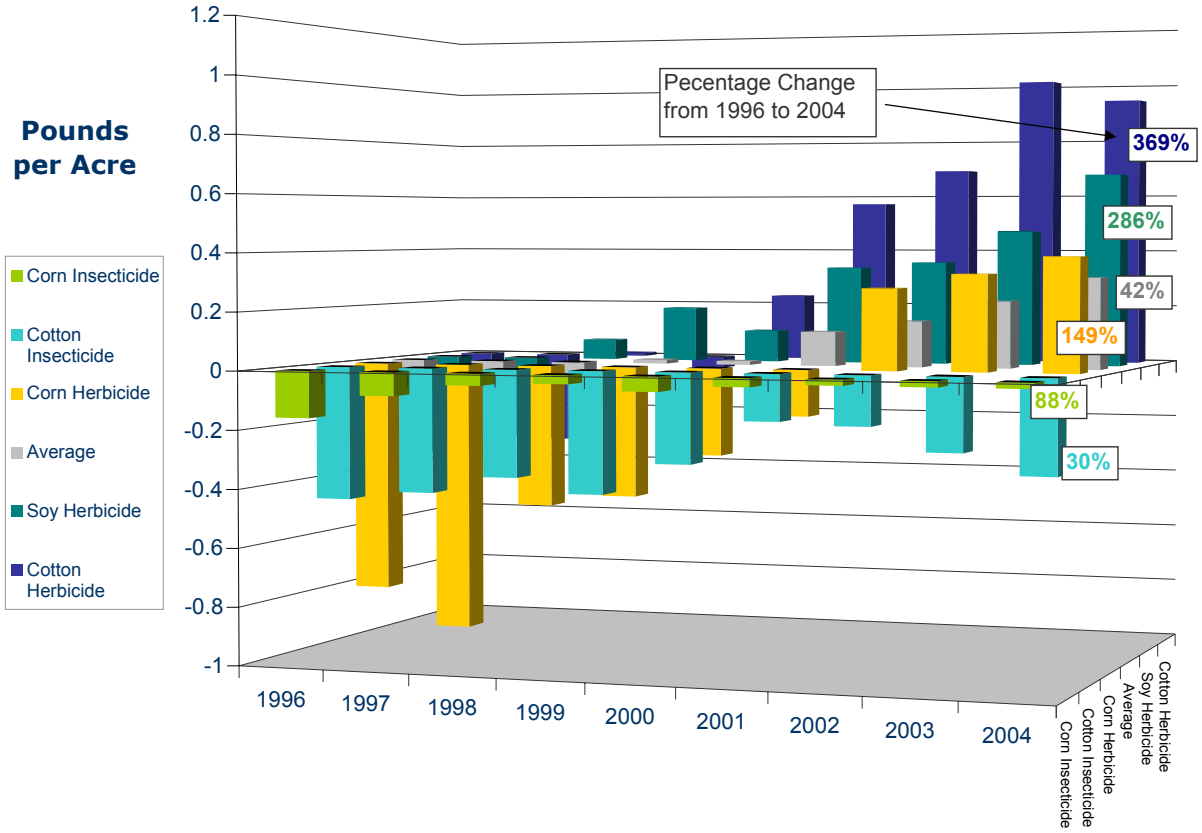



Figure 12. Difference in Pesticide Use (GE vs. Conventional crops on a "Pounds of Pesticide per Acre" basis)[63]

Herbicide tolerance is but one of several ways that GE crop benefits may not be as great as they initially appear. (See Figure 12 above.)

- A comparative study at the University of Nebraska found that "*yields were suppressed with GR [glyphosate resistant] soybean cultivars*". The potential for losses lies between 5-10% yield suppression in GE soybeans compared to non-GE lines caused by the insertion process and cultivar genetic differential.[64]
- In Canada, the number of herbicide applications used on herbicide tolerant canola is higher than for conventional canola. Between 1997-2000, there was an average of 2.13 herbicide applications per crop with Roundup Ready and Liberty Link compared to 1.78 in conventional crops.[65] Both 2,4D and paraquat (grammoxone), highly toxic pesticides, are being recommended by government agencies to control herbicide tolerant oilseed rape volunteers in Canada.[66] Herbicide tolerant varieties were marketed as using lower levels of pesticides and Monsanto's Roundup (glyphosate) is marketed as a low-toxicity herbicide as well. The development of resistance indicates that unintended effects of GE crop technology may result in higher levels of chemical use.

- The Leopold Centre for Sustainable Agriculture examined the benefits of GE crops at the farm level, covering all aspects of crop production. The study found that for both Roundup Ready soya and Bt maize the return essentially equaled those of non-GE varieties. The study notes that "*given the analyses in 1998 and again in 2000, there does not appear to be any difference in the per acre profitability between the two varieties.[...] Bt corn produced a return essentially equal to the non-Bt corn."* [67]

- Another research study found that Monsanto's herbicide resistant soya seems to have an increased lignin content which made the plants brittle in hot temperatures, potentially leading to yield losses.[68]

- Glyphosate application on Monsanto's Roundup Ready soya can inhibit soybean root growth and nitrogen fixation, especially under water deficient conditions, and can lead to yield loss.[69]

- Many U.S. farmers adopted herbicide resistant GE crops because it simplifies weed management. However, in addition to decreased yields, increased pesticide use was reported for Roundup Ready crops, according to official U.S. Department of Agriculture pesticide use data. *"Total herbicide use on RR soybeans in 1998 was 30 percent or more greater on average than on conventional varieties in six states."* [70]

- GE Bt crops pose the risk that targeted pests could develop resistance to the effects of Bt. There is strong scientific data to support this concern.[71] If widespread resistance were to occur, the insect resistant properties of the GE crops would become ineffective. The application of new and even more toxic chemical pesticides would therefore be required.

- There is also research that suggests that secondary pest damage - from pests that are not targeted or controlled by the Bt toxin - increases with the use of Bt crops.[72] Growers will still have to use chemicals against these pests. Further research also suggests that transgenic Bt plants could be harmful to non-target organisms such as natural enemies[73] of pest insects or earthworms.[74]

- Scientific studies have shown that Bt crops may secrete the toxin from the root into the soil[75] and that Bt toxin can persist in certain soils for a long time.[76] The US Environment Protection Agency's (EPA) Scientific Advisory Panel,[77] has recognized this risk and suggested that further studies are needed to determine whether this persistence can cause problems for non-target organisms, and health of the soil ecosystems.

- Syngenta - "Managing Glyphosate-Resistant Weeds, *An Investment in Land Value"*. "…, weed resistance to glyphosate herbicides has recently been documented in various on-farm locations throughout the United States…. Suddenly, glyphosate-resistant weeds have become more than an in-season production and profitability issue. They can also affect the long-term value of farmland and even determine who receives preference as the tenant farmer." …"While weed resistance to glyphosate is not yet a widespread problem, it is more than a laboratory or greenhouse theory. The first on-farm cases in this country were recently documented. Glyphosate-resistant marestail (horseweed) was confirmed by university weed scientists in Delaware and Tennessee, while more than fives cases of glyphosate-resistant rigid ryegrass were reported in California orchards. The high volume of glyphosate being used across the country as a result of RR technology adoption makes this a very real concern for growers, professional farm managers and the owners of farmland."[78]

# 6. GE RISKS AND THE IMPLICATIONS FOR SHAREHOLDERS

## MARKET RISKS

*"Public Acceptance: The commercial success of agricultural and food products developed through biotechnology will depend in part on public acceptance of their development, cultivation, distribution and consumption."* – From the Monsanto 2002 Annual Report

This section covers the general risks to investors resulting from development and marketing of genetically engineered crops and food products.

### Consumer Rejection and U.S. Public Opinion

The depth of market rejection for GE crops is not likely to be equaled by any other consumer product. In addition to large numbers of consumer groups, a majority of the world's governments and many large players in the food industry have banned GE crops and ingredients. Below is a flowchart (figure 13) showing the development of market rejection for genetically engineered foods which shows no signs of abatement. For investors, this list should serve as a stark example of the uphill battle Monsanto and other GE crop producers face in getting products to market.

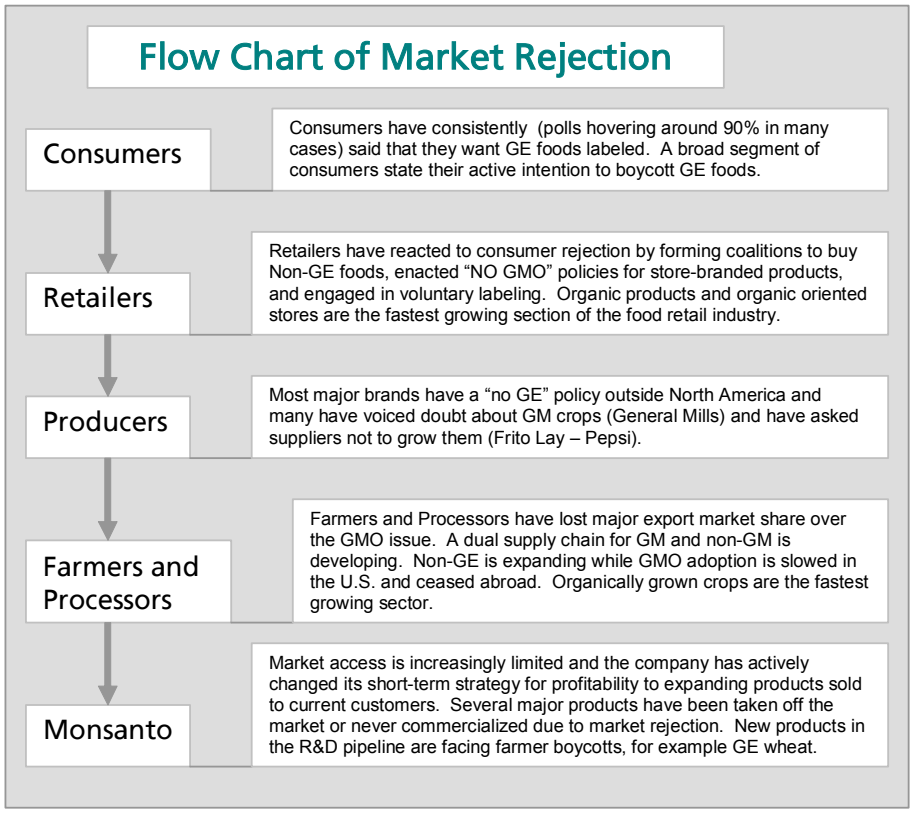
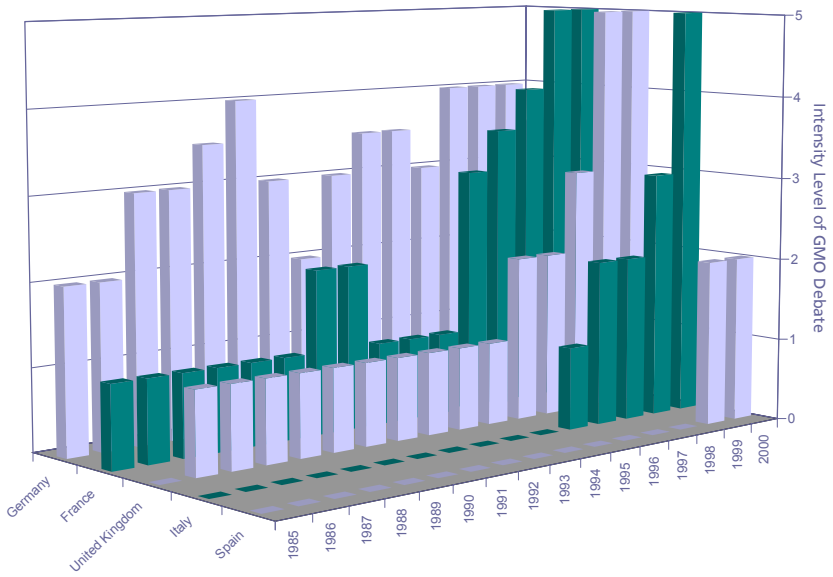



Figure 13. Flow Chart of Market Rejection of GMOs

The market risks for genetically engineered crops are greatly related to the level of consumer awareness about the issue. This has been the main driver of market rejection. A key market to examine in understanding the development of consumer awareness and

opposition to GE crops is the European market. Figure 14 below illustrates the growth in awareness of the issue as reported by the Final Report of the PABE research project for Commission of European Communities.[79]




"0" indicates no debate on the issue at all, in any arena. "1 to 2" (situation B in Figure 2) indicates a debate which is mainly confined within a small number of specialized arenas: the debate involves only a few professionals who handle the problems raised according to the established rules of each specific arena. It hardly enters the media and remains unnoticed by the general public. "3 to 4" indicates a debate which involves a greater number of arenas, greater interaction between the different arenas, and a debate which overflows from specific arenas. This is reflected in greater media interest and changes in opinion polls, but the debate still involves mostly official stakeholder representatives: it is stimulated by NGOs and other forms of organized social movements. "5" (situation D in Figure 2) indicates that the fundamental characteristics of most of the arenas, including the type of actors present and the frames of reference used within each of them, have been significantly influenced by the dynamics of the public debate. Media coverage is high and the non-organized mass public becomes actively enrolled: everybody has heard about the issue and has something to say about it.

Figure 14. Intensity Level of GMO Debate in Five Selected European Countries

Source: PABE (2001) *Public Perceptions of Agricultural Biotechnologies in Europe*.
(The authors emphasize, that this should not be taken as a strictly quantitative assessment of the situation, and that the graph in Figure 14 should be considered together with the qualitative narratives in section 5.2. (pgs. 41-5) of the report.)

The Public Perceptions report research shown above was conducted through focus groups designed to gather in-depth understanding of public knowledge and opinion on the development and sale of genetically engineered food in five European countries. Each country had eleven focus groups designed to capture different segments of the population. Some of its findings are very revealing for investors and shed light on the complexity of public opinion and some of the motivation behind the wide-spread market rejection of genetically engineered crops. Some of it bears repeating here due to the nuanced level of input researchers were able to elicit from participants which gives a greater understanding of public opinion than mere polling. The researchers reported that lack of information was an overwhelming feeling expressed by the focus groups, although this reflected not the amount

of information received but the *quality* of information received. This translated into a demand for labeling.

Comprehensive labeling of products containing GMOs or ingredients derived from GMOs was systematically demanded, but this had not been provided by EU or national legislation (labeling of "GE-free" food products was not considered to be an adequate solution).

Lack of labeling was seen as an infringement of personal choice and control, but this was not solely demanded in order to protect oneself from potential harmful consequences. Labeling was also felt to be important to allow consumers to boycott the products in order to 'send a message' to manufacturers about a whole range of concerns other than health risks associated with GMOs; and to enable post-market monitoring of unintended harmful effects, and removal from the market if such harm was identified. A frequent question raised was "How can long term chronic impacts be evaluated if the products were not even labeled?" It was also felt that labeling would demonstrate that "they [the promoters] have nothing to hide". (PABE, 2001)[80]

In the United States, the largest market by far for GE foods, researchers from 12 American universities, headed by the University of North Carolina, conducted a recent polling study entitled *"The Globalization of Food: How Americans Feel About Food Sources, Who They Trust, Food Security, Genetic Modification, Food Labeling and the Environment".*[81] The researchers obtained a sample of 819 randomly selected US respondents. They adjusted mailed survey responses using 2000 U.S. Census data on age, race, sex, income, education and region in order to make findings more nationally representative. According to researchers 92% of respondents stated that they wanted labels on genetically engineered foods. Only one percent said they did not. 7% were undecided on labeling of genetically engineered food ingredients. When asked if they would eat foods grown with new biotechnological techniques 51% were undecided and there was a split between those agreeing (26%) and disagreeing (23%).

Other results included

- 47% were not sure if they consider genetically engineered plants unsafe.
- 28% say genetic engineering makes plants unsafe.
- 25% believe they're safe.
- 43% aren't sure if genetically engineered foods from animals are unsafe. 39% see them as unsafe and 17% see them as safe.
- 17% say they are safe.
- 71% would pay more for food produced in ways that protect the environment.
- Another 60% would pay more for food produced without using chemicals.
- 81% would pay more if it were grown on farms using good environmental practices.

Previous polls of Americans found similar consistent wariness of genetically engineered foods with a consistent focus on the need for labeling.[82,83]

**U.S. Polling Data History 1997-2004**

| Date | Poll Source | Response |
|---|---|---|
| Sept. 2004 | **Pew Initiative on Food and Biotechnology** | A September 2004 poll conducted by the Pew Initiative on Food and Biotechnology revealed that 92% of Americans surveyed support labeling of GM foods. |
| Oct. 2003 | **Food Policy Institute, Rutgers University** | In October, 2003 the Food Policy Institute at Rutgers University released a follow up to its 2001 opinion poll on genetically engineered crops. Their latest poll found that 94% of Americans say that foods created through GE should have special labels on them. |
| Sept. 2003 | **Pew Initiative on Food and Biotechnology** | On September 15, 2003, the Pew Initiative on food and biotechnology released the results of a follow up pool to their 2001 one. The opinion poll revealed that 89% believed that no GM food product should allowed on to the market until the FDA has determined that it is safe. |
| Nov. 2002 | **American ViewPoint** | On November 5, 2002 American ViewPoint released the results of an opinion poll on genetically engineered foods. The poll found that 86% of Americans surveyed said that GE foods should be tested for safety before they are marketed to the public. Also, 88% believed that the government should require labeling of food products that have been genetically modified. |
| Nov. 2001 | **Food Policy Institute, Rutgers University** | On November 15, 2001 the Food Policy Institute at Rutgers University released the results of their latest opinion poll on genetically engineered crops. Their public opinion poll found that 90% of Americans say that foods created through GE should have special labels on them. |
| Sept. 2001 | **Farm Foundation/Kansas State University** | In a survey of farms through out the U.S. 90% of American Farmers support labels on GE products if they are scientifically different from conventional foods and 61% support labels on GE products even if not scientifically different. |
| Jun. 2001 | **ABC News.com** | In June 2001, ABC News.com found that 93% of people wanted GE food to be labeled. ABC reported that the results showed that Americans "almost unanimously favor mandatory labels on genetically modified foods." |
| Apr. 2001 | **PBS/Frontline** | An April 2001 poll with over 21,000 respondents found that 65% said we should not grow GE crops. |
| Mar. 2001 | **Pew Initiative on Food and Biotechnology** | A March 2001 poll found that 75% of Americans believe it is important to know if food is made with GE ingredients. 58% say they oppose the introduction of GE foods, while those that believe that GE foods are not safe or are unsure of the safety of GE foods total 71%. |
| Feb. 2001 | **International Food Information Council** | A February 2001 poll found that just 37% of Americans support the Food and Drug Administration's policy on labeling GE foods, while 58% support critics of the agency who call for mandatory labeling of all GE food. |
| Dec. 2000 | **Oxygen/Market-Pulse** | A December 2000 poll found that 85% of Americans support labeling of GE foods, with 88% supporting safety testing. Only half of women surveyed say they would eat GE food, with only 37% saying they would give GE food to their children. 47% of women say they would pay more for non-GE food. |
| Nov. 2000 | **Reuters/Zogby** | A November 2000 poll found that over 54% of Americans say that recalls of products found with an unapproved GE corn raise questions about the safety of the food supply. 33% believe that farmers should not be allowed to grow GE crops, while under 40% believe that GE crops should be permitted. |
| Jun. 2000 | **Harris Poll** | A June 2000 poll found that 86% of Americans think the government should require labeling of all food from GE crops. |
| Spring 2000 | **Texas A&M** | A Spring 2000 poll showed just 39.5% of Americans approve of current government regulation of biotechnology. According to Susanna H. Priest of Texas A&M, their survey shows that "…the U.S. increasingly resembles Europe in having significant amounts of opposition [to GE food]." |
| Mar. 2000 | **International Communications Research** | A March 2000 poll found that 86% of Americans want labels on genetically engineered foods. |

| | | |
|---|---|---|
| Feb. 2000 | **USA Today Weekend Poll** | A February 2000 poll found that 79% of Americans said it should not be legal to sell GE fruits and vegetables without special labels. |
| Jan. 2000 | **MSNBC** | An internet poll conducted in January 2000 found that 81% of Americans think the government should require labeling of GE food, and 89% think the government should require pre-market safety testing of GE foods, as with any food additive. |
| Dec. 1999 | **The Economist/Angus Reid Group** | A poll conducted in November-December 1999 (reported January 13, 2000) found that "Only 4% of Americans would actually be more likely to buy foods because they are genetically modified. By contrast, 57% [of Americans] would be less likely to buy them. (T)he sharpest distinction between America and Europe lies not in the percentage of people rejecting GE foods, but in public awareness." |
| Fall 1999 | **Gallup Poll** | A Fall 1999 poll found that 68% of Americans want labels on GE food, even if labeling means higher food costs. |
| Sept. 1999 | **BSMG Worldwide for the Grocery Manufacturers of America** | A September 1999 poll found that 92% of Americans support legal requirements that all GE foods be labeled. |
| Jan. 1999 | **Time Magazine** | A January 1999 poll found that 81% of American consumers believe GE food should be labeled. 58% say that if GE foods were labeled they would avoid purchasing them. |
| 1998 | **National Federation of Women's Institutes** | A 1998 poll found that 93% of women surveyed say they want all GE food clearly labeled. |
| 1997 | **Novartis** | A 1997 poll conducted for the gene food maker found that 93% of Americans agree that GE foods should be labeled as such, with 73% saying they feel strongly about labeling. |

Figure 15. U.S. Polling Data on Genetically Engineered Foods (1997-2001)[84]

Consumer rejection has recently taken a turn towards local government. Mendocino County passed a resolution in March 2004 banning GE plantings in the county limits. The California county was the first to take such a measure in the US. A similar measure was passed in November in neighboring Marin County. Several other counties have attempted similar measures with less success. However, the move towards local regulation can be quite strong even when extraordinary resources are employed to block such bans. The pro-GMO lobby in Mendocino county spent $60 per person but could not forestall the regulations. In addition, Trinity County, CA supervisors also passed similar legislation in Fall 2004.

It is important to place the discussion of consumer rejection in the larger context of market rejection of genetically engineered foods. The dynamics of market rejection are reinforcing as the economic consequences flow from one sector to the next. As can be seen in the next section on rejection of GE foods by the food industry, consumers are beginning to move the food retail industry further and further away from full adoption of GE foods. As full market penetration by GMOs has failed to materialize, the section of the economy with a vested economic interest in preventing the further commercialization of GMOs has grown.

## Food Industry Rejection

Driven by consumer rejection of GE foods, retailers and producers have been moving away from GE foods. Below are some of the GE food crops which have been developed but failed to be commercialized or were removed from the market due to consumer rejection.

- GE wheat was withdrawn from world markets in 2004 due to intense pressure from farm groups concerned over export market loss in the EU and beyond. The resulting program stoppage cost Monsanto approximately $60 million in 2004 alone.

- Monsanto abandoned bio-pharmaceutical crops in 2003, citing potential liability as one of the main reasons for doing so. It is likely that food producers were instrumental in this decision given the fact that the industry had voiced considerable concern about the technology.
- GE potatoes were withdrawn from the U.S. market in 2001 by Monsanto after a series of major market rejections, including by McDonald's, Burger King, McCain's and Pringles.[85]
- GE flax seed was taken off the market in 2001 under pressure from the Flax Council of Canada and the Saskatchewan Flax Development Commission because European customers, who buy 60 percent of Canada's flax, said they didn't want GE flax.[86]
- Genetically engineered rice has also faltered with Aventis backing off from commercializing its herbicide resistant GE rice largely because of warnings from millers and large value-added domestic and foreign producers that they'll reject it.[87]
- GE sugar beet has also been rejected by U.S. sugar refiners who told farmers to avoid GE sugar beet because Japan, which accounts for 80% of the sugar beet pulp market from the US, will not buy GE crops.[88]
- Subsequently to the StarLink corn scandal, Aventis CropScience (now Bayer CropScience) decided to abandon GE StarLink corn and withdrew it from the market.

These market failures for the GE industry represent a consistent pattern of market rejection that is working its way up the industry supply chain from consumers to producers to farmers.

Figure 16 below is a sample list of food companies representing in excess of $450 billion in yearly revenues that have publicly committed to remove GE ingredients from their supply chains in key countries or regions. The scale of rejection by each company varies from those who have removed only GE ingredients from food for human consumption in products sold in one or more countries, to companies who have an international or global policy to remove GE ingredients from their supply chain and also to exclude the use of GE crops as animal feed.

| | | | |
|---|---|---|---|
| Aldi | Coop | Hipp | Sapporo |
| Alpro Soya | Corona | Kirin | Soya Hellas |
| Amadori | Danone | Kraft Jacobs Suchard | Spar |
| Asahi | Delhaize Le Lion | Marks&Spencer | Superquinn |
| ASDA | DUC | McCain | Tegel |
| Barilla | Edeka | McDonald's | Tengelmann |
| Ben & Jerry's | Esselunga | Migros | Tesco |
| Bodin | Ferrero | Nestlé | Trader Joe's |
| Burger King | Findus | Nutricia | Unilever UK |
| Cadbury's | Friki | ParknShop | VitaSoy |
| Carrefour | FujiOil | Perdigao | Waitrose |
| Coca Cola | Gerber | Sadia | Wiesenhof |
| Colruyt | Heinz | Safeway | Wimpy Fast Foods |

Figure 16. List of Food Companies with "No GMO" Policies

These companies are among many worldwide that have responded to consumer demand for non-GE foods. The management of the companies may be generally sympathetic to the promises of GE crops but they have recognized the potential for profit losses that would result from not responding to consumer demand. The food industry is in the front line of the consumer complaints regarding GE foods and they bear much of the burden of government regulations regarding labeling, segregation and product recalls. Recent accidents with GE crops highlighted in this report help explain the waning enthusiasm for GE foods in the industry, with pharmaceutical crops being of particular concern. The recent accidents in the U.S. have pushed even the most staunch supporters of GE foods to call for much stronger safeguards. The prospect of pharmaceuticals in their cornflakes is one which rightly concerns them.

## Rejection by Farmers: The GE Wheat Case

*"We will not only avoid buying GM wheat, but we will probably be forced to completely avoid importing from those countries/regions where it is known that GM wheat is grown."* - Antonio Costato, President and CEO of Grandi Molini Italiani. (GMI has six mills in Italy and turns over some 1.4 million tonnes of grain annually.)[89]

*"These bills* [banning GE wheat] *are surfacing in North Dakota because of a genuine, sincere concern for the market. Our major wheat customers say they won't accept any wheat that has genetically enhanced characteristics, and we're listening to our customers."* - Terry Wanzek, chairman of North Dakota's Senate Agriculture Committee

*"First of all, we are consulting our customers, located in over 70 countries around the world. The bottom line is that most of them don't want GM wheat right now. Over 80 per cent of markets for Canada Western Red Spring wheat, including customers in Japan, the United Kingdom and Italy, are resistant to GM wheat in one way or another. This opposition could mean blocked shipments and traditional customers looking elsewhere if RRW is commercially grown in Canada."* - Ken Ritter, Chair, Canadian Wheat Board[90]

In 2003 Innovest highlighted the market risks of GE wheat commercialization. At the time Monsanto maintained to investors that GE wheat would be a significant source of future revenue. However, wheat farmers quickly became convinced that the economic costs of consumer rejection justified opposing commercialization. This process exactly mirrors the flow chart from Figure 13 above.

The significance of the controversy surrounding genetically engineered wheat (Roundup Ready) is of particular importance due to the breadth of opposition to its commercialization. The mainstream farming community, non-governmental organizations, industrial wheat sellers, processors and users all asserted their opposition to the commercial introduction of GE wheat. While some of these parties have traditionally supported the use of GE crops, few supported the introduction of Monsanto's Roundup Ready wheat.

Arguments that were made against genetically engineered wheat included:

- Opposition to GE wheat from major wheat markets.
- Impossibility of segregating GE from non-GE wheat after commercial approval.
- Significant agronomic problems associated with Roundup Ready wheat, and commensurate increases in costs for farmers.
- Threats to organic farming.
- Unresolved liability issues arising from farmers who face genetic contamination or market loss.

- Environmental and possible human health risks from GE wheat.

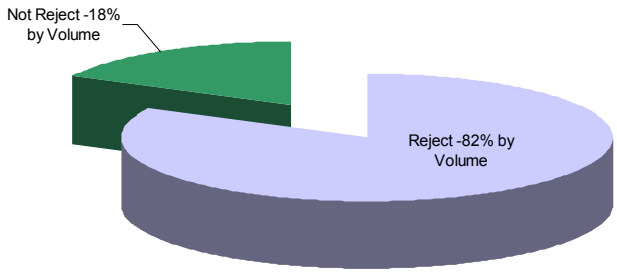



Figure 17. Canadian Wheat Board – Assessment of Market Acceptance for GE Wheat (2002)[91]

Monsanto's abandonment of GE provides a good case study of how farmer rejection of GE crops, based mostly on economic considerations, is beginning to occur. Monsanto publicly stated that they would only commercialize GE wheat if they could first gain pre-acceptance from buyers as well as environmental and health clearance from regulatory authorities. Given that approximately 50 percent of the wheat crop in the United States (approximate value in 2001 $3.5 billion) and 70 percent of the wheat crop in Canada (approximate value $3 billion annually) is exported, North American farmers and the wheat industry faced significant income loss as a result of the possible commercial approval of GM wheat. Figure 17 above illustrates why wheat producers were so unanimously opposed to GE wheat commercialization on economic grounds.

In response to the threat of GE wheat commercialization, the Canadian Wheat Board asked that before GE wheat could be approved, a cost benefit analysis of the impact of commercialization should be done.[92] This marks a change from previous commercialization processes that Monsanto has faced. Now instead of merely meeting safety requirements, the company may have to show that no economic harm will be done to farmers in the process of commercialization. Under the current market situation which puts large markets such as the EU off-limits, this development could create additional barriers to Monsanto's product development process.

## International Markets Shifting to Non-GE crops for Food and Animal Feed

Virtually the entire European food industry has already taken action to ensure that no GE ingredients are directly used in any of their food products. Such policies are being actively pursued by major retail groups and food manufacturers. A significant number of these have already extended their policy to cover animal feed. Since animal feed represents an estimated 80-90% of the market for crops such as soya and corn, rejection in the feed market can be anticipated to have a greater economic effect than rejection in the consumer food industry.

Recent changes in EU policy have certified herbicide tolerant corn for import. Insect tolerant corn is now under investigation. These changes have lead to strong gains in Monsanto's stock price. However, given consumer and producer reluctance to eating GE

foods or eating animals raised on GE feed, it is unclear whether this regulatory change will lead to increased profits for those US GE corn growers.

The U.S. Department of Agriculture in May 2001 stated that, "*Over the last 12 months, demand for certified biotech-free soybean meal has grown from near zero to 20-25 percent of the EU market according to officials in the compound feed industry.*"[93] Since then there has been a further series of commitments by major companies across Europe to use only non-GE feed.

Below is an illustrative example of a company statement taken from the UK.

**Heinz: February 2003 (Policy statement) GMO**

- Heinz remains committed to taking every possible step to ensure that Heinz varieties remain free from ingredients derived from genetically modified crops and this includes animals fed on GM crops.
- Where there is the potential for GM material to be present, or where ingredients are derived from soya or maize, we source non-GM, identity preserved ingredients through carefully audited suppliers. In addition, independent testing is carried out.
- The use of GM crops in animal feed is a sizeable farming issue particularly with respect to commodity ingredients widely used in food manufacture. However, Heinz has continued to review this issue.
- As a result of our achievements to date and our continuing ingredient review programme, the suppliers we use for all infant feeding meat ingredients do not use any GM animal feed. Likewise, Heinz Europe only procures lamb and poultry that are fed on non-GM feed.
- With respect to other ingredients such as eggs and dairy produce, we continue to make progress as part of our GM review programme.

## The U.S. Food Industry: Tipping Points Towards a GE-Free Food Supply

The first mainstream US retailer, Trader Joe's, recently followed the major health food retail chains Genuardi's, Whole Foods and Wild Oats in rejecting GMOs saying that "*we determined that, given a choice, our customers would prefer to eat foods and beverages made without the use of genetically engineered ingredients.*"[94]

It is clear that the US food industry is already aware and increasingly cautious about the potential negative financial impacts of GE foods. Most companies have experience on the issue. Through global or international operations and communications, they receive significant consumer feedback on the issue. National organizations, in particular the Grocery Manufacturers Association of America (GMA), have been outspoken in their support of GE foods and of the potential benefits, however their members are seeing costs and burdens resulting from GE food. Conversely, counter-balancing financial benefits have yet to be identified for retailers and producers. In addition, it is difficult to identify benefits that the current GE crops on the market have for consumers. GE foods are neither cheaper to buy, nor fresher, nor better tasting than conventional or organic foods. The current GE crops are designed to benefit farmers but the promised second generation of GE crops, which were intended to provide consumer benefits, have not materialized. Monsanto's pipeline previously contained herbicide resistant wheat and pharmaceuticals both of which have been recently abandoned. From what appeared to be a robust register of second generation crops, only a preliminary planting of low trans fat soybeans has occurred. Incidentally, the low trans fat trait isn't even due to genetic manipulation but was created through conventional breeding.

How long it will take for the US food industry to follow what is rapidly becoming the global standard of either non-GE, labeled as "GE", or labeled as "Organic" remains to be seen. With consumer support for GE labeling in the 70-90% range and the food industry facing costly segregation procedures, it would be fair to guess that retailers and producers have already assigned teams to look at the logistics.

Monsanto has chosen an aggressive GE development strategy at the same time that previously pro-GE or non-aligned economic interests are lining up against further commercialization of the technology. This is a development that should give investors pause.

## INTERNATIONAL REGULATORY RISKS

Regulatory and institutional barriers to the commercialization of genetically engineered crops have expanded and solidified considerably since the introduction of mass produced GE crops in 1996. In many ways these barriers comprise the largest obstacle that Monsanto and other genetic engineering firms face in the commercialization process. In the past Monsanto pinned its hopes on opening up new markets as the path to increased profitability. Monsanto set out ambitious goals in 2000 and 2001 for regulatory approval as part of its business plan for its GE crops but largely failed to win those battles. As a Senior Analyst from Lehman Brothers put it: *"This is a company that has been optimistic on the verge of lying."* [95] In 2002 the company scaled back its goals for regulatory approval while seeking to work with U.S. government representatives to push for a WTO challenge to bans on GE crops.[96] The sections below outline the development of regulatory barriers world-wide that have come about due to consumer rejection and scientific caution regarding GE crops.

## Regional Regulatory Situation

The tables below show the development of regulatory action which may stop GE crops from spreading into new markets.

| Asia, Africa, Oceania | | | | |
|---|---|---|---|---|
| **Country** | **Protocol on Biosafety** | Labeling Requirements | **Ban or Moratorium on Commercialization** | **Ban on Imports** |
| Australia | | Standard 1.5.2 of the Food Standards Code<br><br>Foods must be labeled with >1% GM ingredients | State Bans The Australian government approved the planting of GE Canola in 2003, but the states of **New South Wales, South Australia, Tasmania, Victoria, Western Australia, and the Australian Capital Territory** have instituted moratoriums of various lengths, effectively blocking the planting of the first GE food crop in Australia. **Queensland** is the only state that hasn't instituted a moratorium, but canola is not produced there. March 2004: **Western Australia** bans GE crops. **Northern Territory** has a ban on growing cotton until September 2004, to research GM varieties. October 2004: **Tasmania** passed the GMO Control Bill 2004, extending its moratorium on GE food crop until 2009. | |
| China | | Decree No. 10 of the Ministry of Agriculture, 1/5/02<br><br>www.agri.gov.cn/ (Chinese Ministry of Agriculture site, in Chinese) | | |
| India | Ratified | | | |
| Indonesia | Signed | 1996 Food Law www.deptan.go.id/english/peraturan_e/bdd.htm (Bureau of Law and Public Relations, Ministry of Agriculture, in Indonesian) | | |
| Japan | Ratified | Food Sanitation Law and Japan Agricultural Standards Law | | |
| Korea (South) | Ratified | Regulated by the Ministry of Agriculture & Forestry and Korea Food and Drug Administration | | |

| Country<br><br>EU Member | Protocol on Biosafety | Labeling Requirements | Ban or Moratorium on Commercialization | Ban on Imports |
|---|---|---|---|---|
| New Zealand | Signed | Standard 1.5.2 of the Food Standards Code | October 2003: New Zealand's 2-year moratorium on applications to release GMOs into the environment expired. See www.gm.govt.nz. | |
| Russian Federation | | Resolution of the Chief Russian Sanitary Inspector #13 of November 8, 2000 "On Labeling Genetically-Modified Food Products" www.aris.ru/WIN_E/ (Ministry of Agriculture site)<br><br>April 2004 regulation: foods containing 0.9% or more genetically modified material must be marked (instead of previous 5%) | | |
| Thailand | | 2002 Public Health Ministry Announcement | Moratorium | Plant Quarantine Act prohibits imports without a permit from the Dept. of Ag., and permits are only for experimental purposes |
| South Africa | Ratified | Foods, Cosmetics and Disinfectants Act January 16, 2004 | | |

| Europe | | | | |
|---|---|---|---|---|
| **Country**<br><br>**EU Member** | **Protocol on Biosafety** | **Labeling Requirements** | **Ban or Moratorium on Commercialization** | **Ban on Imports** |
| European Union | Ratified | Regulation No. 1830/2003<br><br>Regulation No. 1829/2003<br><br><br>Beginning April 2004, EU requires all foods and ingredients produced from GMOs to be labeled, except 'adventitious' levels of up to 0.9% for those GMOs currently approved in the EU. | Sept. 8, 2004: European Union approves the first GE seeds (Monsanto's MON810 maize) for purchase and planting, marking the end of a nearly six year moratorium. | May 19, 2004: European Commission votes to allow imports of Bt-11 maize, ending a De Facto Moratorium in place since 1998. |
| Austria | Ratified | EU Compliant | Austria has banned three EU-approved GE corn types | |
| France | Ratified | EU Compliant | Has banned EU-approved GM crops. | |
| Germany | Ratified | EU Compliant | Has banned several EU-approved GM crops. | |
| Greece | Ratified | EU Compliant | Has banned several EU-approved GM crops. | |
| Italy | Ratified | EU Compliant | 2000: Amato Ministerial Decree banned biotech food, feed, and planting seeds. | |
| Norway | Ratified | Gene Technology Act No. 38 "The King may issue regulations concerning the marking of products that consist of or contain genetically modified organisms" | | |
| Spain | Ratified | EU Compliant | April 2004: Banned commercialization of Syngenta's Bt176 corn. | |
| United Kingdom | Ratified | EU Compliant | Has banned EU-approved GM crops. Over 50 local authorities have now voted for GM free policies. | |

| Americas | | | | |
|---|---|---|---|---|
| **Country** | **Protocol on Biosafety** | **Labeling Requirements** | **Ban on Commercialization** | **Ban on Imports** |
| Argentina | Signed | | | |
| Bolivia | Ratified | | | |
| Brazil* | Ratified | Executive Order 4,680, April 24, 2003; | Brazil had a moratorium on RR soy since 1998 and all GE crops since 2000. 9/25/03: Provisional Measure 131 was passed to allow the planting and marketing of GE soybean seeds until January 31, 2004. March 26, 2003, Law 10, 688 July 13, 2003 and Executive Order 4,846. | |
| | | Public Consultation Number 1 | The biotech-friendly Biosafety bill passed in the Senate on October 6, 2004, and is pending a House vote. | |
| | | March 30, 2004: Food products with >1% GMO material must be labeled, except GM soya. Law unclear whether it applies to imported products. | The president signed an executive order allowing the planting & marketing of GE soy until January 31, 2006. | |
| Chile | Signed | Government Decree June 2000 | | |
| Ecuador | Ratified | 2001 Consumer Defense Law, Article 10 | | |
| Mexico | Ratified | Law of Biosafety for Genetically Modified Organisms (passed by Senate April 2003) | Mexico had a de facto moratorium on genetically engineered crops since 1998. This was lifted in October 2003 to allow planting for experimental purposes. | Feb.26, 2004 ban on imports of GE maize |
| | | | Feb.26, 2004 ban on commercialization of GE maize | |
| Paraguay | Ratified | | | |
| Uruguay | Signed | | | |
| Venezuela | Ratified | | April 2004: President Chavez made a declaration banning all cultivation of GE crops; however, no official law or decree has been passed. | |

Figure 18. Examples of Regulatory Barriers to GMO Commercialization

Agriculture is in many ways a more "political" sector of the economy than many others, and investors should consider the political ramifications of crop production as well as the economic factors. In the case of genetically engineered foods, politics plays an even stronger role than usual because these crops cross regulatory boundaries such as environmental, trade and public health.

## Labeling

Around the world, GE restrictions are increasing and labeling of GE food is becoming standard practice (see figure 14). This development reflects public demand, as surveys have shown that worldwide 70 to 90 percent of the public are in favor of clear and mandatory GE labeling. Where such labeling requirements have been legally enacted, consumer-products containing or derived from GMOs have not been placed on the market successfully.

Japan, which takes 20% of all US food exports worth $11 billion a year, has had a labeling law in place since 2001. Recently Japan announced a revised GE labeling regime that adds potato products. The earlier scheme imposed rules on an initial list of 24 product categories. In the same year, South Korea, another important market for U.S. products, implemented mandatory labeling rules for GE foods. The USDA noted recently that "*residual effects of the StarLink problem and mandatory labeling requirements have shifted Korean corn processors toward suppliers perceived not to be producers of biotech enhanced corn.*"[97]

In addition, China, the world's single largest importer of soybeans, has introduced labeling and safety regulations for GMOs. Under the new Chinese labeling system, GE soya, maize, oilseed rape, cotton and tomatoes must be clearly labeled, regardless of whether the GE ingredient can be detected in the final product or not. The import or sale of unlabeled GMOs is illegal.[98] China's Dalian Commodity Exchange recently introduced new contracts for non-GE soybeans to conform to the country's rules on GMOs. Trading of non-GE soya futures in Japan's Tokyo Grain Exchange started already in June 2000.[99]

Other Asian governments, including Thailand, Philippines, Malaysia and Indonesia, are already discussing GE labeling. Australia and New Zealand have adopted a strict mandatory labeling regime for GE food which came into force in December 2001.[100]

Africa does not generally represent a strong commercial market for Monsanto's products. Nonetheless, several African nations have enacted anti-GE food aid policies. Although this will have little direct affect on seed sales, food aid can be an important avenue to alleviating excess supply in the United States. South Africa, one of the most important commercial GE markets in Africa, has recently introduced mandatory labeling of GE products.

In the European Union, two new regulations on traceability, labeling and approval procedures for GE food and animal feed are under discussion and expected to enter into force by the end of 2003 or beginning of 2004. The tightened labeling regime would include highly processed products derived from GMOs such as oil and starch as well as animal feed. Traceability of GMOs is included in the proposed regulation for the first time, obliging producers to indicate all GMOs which 'have been used' in a shipment.[101] These regulations can be expected to drive further rejection of GE ingredients.

The new EU accession countries[102] will eventually be covered by EU legislation of GE crops, including strict labeling and safety testing requirements. Also in the major GMO producing countries, USA, Canada and Argentina, there are debates about the issue, with proposals for GE labeling laws being discussed on the State and federal level. Support for labeling in the U.S. has been consistently high in many polls. (See Figure 15 above)

## The Biosafety Protocol

On 29th of January 2000, the Conference of the Parties to the 1992 Convention on Biological Diversity (CBD) adopted a supplementary agreement, known as the Cartagena Protocol on Biosafety.[103] The Protocol then came into force in 2003. This will impose substantially greater documentation and risk assessment costs on GE exporters.

The Protocol seeks to ensure the safe transfer, handling and use of LMOs - living modified organisms (i.e., genetically modified organisms) - that may have adverse effects on the conservation and sustainable use of biodiversity, also taking into account risks to human health. The Protocol is specifically concerned with cross-border movements of LMOs. Examples of organisms treated as LMOs under the Protocol include seeds, microorganisms for bioremediation, fish, and modified crops such as soya, canola, corn and rice. LMOs do not include processed foods derived from GMOs (e.g. vegetable oils, peanut butter, corn flakes, etc).

It should be noted that the Protocol is neither superior nor subordinate to the existing World Trade Organization (WTO) rules. This may create inconsistencies in international law, should the refusal of an import on the grounds of biosafety be seen to be a trade barrier masquerading as environmental protectionism. However, it should also be noted that the WTO's agreement on Sanitary and Phytosanitary Measures (SPS), like the Protocol, spells out what procedures signatories must follow in restricting trade in the face of scientific uncertainty. Some requirements are in fact stricter than the Protocol.[104]

### Key Features of the Protocol

A key element of the Protocol is its incorporation of the precautionary principle.[105,6]

The Protocol recognises that scientific knowledge of GMOs is incomplete and in the absence of scientific certainty about environmental harm allows governments to take necessary measures to prevent such harm. The Protocol expressly allows the government of an importing country to ban or severely restrict imports of GMOs on the basis of the precautionary principle. This applies regardless of whether the exporting country is a signatory of the Protocol or the CBD.

An advance informed agreement (AIA) procedure is established for LMOs destined for direct introduction into the environment, such as seeds and microorganisms. This is designed to ensure that governments are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory. In such cases, the exporter must provide a

[6] There is no internationally agreed definition of the Precautionary Principle, however, Principle 15 of the 'Rio Declaration on environment and development' by the United Nations Conference on Environment and Development in 1992, explains the Precautionary Approach: *"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."*

detailed, written description of the LMO to the importing country in advance of the first shipment.

Shipments of commodities that may contain LMOs destined for food or feed products must be identified as such in their accompanying documentation, along with relevant traits and characteristics, requirements for safe handling, storage, transport and use, and information about the importers and exporters. However, an importing country also has the right to request that an AIA procedure is applied to commodities **before** imports can take place.

A definitive documentation regime for LMO commodities and more rigorous standards for identification, handling, packaging and transport of LMOs is under discussion by the Parties to the Protocol. Notably, non-parties to the CBD and non-parties to the Protocol have little influence in decision-making under the Protocol.

Also under discussion is the system for liability and redress. This includes the attribution of liability, time limits for redress, and the extent of compensation and restitution. A liability regime may emphasize implementation of preventative and reinstatement measures, cost recovery for these measures and compulsory intervention by public authority.[106] Significantly, the majority of international legal instruments channel liability to the "operator" – the person who has the operational control of the activity at the time of the incident causing damage. The current aim is to reach an agreement on these issues within the four-year period following the signing of the Protocol, implying that these issues will be clarified by the end of 2004.

### Relevance to Monsanto

The company is clearly interested in seeing free trade of GE products without burdensome bureaucratic approval procedures and trade barriers raised through environmental protection measures. This might be hampered to some extent by the entry into force of the Protocol. The prior notification and consent regime is likely to be burdensome as Article 15 of the Protocol goes some way toward laying the onus on the exporter to undertake the risk assessments and risk management of the exported commodity, and to establish the harmless nature of the LMO in question. This documentation will be unwelcome for exporters who will be forced to segregate LMO and non-LMO commodities. This requirement will place sizable burdens on exporters and will certainly be costly. Alternatively, exporters may be required to label all exports with the words 'may contain LMO-FFPs' – a move that may result in the discounted value of these shipments.

## Politics and Genetically Engineered Foods

Genetically engineered foods have been a major trade and environmental controversy since before their commercial introduction in 1996. Genetically engineered crops are increasingly seen as an "American" product since the U.S. comprises the largest market for GE crop production, hosts the largest industry players, and has had the most aggressive trade policies regarding GMOs. While the outcomes of the political dynamics surrounding international trade are uncertain and

subject to interpretation, the fact that U.S. trade representatives have backed off of a WTO challenge to the E.U.'s current ban on GMOs is an indication of the serious role politics will have in this issue. Monsanto, as the industry market leader, is particularly vulnerable if a GE foods backlash is associated with any anti-American sentiment. Investors should take into account the current negative state of relations with key allies in determining the potential for success in opening up important foreign markets, especially the EU. Given the overwhelming dominance of Monsanto in the [107]industry, it is likely that even if markets are opened to GE foods and production, boycotts of GE foods could result, with potentially negative results for the bottom line. A recent poll (of 8000 consumers) by Global Market Insite showed that nearly 1 in 5 European consumers avoid U.S. based- products.

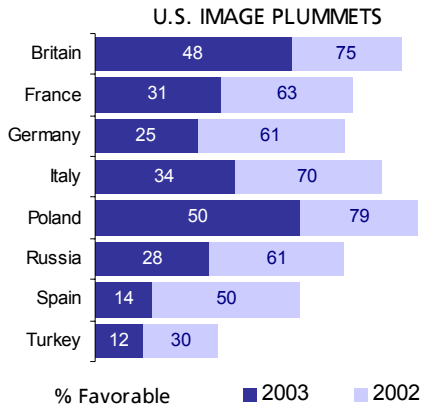



Figure 19. Drop in U.S. Approval Ratings World-wide
Source: The Pew Research Center for the People and the Press (March 18th, 2003)[108]

Figure 19 above provides an example of the change in sentiment towards the U.S. in select countries over the past year. Monsanto's long term growth is linked to opening up markets to which genetically modified foods are currently blocked. The company is working with allies in the U.S. government,[109] in particular the US trade office, to pressure the WTO to open up markets. However, as seen in the PABE report on European consumer attitudes (see Figure 14 above), consumer rejection of GMOs appears to be closely linked to awareness in the general populace about the issue.

Given that a WTO challenge would likely result in a certain amount of publicity, it is reasonable to wonder if success at the WTO would be a pyrrhic victory, especially where Europe is concerned.

## Intellectual Property - Litigation and Contingencies:

*"We are involved in major lawsuits regarding contracts, intellectual property, biotechnology, antitrust allegations, and other matters. Adverse outcomes could subject us to substantial damages or limit our ability to sell our products."* – Monsanto, 2003 Annual Report pg.40

Due to the nature of the agricultural seed industry, the ability of the company to ensure a return on the sale of its products is heavily dependent on patent rights. This has resulted in a large number of law suits for violation of those patent rights. Monsanto has been accused of taking a heavy-handed approach with farmers regarding potential patent rights infringement.[110] This issue overlaps with the issue of potential contamination as traits that end up in a farmer's field who has not signed an agreement with Monsanto may be liable for patent rights infringement. Conversely, Monsanto may be liable for contamination under the same circumstances. The company states: *"...we may be unable to obtain protection for our intellectual property in key jurisdictions. Even if protection is obtained, competitors, growers, or others in the chain of commerce may illegally infringe on our rights and such infringement may be difficult to prevent or detect. For example, the practice of saving seeds from non-hybrid crops (including, for example, soybeans, canola and cotton) containing our biotechnology may prevent us from realizing the full value of our intellectual property, particularly outside the United States."*

## Insuring Genetically Engineered Crops

*"Concerns about the adventitious presence [*unintended contamination by genetically engineered proteins] *may also lead to more stringent regulation, which may include: requirements for labeling and traceability**; financial protection such as surety bonds, liability or insurance**; and/or restrictions or moratoria on testing, planting or use of biotechnology traits.* – From the Monsanto 2003 Annual Report, pg. 39 [emphasis added]

One of the main problems with gaining new access to markets is the reassessment of GMOs by insurers in the aftermath of the StarLink fiasco. In New Zealand for instance, a study paper by the Law Commission on insuring operations utilizing or developing genetically modified crops had some sobering conclusions for farmers.

"*Given the current stage of the genetic modification industry, full insurance is unlikely to be available for all projects that might be approved by ERMA* (Environmental Risk management Authority)." Insurers are likely to be deterred by the absence of information on which sensible underwriting decisions can be made (lack of claims history, uncertainty of future claims). As the genetic modification industry develops and experience is gained, insurance may become more available, but because of the pace of the biotechnology industry, such delay may often be tantamount to a prohibition.[111]

The New Zealand Law Commission has identified several key issues of concern with respect to insuring GMO producers and developers. Those include:

- Time periods between the development of problems and the time by which claims are made. In that time, the insured company may no longer exist or the insurer may no longer exist.

- The insurance industry is unlikely to be able to cover the liability if catastrophic damage is suffered. There is also the possibility of irreversible or incompensatible loss being suffered.

These risks are highlighted by the fact that currently, the largest insurance company for the UK farming industry, NFU Mutual, has stated that it will not insure against genetic contamination or damage. Other major UK insurers as well as those in Germany have begun to follow suit, seeing the potential liability of GE crops one they, and likely re-insurers do not want to bear. This development is likely to have significant impacts upon farming decisions in these areas if farmers cannot get insurance for their operations or perceive added risk and follow the insurance industry in moving away from GE crops.

## ENVIRONMENTAL AND HUMAN HEALTH RISKS

### The Technology

Genetic engineering technologies involve the insertion of novel gene(s) into the DNA of a host. Whilst the sequence and primary function of the genes in the insert are both usually well-defined, current methods insert gene sequences into the host DNA at random positions. There is no external control on the position at which the insert is incorporated into the host DNA. Together with differences in the local environment of the inserted genes, this makes the expression of the inserted and surrounding natural genes unpredictable. Hence, inserted genes can cause unintended additional effects, which can be unexpected.[112]

Monsanto predominantly uses "particle bombardment", also known as "biolistics" to produce GE crops. DNA is forcibly introduced into cellular tissue, where it hopes recombination occurs as the cell heals. During particle bombardment, microprojectiles (usually gold particles) are coated with DNA and then fired at cells of the plant that is being genetically engineered.

Several studies have now shown that the particle bombardment technique gives rise to several artifacts including multiple copies and fragments of the genetic insert also being present in the organism's genome. In addition, the inserted DNA itself can become inverted and the regions immediately adjacent to the genetic insert (the flanking regions) can become deleted or rearranged.[113] In some cases, significant rearrangements of genomic DNA were observed[114] and scrambling of the inserted gene and genomic DNA[115] have been observed. It is not possible to predict the consequences of unidentified regions of DNA, of additional copies and fragments of the inserted gene.

### Human Health Risks

There are two principal ways in which genetic engineering can affect food safety: Gene disruption or instability may lead to new toxins being produced; and/or the new protein produced by the foreign gene may cause allergies or toxicity.

#### Substantial equivalence:

For all regulatory authorities, assessment of GE products for food makes regulatory use of the concept of "substantial equivalence" where, after routine chemical analysis, the food is considered to be equivalent to its unmodified counterpart. Criticism of the concept of substantial equivalence has been raised in many scientific papers[116] and by respected organizations including the U.S. National Academy of Sciences,[117] the Royal Society,[118] the Canadian Royal Society[119] and the British Medical Association.[120] Substantial equivalence was never intended as a scientific tool, but rather as a conceptual tool for regulators. The most significant criticism of substantial equivalence is that it has been used as an excuse to not perform adequate testing on GE crops, whereas it should be an entry point for compositional analysis.[121] There is no standard list of what should be measured and there is no process to look for unexpected or unintended changes – one of the most important concerns over GE food safety.

## Allergy and toxicity testing

There are some limitations with the systems to assess the potential allergenicity or toxicity of GE products. Genetic engineering is designed to produce new proteins not normally present in the plant and these may cause allergies. It may also result in unintended modifications to existing plant proteins, which could make them allergenic. However, it is not possible to predict whether a protein is a potential allergen with any certainty. Tests examining the protein's characteristics and comparing them with known allergens are not an entirely foolproof method of detection. This is partly due to the fact that the proteins may never have been part of humans' diet before so there may be no experience to go on or incomplete data for comparison.

When food safety testing is performed on GE crops, it is only short-term - over days or a few weeks. There is no long-term testing or testing for chronic effects of toxicity or nutritional changes. Because of this, the French food safety authority, AFSSA, concluded that current safety testing is not sufficient to ensure the safety of GE foods.[122] Their report also stated that it was important to research into the possible gradual development of allergic reactions through prolonged exposure to GE foods. Even if the allergenic potential of a GE crop is recognized by the regulatory authorities, it can still end up in human food.

Aventis' StarLink was a type of insect resistant GE corn grown in the USA from 1998, which produced the *Bt* protein, Cry9C. It was only approved for animal feed and industrial purposes, as there were concerns that the Cry9C protein could cause allergies because it shares characteristics of other allergens. However, in September 2000, StarLink was found in corn taco shells and other foods, and over 300 corn products had to be withdrawn from the market.[123] It is not known how StarLink came to be in the human food chain - it may have been inadvertently mixed with other corn at a mill, or a conventional crop may have cross-pollinated with a StarLink crop.[124] With the recent ProdiGene contamination case it was revealed by company executives that no formal human health safety testing had been done prior to growing GE pharmaceutical corn in open field trials.[125] These episodes raise questions about the ability to control, segregate and regulate GE crops.

## Potential Risk for Infants

The Royal Society[126] considered the possible effects of GE foods on the health of infants. The report recognized that food allergies are far more common in children than adults, stating that: "*food allergies occur in 1-2 % of adults and 6-8 % of children.*" Therefore, children would be most vulnerable to any allergens that may have gone undetected in GE food. In the report, infants are classified as a "*high risk group*" for post marketing surveillance of deleterious effects of GE foods in humans. It was also recognized infants are vulnerable to harmful effects from nutritional changes in their diet. Any changes in the composition of foods made from GE crops could be important when given to infants over a long period of time, especially if it is a food such as infant formula which infants may live off as a complete food. The report recommended that any GE ingredients in foods such as infant formulas "*should be investigated most rigorously.*"

### Antibiotic Resistance Marker Genes

It is often standard procedure for GE crops to contain antibiotic resistance marker genes which are used during the gene insertion process. There is concern that such genes may be transferred to soil or gut bacteria. This would aid the increase of antibiotic resistant bacteria, making bacterial infections difficult to treat. The EU has now passed legislation with a timetable to phase out antibiotic resistance marker genes[127] by the end of 2008 and the FAO/WHO Codex Alimentarius[128] has also recommended phasing out the use of these marker genes.

### Conclusions

There are concerns about the safety of eating GE foods. The safety testing systems appear to have inadequacies. Genetic engineering can produce unintended and unexpected effects but the regulatory processes, which are based on the principle of 'substantial equivalence', are not designed to detect such effects. The systems used to detect allergenicity and toxicity rely on incomplete information. The long-term implications for human health of eating GE food, including the use of antibiotic resistance marker genes, are not known, but infants are known to be especially vulnerable to allergies and changes in the nutritional composition of their diet.

As the process of scientific understanding of gene function continues to grow and as new methodologies for testing become available, a more rigorous testing of the safety of GE crops will be possible.

In the meantime consumer opinion appears likely to continue to view GE food as having little direct benefit, limited safety testing and either unknown or potential risks.

## Environmental Risks

There are numerous environmental or ecological risks associated with GE crops. Many of these may expose companies producing the GE crops to significant liabilities. Below are several examples of environmental liabilities stemming from the research, development, and commercialization of GE crops.

## Gene flow to neighboring crops (Crop-to crop)

Gene flow can occur via cross-pollination of the same crop from neighboring fields. For many crops, there is little information on the extent and distance of cross-pollination. However, the number of studies is steadily increasing and these show that there is considerable potential for cross pollination from crop-to-crop.[129] Gene flow is affected by local ecological conditions and agronomic practices, e.g. field size.[130] Therefore, it is not possible to accurately predict pollen movement and separation distances may be inadequate.[131]

The contamination of neighboring crops can have severe implications for organic farming, e.g. certified organic farmers, who have initiated a class action lawsuit against GE companies seeking compensatory damages for revenues lost through contamination of organic crops with the companies' GE herbicide-tolerant canola.[132] In addition, there have been incidences of contaminated seed being rejected from the EU, or even corn fields burnt, with compensation payable to the farmers.[133]

Contamination during harvesting and storage can also be significant. One of the major issues is the control of "volunteers", i.e. unsown GE seed from a previous crop growing in a field margin/roadside or within the crop. This is particularly important for canola, the seeds of which can remain dormant in the soil for several years.[134] Control of feral populations, e.g. with herbicides, could adversely affect biodiversity in hedgerows, roadside areas and railway banks which may also be a haven for wildlife. There is an issue over who will be responsible for control of volunteers. There are also implications for the type of herbicide used should "gene stacking" occur. Canola (or rapeseed) volunteers resistant to three herbicides in Canada, caused by cross-pollination of GE and conventional herbicide resistant crops[135] now require control with the notorious herbicide, 2,4-D. The spraying of such a herbicide to control GE volunteers in non-arable land (e.g. hedgerows) would have serious consequences, and possible liabilities for the producer(s) of the herbicide resistant crops.

## Crop-to wild gene flow.

All crops can outcross with their wild relatives somewhere in the world.[136] For example, GE oilseed rape has been shown to hybridize with wild relatives in Europe,[137] rice will outcross with wild relatives in Africa, Asia and Australia.[138] The long-term implications of this crop-to-wild gene flow are uncertain – predicting the transgression of the genetic trait through a population is not simple. However, it has been shown that the trait does not necessarily need to confer an ecological advantage to a plant in order to transgress through a population. There may be considerable impacts on biodiversity from gene flow involving traits such as insect resistance, or drug producing genes ("pharma" crops).

GE corn has been found to hybridize with traditional land races in Mexico.[139] Mexico is a centre of diversity or centre of origin for maize, the "home" of cultivated maize. Studies of the contamination, and the implications, are still in progress, but the origin of the GE corn is thought to be imports from the US for food use. Thus,

the export of grain to other countries may have environmental liabilities, even if no planting is intended.

## Unintended Effects

GE plants can have effects other than those that were intended. The majority of studies to date have focused on the non-target effects of insect resistant *Bt* crops. However, such unintended effects could be applicable to a wide range of insect (and possibly virus) resistant crops.

Research has suggested that transgenic *Bt* plants could also be harmful to non-target organisms that feed on pests exposed to their toxins. The U.S. Environmental Protection Agency's (EPA) scientific advisory panel,[140] has recognized that the *Bt* toxins can persist in soils and that further studies need to be done to determine whether this persistence would cause problems for non-target organisms and the health of the soil ecosystem.

## Conclusion

In the short time since GE crops have been first grown commercially a number of the predicted problems have occurred including gene flow to neighboring fields and wild relatives creating unwanted GE contamination of non-GE farming systems and creating "volunteer" weeds which are resistant to a number of herbicides. Bt plants could also be harmful to non-target organisms that feed on pests exposed to their toxins.

# 7. RISKS BEYOND GENETIC ENGINEERING

## Traditional Chemical Risks and The Solutia Bankruptcy

Monsanto's history as a company goes back a number decades before its current manifestation as an agricultural products company and it still retains liability for many of its previous chemical operations. In particular, the previously owned subsidiary, Solutia, was forced into bankruptcy in 2003 after it was found liable for PCB contamination in Anniston, Alabama. Monsanto has indemnified former owner Pharmacia for any liabilities relating to Solutia. Monsanto's liability in the PCB case totaled $394 million which wiped out all Agricultural Productivity segment earnings in 2003.[141] As the result of prior agreements, Solutia also has debt obligations, supply obligations and stock options that are due to Monsanto.[142] The current bankruptcy proceedings put the collection of these items into jeopardy. Moreover, Solutia's liquidity problems make it significantly more likely that Monsanto will be required to indemnify the company in future court cases.

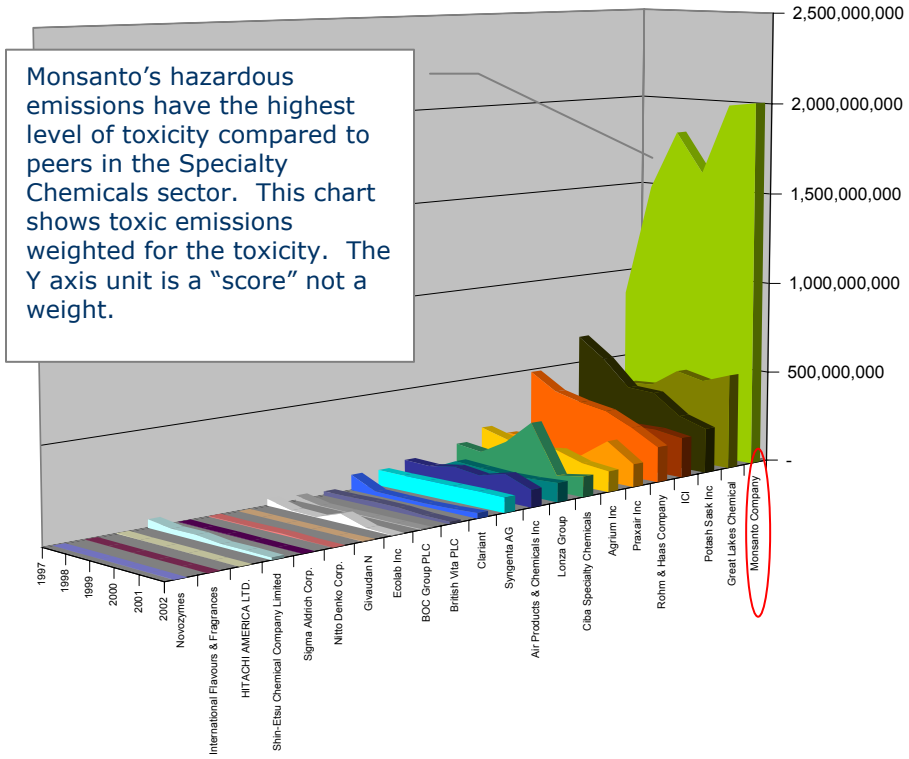



Figure 20. Toxicity Weighted Emissions for U.S. Facilities
Source: US EPA Toxic Release Inventory

Monsanto has the highest risk exposure relative to peers in the specialty chemicals sector (as defined by Morgan Stanley's MSCI Index). (see Figure 20 above) Significant numbers of organochlorine contaminant (dioxins, furans and PCBs) related liabilities could, as they have in the past, result in burdensome court cases and expensive payouts.

Monsanto has manufactured many high-risk chemicals in the past which still persist in the environment or comprise the significant site liability which Monsanto remains liable for. Currently Monsanto is liable for some 89 hazardous waste sites in the U.S. This does not include site liability outside the U.S. or similar potential liability from Solutia which the company may also be liable for.

### Roundup Dependence Makes Monsanto Vulnerable to Climate Change

As a provider of agricultural productivity products such as seeds and chemicals, Monsanto's fortunes are closely linked to those of farmers. Natural phenomena therefore play a greater direct role in the company's productivity than most companies in the chemical sector. As Monsanto stated in its 2002 Annual report: *"**In 2002, much of the United States experienced its worst drought since the Dust Bowl of the 1930s. Adverse weather** and continuing competitive pressure on our flagship product, Roundup herbicide, **reduced U.S. revenues of branded Roundup by 26%.**"* [emphasis added] [143] While there is not space within the scope of this report to fully cover an issue as complex as climate change, it is clear that Monsanto is very vulnerable to climate change, as seen with recent widespread drought, which scientists have linked to climate change.[144, 7]

This year was an exceptionally good year for farming worldwide with near ideal conditions. These better than average growing conditions are reflected in a slight increase in Glyphosate sales. However, conditions differ from year to year and projections for next year are assumed to continue the downward trend in Glyphosate sales. Going forward, increased weather volatility as a result of climate change may further impact Monsanto's profitability by negatively impacting farmers incomes and thereby reducing spending on inputs.

## Agent Orange: Overview & the 1984 Settlement

*"When we initiated the herbicide program in the 1960's we were aware of the potential damage due to dioxin contamination in the herbicide, however because the material was to be used on the enemy, none of us were overly concerned." – Dr. James Clary, military scientist in a letter to congress.*[145]

During the Vietnam War, Monsanto was one of the major manufacturers of "Agent Orange",[8] a chemical defoliant which was used as an anti-guerrilla war tactic to deny North Vietnamese forces cover in the jungle. In addition to Monsanto, other

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[7] Innovest Strategic Value Advisors has extensively covered the challenge investors face with respect to climate change. For more information on climate change, investment and fiduciary responsibility please see: **The Carbon Disclosure Project:** Carbon Finance and the Global Equity Markets (February, 2003); **Climate Change & the Financial Services Industry -** Module 1 - Threats and Opportunities & Module 2 - A Blueprint for Action (October 2002); Innovest with guidance from UNEP Finance Initiatives Project Coach, Dr. Andrew Dlugolecki; **Value at Risk: Climate Change and the Future of Governance** (April 2002) CERES Sustainable Governance Project Report prepared by Innovest Strategic Value Advisors, Inc. All reports are available free of charge on Innovest's website: www.innovestgroup.com. Click on the link to "Publications". For general information about climate change science please contact the UN Environment Program's Intergovernmental Panel on Climate Change (IPCC). www.ipcc.ch

[8] A number of herbicides were used in the war, known as the "rainbow herbicides" due to the colored stripes denoting the chemicals on the storage barrels, Agent Orange being the most prominent among them.

manufacturers included Dow Chemical, Hercules Inc., Diamond Shamrock Chemicals Company, Uniroyal Inc., Thompson Chemical and T-H Agriculture and Nutrition Company. Dow and Monsanto were the largest producers of Agent Orange (28.6% and 29.5% respectively) with the other companies manufacturing smaller fractions of the chemical. (See Figure 21 below.)

Agent Orange was extremely toxic and contaminated to varying degrees with dioxins, which even at that time were known both inside and outside Monsanto to have severely toxic properties. As a result of health impacts arising from Agent Orange exposure, the Veterans Administration maintains a medical registry to track the health of veterans who've been exposed.

The US Government now recognizes the following conditions are related to exposure to Agent Orange: Type II diabetes, spina bifida, various cancers,[146] Hodgkins disease, acute and sub-acute neuropathy, a large number of soft tissue sarcomas and multiple myeloma.[147]

The health effects of Agent Orange on U.S. soldiers led to extensive court battles over responsibility for the damage caused by exposure. Monsanto and its fellow defendants maintain that as government contractors, they are shielded from prosecution. In addition, they maintain that the government knew about the dioxin contamination and ordered them to continue production for the war effort in Vietnam. Judge Weinstein, who oversaw the case in the early eighties, determined that long term litigation was not in the best interest of the litigants and brokered an out of court settlement fund of $180 million for the veterans in 1984.[148] (See Figure 21 below.) Observers at the time indicate that the defendants might have settled for as much as $400 million.[149]

According to the Dept. of Veterans Affairs, 52,000 veterans received payouts from the fund which disbursed the last monies in 1994, after which it was closed for lack of funds. The issue, however, appears to be expanding rather than receding. Recent studies[150] of U.S. veterans have confirmed the connection between Type II diabetes and exposure to Agent Orange, in particular the dioxin component of the herbicide, as well as a plethora of other diseases that emerge long after exposure occurs. The Supreme Court recently ruled in favor[151] of a new group of veterans who say their Agent-Orange exposure related illnesses occurred after the 1984 settlement funds were closed to new applicants in 1994, and thus reopened the possibility of another payout to veterans. (See Figure 22 below.) The case has currently been remanded back to lower courts for a final determination.

In the 1984 settlement roughly 50% of the applicants received compensation. It should be noted that the scope of health problems linked to Agent Orange exposure through scientific studies has widened significantly and includes damage to the health of children of veterans born after exposure.[152] The implication is that a greater proportion of claims could be honored as a result of better scientific understanding of the links between Agent Orange exposure and disease/birth defects.

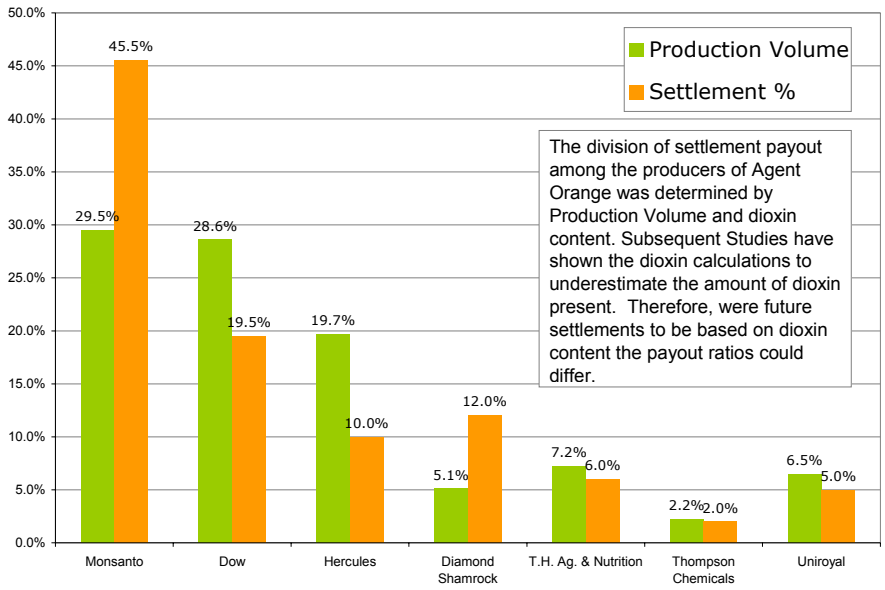


Figure 21. 1984 Agent Orange Settlement Allocation
(Source: Schuck P. 1986[153])

| United States Veterans and Agent Orange –Claims to US Government | |
|---|---|
| Number of vets who took exams under the Agent Orange Registry prior to 1984 | 70,600[154] |
| Total number of claims received by 1994 under Payment Program set up in the out of court settlement. | 105,000 |
| Number of vets receiving VA disability compensation for Agent Orange-related causes. | 52,000 |
| Number of vets who've taken exams under the Agent Orange registry since March 2000. | 297,194 |
| Number of claims filed alleging Agent Orange exposure-related health effects as of 2003. | 99,266 |

Figure 22. U.S. Veterans Affected by Agent Orange Exposure
Source: U.S. Office of Veterans Affairs

## Agent Orange: Concerns Beyond U.S. Vietnam Veterans

Agent Orange exposure has also become an issue for military personnel stationed outside of combat zones and for U.S. civilians as well. Soldiers stationed on Guam who handled Agent Orange have become ill and symptoms of TCDD (dioxin) poisoning are apparent in the general population of the island as well.[155] TCDD contamination as a result of Agent Orange handling has been measured at up to 1900 ppm in some areas of Andersen Air Force Base on Guam.[156] Given that safe levels of TCDD have been placed at below 1 ppb by the EPA and even lower by many state regulatory agencies (toxic effects have been measured at parts per trillion), this implies an extraordinary level of contamination. TCDD has been shown


in laboratory animals to have multigenerational impacts, not just on the offspring of exposed animals, but on the next generation as well.

In addition to new studies detailing health impacts, there is ongoing research to more accurately calculate levels of TCDD contamination of Agent Orange, and thus, exposure as a result of the use of Agent Orange. According to recent studies by Columbia University's Mailman School of Public Health[157,158] the amounts of TCDD contaminant in Agent Orange were up to four times greater than previously estimated. The equivalent of 600 kg of pure TCDD was sprayed and spilled in Vietnam. Given that this is a compound for which yearly emissions by the chemical industry are measured in grams and exposure thresholds are calculated in picograms, this represents an extraordinary amount of dioxin.

Figure 23. Agent Orange Spraying in Vietnam
(Source: BBC)

According to Dr. Arthur Galston, Professor Emeritus at the Yale School of Forestry & Environmental Studies, who spoke at the Yale University conference, The Ecological and Health Effects of the Vietnam War, "*the use of Agent Orange as a defoliant and herbicide in Vietnam was the largest chemical warfare operation in history, producing considerable ecological as well as public health damage*."[159] Further studies[160] show that dioxin levels remain high in many Vietnamese exposed to Agent Orange and even their children. U.S. bases, such as Bien Hoa for instance, still show dioxin contamination levels of 1.2 ppm[161] and food samples taken from the area in 2002[162] show dioxin levels approaching those found during the Vietnam War. As a result of exposure to TCDD contamination and Agent Orange, numerous groups are seeking restitution from Monsanto and other Agent Orange manufacturers. According to various estimates,[163] from 500,000 to 1,000,000[164] Vietnamese are suffering from exposure to chemical defoliants used during the war and up to 500,000 have died as a result of such exposure, according to Vancouver-based Hatfield Associates, an environmental research consultancy. On Jan. 30, 2004, a class action lawsuit was filed by the Vietnam Association for Victims of Agent Orange on behalf of three Vietnamese citizens listed as plaintiffs. The case was filed in Brooklyn, New York listing the manufacturers of Agent Orange as defendants. Nguyen Trong Nhan, the organization's vice president, said more than 20 American companies engaged in the production of Agent Orange were named in the suit, including Monsanto and Dow Chemical.[165] The amount of money the three plaintiffs are seeking in damages has not yet been disclosed. Since the case was filed many additional Vietnamese plaintiffs have joined the suit and given the vast number of people affected this trend seems very likely to continue.

Additionally, legal challenges and appeals have been brought by New Zealand and South Korean troops who served in Vietnam and were exposed to Agent Orange. Veterans organizations in South Korea estimate that the number of those

exposed is in the tens of thousands.[166] 300,000 South Koreans fought with U.S. forces in Vietnam between 1965 and 1973.

Given Monsanto's intimate connection with Agent Orange production, this implies a significant level of liability outside the U.S. in addition to the issue of U.S. veterans. Also the recent spate of activity around the issue, such as lawsuits, conferences, diplomatic pressure for assistance, and protests by foreign veterans, implies that the issue could have a detrimental effect on the company's reputation with unknown consequences for future profitability.

# 8. CONCLUSIONS: WHAT IS THE FUTURE FOR MONSANTO?

- **Monsanto faces unique risks, which therefore require that an alternative format be created for assessing that risk by senior management, and reporting it to stakeholders.**
- **Investors need assurances that long-term value creation will not be eroded by increasing liability stemming from GE crop development and commercialization.**
- **Stakeholders need to be assured of the safety and integrity of Monsanto's products given their impact on human society.**
- **Increased transparency on these issues will help Monsanto's brand image.**

The issues for Monsanto shareholders can be summed up as follows:

Monsanto's stock at the end of 2004 is overvalued. A PE multiple of 40-50 is not sustainable in the mid-to-long term. Therefore, long term value is where Monsanto's real value lies. That long term value is at risk and Monsanto's senior management has not been transparent in the discussion of these risks to shareholders and stakeholders.

1. Market rejection will continue to limit profits and imperil the industry.

2. Contamination of conventional crops by GE traits is inevitable, and resistance by pests will only increase. This implies large liabilities for the company and the industry.

3. Currently, the FDA does not approve GE crops for food safety, as this is a voluntary consultation process.

In summary, the risks to Monsanto's shareholders from the company's genetic engineering business are substantial. In addition, the company already carries historical risk liabilities well in excess of sector peers. As this report illustrates, the company faces business constraints in the form of market rejection by consumers, producers, and farmers; significant legislative hurdles to commercialization; uncertainty in the face of human health and environmental impacts stemming from the company's products; and finally, significant risk exposure from potential contamination of the human food chain by unapproved genetically engineered traits. It should be stressed that even if the company is a good actor with respect to safety and control during product development, problems stemming from actions by a competitor could impact the company's profitability.

Another contamination event on the scale of the StarLink fiasco could conceivably impair Monsanto's genetically engineered seed business with the potential to substantially reduce the market. While many observers would consider this possibility remote, recent experience including the ProdiGene case detailed above, indicate that such an event is quite possible.

In light of this, it appears the company's stock is currently overvalued and that present value (as of 12/04) is based upon a perception of future earnings that are not likely to fully materialize. To help investors gauge the level of risk, analysts should pose the following questions to Monsanto:

- What would the likely impact of GE food labeling requirements be to Monsanto should it occur in the U.S.?
- What is the risk that the company will incur contamination costs on the scale of the StarLink problem? Has Monsanto done its own analysis and case study of the Starlink contamination event and its impact upon Aventis? If so, will that study be made available to stakeholders?
- At what stage of development does Monsanto conduct impact assessments and calculate potential liabilities for genetically engineered crops?
- If market rejection of the company's genetically engineered seeds should increase, what are the company's plans to diversify?
- What is the company's strategy should a WTO challenge to the EU moratorium on genetically engineered crops fail, or should the scope of acceptance be limited?
- Given the level of risk exposure facing the company, can Monsanto make copies of the Regulatory Affairs and Scientific Outreach Units Monthly Summaries for recent years available to shareholders?[167]
- Can the company more effectively utilize its current research and development assets to produce seed varieties that are not genetically engineered and therefore will face less market rejection and have a lower risk profile?

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