# Potential Market Impacts from Commercializing Round-Up Ready® Wheat

## September 2006 Update

**By Dr. Robert Wisner, Iowa State University**
**and**
**Western Organization of Resource Councils**

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## Summary of our 2006 Conclusions

Through mid-2006, we have not seen evidence, either from WTO policies or other developments, that consumers in major foreign markets are significantly changing their views toward GM Round-Up® Ready wheat from those of two years ago. That conclusion is especially true in the EU. It appears to apply to either herbicide-resistant or fusarium-resistant GM wheat, although in the future it might be possible to demonstrate to some consumers that the latter type of wheat offers benefits to themselves as well as farmers. The chances for widespread market acceptance of fusarium-resistant wheat would be increased if foreign consumer concerns are carefully addressed through transparent examination of food safety and environmental risk assessments by independent scientific researchers.

Despite a WTO ruling that EU unnecessarily delayed approval of several GM corn events (varieties), a number of EU countries have partial or total restrictions on production of GM crops, and more than 3,500 elected local governments and 170 specific regions in Europe declared themselves to be GM-free.[1] The WTO did not rule against EU's detailed GM labeling and traceability policies. Accordingly, some developing countries could conceivably pattern their GM policies after the EU format. In developments related to the U.S. WTO case against EU, EU scientists were commissioned to examine industry feeding trials used in the U.S. commercialization of a type of GM corn. Scientists involved concluded the studies raised serious safety issues that warranted more extensive testing. Their conclusions were reported by popular media in Europe, and in some cases may be causing increasingly negative reactions toward GM foods among some consumers. ***In this report, we do not in any way endorse or attempt to validate findings of the EU scientists.*** They are noted here to help readers understand the background behind EU consumer attitudes toward GM foods.

In 2005, we noted that new varieties of soybeans were developed through conventional breeding that offered potential health benefits to consumers through reduced risk of heart disease. Seed companies inserted a GM herbicide-resistant gene in some of these new varieties of soybeans, and we noted that this could bring a possible turning point in foreign consumer attitudes toward GM foods. Consumers might see these products as having benefits, not just for producers, but for consumers as well. Available supplies of these soybeans will increase in the next few years if demand warrants an increase, and it will be important for the wheat industry to monitor consumer acceptance of them. Indicators of foreign market acceptance so far do not show that these new varieties of soybeans have changed attitudes toward GM foods. For the 2005-06 soybean marketing year, U.S. soybean exports to the EU have fallen extremely sharply and U.S. soybean meal exports to EU have fallen to economically almost insignificant levels. U.S.

soybean exports to a number of other important foreign markets also have dropped substantially in the 2005-06 marketing year, probably for reasons other than GMO issues.

In the past year, we have seen no technological developments that would significantly reduce the costs of segregating GM and non-GM wheat supplies in marketing channels. If a low-cost acceptable segregation system could be developed, that would increase the likelihood of market acceptance of GM wheat. With the low tolerances allowed for GM food ingredients in some foreign markets, effective market segregation to meet those low tolerances would be important if negative impacts on export demand from commercializing GM wheat at this time are to be avoided.

# Update on Potential Market Impacts from Commercializing Round-Up Ready® Wheat: August 2006*

**By Dr. Robert Wisner, Iowa State University**

Monsanto researchers have developed a genetically modified type of hard red spring wheat that resists Round-Up® herbicide. This herbicide is a broad-spectrum chemical that controls most weeds, including certain grasses that in some areas can be a problem in wheat production. Round-Up® also is a commonly used herbicide in the production of conventional no-till wheat. In May 2004, Monsanto announced it had decided to indefinitely delay the commercialization of this type of wheat because of concerns about foreign consumer market acceptance of genetically modified (GM) foods. (In this report, the terms GM and GMO are used interchangeably to refer to GM crops and food, since some direct quotations from other sources use the latter terminology.)

GM technology involves insertion of a gene from a totally unrelated organism into wheat to create resistance to the herbicide. Similar technology has been in widespread use for soybean and cotton production in the U.S., soybeans in Argentina, and in canola production in Canada for the last six years. It is also available for corn in the U.S., but is less widely used than for soybeans.

## Highlights of our 2003 Findings[2]

Our 2003 report concluded that commercialization of genetically modified wheat in the U.S. at that time or in the next few years would create a high risk of loss of one-third to one-half of the U.S. hard red spring wheat exports and an even larger percentage of durum wheat exports. Durum wheat would be at risk due to potential co-mingling with hard red spring wheat in marketing channels. Significant risk also would be involved with white wheat from the Pacific Northwest because of potential co-mingling in marketing facilities. ***We projected these potential market losses to occur due to the likely total loss of the EU market for U.S. hard red spring and durum wheat, along with losses of from one-fourth to one-half of the non-EU markets for these two classes of U.S. wheat.*** Market losses of this magnitude would risk pushing hard red spring and durum wheat prices down to feed wheat levels, as normally exported supplies would be diverted into domestic feed markets in competition with corn and other feed grains. Negative effects on wheat prices would have negative economic consequences for wheat growers, rural communities and businesses, and for local governments through diminished tax receipts. Increased government program payments would only partially offset lower wheat prices.

While some observers use U.S. GM corn and soybean exports as indicators of likely foreign market impacts from commercializing GM wheat, these crops have important differences from wheat in the market place. Hard red spring wheat is a food grain, and would be readily identified

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in food products through foreign food labeling programs. U.S. corn is mainly processed through livestock in industrialized countries rather than being consumed directly as human food. Since it is processed through livestock and poultry, the Round-Up Ready® gene in most corn and soybean products would not be detected in the food labeling programs. Similarly, when GM corn is processed to manufacture starch, corn oil, or corn sweeteners, the GM protein is removed and allowing such foods in most cases to avoid GM food labels. Soybeans are largely processed into soybean meal for animal and poultry feed, and for soybean oil. In both cases, for many countries, the Round-Up Ready® gene would not be detectable for the food labeling program. An exception is the EU, where recently modified labeling programs now apply to livestock and poultry feeds as well as human food products. ***Despite these differences between feed grains and food grains, the U.S. corn industry lost essentially all of the EU market for its corn several years ago. The U.S. soybean industry has faced a declining share of the EU soybean market and a sharp decline in soybean meal exports to the EU.***

***Another important difference between wheat markets and those for corn and soybeans is that the U.S. produces a much smaller portion of the world wheat crop than either the corn or soybean crops. A third difference is that the U.S. corn industry has enjoyed rapid growth in processing of corn for fuel ethanol.*** Growth in this market has much more than offset loss of EU exports. ***Wheat exports represent a much higher percent of total demand thando corn exports, and wheat does not have an alternative rapid-growth sector paralleling that of the ethanol industry to offset loss of export markets.***

Important new potential wheat competitors include several former Soviet republics whose climates are well suited to raising wheat. These countries likely will expand production significantly in the years ahead. ***A price differential between GM and non-GM wheat created by market segregation costs would provide further incentive for these countries to expand non-GM wheat production to meet the needs of nearby consumers.***

## Indicators of Foreign Market Acceptance from our 2003 and 2004 Studies

*Surveys released in early 2004 by the United States Department of Agriculture's Foreign Agriculture Service , and in the previous two years by U.S. Wheat Associates and the Canadian Wheat Board showed very widespread potential foreign market resistance to Round-Up Ready® Ready wheat, in Europe and in many other foreign markets important to U.S. and Canadian spring wheat.* Responses from important foreign millers and some U.S. wheat millers indicated processors of wheat would be forced to be sensitive to the desires of final consumers of wheat products, to maintain integrity of their brands.

Conclusions in our 2003 report were based on this information as well as European Union surveys of consumer attitudes, widespread consumer reactions against GMO rice in Japan, and several other key indicators of market acceptance. Consumer acceptance appeared to be closely related to perceptions about adequacy of government regulatory, testing, and approval mechanisms, long-term food safety concerns, and long-term environmental concerns. It was beyond the scope of our report to address the validity of these concerns. ***However, the report strongly emphasized that consumer perceptions are the driving force in markets where***

***labeling allows consumers to distinguish between GM and non-GM foods. In late 2003, approximately 38 nations had food labeling programs identifying foods that contained more than a specified percentage of ingredients that were genetically modified.*** With the addition of 10 nations to the EU in 2004, the number of countries with food labeling programs has increased considerably. Unlike the U.S. marketing system, these labeling programs allow foreign consumers to express their preferences about GM food to the food industry. The industry, in turn, is able to send market signals back to wheat producers and the seed industry about preferences for GM vs. non-GM wheat.

Additional information incorporated in our analysis included major challenges in segregating the GM vs. non-GM wheat in seed, commercial wheat production, and wheat marketing channels. Difficulties in segregation cause potential problems for organic wheat producers as well as others who want to produce non-GM wheat. A number of important legal issues are raised relating to who is responsible and who pays for damages if another producer's wheat is reduced in market value because of co-mingling. Similar issues apply to elevators and processors who are merchandising or milling non-GM wheat. Most indicators pointed to high costs of segregation at the level needed to meet foreign labeling requirements, with these costs being passed on to buyers who prefer non-GM wheat. This cost differential would create an incentive for foreign wheat producers to increase production and exports of non-GM wheat and capture part but not the entire premium that would have to be paid for segregating non-GM U.S. spring wheat. A closely related concern, maintaining the genetic integrity of the non-GM seed wheat supplies, was identified by Canadian researchers.

## 2004-2006 Developments with Potential to Influence Market Acceptance of Round-Up Ready® or Other Input-Trait Genetically Modified Wheat

Our updated analysis in 2005 indicated consumer attitudes toward GM wheat in many foreign markets did not appear to have changed significantly, although we noted that China had emerged as an important market for U.S. spring wheat and might be a bit less sensitive to GM issues than some other markets. We also noted that low trans-fat varieties of soybeans had been developed with conventional breeding methods and the herbicide-resistant gene had been inserted in these varieties to provide the first genetically modified crop with the potential for clearly observable consumer benefits. We indicated that foreign consumer attitudes toward these new varieties of soybeans would be important to monitor since they could provide clues to possible consumer attitudes toward disease-resistant genetically modified wheat.

Important developments during the past year that serve as indicators of foreign market acceptance and potential U.S. wheat export levels if GM spring wheat were commercialized include (1) the U.S., Argentina, and Canada WTO case against EU on GM issues, (2) foreign soybean market reactions with the development of low trans-fat soybeans, (3) trends in wheat exports to China, (4) the latest EuroBarometer survey of consumer attitudes toward various food-related issues, and (5) widespread European publicity about details of private-sector GM testing that was the basis for approval of genetically modified corn in the U.S. Available reports from senior European scientists who reviewed the study may have heightened European concerns about the safety of GM food.

In a very recent development, reports in mid-August showed strong negative Korean, Japanese, and European reaction to reports that traces of a type of GM rice that had not been commercialized were found in commercial U.S. rice supplies. South Korea reportedly demanded that its importers be assured that there is no GM rice in supplies sent to them. Their request carried implications that Korea's purchases of rice from the U.S. might be completely halted if this demand is not met.[2] In the EU, reaction was as follows: "On Tuesday, the EU said it was poised to prevent unauthorised biotech rice detected in the United States from entering its food chain"[3] Japan responded to the news that traces of GM rice were found in commercial supplies by suspending all imports of U.S. long-grain rice. Its food agency has not approved any GM rice varieties for sale in Japan[4], although two herbicide varieties have been deregulated in the U.S. These reactions indicate the GM issue is still a very sensitive one in these countries.

These developments and other available indicators of consumer attitudes continue to suggest that in 2006, foreign market reactions would be similar to those of two years ago if it were commercialized at this time. Despite the development of low trans-fat soybeans (a GM soybean with identifiable consumer benefits), U.S. soybean exports in the 2005-06 marketing year have dropped sharply—especially to the European Union and China. With China's large purchases of U.S. hard spring wheat last season, it was hoped that country would become an important new wheat customer that might offset potential reduced markets elsewhere if GM crops were commercialized. However, with better crops, China sharply reduced its imports of U.S. hard red spring wheat in the 2005-06 marketing year. The U.S. WTO confrontation with EU about its GMO policies does not appear likely to create more positive attitudes of EU consumers toward GM food. ***In fact, some observers believe the events related to the confrontation may further harden consumer attitudes there against GM food products.***

Recent reports indicate wheat producer groups have become increasingly interested in taking steps to encourage the U.S. approval of GM wheat, partly with the hope that the technology will accelerate the development of fusarium-resistant varieties and possibly other varieties that will improve the efficiency of wheat production.[5] Fusarium has been a serious and expensive disease for many producers of hard red spring wheat in the U.S. in recent years. With producer and industry efforts to encourage approval of genetically modified wheat, an updated indication of potential acceptance of GM wheat (either herbicide resistant or fusarium-resistant) in foreign markets is timely.

The Global Cereals Manager of Syngenta Seeds has expressed the view that not all export markets are ready for GM wheat and that market acceptance is extremely important before such products are introduced: "When Syngenta's John Bloomer contemplates whether the markets and consumers are ready for GM wheat, his answer is pretty simple. 'No, not all markets are ready for GM wheat just yet,' Bloomer says. 'There is still a job to do to prepare markets for these products… It's critical that we don't disrupt the grain trade — we are very, very aware of that,' says Bloomer. 'We have to have sufficient acceptance across the key export markets. It's not about fancy advertising. It's about listening and taking on board people's concerns.'"[6]

In considering the introduction of a new genetically modified wheat variety or varieties into global markets, it should be noted that faculty from the Harvard Business School also express the

importance of considering consumer reactions. They stress that it is important "… to assess the global food system from the perspective of every player in the vertical food chain—from genomics to governments… farms to food companies… supermarkets to consumers."[7] Foreign consumers are key participants in the market for genetically modified wheat. With exports accounting for 56% of the market for U.S. hard red spring wheat[8], export market acceptance is vital to the U.S. wheat industry's economic health.

A few non-GM varieties of fusarium-resistant wheat have recently been developed for commercial production.[9] At this writing, no GM varieties of fusarium-resistant wheat have been developed and industry reports indicate commercial varieties of GM fusarium-resistant wheat may still be several years away. Thus, genetic modification is not necessarily the only solution for the fusarium problem. One report from a wheat industry meeting in Grand Forks, North Dakota this past winter indicated Syngenta plant breeders are working on several varieties of fusarium-resistant wheat that are being developed through conventional breeding and appear to offer significant potential for dealing with the disease. Attendees at the meeting reported that these non-GM varieties might be offered to producers *instead of genetically modified varieties* because of less time required for their development.[10]

## The U.S.-EU WTO Confrontation on GM Policy and Possible Implications for Wheat Exports

In response to an unofficial EU multi-year moratorium on approval of additional GM corn varieties, the U.S., Canada, and Argentina presented their concerns about resulting negative impacts on trade to the WTO (World Trade Organization). They expressed the view that EU's GM policy was a violation of established trade rules and was restraining corn exports to the EU. The Pew Initiative report indicated U.S. actions also reflected a broader concern than just the EU market restrictions.

> "U.S. officials also believe that a challenge is necessary to discourage other countries, especially those in the developing world, from using the EU regulatory approach as the basis for their own regulations on agricultural biotechnology products, which could result in even wider-scale disruptions of U.S. trade. President Bush is concerned that stringent EU restrictions have led to the refusal of several South African nations to accept U.S. food aid that included GM corn, further exacerbating famine, a charge that EU officials vehemently reject." [11]

There are numerous important differences between the U.S. and EU policies on GM food products. A key issue that has caused major disagreements between the two governments and is related to the WTO case is the concept of "substantial equivalence." This concept is a centerpiece in U.S. policy on GM crops. It is the concept that GM crops are not materially different than similar non-GM products currently on the market. Additional detail on differences in EU vs. U.S. GM food safety review of GM crops is described as follows:[12]

> "The U.S. does not verify the safety of any biotech [food] product, but approves products based on the "safety and nutritional assessment" submitted by biotech companies and based on the company's conclusion that its findings "do not raise issues that would

> require pre-market approval… the EC requires independent verification by a competent authority of the company's claims for its products."[13]

For those who want confirmation that the U.S. government typically does not test or approve GM crops, but merely accepts test results presented to it by the developer of the crop, a typical letter given by the Food and Drug Administration to the developing company is publicly available from the Food and Drug Agency web site.[14] In the U.S. approval process, GM crops have been treated as "substantially equivalent" to non-GM versions of the same crop if nutritional characteristics are approximately the same and known allergens are not present in the GM crop.

Some observers see the recent decision in the WTO biotechnology case brought by the U.S., Canada, and Argentina against EU as being an important positive influence on future acceptance of GM wheat in Europe, while others disagree strongly. The WTO decision might also have had the potential to restrict developing nations from following GM policies patterned after those of the EU, *if WTO had found the EU labeling and traceability policy to be a violation of established trade rules.* In that case it would have been a definite positive influence on future market acceptance of GM wheat in non-EU countries. *However, the case was a very important positive outcome for countries that want to provide consumers with GM-non vs. GM food choices. The WTO did not strike down the EU GM labeling and traceability policies.* If that had happened, the WTO decision likely would have paved the way for US. commercialization of GM wheat and potential marketing of such wheat in Europe.

The major results of the case were (1) acceptance of one point in favor of the U.S. and against the EU, namely that the EU had inappropriately delayed acceptance of a substantial number of GM corn events and (2) since GM labeling is still allowed by WTO, *European consumers will have the final say on whether GM wheat, either herbicide-resistant or fusarium-resistant, will be accepted in European markets.* "The WTO interim ruling does not question the right of countries to adopt strict biosafety legislation or even bans, to protect the public and the environment from GMOs."[15] The results appear to leave the EU with substantial flexibility to continue its detailed labeling and traceability program for GM foods, feeds, and food ingredients.[16] The outcome also does not appear to restrict other non-EU countries from establishing GM policies that follow the EU format.[17] ***As we have emphasized in earlier reports, if GM food labeling programs are in place, as they are in over 45 foreign countries, consumers rather than government mandates will determine whether the markets will accept GM wheat.***

One scholar sums up the current situation as shown below. His comments apply to many international markets, but not to the U.S. food market.

> "Ultimately in any marketplace, the customer is always right. Legal actions or no legal actions, it's hard to force customers to buy something they don't want. Regardless of how biotech supporters and the U.S. government spin the ruling, it will not change the preference of food buyers." [18]

In the U.S., consumers have no way of distinguishing between foods produced from GM vs. non-GM ingredients, except by buying organic products or by purchasing products made from crops

that have not yet been genetically modified. However, it is important for the wheat industry to note that such choices are available in many important foreign wheat markets.

Reports from Europe in the wake of the WTO decision continue to confirm strong resistance to GM food and crops. The following quotation illustrates some of the depth and breadth of concern there and attitudes potentially affecting market acceptance of GM wheat:[19]

> "More importantly, European public opinion remains steadfastly hostile towards GM food. The WTO did not rule on two important questions put before it, namely whether GMOs are effectively the same as non-GM foods, or if they are safe. Such a ruling is unlikely to persuade the public or EU institutions to accept GMOs. Quite to the contrary, opposition is growing: in the past few days Hungary has declared that it is in its economic interests to remain GM-free, and Greece and Austria have affirmed their total opposition to the crops. Opposition at local government level in Europe is also increasing, with more than 3,500 elected local governments and 170 specific regions in Europe now declaring themselves GM-free. As of November 2005, even the WTO's Geneva headquarters are in a country operating a legally binding moratorium on the cultivation of GM crops."

Information on the WTO ruling that is available at this writing should be considered somewhat preliminary although the WTO released its "final" report in May 2006. An appeal of the conclusions by the U.S., Argentina, and Canada is possible and perhaps quite likely, even though the moratorium issue appears to be settled. It should also be noted that despite a WTO ruling against EU policies on hormone-fed beef nearly seven years ago, the U.S. has failed to regain the EU beef market.[20] The beef trade results are an indication that further negative WTO rulings toward EU would not be a guarantee of GM wheat acceptance in Europe. As a further indication of European resistance to GM crops, the EU approved Poland's ban on 16 varieties of genetically modified corn in May 2006 despite the WTO ruling . "The Commission authorised the ban, which also prohibits the use of … non-GM maize varieties in Poland, after it was given unanimous approval by EU member states."[21]

## Will Low Trans-Fat Soybeans Change Foreign Consumer GM Attitudes?

In 2005 we noted that development of low trans-fat soybeans by conventional breeding methods and insertion of the Round-Up Ready® gene in these varieties was a development to be watched closely. Trans-fats have been linked to heart disease, and this product might be viewed by consumers as the first GM crop with readily identifiable consumer benefits. Low trans-fat soybeans became available commercially in 2005, although supplies are still limited. Europe has not yet followed the U.S. pattern of dealing with trans-fats. ***So far in the September 1, 2005-August 31, 2006 soybean marketing year (through August 17, 2006), U.S. cumulative soybean export sales to the EU were down from the same period a year earlier by a shocking 54%. U.S. soybean meal exports to the EU during the same period were down 56% from the previous year's low level and have dropped to almost economically insignificant levels.*** Historically, the EU has been the largest overseas customer for U.S. soybeans and often has been its largest foreign buyer of soybean meal. U.S. soybean meal sales to the EU in the period noted above are equivalent to the meal from ***one million*** bushels of soybeans out of the ***3.1 billion bushel*** 2005 U.S. crop.[22] ***From this information, it is clear that low-trans fat soybeans have not yet***

***encouraged EU consumers to buy more U.S. GM soybeans.*** U.S. soybean exports to the EU in the next few years could be an important lead indicator of potential market acceptance of GMO wheat. ***Loss of the U.S. corn export market in EU and the sharp downward trend in US soybean and soybean meal exports to EU are strong cautions to the wheat industry that GM issues in that market should be taken seriously.***

## EU EuroBarometer Survey of Consumers

The EuroBarometer is a Community-wide scientific survey organization that monitors consumer attitudes toward various issues of importance to government and industry. A report published in February 2006 by the European Union EUROBAROMETER showed the results of a large-scale EU-wide survey of consumer attitudes toward a number of perceived food risk items, including genetically modified foods. The report was requested by the EU Directorate-General Health and Consumer Protection Office as well as the European Food Safety Authority. It was coordinated by Directorate-General Press and Communication Office***. The report indicated 62% of EU consumers believed food safety as related to GM foods has worsened in the last 10 years, although it did not quantify the degree of concern***.[23] The large-scale survey of consumers was taken in the fall of 2005.

## Heightened Food Safety Concerns in Europe

Another development affecting EU consumer attitudes toward GMO foods is widespread media coverage of scientific reports showing adverse findings related to food safety. Those findings surfaced as European scientists reviewed private commercial testing that was the basis for U.S. government approval of commercialization of a type of genetically modified corn. The EU, in processes related to the WTO case, was able to obtain a report on the rat feeding trials used by Monsanto to test the safety of a type of GMO corn. Otherwise, the report would have remained confidential and information in it would not have been available to the public. Senior European scientists were commissioned to review and evaluate the feeding study. Through court orders, they were able to obtain permission to make some of their findings public. The Institute for Agriculture and Trade Policy in Minneapolis summarized this development as follows:

> "In addition, the European press has widely covered the recent discovery of internal studies by Monsanto that a variety of GM corn, Mon 863, under consideration to be commercialized in the EC, when fed to rats, caused changes in the blood composition and reduced kidney size.[10] While such revelations fall outside the period of EC regulatory review against which the U.S. has brought charges, the EC's ability to implement the WTO ruling will certainly be affected by the ongoing "surprises" about GMOs not revealed in the U.S. approval process for biotech products."[24]

Extensive detail on the study and its evaluation by two respected European researchers is available from at least three sources. [25] The fact that a court action was required for the researchers to make their findings public may tend to increase consumer distrust of U.S. processes for approval of GMO crops. The European researchers reportedly indicated the Monsanto study was done using outdated methods and flawed research designs, and in their view

these problems raised serious questions that also would increase consumer concerns about the safety of GM foods and the adequacy of current U.S. pre-market testing procedures.

The European consumer reactions can be better understood by looking at a small portion of the findings reported in these two EU studies. ***The excerpts below from a French report[26] are presented only to provide readers with a better understanding of potential foreign market influences affecting the demand for GM foods. Our report does not in any way endorse or attempt to assess the validity of these European evaluations.*** This information has been readily available to EU consumers. It is presented in detail here through direct quotations and excerpts from scientific reports to give U.S. readers a broader understanding of issues being raised in Europe that could affect the acceptance of GM wheat. We added bold and italics to the text in some places for emphasis. In some cases, words in the quotations are spelled using European versions of the English language.

> "*Background information.* MON 863 is a GM maize from the first generation, second category of GMOs; i.e. genetically modified to produce a pesticide. The first generation of GMOs commercialized in open fields since 1995 either tolerate a pesticide for the first category (72% of GMOs tolerate for instance mainly the herbicide Roundup, like NK603 maize from Monsanto) or produce a pesticide for the second category (generally around a kg/ha, like artificial Bt toxins in MON810 or MON863 maize; these different insecticides are produced in 20% of GMOs). The second generation of GMOs (8% of total) developed from 1998 make both: producing *and* tolerating a pesticide. Then virtually all GMOs commercialized in agriculture have been designed to contain pesticides that they absorb and/or produce (all the remaining characters are less than 1%). The third and fourth generations are anticipated from the actual experiments in fields to produce two insecticides and to tolerate one or two herbicides.
> MON 863 *description.* The genetic modification has inserted an artificial genetic construction, called the transgene, by particle bombardment by chance in the maize genome from immature cells. These cells have then regenerated new transformed plants, so called GMOs. Everyone agrees that this may have created insertional mutagenesis effects that are not visible by the compositional analysis; this kind of analysis by *substantial equivalence* can by definition only be partial**. From a reductionist point of view, the hypothesis taken is that an artificial genetic modification by particle bombardment (or by an equivalent method) does not create more risk than unknown genetic effects possibly visible after classical hybridization. This hypothesis has not been demonstrated yet, but has been used to avoid labelling and long-term feeding studies with GMOs in North America.**
> In our precise file, the genetic modification has been performed and reaches three separate goals :
> 1) to produce a variant of an artificial insecticide called Cry3Bb1 by the maize plant (49-96.5 µg/g) throughout its development and in all organs (adapted 35S promoter is used in the genetic construction).
> 2) To facilitate economically the maize selection, Monsanto ***has used and maintained within the GM plants an antibiotic marker gene called NPTII (neomycin hosphotransferase II). The latter produces into the vegetal cells a protein inducing resistance towards at least kanamycin, a well known antibiotic. This is also a sign of the first generation of GMOs which have been made rapidly with low consideration of the following problem. Antibiotic resistance is recognized to be a major health problem in numerous countries, developed because of the growing development in the***

***environment and bodies of antibiotic resistance genes. This is a phenomenon amplified by the common use of antibiotics according to the scientific community, which agrees to limitate their use nowadays.*** In this context, it could appear very strange to promote a food containing an antibiotic resistance, overall since Monsanto has already developed transgenic maizes without this kind of marker genes. This is true even if the company says that the antibiotic resistance has little chance to spread out from this agriculture, and that this will have if any very little effect on human and animal health. **This belief is not supported by well-designed experiments to prove it. This could shed a very big trouble in citizens' mind on the real goals of this company on health protection ; and this is not good for the development of biotechnologies in general**, that have been highly promoted by member states policy, including by heavy financial supports." …

**"RESULTS**

All the scientific committees consulted agree with Monsanto that [statistically significant] differences (summarized below) have been reported during the 90 day study between control and treated rats (with GMOs) on numerous parameters including blood composition and detoxification organs such as kidneys. EFSA indicates at this level:

- Some differences were observed in haematological parameters, including total white blood cell, lymphocyte and basophil counts;
- At study termination, statistically significant differences were observed for reticulocyte counts between the female animals fed 33% MON 863 and those fed the control and reference lines;
- Individual kidney weights of male rats fed with the 33% MON 863 diet were statistically significantly lower compared to those of animals on control diets;
- a statistically significant lower incidence of mineralized kidney tubules was noted for rats fed 33% MON 863 maize compared to those fed the control maize.

Significant effects in comparison to controls are also noticed with other GMOs tolerant to Roundup, and in total with at least 4 GMOs for which this kind of tests has been done, **resembling classical side-effects of pesticides in toxicology.** But this has also been observed for MON 810 maize producing another insecticide: *For rats fed 33% MON 810 maize, a statistically significantly lower albumin/globulin count was observed compared with control and overall reference lines at study termination.* On the other hand, public CGB discussions report inflammation and regeneration abnormalities in male kidneys fed with MON 863, significant increase of glycemia in treated females. Scientific committees in Austria, Italy, France, Spain, Sweden, and The Netherlands in particular have given questions to Monsanto on toxicity and allergenicity of this maize or MON 810, or both, or MON 863 x MON 810 after the transmission of the Company data, even if the time to evaluate the documents was very short… If we compare GMOs with other products tested for their safety, the closest example possible is for pesticides, since this MON 863 GMO has been genetically modified in order to produce a pesticide. The european legislation concerning pesticides has been for a long time directed by the directive CEE/91/414, and its successive adaptations. This legislation precises that, concerning the toxicity study of pesticides in food and feed for humans and other mammals, **three month tests should be done for three species (generally rat, mouse, and dog), and that pesticides are given in food during one year to one species (generally dog) and during two years on another one (generally rat, this approximately corresponds to its life span). There is no scientific reason to avoid these kind of experiments for actual GMOs."** [Bold emphasis added.]

***U.S. GM industry feeding studies typically have been for a 30-day period,[27] much shorter than recommended in Europe. As noted above, European scientists believe the trial period should be long enough to show any impacts on reproductive systems as well as other possible longer-term health effects.***

A few excerpts from a German study of the same rat feeding tests raised other questions about the study's design, methodology and interpretation of findings for GMO approval purposes. These excerpts are shown below.[28] We again added bold on some items for emphasis.

> "8. References to statements such as *"A statistically significant finding may not automatically constitute definitive evidence of an adverse or toxicologically significant effect"* is unacceptable in this form. **So who is going to define what is biologically significant? Apparently, it is the authors of the report!** We have to remind the authors that if they accept the principle of substantial equivalence any non-equivalence must at least be subjected to further detailed studies. **What is the point of performing sophisticated tests and measurements if after finding significant differences they are dismissed as not biologically significant?** (See for example differences in kidney weights and many others!) …
> 9. Re: the Monsanto supplemental analysis of "selected data" for consideration by the CGB. It is unacceptable for any experimental scientist to regard something as important as significant increases in white blood cell and lymphocyte counts and decreases in kidney weights in male rats or a decrease in reticulocyte counts in females as representing normal biological variability.…
> 14. Apart from the kidney weight data no other organ weights are given! It is incredible that no actual values are given for parts of the gastrointestinal tract even though that is where any food, including GM foods, will first impact on!
> 15. Postmortem examination is only given for 'selected' tissues. Why?"

It is clear from the tone of the above excerpts that these European scientists view the U.S. testing procedures used for commercialization of GM products as being woefully inadequate. It also remains unclear whether their views will have any future influence on global GM trade policies relating to WTO, the United Nations, and the Cartagena Protocol on Biosafety. The Cartagena Protocol is a global treaty outlining how GM products are to be monitored and treated in world trade. It has been ratified by 132 nations (but not the U.S.) and went into effect on September 11, 2003. *Most important for wheat growers is the potential impact of these European reports on foreign consumer attitudes toward GM foods.* Because of several important food safety problems that have faced European consumers in recent decades, consumer trust in government regulation and oversight of food safety in Europe appears to be at a lower level than in the U.S. With this background, it could be a difficult challenge to design European consumer "GM market education" or promotion programs that would offset publicized findings of the two scientific reports noted here.

## How Important is The European Market for Spring Wheat and Durum Producers?

The European Union typically is second only to Japan in importance to the U.S. as a foreign market for hard red spring wheat. In the past two marketing years, the EU has accounted for about 15% of all U.S. hard red spring wheat exports. That is an economically significant level but is down from 21% in 2003-04 and 16% in 2001-02. The latter year was the base period for our study of potential market acceptance of herbicide-tolerant GMO wheat.

The EU is more important for U.S. durum wheat than for hard red spring wheat. It accounted for 30 to 34 percent of U.S. durum exports in the last three marketing years. North African countries, whose consumers may be influenced by European GMO views and policies, is only a minor market for U.S. hard red spring wheat. It accounts for slightly less than one percent of all U.S. exports of this type of wheat. North Africa is a sizeable market for U.S. hard red winter wheat, but sales of this type of U.S. wheat appear have been restricted some by nearby supplies from Ukraine and Russian Black Sea ports. North Africa also is an important market for U.S. white wheat and durum wheat. In the last three years it accounted for 30 to 45 percent of U.S. durum wheat exports. Loss of the EU and North African markets would be a very serious problem for the U.S. hard red spring and durum wheat industries.

## Is China a Reliable New Market that Can Offset GM Wheat Export Losses Elsewhere?

In the 2003-04 and 2004-05 marketing years, China emerged as a substantial buyer of U.S. hard red spring wheat. In the first of these two years, it accounted for seven percent of all U.S. hard red spring wheat exports, and in the second year it accounted for 11 percent. However, China is a volatile market for wheat. In the marketing year ending May 31, 2006, it accounted for only two percent of total U.S. hard red spring wheat exports.

Based partly on China's purchases of U.S. soybeans, a number of market analysts believe its wheat import market is potentially less sensitive to GM wheat issues than that of other countries. China consumes more soybeans directly for human food than western nations, although most of its imported soybeans are processed into soybean oil and meal. China is the world's largest importer of soybeans, and purchases supplies from both the U.S. and South America. U.S. soybeans are mostly GM varieties, as are those from Argentina. Unlike wheat-based foods, much of China's soybean imports are processed so that GM soybean protein is removed from the oil, and the meal is fed mostly to livestock and poultry. Thus, Chinese consumer attitudes toward soybeans may not be a reliable indicator of potential acceptance of GM wheat, if it were to be commercialized. China has a GM food labeling program, but it does not appear to be enforced as strictly as in other countries.

If China's wheat market is less sensitive to GM issues than Europe and other Far East markets, China could be viewed as a substitute market to replace losses elsewhere if GM wheat is commercialized. However, not much is known about the potential sensitivity of Chinese

consumers to GM wheat. One recent report indicates a Chinese parent brought a lawsuit against the Kraft Company for using unlabeled GM ingredients in baby food.[29] Another report indicates Kraft has agreed to remove all GM ingredients from its Chinese food products.[30] A third report in late 2005 indicated a committee of Chinese officials and scientists were unable to recommend commercialization of GM rice because of inadequate information on its safety.[31] A later report indicated that the Chinese government is still working to develop GM rice.[32] However, at this writing, it appears that no time table has been set for its possible commercialization.

## Summary and Conclusions

U.S. wheat for many years has been an export-oriented crop. Well over half of the nation's hard red spring wheat production typically is sold abroad along with 28 to 38 percent of the U.S. durum crop. Growth in domestic demand has been slow and linked mainly to population growth. Export markets have been important to the industry as a way of utilizing excess production capacity as well as in supplying food needs for an expanding global population. The U.S. spring wheat industry has an excellent reputation for quality and reliability in world markets and it is important to maintain that reputation. Wheat industry firms and organizations are to be commended for their sensitivity to foreign consumer needs and concerns.

A cornerstone principle in non-agricultural marketing is that the consumer is always right and that products should be designed with the consumer in mind. Biotechnology offers important potential benefits to U.S. farmers in their efforts to control insects, weeds, and possibly diseases. Thus, it could offer the potential to improve farmers' competitiveness in spring wheat production relative to international competitors who may not yet have such technology and perhaps relative to other domestic crops such as corn and soybeans. However, potential advantages would be realized only if the wheat is widely accepted in international markets and does not have negative impacts on durum wheat or other varieties shipped through the same marketing channels.

GM crops so far have not been designed with the final consumer in mind. Foreign food labeling programs – unlike in U.S. markets – offer consumers the ability to choose between GM and non-GM wheat. In a number of important foreign wheat markets, consumers have shown concern about food and environmental safety issues related to GM crops and food. At the same time, they have not yet experienced readily identifiable benefits from these crops. We provided documented evidences of foreign consumer concerns in our 2003 report on foreign market risks of commercializing GM wheat. A USDA Foreign Agriculture Service survey of foreign markets, published in early 2004, provided additional verification of widespread foreign consumer concerns.[33] The key issue from a marketing perspective is not whether these concerns are valid, but *what the consumer thinks about the product and whether they will buy it or go elsewhere for supplies*. If there is high risk that consumers will seek non-GM wheat supplies elsewhere if the U.S. commercializes GM wheat, commercialization will create a high risk of negative impacts on spring wheat and durum wheat prices. In our 2003 report, we concluded that commercialization of GM herbicide-resistant wheat at that time would create substantial risk of negative impacts on prices.

Through mid-2006, we have not seen evidence, either from WTO policy decisions or other developments, that consumers in major foreign markets are changing their views toward GM wheat. That is especially true in the EU, and the conclusion appears to apply to either herbicide-resistant or fusarium-resistant wheat. Because of widely publicized negative information on scientific reviews of rat feeding studies, EU consumer attitudes toward GM foods may have become somewhat more negative than in the past. However, if the safety issues, concerns, and research credibility questions raised by EU scientists can be dealt with in an open and publicly transparent manner by independent researchers, it may be possible to demonstrate to some consumers at a future time that fusarium-resistant wheat and other types of GM wheat offer benefits to themselves as well as to farmers.

## A Note on Reasons behind Long-Term Decline in U.S. Wheat Acreage

A number of organizations and businesses associated with the U.S. wheat industry as well as wheat growers have become concerned about the long-term downward trend in U.S. wheat planted acreage and the declining U.S. share of world wheat exports. At a recent industry meeting, these groups made commitments to encourage the development of biotech (genetically modified) wheat, with the view that this technology will create technological developments making U.S. wheat more competitive in world markets.[34] At the same time, the wheat industry participants stressed that careful attention will be given to ensuring that resulting products are accepted by consumers.[35] At this stage, there is no way of knowing for certain whether genetically modified varieties of wheat would halt or reverse the decline in U.S. wheat acres. The decline has occurred in response to major government policy changes, as well as accelerated growth in demand for alternative crops and development of varieties of alternative crops more suited to the short growing season of the Northern Plains. It also has been influenced by a sharp increase in wheat exports from former Soviet republics. By western standards, wheat yields in these countries are not very impressive. But the shift to a market-oriented economy has encouraged farmers in the region to produce crops for which they have a comparative advantage in world markets. To better understand factors behind the declining U.S. wheat acres planted, it may be helpful to observe some of the underlying trends involved in changing cropping patterns in the Wheat Belt.

### Wheat Classes & Factors behind declining Soft Red Wheat Acreage

U.S. wheat production is made up of five main classes or types of wheat, each being used for different purposes and generally grown in different parts of the U.S. In some regions, competition for cropland from alternative crops is more intense than in others. For example, soft red winter wheat is grown mainly in the eastern Corn Belt, Missouri, and the south central and southeastern U.S. In these regions, it is a secondary crop. In the Corn Belt, the major crops are corn and soybeans. In areas of the eastern Midwest where weather conditions are favorable for soft wheat, the crop has allowed crop farmers to diversify production and has provided a second source of cash flow that occurs a few months before the main harvest season. In southern parts of this region and in the mid-South, the longer growing season allows farmers to plant soybeans immediately after the wheat harvest, thus producing two crops per year on the same land.

Usually, however, the double-cropped soybeans have a lower yield per acre than full-season soybeans.

In the soft red wheat producing region, as grain farms have become larger and more specialized, corn and full-season soybeans have been increasingly competitive with wheat and have resulted in lower wheat plantings. This part of the Wheat Belt typically has the second highest wheat yields per acre in the U.S., but has sometimes had quality-reducing disease problems that result from relatively high rainfall and humid conditions. ***In major corn-growing states in this region, changes in farm policies starting in 1996 appear to have strongly encouraged a decline in wheat acres. The 1996 Farm Bill decoupled government farm program payments from plantings. That change meant farmers no longer saw a need to plant wheat to maintain their wheat acreage base and collect wheat payments.*** The change allowed more market-oriented cropping decisions. The market as well as government income support programs encouraged shifting of some land to crops such as corn and soybeans, which have had much more rapid market growth than wheat. These shifts were encouraged by a much higher government loan rate for soybeans than for wheat. For example, at this writing, the average soybean loan rate in Mclean County Illinois is $5.12/bu., while the wheat loan rate is $2.73/bu.[36] The average yields for soybeans and wheat, respectively, in that county in 2004 were 54 and 75 bushels per acre. Thus, the soybean loan rate was 88 percent higher than that for wheat while the wheat yield was 39 percent higher than the soybean yield.

## Hard Red Winter Wheat

The major producing region for this crop is from Nebraska to Texas in the Great Plains, although some hard winter wheat is also grown in South Dakota, Montana, and other near-by states. In a large part of this region, farm policy changes triggered by the 1996 Farm Bill also were a factor behind declining wheat acreage. De-coupling of farm payments and sharply higher loan rates on soybeans than wheat resulted in large increases in soybean plantings in areas where rainfall was satisfactory for growing soybeans. In previous years, government programs had encouraged production of wheat. For Sumner County Kansas, the average wheat yield for all wheat was 39 bushels per acre in 2005 while the average soybean yield was 26 bushels per acre. The respective loan rates for soybeans and hard red winter wheat for 2006 in Sumner County are $4.95 and $2.96 per bushel, respectively. Soft red winter wheat in that county has a loan rate of $2.56 per bushel. Sumner county is a substantial producer of both wheat and soybeans.

## Hard Red Spring and Durum Wheat

The major producing region for these types of wheat includes Montana, the Dakotas, and Minnesota. In the Dakotas and Minnesota, farm policy changes as well as the development of shorter-season soybean varieties and a rapidly expanding export demand for soybeans were major factors behind declining wheat acreage. In the international markets, China shifted from a soybean exporter to a huge importer in the late 1990s and early 2000s as rapid economic growth created a huge and growing demand for animal feeds and soybeans. Farm policy changes and development of shorter-season corn varieties also were important factors behind reduced wheat

acreage in this part of the Wheat Belt. Demand for corn has accelerated sharply in recent years with U.S. policies that encourage the production of renewable fuels such as corn-based ethanol for motor fuel. In the western part of this region, wheat acreage has been much more stable. That part of the Wheat Belt has inadequate rainfall for extensive production of corn and soybeans, so wheat has continued as the dominant crop. In the Northern Plains, problems with fusarium – which sharply lowers wheat quality and reduces yields – also have contributed to the shift from wheat to other crops. Fusarium-resistant varieties, whether from genetic modifications (if acceptable in international markets) or conventional or other breeding methods, might help some in slowing the reduction in wheat plantings. However, major driving forces behind cropping changes in the region appear to have been related to government programs and differences in rates of demand growth of alternative crops vs. wheat. In rapidly developing countries, increased income tends to cause consumers to include more protein and less grain-based food such as wheat and rice in their diets. That, in turn, creates growth in demand for soybean meal and corn for livestock and poultry production.

## White Wheat

The major white wheat producing region is in the Pacific Northwest (PNW), which is comprised of Washington, Oregon, and Idaho. Small pockets of soft white wheat production also have existed historically in Michigan and New York. The PNW typically has higher wheat yields than other areas in the U.S. due to climate and the type of wheat being grown. In 2005, Oregon and Washington had state average wheat yields of 59.8 and 62.6 bushels per acre respectively. As in Montana, wheat plantings in this region have been much more stable than in areas further east.

## Will Major Improvements in Wheat Breeding Come Only Through Genetic Modification?

There is no clear-cut answer to this question. So far, the dominant types of genetically modified crops are insect and herbicide-resistant varieties of corn, soybeans, and cotton. Research is being done to develop fusarium-resistant genetically modified varieties of wheat. If successful, and if acceptable in international markets, that could help deal with a serious disease problem in spring wheat. However, some sources indicate conventional breeding may also offer the potential for such varieties, possibly before genetically modified varieties are available.

Other areas for genetic improvement of wheat also could be explored, including possible insect and disease resistance, and development of higher-yielding and more drought-resistant varieties. Some sources indicate an emerging new plant breeding technique called Marker Assisted Selection (MAS) may offer many of the potential benefits of genetic modification while avoiding some possible side effects such as foreign consumer concerns and possible rejection. This technique utilizes mapping of the genetic code of wheat, and is described by the Center for Food Safety as follows: “With MAS, scientists locate the chromosomal regions (markers) in plants that are associated with desirable traits, and use this information to speed up traditional plant breeding.”[37] Research is being done to use this procedure in developing fusarium-resistant wheat, although it is too early to predict its degree of or timing of success.[38] Research at Montana State University is described as follows:

"To find the important genes, researchers will use molecular markers, which act like chemical flags of genes. Using markers greatly speeds incorporation of useful traits into new wheat varieties. For instance, Talbert pointed out that Montana breeders have developed molecular markers to assist with breeding for sawfly resistance and bread quality traits. Working with wheat industry representatives, the nation-wide team of breeders divided up the work. The goal of the Montana group is to identify molecular markers for genes related to increased yield and quality in dryland wheat production."[39]

## Concluding Comments

Reasons behind the long-term decline in U.S. wheat acreage and share of global wheat markets are complex and reflect a combination of government policies, comparative advantage of foreign competitors in production of wheat vs. other crops, relative demand growth of corn, soybeans, and wheat, wheat diseases, and other factors. "In the next several years, U.S. government incentives for production of biofuels from corn and soybeans almost certainly will cause these crops to provide intense competition with wheat. Genetic improvements in wheat -- if the resulting varieties are acceptable in international markets -- could somewhat moderate the intensifying competition. However, we have not seen evidence, either from WTO policy decisions or other developments, that consumers in major foreign markets are changing their views toward GM wheat so as to make such varieties acceptable in international markets."

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