Journal of Agricultural and Applied Economics, 37,2(August 2005):409–414

Biotechnology and International Competitiveness: Implications for Southern U.S. Agriculture: Discussion

Stanley M. Fletcher and Denis A. Nadolnyak

Agricultural biotechnology is an important issue in the United States and worldwide because its acceptance by consumers, as well as producers, remains problematic. The United States currently is the world's leader in both agbiotech research and production. In 2004, the United States planted 47.6 million hectares of genetically modified (GM) crops, with Argentina planting 16.2 million hectares followed by 5.4 million hectares for Canada, 5 million hectares for Brazil, and 3.7 million hectares for China (*Nature Biotechnology*). However, strict regulations and standards imposed by some governments on trade in GM crops pose threats to U.S. agriculture and the biotech-research industry.

U.S. agriculture is more dependent on agbiotechnology than any other country in the world because the United States had 57% of the GM-planted acreage in 2004. Therefore, it is particularly vulnerable to the GM crop trade barriers that have been imposed by the European Union (EU) and other countries. The issues of agricultural biotechnology can be broadly classified as follows:

1) issues of producer acceptance of biotechnology;
2) issues of consumer acceptance of food that contains GM ingredients;
3) trade-related issues of regulation and labeling imposed by foreign governments;
4) environmental and food safety concerns;
5) long-term welfare, distributional, and structural effects of agricultural biotechnology in the industrialized countries and in the developing world.

Stanley M. Fletcher and Denis A. Nadolnyak are professor and coordinator and postdoctoral research associate, respectively, National Center for Peanut Competitiveness, Department of Agricultural and Applied Economics, University of Georgia, Athens, GA.

Producer Acceptance of Biotechnology

Producer acceptance of GM crops has been confirmed by extremely high adoption rates in the United States, as well as in some Latin American and Asian countries. Surprisingly, however, little conclusive research on the actual producer benefits has been done. On the one hand, some U.S. farmers estimate yield increases from planting Bt corn at 15% and a cost savings of $25 per acre. On the other hand, many farmers fear low prices that result from overproduction plus the substantially higher costs of GM seed and technology fees, the cost associated with testing, segregation, certification of non-GMs, the risks of liability brought about by cross-pollination and contamination, and the loss of markets, both foreign and domestic.

Complaints have been voiced about the overly complicated nature of GM crop production. Farmers often find themselves caught in the middle of a debate between chemical manufacturers, seed companies, agribusiness concerns, grain exporters, foreign and domestic consumers, and governments around the world. The rapid acceptance of GM crops by

production agriculture shows that farmers may want to have these products as part of their planting options for the future. But the uncertainty over marketability, cross-pollination, certification, and liability has been driving farmers away from the technology. These factors have been responsible for the 20% drop in GM crops' planted acres in the United States in 2000 compared with 1999. Currently, however, the GM planted acreage is increasing, as the paper by Marchant and Song points out.

To the American farmer, the debate over genetically modified crops is not an issue of science, environment, or health. Instead, it is an issue of economics. Can U.S. farmers afford to grow a crop that they may not have a market for in the fall? Or, can they deal with the concerns over on-farm segregation and the risk of liability caused by pollen contamination? Consumer resistance in Europe, Asia, New Zealand, Australia, Canada, Mexico, South Africa, and the growing resistance in the United States makes farmers doubt that many market opportunities will remain available for GM products.

It is important to remember that, while farmers have no control over market prices and regulations, they control their plantings of GM crops. Persistence of uncertainty about the GM crop markets may easily lead to shrinking production volumes and reversion to non-GM crop production. However, this scenario probably will not occur given that the source for seed is controlled by the private sector in most cases. If a farmer wanted to switch back to a non-GM crop, the seed may not be available.

Consumer Acceptance of Food That Contains GM Ingredients

Consumer attitudes are formed largely under the influence of the media, controlled by many interest groups that can be identified as the stakeholders in the GM controversy debate. Perhaps because these groups have vastly divergent interests, empirical studies find great variety in the consumer attitudes toward agricultural biotechnology and GM-containing foods in particular. The protagonists in the GM crop debate tend to overlook either good or bad aspects of GM crops in agriculture. The reason for such behavior is that they have agendas and, therefore, must ignore anything that contradicts their position. The most important players who are in opposition to influencing the public opinion are as follows:

Private sector:

- *The life science companies* (e.g., DuPont, Monsanto, and Syngenta). Life science companies try to promote as many GM foods as they can and encourage as much positive publicity.
- *Food manufacturers and retailers.* As these companies are consumer-oriented, they, particularly in Europe, strive to segregate foods or ban them altogether.
- *Producer associations (especially in Europe).* Producer associations often do not see much virtue in GM crops or foods as they only want the government to support the farmer.

Public sector:

- *Governments and regulatory agencies.* Governments focus on food and environmental safety and on competition issues. Currently, the United States sees Europe's fear of GM foods and agricultural products as the single greatest trade threat faced by the United States to agricultural exports.
- *Scientists and scientific organizations.* Scientists also differ a lot. Some believe the GM development should focus on addressing nutritional deficiencies of the Third World. Some scientists argue that the risks of releasing GM crops into the biosphere are substantial and the technology introduction should be stopped until further investigation.

Public interest groups broadly represent consumer and environmental concerns, as well as the concerns about the Third World (in the sense that delays with GM introduction works

against its needs). Public interest groups can be divided into:

- *Consumer groups* that are strong in Europe (labeling approved by 86% in 1999 plus bans) but also gaining strength in the United States (Natural Law Party, Consumer Reports publishing sensational articles).
- *Environmental groups* (Greenpeace and many others). Environmental groups argue against the corporate structure of the life-science industry and subsequent increase of globalization and poverty.

Thus, it is important to remember that public opinion is largely a result of the interplay of the campaigns waged by these constituencies.

Trade-Related Issues of Regulation and Labeling Imposed by Foreign Governments

In regard to U.S. agriculture, the most important thing is how freely can the GM crops be traded, i.e., the issue of barriers to trade that stem from policies and regulations that are hostile to biotech crops. As is well known, the EU trade policies and regulations restricting exports of GM crops have hurt U.S. agriculture. To understand the reason for the EU resistance, it is important to consider briefly the differences in the two regulatory backgrounds:

- In the United States, concerns about GM crops were prevalent in the early stage of their development. Although there is still concern, the public does not seem overly concerned about it. This, in part, may be due to the confidence the public has in the U.S. regulatory system. The United States has not had a major food crisis from a food-safety point of view that has damaged the integrity of the regulatory system. The American public believes that they have a safe and reliable food supply relative to other parts of the world.
- In the EU, there were two major overhauls in agricultural policies in 1992 and in 1999. The goal was to reform the Common Agricultural Policy (CAP) in order to move toward more market-oriented production, which, given previously high domestic support, could be done by encouraging reduction in output (freeing budgets from export subsidies). Thus, the emphasis was on increased quality. Apart from that, the Bovine Spongiform Encephalopathy (BSE) crisis was considered a failure of science and of the regulatory system, which resulted in adoption of more cautious policies and regulations. This might explain the EU's reluctance toward output-enhancing GM crops.

The main conclusion seems to be that, from the point of view of trade policy, a mutually agreed rule-based system is necessary to guard against implementation of domestic policies that react to headlines of the day and to pressure from groups looking to manipulate consumer opinion for their purposes (Harhoff, Regibeau, and Rockett). Although such guidelines in principle exist within the World Trade Organization framework, they do not seem to be working very well (CropBiotech Net).

Environmental and Health Concerns

The long-term effects of agricultural biotechnology remain obscure. Several serious environmental (nonmarket) effects have been suggested but have yet to materialize. These include:

- Risks to nontarget organisms (insects other than the targeted pests are killed by the pesticide), leading to disruption of food chains. No indication of it so far.
- Developing insect and weed resistance (particularly insects because they multiply fast).
- Genetic flow (primarily to wild relatives). So far, it has been a potential problem with canola because of the number of its wild relatives.
- Weediness of crops (when crops become weeds due to imposed sustainability). To

date, it has been a problem with canola because some seed is always lost in harvesting. Corn is not really viable.
- Loss of antibiotic effectiveness. (Antibiotics are just like herbicides: the enzymes that inactivate herbicides may also inadvertently inactivate antibiotics in people.)

The major food safety concerns are as follows:

- Changes in known toxicants. Toxicants are always present in foods but in insignificant quantities.
- Changes in nutrient levels. All sorts of things that affect absorption and/or metabolism.
- Allergenicity. Allergens in food are proteins. GM crops contain slightly different proteins.
- Food-safety effects from agronomic changes. For instance, toxicants such as aflatoxin and fumonisin are more likely to occur in plants that suffered mechanical damage from, say, insect feeding.

While scientists and interest groups have spent significant levels of funds and effort looking for these effects, none of them has really been detected.

Long-Term Welfare, Distributional, and Structural Effects of Agricultural Biotechnology in the Industrialized Countries and in the Developing World

The issue of long-term effects is how genetically engineered crops are going to change the world. It seems that they are going to have different effects whether one looks at it from the perspective of the developed countries' relative to developing countries' agriculture. Although the developed countries' agriculture is already industrialized and will most likely experience productivity increases, the effects on the developing world have been compared with the effects of the Green Revolution, particularly its structural and income distribution effects. The Green Revolution benefited mainly big farmers who could afford the chemicals, irrigation systems, and new varieties. and thus they achieved high yields. But, this adoption produced resistant pests, degraded soil quality, and increased monoculture farming (genetic uniformity), which potentially could affect the basis of future production.

However, it still remains to be seen what the effects of GM production will be. So far, Western agbiotechnology research has been focused on the developed-world agproduction: in 1999, 82% of GM crop area was in the industrialized countries (the United States had 72%), of which herbicide-tolerant soybeans and Bt cotton consisted of more than 90% (USDA-ERS).

Little private research has focused on developing countries' crops, other than rice and cassava. Whatever research had been conducted was a result of charity (private donations from Rockefeller Foundation, Monsanto, etc.). At the same time, direct transfers of the technology from the North seem impossible: poor farmers cannot afford herbicides (Traxler). At the same time, there are success stories: In Côte d'Ivoire, for example, a Future Harvest Center crossed African and Asian rice, which produced a leafy plant that denies sunlight to weeds. This resulted in significant reduction in agricultural labor requirements, which freed some time for child nutrition and care.

The development of agricultural biotechnology has created a lot of diverse issues that obstruct its diffusion. However, unless other means of radically increasing agricultural productivity are discovered, the advent of agbiotechnology is inevitable. World land, water, and other natural recourses are being exhausted but the population continues to grow. Estimates suggest that, by 2020, the world population will increase by more than 30% (to 8 billion), which will require 40% higher grain production (IFPRI). Under the rising pressure for increased food supply, governments will find it increasingly harder to oppose GM crops.

Now, with this in mind, let us proceed to the paper presentations. The first paper by Eric Wailes addresses the concepts, issues, and analysis of biotechnology on international

competitiveness. This is a very broad subject. One can even say that it is quite impossible to cover all the concepts and issues, let alone analyze them, in a single session. However, Dr. Wailes does a good job addressing the topic. Although U.S. farmers have the highest adoption rates, do they have any alternative other than to be the major adopters? Practically all crop seed is supplied by private companies with very little coming from the public sector. Today, most seed companies are owned by agricultural biotechnology companies or controlled by them. Thus, if a farmer wanted to plant a non-GM crop, he would be hard pressed to find the seed.

Most benefit-cost research on GM crops has been ex ante studies, as pointed out by Dr. Wailes. The ex post studies that have been completed provided mixed results. Furthermore, research on the quality issues from using GM seed has been lacking (Fernandez-Cornejo, McBride). For example, there have been recent reports about cotton quality issues from the GM cotton from the textile mills. Increasing yield and/or decreasing cost are not enough. One must be concerned about the quality of the produced crop. Many times, this is not a critical area in the breeding programs where maximizing yield and/or decreasing cost are the top factors. But, if we do not maintain quality, we will not be able to differentiate our crop from our competitors.

Dr. Wailes did a good job addressing the international trade and marketing system issues. With the advent of GM crops and the cross-pollination issues such as the Starlink case, dual marketing systems will need to evolve. This will ensure traceability and identity preservation. Manufacturers want to be able to trace the ingredients of their food products back to the source, which is the farmer. This will become more critical as we move to the second and third generations of GM crops. However, this can be a costly endeavor, as pointed out by Dr. Wailes, with a cost range of 1–72 cents per bushel.

To summarize Dr. Wailes's paper, there is a definite need for more research. In particular, more ex post analysis is needed. In addition, the research needs to include more recent years. Too much of the research addresses an irrelevant time period. Finally, more studies are needed on the second- and third-generation GM crops benefits relative to costs.

The second paper by Marchant and Song addresses the assessment of biotechnology policy and trade in key markets for U.S. agriculture. In particular, the paper focuses on China. Overall, the paper provides a fairly standard presentation of summary statistics on agricultural trade. The summary of the EU regulations approval process is brief.

The discussion of the Chinese biotechnology policies is quite interesting. In particular, it was interesting to learn that, in terms of public-sector investment in agbiotechnology research, China ranks second only to the United States. Furthermore, that more than 130 transgenic plant species have already been developed, and that the Chinese government has committed to raising budgets for plant biotechnology research by 400% over the next five years is truly indicative of China's view of biotechnology.

The general conclusion is that, while China has adopted strict regulations on GM crops, it is more accommodating of the U.S. imports than the EU. In the future, the Chinese government will remain very cautious in administering its biotechnology policies, which will be heavily affected by international debates on biotech product issues.

In their paper, they state that China's biotechnology policies did not affect U.S. exports. I find this statement most interesting given they earlier stated that China significantly increased their imports of U.S. GM crops after 2002. Furthermore, many models indicate that the price received by U.S. farmers is heavily influenced by China's level of food imports (Shoemaker *et al.*).

The final paper by Greg Traxler and Curtis Jolly was about the consequences of biotechnology policy for competitiveness and trade of southern U.S. agriculture. This was the only paper that dealt with southern agriculture. However, they were never explicit about the meaning of the statement that the United States is competitive in GM crops. No evidence was provided to support this statement.

The paper also discusses the benefits from GM crops to the consumers based on research. But who truly benefits? Most of the research addressing benefits states that the consumer benefits, but the consumers in the studies are really the companies. We need to do a better job in identifying who really receives the benefits.

Given that southern agriculture is basically a marginal producer of corn and soybeans, the question that was not addressed in this session is, Does biotechnology enhance the competitiveness of southern agriculture? We would say that it does not necessarily help Southern agriculture at present with the current available GM crops. Yet, the second and third and so forth generations of GM crops may help southern agriculture. For example, there has been talk about southern agriculture specializing in growing GM plants that are used by the pharmaceutical industry (so-called pharming).

Biotechnology has put farmers on the treadmill of adoption. They must do it or else lose their advantage. The major obstacles to biotechnology are not necessarily scientific but rather institutional and economics. Lastly, has biotechnology started to level the playing field in terms of productivity? Biotechnology can be easily transported around the world. In Marchant and Song's paper, they showed the major increase in biotechnology research by China's government. Most of the basic technology was developed in the United States at our land-grant systems. When classical breeding was the major development of crops, it could not be easily transported to other countries. An infrastructure was needed along with the human capital. The United States had the edge. Furthermore, a crop developed in the United States would not necessarily perform as well in another country. Yet, the biotechnology of inserting a gene or removing a gene could be performed anywhere that had the appropriate lab. This could be performed on those crops countries adapted to their own environment. Thus, the playing field is being leveled. The challenge is there for the United States and Southern agriculture.

References

CropBiotech Net. Various issues. Knowledge. center@isaaa.org. Internet site: www.isaaa.org/kc (Accessed March 31, 2005).

Fernandez-Cornejo, G., and W.D. McBride. *Adoption of Bioengineered Crops.* ERS Agricultural Economic Report No. AER810, 2001. Internet site: ers.usda.gov/publications/aer810/ (Accessed March 15, 2005).

Harhoff, D., P. Regibeau, and K. Rockett. "Some Simple Economics of GM Food." *Economic Policy* 16,33(2001):265–299.

International Food Policy Research Institute (IFPRI). *Global Study Reveals New Warning Signals: Degraded Agricultural Lands Threaten World's Food Production Capacity.* May 2000. Internet site: http://www.ifpri.org/ (Accessed February 23, 2005).

Jolly, C., K. Jefferson, and G. Traxler. *Consequences of Biotechnology Policy for Competitiveness and Trade of Southern U.S. Agriculture. Journal of Agricultural and Applied Economics* 37,2(2005):000–000.

Nature Biotechnology. 23,3(2005):281. Internet site: http://guide.nature.com/ (Accessed March 27, 2005).

Marchant, Mary A., and B. Song. "Assessment of Biotechnology Policies and International Trade in Key Markets for U.S. Agriculture." *Journal of Agricultural and Applied Economics* 37,2(2005):000–000.

Shoemaker, R., J. Harwood, K. Day-Rubenstein, T. Dunahay, P. Heisey, L. Hoffman, C. Klotz-Ingram, W. Lin, L. Mitchell, W. McBride, and J. Fernandez-Cornejo. *Economic Issues in Agricultural Biotechnology.* ERS Agriculture Information Bulletin No. 762, 2001. Internet site: http://www.ers.usda.gov/publications/aib762/ (Accessed March 10, 2005).

Traxler, G.J. "Assessing the Prospects for the Transfer of Genetically Modified Crop Varieties to Developing Countries." *Agbioforum* 2,3–4(1999). Internet Site: http://www.agbioforum.org. (Accessed March 26, 2005).

U.S. Department of Agriculture, Economic Research Service. *Briefing room: Agricultural Biotechnology: Recent Research Developments.* Internet site: http://www.ers.usda.gov/Briefing/Biotechnology/researchdevelopments.htm (Accessed March 20, 2005).

Wailes, E.J. "Concepts, Issues, and Analysis of Biotechnology on International Competitiveness." Invited paper presented at the Southern Agricultural Economics Association's Annual Meeting, Little Rock, AR, February 2005.