Is Biotechnology in China's Future?

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China is at the forefront of plant biotechnology research and is the world's fourth-ranked country (behind the United States, Canada, and Argentina) in area sown to biotech crops. Genetically modified (GM) varieties of all of China's major crops, as well as some fish and livestock, are in development or testing, but by 2001 only a few GM plant varieties had received commercial approval, including two types of cotton (which account for nearly all of China's biotech crop plantings) and varieties of tomatoes, sweet peppers, and petunias (table J-1). GM tobacco was China's first transgenic crop widely grown in the early 1990s, but it was withdrawn due to trade concerns.

Insect-resistant Bt (*Bacillus thuringiensis*) cotton, approved for commercialization in 1997, accounted for most of China's acreage planted in GM crops in 2001. Adoption of Bt cotton revived cotton production in the north China plain, where devastating boll worm infestations had affected production in the mid-1990s. Bt cotton was quickly accepted by farmers

Table J-1—Number of genetically modified plants approved in China through 1999

Crop	In trials or awaiting commercialization	Commercialized
	Number of varieties	
Cotton	13	2
Rice	16	0
Wheat	1	0
Corn	2	0
Soybean	2	0
Potato	8	0
Rapeseed	2	0
Tobacco ¹	4	1
Peanut	1	0
Cabbage	1	0
Tomato	5	1
Sweet pepper	2	1
Petunia	2	1
Other	6	0

 $^{^{\}rm I}$ Insect-resistant to bacco was commercialized in 1992 but stopped in the mid-1990s for trade reasons.

Source: Huang, J., Q. Wang, and Y. Zhang. "Agricultural Biotechnology Development and Research Capacity in China," Center for Chinese Agricultural Policy, Chinese Academy of Sciences, February 2001.

and accounted for nearly all cotton grown in Hebei province in 2000. China's success with Bt cotton suggests that biotech crops can have dramatic impacts on agriculture. Insect-resistant cotton varieties reduced production costs by 14-33 percent (Pray et al.), reduced farmer health risks, and improved water quality by reducing the frequency of pesticide sprayings. Preliminary calculations suggest that shortrun benefits of Bt cotton far exceed the costs of the crop's development (Huang et al.).

Though China's government has enthusiastically backed biotech research since the 1980s, its slowness in approving biotech food crops seems to represent a cautious approach to releasing GM foods to the market. In light of emerging consumer concerns about GM foods in Europe, Japan, and South Korea during the late 1990s, policymakers may have second thoughts about the safety of genetically modified foods. Alternatively, China's caution in releasing GM varieties may be a strategic move aimed at gaining a competitive edge in overseas markets by keeping China's production free of genetically modified varieties. The long delay in publishing final biotech regulations in 2001 and the lack of details in those regulations suggest that policymakers are still debating the biotech issue.

Strong Commitment to Biotech Research

Most biotech research in China has been government-funded. During the 1990s, China's investment in plant biotechnology rose at a significant rate. Between 1995 and 1999, biotech spending more than doubled from the equivalent of \$40 million to \$112 million and China announced plans to increase research budgets 400 percent over the next 5 years (Huang et al.). Biotech research in animal and plant agriculture combined is estimated to account for 15 percent of China's agricultural research, much higher than the 2-5 percent share typically devoted to biotech research in developing countries. China accounts for an estimated 10 percent of the world's public expenditures on agricultural research and development (Pardey and Beintema).

China's share of total biotech research expenditures is much smaller than its share of public expenditures because there has been little private research in China. Private spending has been estimated to account for half of biotechnology research expenditures worldwide. Most of the genetically engineered herbicideand insect-tolerant corn, cotton, canola, and soybean varieties that have been widely adopted by farmers outside China were developed by the private sector. In China, a Bt cotton variety developed by Monsanto is the only private sector variety that has been widely adopted. Lack of protection for intellectual property rights and restrictions on foreign firms have kept many foreign agricultural biotech firms from entering the China market.

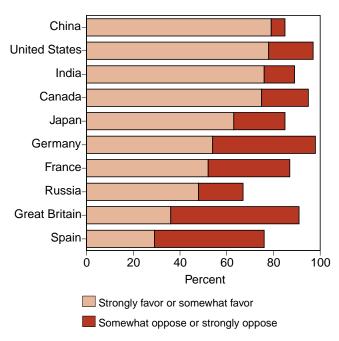
The most popular genetically engineered varieties developed by the private sector have appealed to farmers on the basis of the cost and labor savings they promise. The early commercial successes have been GM crops for feed and industrial use (soybeans, corn, and cotton). In contrast, China's biotech research program has devoted a larger share of resources to increasing yield and pest resistance in rice and other food crops, a reflection of the government's concerns about food security. Private firms have tended to concentrate on developing seeds for high-volume, high-margin markets for widely grown crops in order to recover the high initial development and regulatory approval costs in Western countries. China's research institutes have developed an inventory of smaller specialty varieties (vegetables, flowers, peanuts, tobacco, fish, and animals) that may give China's farmers a competitive edge in niche markets in China and other developing countries.

Will Consumer Acceptance Continue?

The sparse information available suggests that the public and news media in China have been supportive of agricultural biotechnology. A 1999 Environics International survey of consumers in 10 countries found that China's consumers were among the world's strongest supporters of agricultural biotechnology research (fig. J-1). Preliminary 2001 survey results reported in China's official newspaper, China Daily, indicated that China's consumers had a high level of awareness, but little accurate knowledge, of GM foods. The support for biotechnology probably reflects the government's traditionally strong support, since the news media is controlled by the state. A shift in official policy regarding genetically modified foods could

Figure J-1 Attitudes toward biotech crops in various countries, 1999

How do you feel about the use of biotechnology to grow pest-resistant crops requiring fewer chemicals?



Source: Environics International, reported in Washington Post, October 16, 1999.

lead to a change in media coverage and in consumer attitudes. Some scientists have expressed concern that consumer attitudes could easily be shifted by inaccurate or negative media coverage (Sheng).

Markets for GM-free foods have developed in Japan and other countries. Such markets could develop in China as consumers direct more attention to food safety and environmental issues. However, most Chinese consumers will probably not be willing to pay the substantial price premium associated with costly segregation and identity-preservation transportation, storage, and handling methods required to ensure that such products are free of GM content.

Regulatory Environment Uncertain

In January 2002, China published regulations that required labeling and safety certification for all GM animals and plants entering China for sale, production, processing, or research. Foreign companies selling genetically modified organisms (GMO) for seed, production, or processing and importers intending to use GMOs for research purposes are required to obtain a GMO safety certificate from China's Ministry of

Agriculture. The application for the certificate requires documentation that the GM product has been found to be safe and is permitted for use and sale in the exporter's home country, and applicants must specify safety measures to be taken in the course of exporting the GMO to China. China's regulations require importers to be issued safety certificates before they can sign contracts to import GMO products to China, and the approval process for certificates can take up to 270 days. The products specifically covered include soybeans, rapeseed, oil and meal made from soybeans and rapeseeds, corn, cotton seeds, and tomatoes, and the regulations direct China's State Council to issue a full list of products that require GMO labeling.

The initial regulations published by the Chinese government left important details unspecified. Trade in soybeans was disrupted as traders waited to see whether imports of GMO soybeans would be allowed under the new regulations. The United States raised concerns that the lack of details given, the complexity of the regulations, and apparent discriminatory treatment of imported versus domestic products could disrupt trade in oilseeds and corn. Costly paperwork to obtain safety certificates, testing, and uncertainties about whether shipments will be approved for import could raise costs for Chinese processors and reduce China's imports from the United States, Canada, and Latin America, where GM varieties of oilseeds and corn are widely grown.

The effects of China's GMO regulation will be determined in large part by how inspection, testing, and approval are administered and operated. Testing for biotech content must be rapid, economical, accurate, and standardized. Failure to effectively regulate the dissemination and marketing of bioengineered plants and animals could lead to consumer dissatisfaction and wide resistance to biotechnology if defective or harmful varieties are released or consumed by the public. China will also need to carefully regulate and monitor biotech producers to ensure that safe and appropriate practices are used in the cultivation of biotech crops. For example, plantings of Bt cotton should be interspersed with non-Bt "refuges" to prevent development of resistant pests, but it is not clear that this practice is being followed in China.

Public Versus Private Sector

Will the private sector play a bigger role in China's biotech research? Until recently, China's fragmented

What We Need to Know

Will China's regulation of biotechnology boost or retard the dissemination of GM food and fiber? Will imports be affected?

Will Chinese consumers' acceptance of genetically modified foods continue?

How will the adoption of GM crops in China affect exports to other Asian countries vis-à-vis U.S. products?

How will the structure of the Chinese seed market evolve as foreign firms gain entry and how will this affect farm input costs and access to seed technology?

seed industry was made up of small regional companies that relied on the public sector for research and development. However, in recent years the seed industry has begun to commercialize. Several large companies from other sectors of the economy have bought up local seed companies to forge them into national companies. A number of provincial seed companies and research institutes have been able to raise capital on the stock markets. A few foreign companies have been allowed to enter the Chinese seed market and are likely to grow further following China's WTO accession. To encourage further biotech development in the domestic seed market, China is strengthening protection for intellectual property rights and relaxing restrictions on private and foreign firms.

Further Reading

Directorate-General for Agriculture, Commission of the European Communities. *Economic Impacts of Genetically Modified Crops on the Agri-Food Sector*, Working Document Rev. 2, Undated, http://europa.eu.int/comm/agriculture/publi/gmo/full rep/index.htm

Huang, J., S. Rozelle, C. Pray, and Q. Wang. "Plant Biotechnology in the Developing World: The Case of China," University of California-Davis REAP working paper, September 6, 2001, http://www.reap.ucdavis.edu/working_papers/plant_biotechnology.pdf

Pardey, Philip G., and Nienke M. Beintema. *Slow Magic: Agricultural R&D a Century After Mendel*, International Food Policy Research Institute, Food Policy Report, October 2001.

- Pray, C., D. Ma, J. Huang, and F. Qiao, "Impact of Bt Cotton in China," Presented at 4th International Consortium on Agricultural Biotechnology Research in Ravello, Italy, August 24-28, 2000.
- Pray, Carl E. *China, Private Investment in Agricultural Research and International Technology Transfer in Asia*, Carl E. Pray and Keith O. Fuglie (eds.), Agriculture Economics Report No. 805, U.S. Department of Agriculture, Economic Research Service, November 2001.
- Sheng, He. "Heard of It, But What Is It?" *China Daily*, August 16, 2001.
- U.S. Department of Agriculture, Foreign Agricultural Service. *China, People's Republic of, Oilseeds and Products, MOA Assesses the Impact of Biotech Regulation*, GAIN Report No. CH1028, June 27, 2001, http://www.fas.usda.gov/gainfiles/200106/115681097.pdf