Experience in the Development and Commercial Use of Agricultural Biotechnology in China

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China started R & D in transgenic crops in 1983 and initiated field testing in 1989. In 1996, the MInistry of Agriculture (MOA) established the Office of Genetic Engineering Safety Administration (OGESA) to regulate field testing, environmental release and commercialization of transgenic organisms. Since 1997, transgenic crops have been planted on commercial scale in China starting with Bt cotton of Monsanto and the Chinese Academy of Agricultural Sciences (CAAS) which now approaches 400,000 hectares in the year 2000. Other commercialized transgenic crops include virus resistant and shelf-life altered tomato, virus resistant sweet pepper and flower color-altered petunia. Field test of several transgenic major crops such as rice, potato, soybean, tomato, sweet pepper and tobacco for various traits are ongoing. Biosafety tests conducted according to standard procedures showed the biosafety to environment and food safetiness of transgenic crops. Due to external, mostly European pressures, approval of licenses to commercialize other crops has been suspended since 1999.

China is the most populated and one of the largest agricultural countries in the world, with only about seven percent of the world's cultivable land feeding over 20 percent of the world's population. With the rapid increase in population as well as dramatic decrease in cultivable land, food security for the people remains a major concern. Chinese scientists, for many years, have been making great efforts to improve the crop yield by traditional breeding techniques which have contributed significantly to agricultural production. Starting 1983, with the development of transgenic techniques, more and more transgenic plants have been developed and agricultural biotechnology has become a powerful tool for improving agriculture production. This paper discusses the experience in research and development, field release and commercialization of agricultural biotechnology products in China.

Development of Genetically Modified (GM) or Transgenic Crops in China

From 1986 onwards, with support from the National Five Year Plan, National High Tech Planning, National Natural Science Foundation and other grants from the Ministry of Agriculture (MOA), over 100 laboratories in China have been involved in transgenic plant research. Our laboratory released TMV-CP and C-MV-CP transgenic tobacco and tomato plants in the fields for testing for virus resistance in 1990. In 1996, the MOA established the Office of Genetic Engineering Safety Administration (OGESA) to regulate field test, environment release and commercialization of transgenic organisms. In 1997, four licenses for commercialization were granted and 41 field tests out of 55 applications were approved by the OGESA, while seven applications were pending (Table 1). In 1998, out of 16 applications, two licenses for commercialization were granted and 49 field tests out of 68 applications were approved. Eighty thousand hectares of transgenic crops (mainly including insect-resistant Bt cotton, Bt corn, virus-resistant sweet pepper and tomato as stated in Table 2) were planted in 1998 and will reach approximately 400,000 hectares in 1999. By June 1999, the six

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licensed transgenic crops, three of which were granted to our laboratory (Table 2), were approved for planting in another 20 different locations throughout China for commercialization while 42 field tests were approved.

Table 1. Releases and Commercialization of GMOs in China.

Year	Applications	Commercialization	Environmental releases	Field Trials	Pending
1997	55	4	31	10	7
1998	68	2	10	39	16
June1999	73	20 (different locations)	18	24	11

Source: Data from the Office of Genetic Engineering Safety Administration, Ministry of Agriculture

Table 2 shows the different crops approved for commercialization in China. Of the six licenses approved, the first and second are BT cotton of Monsanto Company and of the Chinese Academy of Agriculture Sciences (CAAS). The third is for tomato of Guandong Agriculture University. Our laboratory obtained the next three licenses for virus resistant tomato, virus resistant sweet pepper, and CHS, or controlled color formation of petunia plants.

Table 2. Commercialization and Field Releases of Transgenic Plants in China.

Commercialization		Field Releases	
B.t. Cotton, insect-resistant	CAAS	Rice	Tobacco
	Monsanto Co.	Potato	Corn
		Soybean	Orange
Tomato, virus-resistant	Peking Univ.	Tomato	Eucalyptus
Tomato, shelf-time altered	CCAU	Sweet pepper	Oil-rape
Petunia, flower-colour-altered	Peking Univ.	Poplar	
Sweet pepper, virus-resistant	Peking Univ.		

In 1998, Monsanto Company planted over 66 hectares of Bt cotton and the CAAS planted over 10 hectares in Liaoning province and in Hunan province. During the first year of planting Bt cotton, almost 40 percent of cotton plants in the Hunan province were insect-protected transgenic crop. On the other hand, many other major crops are now being field tested; these include rice, wheat, potato, onion, peppers etc.

During the early phase of field release of the transgenic cotton, farmers, producers and government officials especially the local officials noted the significant differences, especially in the resistance against insect pests and reduced number of application of pesticides resulting in a good yield, between the transgenic and non-transgenic crops. This encouraged the local farmers and local government to use this technology. Many companies were therefore organized to commercialize this technology very rapidly. The area planted to transgenic crops grew from 1997 to 1999, increasing about three-fold in size yearly and now covers more than the Hunan – Hobe province and other provinces.

Controversy over Biosafety

Biosafety of transgenic crops has been a hot issue all over the world in the past years. In China, the public generally accepts commercialization of transgenic crops and most people believe that agribiotechnology is a powerful tool for promoting agricultural production that will provide enough food for the world's increasing population especially those in developing countries in the future. However, because of this controversy on biosafety of GM or transgenic crops especially that in Europe, several applications for commercialization of transgenic crops, including those already field tested like rice, wheat, corn and other major crops for insect resistance, were denied this year.

The government has been paying much attention to agrobiotechnology so that it will be safely used to help tackle the food security problem. Many measures have been taken when conducting transgenic plants field trials, e.g., careful planning and field selection, including the consideration of wild species around. Pollens of transgenic plants had been widely collected and tested for possible gene flaws. In 1995, supported by the European Union, Professor R. Casper of Germany led an EU delegation to China to evaluate the biosafety status of transgenic plants in the fields. They went to several locations in Hunan and Liaoning Provinces to collect samples of transgenic plants and came to the conclusion that transgenic crops behave normally and that no mutated virus was found in our transgenic crops after five years of field releases.

In our laboratory, experiments on evaluating the safety of transgenic tomato and sweet pepper have been conducted, strictly according to standard procedure. The results showed no significant difference between rats fed with GM products and those with normal diets in growth rate, food consumption coefficiency, blood systems, function of livers and kidneys, reproductive systems as well as the metabolism of protein, fat, and sugar.

However, because some countries have different opinions on the safety issue of transgenic foods, the application of agrobiotechnology has been largely retarded, although a large number of safety tests have been and are still being carried out to confirm the safety of transgenic products as food. An international harmonization should be reached because the lack of such harmonization will result in international conflicts on import and export of agricultural products. This will, in turn, indirectly block the development of transgenic technology. It is reasonable for us to believe that within the next 10 years agribiotechnology will help the world resolve the problem of food shortage.