International Workshop on the Global Status of Transgenic Crops

Chinese Academy of Sciences and the U.S. National Academy of Sciences

16-17 October 2014, Huazhong Agricultural University, Wuhan, China

The International Workshop on the Global Status of Transgenic Crops, co-organized by the Chinese Academy of Sciences and the U.S. National Academy of Sciences, was held on October 16-17, 2014 at Huazhong Agricultural University, Wuhan, China, hosted by the National Key Laboratory of Crop Genetic Improvements. Nineteen experts on global biotechnology research and development, from 10 countries including members of the academies of sciences from several countries presented papers at the workshop. Among them was Marc Van Montagu, one of the original developers of transgenic technology and winner of the World Food Prize. Several of the participants were members of the principal national agricultural institutes in their home countries. The papers represented three themes in the subject area, including the present state of development and future trends in GM technology globally, reports on the situation in individual countries and areas, and the controversial aspects of the development of this technology including biosafety considerations.

In their presentations, the participants analyzed the rapidly developing field of molecular biology as it applies to the development of new varieties of crops as well as the state of industrialization of such crops. In the years since 1996, when the first field commercial plantings of GM crops were put in place, the underlying science has moved ahead rapidly as have the commercial gains attributable to such crops. In 2013, GM crops were grown on 175 million hectares by 18 million farmers in 27 countries. Another 31 countries have permitted the import of products produced by GM plants for animal feed or as ingredients in human food. This area has grown from 1.7 million hectares devoted to the cultivation of such crops in 1996, roughly a 100-fold increase. As pointed out by Dr. Brookes in his analysis of these crops, the direct gain from the adoption of GM crops in 2012 amounted conservatively to USD$18.8 billion, with the cumulative gain from 1996 to 2012 amounting to USD$116.6 billion. Over this period, the production of GM soybeans made possible the production of 122 million tons, and that of maize 210 million tons. There was an accompanying reduction in herbicide use of 503 million kg, which amounted to a decrease in the Environmental Impact Quotient of 18.7%. In 2012, the reduction in the emission of greenhouse gasses related to the cultivation of GM crops amounted to the equivalent of removing some 11.88 million automobiles from the road. These major economic and environmental benefits have been the key drivers for the adoption of GM technology by so many farmers over such a short period of time.

Globally, some 27 kinds of transgenic crops have been commercialized, including 19 crops for human food, an additional three for fiber and animal food, and three kinds of flower crops. The four main food groups for which GM varieties are cultivated and the proportion of each worldwide that consists of genetically modified strains are soybean, 79%, cotton 70%, maize 32%, and rapeseed, 24%. The two main GM traits used agriculturally at present are herbicide tolerance and insect resistance. These are called “input traits,” and are of direct benefit to the farmers who cultivate such crops. Other traits such as golden rice, rich in β-carotene and soybeans with a high content of oleic acid would be of direct benefit to consumers and are awaiting approval for commercialization.

Most GM maize worldwide is used as animal food, most of the soybeans are used to produce edible oil, and other GM crops, such as papaya, summer squash, and sweet corn, are consumed directly by human beings. In addition, a large number of products from GM organisms are used as additives in food consumed by human beings, including starch, sweetening agents, sucrose, lecithin, and others. On the shelves of a typical supermarket in the USA, more than two-thirds of the products offered for sale include elements produced by GM organisms. Virtually all of the beer and cheese produced in the world, as well as insulin and many other medicines, contain products made by GM organisms. Worldwide, billions of people regularly consume such products, and hundreds of millions have consumed them regularly for well over a decade.

The USA was the first country to adopt GM crops on a wide scale. In 2013, GM crops were grown on 70.1 million hectares of farmland, the largest area devoted to such crops in any country. The principal GM crops grown in the USA are soybean, maize, cotton, rape, alfalfa, summer squash, and sugar beets. Among developing countries, Brazil, which has very strong legislation in this area, leads in the cultivation of GM crops, which are grown on more than 40 million hectares of its farm area. The GM crops grown in Brazil are primarily soybean, maize, and cotton. Brazil ranks second only to the USA in the area devoted to the cultivation of GM crops. In China, the adoption of GM cotton led to the production of some 4.2 million tons in 2013. China also grows GM virus-resistant papaya. In the same year, India grew GM cotton on more than 11 million hectares. Three African countries, South Africa, Bukina Faso, and Sudan, grow GM crops commercially. South Africa was the leader in 2013, with an area of 2.9 million hectares of farmland devoted to the production of GM maize, cotton, and soybeans. The area devoted to Bt cotton in Burkina Faso was 690,000 hectares, and in Sudan 69,000 hectares.

The situation in BRIC countries is of great interest. As explained by Alexander Lima Nepomuceno, Brazilian scientists were able to explain the importance of GM crops properly to the government after 1998, when the approval by the National Technical Biosafety Commission (CTNBio) of GM soybeans, was challenged by Greenpeace and IBAMA, the Brazilian Environmental Institute. These actions led to a de facto moratorium on the cultivation of GM crops in Brazil for some seven years. During this period, however, farmers in southern Brazil continued to import large amounts of GM soybean seeds illegally from neighboring Argentina, where their cultivation remained legal. The argument between the parties in Brazil was finally resolved in 2005, by which time the illegal crop from GM soybeans in Brazil exceeded 8 million tons. President Lula, bowing to reality, proposed and led the passage of a bill approving the cultivation of GM soybeans in the country. Subsequently, the area devoted to the cultivation of GM soybeans in Brazil has grown rapidly, and many other GM crops are approved for commercialization or in the process of approval.

The opposition to the cultivation of GM crops in Europe is a key factor in the global confusion concerning the adoption of this technology. On a limited basis, however, Europe permits the cultivation of Bt maize MON810 and the GM potato strain EH92-527-1 (Amflora). In 2012, 133,000 hectares of farmland in Europe were planted in GM crops, but this amounted to a mere 0.06% of farmland in Europe. Currently, the European Food Safety Authority (EFSA) and the EU itself have tended to support authorizing the cultivation of certain GM crops on the basis of the scientific information submitted. A review of the evidence concerning the safety of GM crops conducted by the EU reached the conclusion that "biotechnology, especially GM technology, is not more hazardous than conventional breeding technology." The Byzantine complex of bodies that in effect authorize the acceptance of GM crops, which include standing committees of the EU, its Council of Ministers, and some groups representing consumers, political bodies, and NGOs, continue to oppose and block the adoption of GM technology against all available scientific evidence. Within Europe, attitudes on this technology vary greatly from country to country, with for example eight European countries blocking even the adoption of the generally approved MON810 maize. According to Justus Wesseler, the nationalization of GM crop permissions has led to regulatory synchronicity that is clearly in opposition to the Single European Market principle and runs counter to WTO rules as well.

Despite the diversity of biosafety regulation in different countries, a set of regulatory bodies and laws have been accepted on an international basis to assess GM crop safety and the approval of both the commercialization of such crops and their movement between countries. Accordingly, principles for biosafety for GM crops have been developed. Many countries have adopted either mandatory or optional labeling as a way of informing consumers about the presence of products from crops developed by this particular method of breeding in their foods. Some 69 countries label foods that contain products from GM organisms, with China labeling more kinds of foods produced in this way than any other country.

In their presentations, the scientists addressed the controversy concerning the adoption of products from GM technology throughout the world. Many countries in Europe, Asia, and Africa continue to oppose such technology, as do a number of consumer groups, politicians, and NGOs. There is no valid scientific evidence to oppose such products, as shown by studies from virtually every competent scientific and medical body throughout the world, but the emotional power of such protests, often bolstered by sensational reports in the media, is such as to sway the decisions of politicians in many countries or cause them to adopt a neutral stance against the interests of their own citizens. For example, given

India’s complex regulatory system, illogical popular protests resulted in blocking the commercialization of Bt brinjal, a crop that was developed in India and tested comprehensively for some 12 years. Meanwhile, It is being grown with great success in neighboring Bangladesh. In China, the safety certificate for Bt rice was issued in 2009, but unfounded public opposition has so far blocked its commercialization, which would be of great importance for Chinese farmers and consumers. The opposition cites many factors, often imaginary (human health concerns, for example, or damage to biodiversity) or religious. The government has no option but to take political considerations into account in making their decisions, but they do so at great cost and no gain to the people. When they choose not to make objective decisions, they create an opportunity for further strife and confusion and stifle opportunities for China to assume the leading position in the international development of biotechnology approaches to crop development to which its scientific community entitles it. Within the EU, regulatory synchronicity and the discrepancies between the practices of different nations and even individual regions within those nations have triggered trade friction and disruption, and disempowered the scientists of the very nations that condone the illogical arguments to persist. For both China and Europe, as well as India, the confusion has lessened the competitiveness of the individual countries and regions internationally and deprived their farmers and citizens of access to more productive agriculture and a more adequate supply of food for its citizens.

The supposed effects of the cultivation of GM crops on biodiversity have frequently been used as an argument to block the cultivation of such crops. As Peter Raven argued, however, it is agriculture, practiced on about a third of the world’s land surface that is the archenemy of biodiversity. In the 12,000 years since the development of crop agriculture, the world’s population has increased from about one million hunter-gatherers to 7.2 billion predominantly urban-dwelling people, increasing at the rate of 250,000 people net per day and headed for a total of 10 billion or more during the course of this century. About one billion people are malnourished, their minds and bodies not having sufficient proper food to develop properly, with an estimated hundred million on the verge of starvation at any given time. We are consuming more than 1.5 times the world’s sustainable capacity at present (www.footprintnetwork.org), and so it is evident that we need new strategies such as that presented by GM technology to have the slightest hope of feeding the world's people adequately even now, much less in the future. Low-grade agriculture is the least sustainable and most harmful to biodiversity, productive and sustainable agriculture practiced intensively on existing cropland the most promising for the future. Hybridization between species is a central process of plant evolution, and does not in fact present special dangers when transgenes, in any case very common in nature, are involved.

On the basis of our discussions here in Wuhan, our international group of scholars present the following summary points, originating from our discussion, that concern the present development and future trends for GM crops. They resulted from observations made at our workshop and should be taken as collective opinions resulting from our discussions.

(1) Transgenic (GM) crops contribute to the development of sustainable agriculture, improve food security and reduce the environmental impact of agriculture. They reduce the use of pesticides, increase biodiversity, reduce the pressure on land use by increasing productivity, and decrease the emission of greenhouse gases.

(2) All scientific evidence shows that the transgenic methods used to develop particular crops have no negative effects on the safety of food for either people or animals. The method of making the genetic change does not affect the safety of the food. The large-scale commercialization of such foods over the past 18 years, and their consumption by hundreds of millions of people and billions of farm animals has not resulted in any observed case of sickness or other problems. Virtually all beer, bread and cheese consumed in the world uses products from GM organisms in their manufacture as does insulin and many other medicines, with no one objecting in any way. Transgenic organisms produce foods that are substantially equivalent to those produced by other kinds of organisms, and the argument about the safety of products derived from them is an empty one.

(3) Many modern molecular methods, explained in detail at our conference by leading experts, are available to alter the genetics of individual kinds of crops. Whether these methods result in the

production of “GM” crops any more than conventional breeding methods do is an empty argument, and it is sad to see various other approaches used to improve the characteristics of crops to avoid the controversial GM label.

(4) With the rapid increase in the world’s population from its current base of 7.2 billion people at the rate of an extra million people net every four days, and one billion of the world’s people inadequately nourished at present, the world simply cannot afford empty arguments about the biosafety of individual kinds of food and other products. We need to concentrate our attention everywhere in the world on the development of productive, sustainable agriculture, using all the means at our disposal and applying the tools that modern science has made available to us in doing so.

(5) The complex regulations that we have erected to govern the use of modern techniques in the development of GM crops must be simplified in order to allow the pursuit of the important goal of feeding our fellow citizens. Sensational reports and misinformation lead inevitably to the starvation and death of many in this highly stressed, overpopulated world. We beg the media and public bodies to deal with these subjects, and other scientific topics, objectively because the security of our common future demands it.

(6) Science based, legal frameworks for the sound development and adoption of GM crops already exist in many countries, including China.

(7) Golden Rice is the first nutritionally enhanced GM crop developed as an additional intervention for vitamin A deficiency. Vitamin A deficiency kills around 6000 children globally, every day, and many become blind first. 45% of the Chinese population suffers from vitamin A deficiency, especially pregnant women, and young children. The nutritional technology has been donated by its inventors (Professors Beyer and Potrykus) to be available free of charge in publicly owned rice varieties. However, scientific collaboration and development have been delayed by regulatory hurdles, and societal suspicion. Therefore, Golden Rice has not been able to assist in combatting vitamin A deficiency, identified by the UN as an important public health target for 25 years, and which continues to cause preventable deaths and blindness.

(8) In China, the increased industrialization, urbanization, modernization, and changes in the labor force together demand the development as rapidly as possible of even more productive, sound agriculture. The development of genome research, including GM technology, provides unprecedented opportunities for the improvement of agricultural science and technology in China and throughout the world. The benefits of China's investment in research in these areas must not be wasted. In India and China the widespread cultivation of GM cotton has already proved highly beneficial. Insect-resistant GM rice and GM phytase maize already have received safety certificates in China, and should be made available to farmers without delay.