PANEL 6: BIOTECHNOLOGY IN AGRICULTURE

ORGANIZER, CHAIRPERSON AND RAPPORTEUR

David Zilberman (University of California-Berkeley, USA)*

PANEL DISCUSSANTS

The National Perspective — *Gerald Carlson and Michele Marra (North Carolina State University, USA)*

The Global Perspective — *Carl E. Pray (Rutgers University, USA)*

Agricultural Biotechnology: Status and Prospects — *Susanne L. Huttner (University of California-Berkeley, USA)*

The Industry Perspective — *Sano Shimoda (BioScience Securities, Inc. USA)*

The summer of 1997 was an ideal time to hold a symposium on agricultural biotechnology. In 1996, and especially in 1997, we witnessed the first widespread commercial use of biotechnology seeds in major crops. Carlson and Marra conducted a study on the productivity and effectiveness of BT cotton (an insecticide-resistant cotton variety) and Round-up tolerant soybeans (which allowed more intensive use of herbicide). The BT cotton was adopted by 30 to 40 per cent of growers in the southeastern United States, as well as other parts of the world. In most cases, Marra and Carlson's calculations suggest that it increased yields and reduced costs (more than paying for itself). While there has been some evidence of build-up of resistance, this is not likely to alter projections of continued adoption diffusion of this new variety. Growers seem to be even more receptive to herbicide-tolerant soybeans in the United States and other countries (Argentina), and diffusion was constrained only by the availability of seeds.

To counter the growth of pests' resistance to the new genetically engineered seed varieties, programmes where growers allocate about 25 per cent of their land to traditional varieties have been established. This land supports vulnerable insects that help to dilute the build-up of BT resistance in the pest population. Carlson and Marra report that the prices of these genetically engineered materials vary across locations, depending on the severity of pest problems and the relevant productivity of new varieties. Often growers are asked to pay approximately the existing seed price, but are then charged an extra fee for the use of genetically manipulated materials. These fees (which may be $30 to $40 per acre) also vary by location.

Carl Pray provided a global perspective on the development of research capacity and adoption of genetically engineered seed varieties. Major agribusiness companies have conducted global experiments on genetically engineered soybeans, corn and cotton. In both India and China, there is a widespread effort to introduce genetically engineered, high-yield varieties of rice and wheat that have improved pest-resistance capabilities. There have already been significant acreages of the new biotechnology varieties used in developing countries, and in the future biotechnology will play a major role in improving crops in the developing world. China, in particular, has conducted widespread experimentation with different types of genetically engineered materials for various field crops, and even for those of higher value.

Issues of intellectual property rights protection have already arisen in experiments and in collaboration between agribusiness firms and local organizations in developing countries. Lack of traditional intellectual property rights protection for genetic materials and their efficient pricing are causes for dispute that hamper operations. This results in extra measures to protect genetic materials where field experiments are done. Educational efforts in the economics and management of genetic biotechnology and the diplomatic and legal efforts to reach pricing formulas and intellectual property rights protection will lead to efficiency and enable future collaborative effort.

The CGIAR centres, which provide the genetic materials and seeds for many developing countries, have recognised the importance of biotechnology. They are in the midst of developing a strategy to incorporate it into their activities. The high-cost infrastructure that is needed in biotechnology and the cost of intellectual property rights required for certain key procedures make implementing biotechnology at international centres very difficult. They are considering arrangements that would include partnerships with the private sector and with other, public sector, entities such as universities. Another major issue that has to be resolved is the tradition of providing genetic materials freely to breeders all over the world. There is a growing tendency towards protectionism regarding genetic materials, and future guidelines may need to be established regarding conditions and compensation for transfer of genetic materials.

Many in the developing world resent having to pay for genetic materials that are manipulated in new seed varieties, arguing that most of the available varieties originated in the developing world, and have been preserved by farmers' efforts. Thus it is clear that the economics and policies of biotechnology are intertwined with the economics of 'biodiversity'.

In spite of the recent adoption of biotechnology varieties, Susanne Huttner stated that agricultural biotechnology is significantly lagging behind medical biotechnology. In the United States, much more public money is spent to support basic research in medical aspects than on agriculture. The budget of the National Institute of Health, which funds a substantial amount of work, has risen constantly over the last 15 years, sometimes at annual rates that are close to 10 per cent. Public support for agricultural research conducted by the Department of Agriculture and other organizations has been stagnant for long periods during the last 20 years.

More importantly, large amounts of public money have been spent to establish start-up companies that purchased the rights to develop medical innovations.

These companies provided the engine that led to the medical biotechnology industry's growth and provided some of the most important products in commercial use. They embodied much of the technological change and innovation in medical biotechnology, and their continuous emergence fostered new developments and new technologies. Obviously, many start-up companies have not survived, but some were absorbed by giant pharmaceutical firms and others have become major companies in their own right. There has been much less investment in agricultural biotechnology start-up companies. Survival rates have been very low, and most of the successful ones have been absorbed at an early stage of their lives by agribusiness firms like Monsanto. A few of them (about 10 agricultural biotechnology companies) were established in 1992, and most of the research and virtually all the developments in agricultural biotechnology were done by major agribusiness firms and pharmaceuticals.

Dr Huttner expressed concern that the control of much of the process innovation in agricultural biotechnology by a small number of firms will lead to much underinvestment and underdevelopment, since concentration leads to undersupply. Furthermore, it will give some major agribusiness firms considerable control in the pricing and production of many products. There should be increased public support for agricultural biotechnology research as well as larger development funding. She suggested that farm organizations and cooperatives build the financial muscle to obtain intellectual property rights and valuable genetic materials, thus allowing farmers to be less dependent on major companies. There is an important role for private partnership in developing innovations that may be too risky for private sectors to implement. Dr Huttner, herself, is in charge of a large effort, worth several million dollars, to develop such a partnership.

Sano Shimoda presented a different perspective. As a venture capitalist, he argued that the lack of investment in agricultural biotechnology in the 1990s was reasonable. It had seemed very promising in the late 1980s, but there had not subsequently been a spurt in the development of major development products and investors had lost confidence in the future of the industry. However, recent successes have led to its rejuvenation and revival, and he expects much more private investment in ventures that aim to develop agricultural biotechnology. Like Dr Huttner, he also suggested that the regulations governing agricultural biotechnology, established in the 1980s, served as a damper to growth. While it could be argued that control did contribute to the survival of the industry and its acceptance in the United States, both agreed that some regulations may still be too strict.

Sano Shimodo was optimistic about the commercial potential of biotechnology: it will alter agriculture, especially in states like California. Agricultural biotechnology embodies much more than new pest-resistant and pesticide-tolerant varieties. It will lead to higher quality and differentiated food products. It will produce oils, cosmetic materials and pharmaceuticals. He embraced Dr Huttner's suggestion that agriculture should invest its own funds in capturing development rights. One example is Saskatchewan, where the local agricultural community provided much of the funding for development of new canola varieties and agribusiness based on their use.

After the presentation, the audience raised some major issues. First, it was suggested that procedures of technology transfer from private and public

sectors should be modified to accommodate different environments to increase the efficiency of using new knowledge. Secondly, it was recognized that the private sector (even in the United States) cannot provide the research infrastructure for biotechnology and public sector support must continue. A third conclusion, shared by both speakers and the audience, was the importance of high-quality institutions of research and learning as a breeding ground for new technology. Biotechnology provides a concrete example of the high economic value of research activities in agriculture.

On the other hand, however, concern was expressed about the environmental side-effects of biotechnology. Several people in the audience felt that biotechnology raised much uncertainty and should be developed with caution. They also suggested that emphasis on biotechnology would divert attention from technologies that may be more environmentally friendly. For example, research in better soil management practices and more precise application and input use may increase productivity and reduce environmental damage. Some felt that issues of safety and acceptance of biotechnology have still to be resolved and that they are critical for the future development of the industry. Others raised the issue of intellectual property rights. They were concerned that developing countries were being omitted in the evolution of biotechnology and urged that this should be remedied.