
NABC 6: An Overview

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The agricultural biotechnology revolution is upon us! On May 18, 1994, the U.S. Food and Drug Administration (FDA) approved the first genetically engineered food product for commercial sale, Calgene's Flav'r Savr™ tomato. And dozens of other products are in the pipeline. Indeed, biotechnology has arrived with the potential to provide a vast array of new agricultural products. But is this powerful technology developing along lines that are in the best interest of the public? This was the central unifying question addressed at the National Agricultural Biotechnology Council's (NABC) sixth annual meeting, *Agricultural Biotechnology & the Public Good*, held at Michigan State University, East Lansing, Michigan on May 23-24, 1994. The timeliness of the meeting, which took place just five days after the FDA's approval of Flav'r Savr™ tomato, was evident from the lively, and at times passionate, discussion. Also, there were a record number of registrants, 190, who came from eight countries and 25 states. Participants were a diverse group: farmers, processors, environmentalists, educators, consumers, journalists, academic and industrial scientists, economists, sociologists, administrators, government agency professionals and outreach specialists.

A major highlight of NABC 6 was the in-depth discussions and recommendations about international aspects of agricultural biotechnology. This was the first NABC meeting to specifically address the global nature of agriculture. Given the importance of the topic and response to it, it seems certain that the subject will be included in future NABC meetings. Indeed, some 60 issues were identified by the workshop participants as being important to the international agriculture community. From this set, eight comprehensive key issues were formulated and discussed in depth. These ranged from ownership and access to germplasm; to the social, economic and political impacts of agricultural biotechnology on developing nations; to the need for more unified biosafety standards. As stated by Richard Sawyer, President, International Fund for Agricultural Research and President, Fundacion Peru, "We are globally interdependent with our problems and we must be globally interdependent with our solutions." The land-grant universities and research institutions

that are members of NABC have roles in developing such solutions. A continuing dialogue on global agricultural biotechnology at future NABC meetings should contribute to the process of developing these solutions.

As with previous NABC meetings, NABC 6 consisted of plenary sessions, which were open to the public at no charge, and workshops. The workshops, the participatory exercises that have become the heart of all NABC meetings, gave registrants an opportunity to discuss key issues in depth and formulate recommendations. Plenary speakers provided a wide range of opinions on the concept of public good in terms of biotechnology achievements and potential future developments, and their presentations succeeded in sparking lively participation from the audience. Robert Fraley and Ralph Hardy described current and future biotechnology products and their potential to increase the public good. They placed consumer preference characteristics high on their agenda for increasing public good and stressed potential health benefits to be gained from future biotechnology products. James Cook and Hope Shand supported the idea that biotechnology can have enormous positive impact on public good, but both cautioned that policy issues are critical in determining who benefits from the technology.

As noted by Hope Shand, it is impossible to discuss current and future biotechnology without considering the global perspective, both in terms of the global impact on public good and the transfer of technology across national boundaries. John Dodds and Magdy Madkour discussed projects they are involved in which work to facilitate technology transfer between institutions and between nations. Their respective programs strive to aid developing countries in the implementation of plant biotechnologies for the good of the developing nation. Jose de Souza Silva presented his view of how biotechnology has begun to have international impact. He expressed concern about policy issues and their potential impact on developing nations and suggested possible policy strategies to insure that biotechnology truly does promote international public good.

The after-dinner address at this year's meeting was given by Deborah Fitzgerald, Historian and Professor of Science, Technology and Society at MIT. In her insightful and stimulating talk, entitled *Choices from the Past*, she discussed how technology is related to the culture that creates it. She noted, as did other speakers at NABC 6, that biotechnology, while being labeled as a new scientific phenomenon, is actually the latest in a continuum of technological advances. New technologies, she said, along with scientific "reductionism" and a single-minded concern with production, has limited consumer and producer options. New scientific advances have "replaced rather than joined" the old technology, she said. As a prime example, Fitzgerald cited the U.S. Department of Agriculture's (USDA) discontinuation of funding for research on open-pollinated corn after the development of hybrid corn in the 1920s. She stressed that it is vital to "keep old strategies available," to keep creativity in research and development and "to reward innovation" instead of narrowing options if one is to serve the public good.

Eight workshop speakers (two per workshop) presented a variety of viewpoints, indeed sometimes opposing perspectives, about the idea of public good especially relating to the environment; policy; setting an agenda, both nationally and internationally; and public participation. The highlights of the plenary and workshop sessions are summarized below.

PLENARY SESSION HIGHLIGHTS

There were three plenary sessions: *Current and Next Generation Agricultural Biotechnology Products*, *Biotechnology and the Public Good* and *Agricultural Biotechnology in Developing Nations*. In these, the invited speakers discussed the nature of present and future agricultural biotechnology products and presented a wide range of opinions on the effects that agricultural biotechnology might have on society and agriculture. These presentations sparked a series of spirited question and answer periods which, on a few occasions, included heated dialogue and pointed challenges. Areas of particular concern for certain members of the audience were negative effects that agricultural biotechnology might have on human health and the environment, and whether or not biotechnology can truly bring universal benefit to developing countries. These were critical issues that some participants felt were being glossed-over by the agricultural biotechnology establishment. Though these interactions were emotion-filled, they, along with the plenary presentations, were immensely fruitful, bringing important issues out on the table for consideration. A principal objective of the NABC meeting is to provide a neutral forum for persons with different interests and concerns to participate in meaningful dialogue on issues regarding agricultural biotechnology. This objective was met in full at NABC 6!

Current and Next Generation Agricultural Biotechnology Products

Robert T. Fraley, Group Vice President and General Manager, New Products Division, Monsanto Agricultural Group and Ralph W.F. Hardy, President and CEO of the Boyce Thompson Institute for Plant Research, Inc.

Robert Fraley began his talk by noting that the world's population is expected to double over the next 40 years. To feed this growing population using current agricultural practices, the amount of land used for agriculture would have to be expanded from a land mass about the size of South America, the current land usage, to that of Eurasia. Given this scenario, the benefits of increasing agricultural productivity per acre are obvious. Fraley said that biotechnology is not a panacea for increasing agricultural productivity, but does provide a powerful new tool, in a continuum of improved methods, to expand agricultural potential while minimizing environmental impact. He stressed the benefits of forthcoming biotechnology products such as better insect- and weed-resistant crops and the development of animal growth promoters. Biotechnology will also lead to new opportunities in food processing such as new flavors, food textures and storage properties, and for the improvement of health. There are all kinds of possibilities, he said, including making plant oils

specifically designed to reduce health problems associated with some of the oil products today, or removing natural carcinogen from a food. He noted, though, that there are controversial dimensions to biotechnology. While federal agency approval has come relatively quickly, public acceptance remains uncertain. To increase the likelihood of public acceptance, Fraley believes that arguments about biotechnology need to be made rationally, using sound science, rather than appealing to consumer emotion.

The next speaker, Ralph Hardy, said that the highest priority in achieving public good in the U.S. is freedom of choice. He noted, though, that the opportunity to choose carries with it the responsibility to keep informed. "This challenges the agricultural biotechnology community to provide the information necessary for decision-making," he said. Hardy stated that after freedom of choice, the U.S. public places human health, economics, the environment and sustainability high on their public good list. Present and future biotechnology products with enormous potential for public good include: chymosin, DNA probes for food-based microbial contaminants, self-nitrogen fertilizing plants, biodiesel and biopolymers, transplant organs in transgenic animals, and oral vaccines incorporated into fruits or other foods, he said. But a major obstacle for biotechnology continues to be the transition from technology to marketable product, a process Hardy referred to as the "valley of death." He offered the USDA's Alternative Agriculture Research and Commercialization (AARC) project as a model program designed to help bridge that gap. The AARC program provides funds for precommercialization development of new non-food uses of agriculture and forestry materials and requires a financial return to AARC based on the success of the project. It is in this way that AARC intends to become a self-sustaining program.

Biotechnology and the Public Good

R. James Cook, Chief Scientist, USDA-NRI Competitive Grants Program and Hope J. Shand, Research Director, Rural Advancement Foundation International.

James Cook, like Fraley and Hardy, placed consumer demand high on the agricultural agenda importance list. He suggested that scientists' touting of biotechnology as a powerful new technique, rather than as the latest step in the development of tools for agricultural research, has contributed to public mistrust of biotechnology. In order to emphasize a technological continuum, Cook outlined the importance of previous innovations in genetics and breeding which spawned such widely accepted products as seedless grapes and Russet Burbank potatoes. He said that the primary concern with biotechnology is who will benefit, and that public policy should focus on public gain. He expressed concern that "the number of plant breeding programs supported by the USDA and State Agricultural Experiment Stations is on the decline" and that private sector researchers might take over and fund products with large profit potential to the neglect of local projects. Recent developments in intellectual property rights may restrict access to resources and trade for the public good, he noted. Cook concluded that the technology itself has great po-

tential for public benefit, but that the application can lead to misappropriation of benefit.

Hope Shand, describing herself as a critic, but not an opponent of biotechnology, agreed with James Cook that the central issue is “who will control these technologies and who will benefit from them.” The “genetic interdependence” of the world makes a discussion of biotechnology without keeping the global scope in mind inadequate, she said. Global genetic diversity is important to maintain the capacity for new crop development and food productivity. Her main concerns were the shrinking of biodiversity and the possibility that those providing genetic resources for biotechnology, mainly farmers and citizens from developing nations, may be denied proper credit and compensation.

Shand then presented her view of how financial potential has led to injustice in patenting, access and trade of new biotechnologies and products. According to Shand, a “biopiracy” has developed in which companies patent as a reward for research investment while “farmers and consumers of the developing world have to pay royalties on products which are based on their own biological resources and knowledge.” She cited thaumatin, a super-sweet protein made by certain plants in West Africa that is being developed by Lucky Biotech Corporation, as an example. In conclusion, Shand shared Cook’s opinion that biotechnology products are not dangerous to human health, but that the possible economic and environmental impacts of biotechnology deserve serious consideration.

Agricultural Biotechnology in Developing Nations

John Dodds, Managing Director of the Agricultural Biotechnology for Sustainable Productivity (ABSP) project, Michigan State University; Magdy A. Madkour, Director of the Agricultural Genetic Engineering Research Institute (AGERI) in Egypt and Josie de Souza Silva, Head, Brazilian Public Enterprise for Agricultural Research (EMBRAPA), Secretariat for Supporting State Agencies for Agricultural Research.

John Dodds described how the project that he directs, Agricultural Biotechnology for Sustainable Productivity (ABSP), attempts to meet the various agricultural needs of developing nations. ABSP works with the scientists of developing countries to solve local agricultural problems using public and private sector resources from universities and corporations. ABSP “promotes interaction among institutions and individuals,” with emphasis placed on the development of insect- and virus-tolerant crops. Dodds stressed that the transfer of information to developing countries does not stop with the technology itself. ABSP representatives collaborate with developing country officials and managers to draft international agreements including specification of licensing and intellectual property rights, and the development of biosafety regulations.

In one program ABSP collaborates with is the Egyptian Agricultural Genetic Engineering Research Institute (AGERI) in Egypt which is directed by Magdy Madkour. Madkour discussed the need for agricultural biotechnology in Egypt and other Middle Eastern and African countries highlighting AGERI’s role in efforts to implement biotechnologies. AGERI attempts to expand and

diversify agricultural biotechnology and train professionals with the goal of applying new technologies to agricultural challenges in Egypt, he said. He outlined a number of ongoing projects such as the development of *Bacillus thuringiensis* (Bt), transgenic pest-resistant cotton, transgenic virus-resistant potatoes and the mapping of the rapeseed genome to identify genes involved in environmental stress-tolerance. AGERI works from the developing country perspective to promote institutional linkages both within Egypt and between nations.

Jose de Souza Silva asserted that the global and multidimensional phenomenon of the biorevolution, while having the potential to provide many benefits, poses problems for developing nations. While programs like ABSP and AGERI are empowering for developing nations, they may not be enough to ensure widespread public good as a result of biotechnology. One concern was that biotechnology will indeed increase agricultural efficiency and productivity, but in turn cause a dissociation of agriculture from food production, he said. The changing nature of production could displace agricultural work forces, rendering the agricultural systems of many developing countries, and even entire economies, antiquated and ineffectual, de Souza Silva further claimed that profit-minded scientists are imposing agricultural colonialism on less developed nations and that there are contradictions between the rhetoric and practices of the biotechnology industry in developing countries. Proponents claim biotechnology is a solution to world hunger, yet hunger persists because “excess does not equal access,” he said. He also suggested there was a disparity between the social goals extolled by the biotechnology industry and the private gains it seeks. For instance, there is the “cooperation-competition” paradox in which the biotechnology industry claims the need for international sharing of resources and technology, yet industries and nations have become more competitive with each other regarding intellectual property. In closing, de Souza Silva suggested a number of agricultural biotechnology policy strategies for developing countries to help preserve the public good in their nations: expand their own biotechnology industries, keep their own resources, develop national bargaining power, cooperate with tropical country policies to increase “South-South” solidarity, strengthen public sector biotechnology projects to benefit local areas, and make investment policies in science education.

WORKSHOP HIGHLIGHTS AND RECOMMENDATIONS

The plenary sessions provided the framework for four workshop sessions: *Setting the Agricultural Biotechnology Agenda*, *Biotechnology and the Structure of Agriculture*, *Agricultural Biotechnology and Global Interdependence* and *Environmental Stewardship and Agricultural Biotechnology*. Workshop participants discussed a variety of topics related to public good, ranging from the strengths and weaknesses of processes used to set the biotechnology agenda to the impacts of agricultural biotechnology on the farming community, the environment and the agriculture of developing nations. These discussions resulted

in the identification of numerous key issues and the formulation of recommended actions to be considered by government agencies, concerned citizen groups, corporations, universities, research institutes and the general public. While the list of workshop recommendations is quite diverse, a central theme does emerge: a need for greater public participation in decision-making about agricultural biotechnology and a need to better inform the public about the agricultural biotechnology issues. In fact, fully half of the recommendations made by NABC 6 workshop participants relate to either greater public participation, greater public understanding or better dissemination of information regarding agricultural biotechnology. As concluded by those people in the workshop on *Setting the Agricultural Biotechnology Agenda*, decisions about the application of biotechnology are more likely to be for the public good when there is a greater participation by an informed public. The NABC 6 workshop recommendations provide suggestions for how to accomplish this goal.

Setting the Agricultural Biotechnology Agenda
(see p. 157 for complete report)

Co-chairs: Thomas L. Thorburn, Program Director, Food Systems, Rural Development and Water Resources, Kellogg Foundation and Patricia Traynor, USDA National Biological Impact Assessment Program Coordinator, Michigan State University.

Speakers: I. Garth Youngberg, Executive Director of the Henry A. Wallace Institute for Alternative Agriculture and Susan Offutt, Executive Director of the Board on Agriculture, National Research Council.

Setting the stage for workshop discussion, Garth Youngberg described various public and private “dialogues”—conferences, papers, organizational activities, pronouncements, etc.—that have been vital for the agricultural community’s acceptance of biotechnology. The next step, he said, is to promote public participation in order to involve the public in the planning and decision-making phases of biotechnology research and development. As one of the founding principles of the U.S., direct citizen involvement in policy issues would not be a radical step for biotechnology, he said. He suggested that companies take a serious look at how to bring farmers, public interest groups and other citizens into strategic agenda planning. He said that incorporating producer and consumer ideas into the agenda “would result in more comprehensive and enlightened planning” and would lead to public support of agricultural biotechnology rather than mere acceptance.

Next, Susan Offutt discussed how to improve the decision-making process used to set the agricultural biotechnology agenda. Traditionally, she said, market forces such as profitability and consumer demand tend to direct innovation. Quality, safety and efficacy are market criteria currently considered in agenda setting. But with biotechnology, this process needs to be modified to include consideration of non-market aspects of technology adoption and use, or “the fourth criterion,” she said. Socioeconomic and environmental impacts of agricultural biotechnology are being evaluated alongside market factors.

She cited recent debates in the U.S., Europe and Canada about bovine somatotropin (bST) as examples of how the agenda-setting process has expanded.

The fundamental conclusion that emerged from participant discussion was that participatory decision-making was essential to ensure that applications of biotechnology served the public good. The approximately 50 participants thought that reaching this goal would require improvements in three key areas: public participation; availability of information; and implementation of an accessible, equitable and consistent regulatory system.

Recommendations

Public Participation

There is a need to increase public participation in both public and private sectors of the agricultural biotechnology community to create an agenda-setting environment (process) that more accurately reflects the diversity of values, interests and priorities in our society. Recommendations that were strongly supported by the entire workshop group were:

Review and assess existing public and private advisory structures and modify them as necessary to ensure representative input into the development of the agricultural agenda including biotechnology applications.

Review and define the mechanisms for establishing truly responsible public participation with input focusing on broad areas of societal concern that may benefit from agricultural biotechnology.

Encourage the integration of environmental and social sciences into biological sciences programs.

Availability of Information

Participants concluded that the promotion of ready access to, and active dissemination of, information relevant to agricultural biotechnology issues would not only enhance public awareness, but it may be the first step in establishing a system of feedback between the public and those who set the biotechnology agenda. The following recommendations were strongly or unanimously supported:

Send a representative to the National Association of Biology Teachers (NABT) and the National Science Teachers Association (NSTA) annual meetings to provide a list of resources and experts in agricultural biotechnology that teachers may contact locally.

Include agricultural biotechnology in K-12 science curricula.

Develop an agricultural bioethics course for land-grant institutions and establish it as a requirement for USDA training grant programs.

Continue and expand research on risk assessment and the socioeconomic impact of agricultural biotechnology.

Regulations

The group felt that it was important to implement a regulatory system that was accessible, equitable and consistent. However, there was only one recommenda-

tion that was strongly supported by the group:

Implement prior recommendations on regulations put forth at the NABC 4 meeting in 1992 (see page 160).

Three other recommendations were highly controversial:

Codify statutory requirements for socioeconomic analysis (about half supported, half opposed).

Require that regulators consider equitable allocation of intellectual property rights so that the regulatory process includes consideration for individual compensation (about half in favor, half opposed).

Establish a single regulatory agency clearinghouse monitoring Environmental Protection Agency (EPA), FDA and USDA for biotechnology applications (majority strongly opposed).

There was concern about creating another level of bureaucracy that could undermine existing authorities). Clearly, regulatory issues remain an important, but thorny area of agricultural biotechnology.

Biotechnology and the Structure of Agriculture

(see p. 173 for complete report)

Co-chairs: Frederick H. Buttel, Professor of Rural Sociology, University of Wisconsin and Tom Guthrie, Farmer and Vice President, Michigan Farm Bureau.

Speakers: Dean Kleckner, President, American Farm Bureau Federation and William P. Browne, Professor of Political Science, Central Michigan University.

About 60 participants in this workshop heard Dean Kleckner outline the farmer's role in food production. He spoke with pride about how family farmers are responding to marketplace forces that demand greater efficiency while remaining responsive to consumer preferences. A consequence, however, has been a trend towards larger farms and a change in the structure of agriculture. Kleckner suggested that world population growth will make it necessary for American farmers to become even more efficient, to produce more and to rely more on science-based advances such as those now beginning to come from biotechnology. But even with farmers' increased use of biotechnologies and the trend towards "industrialization," there is still a place in American agriculture for traditional, individually owned farms, Kleckner said. Along with challenges, biotechnologies create new profit opportunities, he said. With effective public policy and continued response to consumer demand, farmers can prosper in the age of biotechnology.

William Browne discussed possible public policy strategies in response to biotechnology. The most important factor in predicting public policy trends is policymaker perception which is based on information available to them, he said. Members of the U.S. Congress and other federal policymakers, he noted, are concerned that biotechnology might increase structural inequities in agriculture, enabling the big producers to get even bigger and putting the smaller producer at a greater disadvantage. However, Browne suggested that the decision makers are not sure how, or if it is wise, to stop the process.

Many policymakers hold out hope that biotechnology can lead to large profits for the agricultural sector and new production methods such as biopesticides and biofertilizers, that may help resolve conflicts between farmers and environmentalists, he said. For these reasons Browne predicted that most policymakers will be inclined to take a “hands-off” approach with regard to new regulations on the applications of agricultural biotechnology. Consolidation and the structural imbalance in agriculture will continue, Browne suggested, and there will be little political debate to stop this trend.

A number of key issues were raised and discussed by the workshop participants. There was a general consensus that agriculture must be responsive to the consumer, that there must be equitable access to biotechnology, that biotechnology will contribute to the continuing vertical integration of the food system, and that a system for analyzing long term impacts of biotechnology on the structure of agriculture must be developed. Many of the workshop participants also felt that there needs to be a balance between the necessity of increased economic performance and social equity. There was concern that new technologies might accelerate the trend toward the industrialization of the food system resulting in a further decline in self-employment, an increase in the scale of production, a growth in specialization and vertical integration, and decreased control by farmers and consumers within the food system. However, other workshop participants, while sympathetic with equity concerns, thought that the efficiency, coordination and competitiveness of the food system were the most important criteria. Several participants expressed the opinion that a food system that produces safe food in an efficient manner is the most equitable system from the larger societal standpoint.

Recommendations

After discussing key issues, participants developed and strongly supported the following recommendations:

Equity of Access to Biotechnology Innovations

It was concluded that decisionmakers must insure the widest possible access to biotechnology so that it does not, itself, come merely to validate, or contribute further to, the structural imbalances in the agriculture and food system.

Provisions are needed to take into account the costs incurred in regulatory procedures in the creation of products/processes for minor/local uses.

The utility patent system was not designed with plants and animals in mind. There is a need for a new Intellectual Property Rights (IPR) system designed specifically for living organisms, or parts thereof. The new system should balance profit with the public desire to encourage invention in general.

There is a need to strengthen public sector research and technology delivery systems.

A forum involving all stakeholders needs to be created in which issues of international access are discussed and attempts at resolution are made.

Vertical Integration of the Food System

Participants believed that biotechnology will contribute to greater vertical integration in the food system. They recommended that:

Land-grant universities should be encouraged to form public/private partnerships to encourage the use of biotechnology and to develop products.

Land-grant universities should remain neutral in the debate on vertical integration in the food system.

Land-grant universities should increase public good research for which there is an inadequate profit motive.

Land-grant universities should seek a broader support base for public good research.

Responsiveness to the Consumer

Participants agreed that agriculture as part of the food system needed to be responsive to information needs. There was no disagreement with the recommendation that:

Information should go out to both consumers and producers.

Two other recommendations on the development of national standards for clear communication and guidelines for information on labels, in brochures and by the media received little support.

Evaluation of Long-Term Impacts

The participants concluded that there is a need to evaluate the long-term impacts of biotechnological innovations in research and product development on the structure of agriculture. They recommended (but with strong disagreement by four participants) that:

Land-grant colleges or equivalent institutions should take the lead in convening broadly representative stakeholders to develop standards and procedures for the long-term sustainability of the agriculture and food system. These principles should be applied to all levels of the system. A wide range of criteria—sustainability, health and safety, and social and economic equity—should guide these evaluations.

Agricultural Biotechnology and Global Interdependence (see p. 139 for complete report)

Co-chairs: W. Ronnie Coffman, Associate Dean for Research, Cornell University and Jim Germida, Professor of Soil Microbiology, University of Saskatchewan.

Speakers: Richard L. Sawyer, President, International Fund for Agricultural Research, and President, Fundacion Peru and William H. Lesser, Acting Executive Director, International Service for the Acquisition of Agri-biotech Applications AmeriCenter.

The workshop began with Richard Sawyer and William Lesser discussing public good issues of importance to the international agricultural community. Sawyer asserted that the ever-increasing human population poses a fundamental

problem for agriculture. He noted that with grain stocks at the lowest levels since 1972 and fish catches decreasing, we are becoming increasingly dependent on land resources for food. He said that agricultural biotechnology can be a force to help Earth sustain the population, but it is difficult to apply and its potential is hindered by the low priority given to agriculture by governments. He suggested that those in agricultural science have not adequately prepared the global community for the importance of biotechnology products; it is necessary to promote these products in a language that all members of society, both in developing and industrialized nations, can understand. Sawyer concluded by asserting that it is essential for biotechnology to be universal.

Lesser then focused on intellectual property rights and the flow of technology and resources between nations. The private sector provides two-thirds of the funds for biotechnology research worldwide with many of the products of this research ultimately delivered in seed, he said. Intellectual property rights are a key means of private sector compensation. Some 70 developing countries are working to enhance intellectual property rights over the next few years, but more than 30 developing countries do not permit patents on plant and animal research. This poses problems for the free-flow of technology and resources. Lesser suggested that the private sector needs to formulate a clear position toward developing countries with regard to the choices and consequences of technology transfer. He stressed the importance of educating the public about intellectual property rights and for developing international intellectual property rights policy to reflect global interdependence.

Recommendations

Equity, Rights and Access

To ensure access to new biotechnology products and resources and to protect equity and intellectual property associated with these technologies, the following strongly supported recommendations were made:

Harmonize existing or develop new systems of Intellectual Property Rights (IPR) which will maximize access to biotechnological and genetic resources while providing equitable compensation to developers of biotechnology and countries of germplasm origin.

As a supplement to such negotiations, multi-country agreements based on existing, successfully operating systems, e.g., EPO (European Patent Office) and UPOV (International Union for the Protection of New Varieties of Plants), should be established between groups of developing nations to facilitate handling of IPR.

One mildly controversial recommendation was put forward:

Extreme variation exists in the political and economic status between and among developed countries and developing countries. Therefore, material and intellectual property transfer agreements must now be negotiated on an individual basis between political, academic and industrial institutions. A non-partisan international panel is needed to address grievances derived from such negotiations.

Institutional Linkages in Capacity Building

To speed the development of tools of biotechnology, and given the importance of linkages in their transfer to solve the problems of food and environment globally, the following strongly supported, multi-part recommendation was made:

NABC should:

- *broaden its base to include other countries and regions*
- *gather information on databases regarding biotechnology on an institutional basis and make it available to the membership*
- *encourage multidisciplinary team-building in the broadest sense*

Socioeconomic

To protect the health, safety and economy of producers and consumers the following unanimous recommendation was made:

An ex ante and ex post system, comprised of representatives from public institutions, agribusiness, consumers and producer groups is needed to assess the potential impacts of biotechnology products and processes on:

- *the environment*
- *food production and prices as well as consumer acceptability*
- *wealth distribution*
- *farmers/labor*

and identify ways to:

- *reduce negative environmental impacts*
- *compensate disadvantaged groups*
- *train agriculturists in the proper management of biotechnology products/processes*

Environmental Stewardship

(see p. 195 for complete report)

Co-chairs: Richard Harwood, C.S. Mott Professor of Sustainable Agriculture, Michigan State University and Jerry DeWitt, Associate Dean for Extension, Director to Agriculture, Iowa State University.

Speakers: John Bell Clark, Biochemist and Organic Farmer, Roseland Farms, Michigan and Sandra S. Batie, Elton R. Smith Professor of Food and Agriculture Policy, Michigan State University.

John Clark began the workshop by admonishing those in biotechnology to use extreme caution when transferring products from the laboratory to the field and to marketable product. Environmental impacts have been predicted, he said, but no large-scale evidence exists to insure environmental safety and human health. He stated that to view biotechnology as a “silver bullet” cure for agricultural challenges is to engage in inappropriate scientific reductionism. Several biotechnology products present inadequate solutions to agricultural problems or address “non-problems.” And institutions such as corporations, and even universities, are pushing technology into marketable products as fast as possible because of potential financial gain, Clark said. He went on to suggest that “without holistic (cradle to grave and beyond) analysis of its products, this industry is doomed to failure.”

Sandra Batie urged, as did Clark, that biotechnology products should be carefully scrutinized before approval, noting that the environment could pay the price for hasty decisions. She agreed that biotechnology has the potential to enhance public good and benefit the environment, but that critics have legitimate counter-arguments which frame the biotechnology debate. For example, critics doubt the environmental motives of profit-minded corporations pushing herbicide-resistant crops and believe instead that such crops will lead to the use of more, not less, herbicides. Some also claim that developing nitrogen-fixing, or herbicide- or insect-resistant plants may unpredictably change the ecosystem and have unforeseen environmental consequences, Batie said. Much of the argument about biotechnology and the environment has not centered on risk, but instead, on who should bear the burden of any costs to the environment. She asked, "Should biotechnology products be readily approved for use, placing the burden of error on the environment? Or should the products be very cautiously screened, placing the burden of error on the inventors and users of the products?" Public participation in this debate is essential, she said.

The 40 workshop participants engaged in broad discussion on a variety of issues related to the environment and biotechnology. One area of strong agreement was that the public should be involved in safety and environmental considerations of biotechnology with public education playing a vital role. There was also agreement on the importance of integrated production systems (IPS) in minimizing adverse environmental impact from agriculture, although there was disagreement over the degree to which such integrative effects could be maximized. A major concern raised about biotechnology was the possible reduction of diversity within production systems and the possibility that greater genetic or cultural uniformity could lead to increased risk of pest or pathogen outbreak. The group strongly agreed that the goal of biotechnology should be to increase the options available for farmers and farming systems, not limit them.

After discussion of the key issues, recommendations were formulated in three areas: integrated production systems, environmental impact, and education and communication. There was also a strong consensus that assessment of long-term impacts of agricultural biotechnology on the environment is essential, but there was little agreement on how this could be achieved, and thus, no recommendations received group support.

Recommendations

Integrated Production Systems

There is a need for both scientists and farmers to know how and when to use biotechnology products in IPS. The following recommendations received strong, but not unanimous, support.

The public sector should fund and conduct more systems research and testing on the potential positive and negative environmental, economic and social impacts and consequences of biotechnology products. The results of the research

must be effectively communicated to producers and consumers in a timely and objective manner (as results are available).

Cooperative Extension Service directors and other appropriate public agency administrators should be given a mandate to devote resources to assist producers in a manner consistent with environmental stewardship (e.g., through comprehensive crop and animal management advancement programs that deal with whole-enterprise management and offer continuing educational update). Biotechnology options should be presented within this systems framework.

Environmental Impact

Agricultural biotechnology carries with it social and political implications. Therefore, it is imperative that a public role be recognized in the debate over areas where biotechnology should be focused and how its products should be incorporated into sustainable agricultural systems. Moreover, the public must be involved in the consideration of safety, of environmental protection and/or stewardship, and the myriad social issues. Participants strongly supported the following recommendations to improve agricultural products and benefit society, scientists working on biotechnology products should:

Identify, evaluate and anticipate risks prior to release. Safety claims should be supported with both public and private research. Assessment criteria should be used.

Focus on development of agricultural biotechnology processes and/or products that will promote long-term environmental health by:

- *maintaining biodiversity*
- *enhancing soil, water and air quality*
- *increasing reliance upon renewable energy sources.*

Recognize the public's concern for this new technology and work with them to understand its complexity and potential.

Bring biotechnology products to the market with reasonable expectations.

Public and private funding institutions, including USDA, EPA, NIH (National Institutes of Health) and private foundations should:

Take action to identify means and instruments to promote biodiversity as a key objective of publicly-conducted agricultural biotechnology research and development.

Education and Communication

Enhanced education and communication about the role of agricultural biotechnology in environmental stewardship will require major public effort. The goal would be to improve the ability of diverse groups to participate in the decision-making process about the impacts of biotechnology and to increase their involvement in environmental stewardship. A majority of participants

avored the recommendations in this area, but there was some dissent based on the broadness of the recommendations.

The Cooperative Extension Service and the Agricultural Experiment Stations, under the auspices of the National Agricultural Biotechnology Council (NABC), should form a committee to develop a public education plan for biotechnology education.

- *the participants should include grassroots members of various communities: consumers, producers, activists, local government, media, retailers, extension staff members and educators.*
- *the subjects of the workshop/focus group discussions should include a base of information about the environmental issues and solicit reaction to these issues from the participants.*
- *the information gathered at these workshops should be accumulated by NABC and published for distribution to statewide and national decisionmakers.*
- *special effort should be made to package and distribute this information to K-12 educational institutions.*
- *the committee should reconvene each year for a minimum of two years and then review accomplishment each year after at the discretion of the workshop/focus group.*
- *this effort should lead to a systematic and sustained educational plan to help the public debate and understand the issues surrounding agricultural biotechnology.*

SUMMING UP

NABC 6 concluded with a final panel session in which four NABC Council members summarized their thoughts about the meeting (*see following paper, p. 21*). Expressing what has become a common view of first-time attendees, Peter Day, Director of the AgBiotech Center at Rutgers University, said that he approached the workshops session with mixed feelings. "I didn't know what we were going to talk about and I was doubtful that we would have a product that was interesting," he said. "I was wrong. The conversations were sparkling and interesting. Once we got to know each other, there was free exchange which was extremely important. It emphasized to me what NABC is all about—open dialogue and listening to other people." Larry Milligan, Vice President for Research at the University of Guelph and also a first time attendee, had similar thoughts and stressed the value of speaking with people who are not within his usual realm of interaction.

Pleased with the productive workshop discussions and the wide scope of views expressed, panelists reiterated several recurring themes from the meeting. Bobby Moser, Vice President for Agriculture at The Ohio State University, commented that, regardless of the topic at hand, discussion ended up focusing on three similar issues: economic feasibility, environmental impacts, and the social impacts and acceptability as biotechnology reaches the consumer. He

predicted that the same three issues will continue to be critical ones for the future. This was also noted by Patricia Swan, Vice Provost for Research and Advanced Studies at Iowa State University, who placed this sixth annual meeting in context with previous NABC meetings. She said that four themes dominated discussion at this annual meeting: 1. access to technology; 2. rights to biological material; 3. the integration of social, economic and environmental issues; and 4. growing concern about public participation in agricultural biotechnology discussions. As her fourth NABC experience, this meeting, she noted, represented a turning point in the agricultural biotechnology dialogue, a shift from preliminary questions and speculations to broader issues and a broader concept of the agricultural sector. Finally, panelists offered a challenge to participants: to take back to their daily lives their personal NABC experience, to expand the circle of dialogue on agricultural biotechnology, and to work to implement the recommendations they had developed.

The meeting concluded with a request from a member of the audience that NABC further address the issues raised at NABC 6, especially those concerning public access to new agricultural biotechnologies. Recognizing this concern as a major issue, the NABC Council, at its meeting preceding NABC 6, had endorsed the theme proposed by the University of Missouri, Columbia for NABC 7, *Genes for the Future: Discovery, Access, Ownership*. When announced, the audience felt this was clearly an appropriate and timely topic. Indeed, NABC 6 was only a beginning; the work has just begun.