Agricultural Biotechnology: 
Economic Growth Through New Products, Partnerships and Workforce Development

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NABC’s eighteenth annual meeting, hosted by Cornell University, convened in Ithaca and Geneva, NY, June 12–14, 2006. Delegates were welcomed to Cornell by Bill Fry (Senior Associate Dean of the College of Agriculture and Life Sciences), and by Steve Slack (NABC Chair 2005–2006/Ohio State University), Tony Shelton (NABC-18 Host/Cornell) and Ralph Hardy (NABC President). Activities on the Monday afternoon, early Tuesday morning and Wednesday morning took place on Cornell’s Ithaca campus, and buses transported the delegates for Tuesday lunch and afternoon activities at the recently established Cornell Agriculture & Food Technology Park (CAFTP) on the campus of the New York State Agriculture Experiment Station, Geneva.

Presentations on past technology-transfer accomplishments and both national and foreign experiences in various structures that facilitate technology transfer provided a strong background for discussions on how public-sector research can produce economic growth through new products, partnerships and workforce development. Agriculture’s track record for public good is impressive; technology transfer has been achieved through diverse methods. The presentations and discussions at NABC 18 provided guidance for the future structure of technology transfer from public-sector research to public good and commercial products.

Session 1—Past Successes, Future Prospects and Hurdles—comprised plenary presentations by Alan Wood (Boyce Thompson Institute, Agricultural Research: Beyond Food and Fiber), Peggy Lemaux (University of California and Berkeley, Ag Biotech Pipeline: What’s in the Lineup?), Ralph Hardy¹ (NABC, Research to Market/Public Good: Economic Perspectives) and Deborah Delmer (Rockefeller Foundation, Road Bumps and Pitfalls for Agricultural Biotechnology). And presentations covering technology transfer in Canada, India, Brazil, China and Germany were made, respectively, by Keith Downey (Agriculture Canada, Rapeseed to Canola: Rags to Riches), K. Vijayaraghavan (Sathguru Management, India:

¹In place of Roger Wyse (Burrill & Company) who was unable to attend.
Alan Wood described a proposal for a National Institute for Food and Agriculture to enable the United States to maintain competitiveness in this field. Having invited NABC-member institutions to submit information regarding recent agricultural research beyond food and fiber with significant societal impacts, Wood described outstanding contributions to society under the headings Energy, Food Safety/Diet, New Products, Animal, Health, Environment and Plant Biology. Seventeen Nobel Prizes have been awarded to scientists involved in aspects of agricultural research, most of whom are not known to the public at large. The value and significance of US agricultural production and research must be more effectively communicated to the public and to legislators in order to improve understanding of the national and global importance of US agriculture, its breadth of impact and an appreciation of its many contributions to society beyond food and fiber, including human health and biobased products.

Peggy Lemaux pointed out that new applications of genetic engineering in agriculture are not limited by the technology. Progress is clouded by factors outside the control of scientists, particularly of academic scientists, like high regulatory costs and limited access to key technologies because of intellectual-property protection. Consumer-acceptance will also be important. It is likely that modern biotechnology will play an increasingly important role in other countries—China for example—where these issues are not likely to be key factors.

Ralph Hardy outlined methods for science/technology transfer to market to achieve public good. He provided public- and private-sector examples of venture capital for early commercialization of agricultural science and technology. Hardy emphasized that licensing income is likely to be relatively small and that the objective of technology transfer should be to maximize public good not to maximize financial gain to the institutional “home” of the invention. Evaluations by and of technology-transfer offices should use the public-good metric, not the income metric.

According to Debbie Delmer, the problems for biotechnology vary according to who you are—a large company that deals with important crops and developed-country farmers, a small private company, a public sector entity, university, national agricultural system or a CGIAR institution. It is difficult to judge the degree to which negative public perception remains a significant issue. Strong research programs on development of genetically engineered (GE) crops are in progress in China, India and Brazil. Even in the European Union, GE crops are now planted in a few countries. Some 10% of people say that genetic engineering of crops is great stuff and another 10% hate it, while in the middle is a vast disengaged majority who really don’t care, including many farmers in the developing world. People are growing tired of the debate. “It’s time to get on with it.” Delmer also noted the importance of making IP available to developing countries and public-sector research.
The development of canola from rape-seed oil, described by Keith Downey, diversified Canada’s agriculture base, eliminated dependence on imported vegetable oil and increased returns to producers while expanding markets at home and abroad. It resulted also in the establishment of a large rural-based, value-added oilseed-crushing and -refining industry. The story continues in that canola is a preferred biodiesel source for northern climates because of its low content of saturated fatty acids. Canola development continues, to better meet user needs.

India’s economy is among the fastest growing in the world—6% to 8% annually over the past decade—according to “Vijay” Vijayaraghavan. On the other hand, growth in agriculture has been less than 2%. A national mission is in progress to revive the under-performing agriculture sector by enhancing farm production and food quality while reducing waste. The strategy includes attracting investments that will trigger high growth in agriculture and in the processed-food industry and partnering in global research initiatives that will help India to acquire as well as provide technologies.

In Brazil, the production of ethanol from sugar cane has increased three-fold in the past 25 years. The current average yield is 6,000 L/ha. However, in line with the Kyoto Protocols, a production increase of at least 3-fold again will be needed by 2010 to satisfy projected demand. This goal is achievable as a result of Brazil's scientific expertise in breeding and genetic engineering, to increase productivity of sugar cane as a crop and improve efficiency of ethanol synthesis.

The public debate in China on the safety of GE crops was “imported” from Europe, stated Zhangliang Chen. It is germane in particular to the improvement of rice productivity in that country, where GM varieties are in final field-trial stages. On the other hand, Peter Welters reported that the scare-mongering of anti-GM-activists in Europe is increasingly recognized for what it is. Examples showing benefits of applying genetic engineering to plants are finding acceptance by the general public. “We have only to inform people correctly and constantly about the progress and the benefits of this new technology. Millions of farmers worldwide can’t be wrong.”

In session 2—Function and Role of University-Based Research Parks in Economic Development—presentations were made by Ashley O’Sullivan (Ag-West Bio, Inc., Canada, From Tools to Products: The Evolution of Saskatchewan’s Agbiotech Cluster), Allen Dines (University of Wisconsin, From Equines to Economic Development: The Story of University Research Park), Wim Jongen (Wageningen Business Generator, Netherlands, Food for Innovation: The Food Valley Experience) and Zhianglian Chen (Agricultural University, China, The Chinese Experience in Innovation).

“What is the bio-economy?” asked Ashley O’Sullivan. From the perspective of Ag-West Bio, it simply involves creating and capturing value from biological systems. The challenge and the opportunity for each region are the ability to understand and to effectively exploit global comparative advantages. The strategy at Ag-West Bio for Saskatchewan is twofold: (i) marketing their excellent bio-economic infrastructure, and (ii) identifying and targeting strategic opportunity sectors. Ag-West is probably the earliest example of a technology park focused exclusively on agriculture.
Allen Dines’ story of the University Research Park in Madison provided an instructive case study of how favorable outcomes can arise from university-established parks focused on fostering commercialization of university research. Wisconsin has a long-term record in technology transfer; the irradiation of milk to produce vitamin D in the 1920s is a seasoned example. Recently, several companies have expressed interest in relocating to the Madison area as a result of opportunities resulting from association with the university-research environment.

The concept that science-based economical development is crucial for general economical development and competitiveness, according to Wim Jongen, begs the question of how to organize the process. The objective of the Food Valley cluster, developed in the Netherlands, is the creation of a network for innovation and business involving companies, research institutes, experimental facilities, incubators and public-private-partnership based R&D programs with the foci being food, health and nutrition. The initiative—by three city councils—has grown into a regional economic force.

Zhianglian Chen reported that, since 1991, the Chinese government has encouraged university professors to form companies. Even in public universities, a professor can run a business from her/his own laboratory, owning 100% of the company or shares thereof. Some professors have made large amounts of money. On the other hand, Chen expects that universities will continue to play a vital role in high-tech business development and innovation, making major contributions to a knowledge-based economy in China. This merging of universities and business was the most tightly coupled example described at the meeting.

Session 3—An Up-Close Look at One Research Park: the Cornell Agriculture & Food Technology Park (CAFTP)—took place at CAFTP as a “town hall” discussion moderated by Dan Fessenden (CAFTP). Brief comments from Michael Manikowski (Ontario County Development), Karen Springmeier (Finger Lakes Workforce Investment Board), James Hunter (Cornell University/New York State Agriculture Experiment Station), Susan Riha (Cornell) and Roger Williams (Cornell) helped to focus the discussion.

Dan Fessenden sketched a brief history of the New York State Agricultural Experiment Station in Geneva, NY, on the campus of which CAFTP is situated, and described the thinking that underpins the Park and the process whereby physical-plant infrastructure—a flexible technology facility—is now available for occupancy. It is envisaged that CAFTP will eventually occupy 70 acres of what was, until recently, apple orchards that had been “retired” from research use. Four start-ups, including agbiotech companies, occupy office space on campus and are expected to enter pilot production in the main facility in the near future. Ground-breaking is expected in 2007 of a USDA-funded grape-genetics research center.

Session 4—Bridging the Gap: From Laboratory to Commercial Product—comprised presentations from William Goldner (USDA-SBIR, Vision, Opportunity, and Challenge: The USDA-Small Business Innovation Research Grants Program), Richard Brenner (USDA-ARS, Technology Transfer in the Agriculture Research Service), Michael Adang (University of
Bill Goldner described the USDA’s Small Business Innovation Research Program. This competitive funding program, authorized by Congress in 1982, stimulates and facilitates R&D by US-owned and -operated for-profit small businesses (<500 employees). All executive branch departments with extramural research budgets exceeding $100 million are directed by legislation to provide a 2.5% set-aside to fund SBIR. Rick Brenner reminded the audience that the USDA helps drive continuous innovation through science and technology by forming Cooperative Research and Development Agreements (CRADAs) with research institutions and the private sector. The Office of Technology Transfer in the ARS is key in facilitating these partnerships and in transferring research outcomes for broad beneficial use by the public and agricultural industries of the United States and other nations. Given recent concerns about rising petroleum prices, the United States will be increasing research emphasis on new, environmentally favorable crops for industrial uses representing new economic opportunities for farmers and reducing dependence on imported fossil fuels. There is renewed hope that the most prosperous era in American agricultural history is dawning to meet continuing and expanding national needs.

Mike Adang described his experience in translating research discoveries to a product via a new company that he founded: Insectigen. He discussed ethical conflicts between the role of the entrepreneur—which can be time-consuming—and the role of the professor with obligations to students, to postdocs, to research colleagues, and to others in the university milieu.

Mary Pat Huxley discussed development of the workforce in general and of the biotechnology workforce in particular. She remarked that the United States is not outpacing its competitors with as wide a margin as it did 40 to 50 years ago. Many workers are unable to meet new technical needs in the workplace, and incoming workers often fail to realize that innovation is the driver of the US economy. Such innovation increasingly relies on workers having scientific, mathematical and technical ability, alongside workplace-competency skills.

Rick Broglie provided concrete examples of bridging “the valley of death”—i.e. transferring science and technology into commercial products. He concentrated on the work that is going on at DuPont Crop Genetics Research and Development, where they try to predict trends for agricultural production in the next 5–10 years. He sees growing demands for biobased fuels and materials, which with other factors, will drive their farmer customers towards more-intensive production systems. They use two complementary paths for product development: the transgenic, gene-discovery approach that has been used for products currently on the market, and, for more complex traits—e.g. balanced amino acids, increased energy availability via increased oil and decreased fiber content—a “new technologies” approach that may or may not involve genetic engineering. New traits have to be commercialized in high-yielding germplasm, and several enabling technologies...
are employed including molecular genetics; backcrossing can be made more efficient by using molecular markers to select lines with the background of the recurrent parent.

Paul Thompson suggested that technological ethics are today better served in the private sector than in the universities. If so, university-industry partnerships could have the result of improving the capacity for university-based science to address ethical issues, if they bring some of the norms and practices that are commonplace in the private sector into the university. Or they could have the result of transferring the relatively weak ethics performance of university science to the private sector. While we can hope for the better outcome, his suspicion is that university-industry partnerships are likely to produce the latter.

The banquet presentation was by Mark Crowell (University of North Carolina, *Knowledge Transfer and Economic Development: The Role of the Engaged University in the Twenty-First Century*) and a supplementary talk was given by Rick Welsh (Clarkson University, *Agricultural Biotechnology and University-Industry Research Relationships: Perceptions of University Scientists and Administrators and Industry*).

Mark Crowell discussed the function of the Association of University Technology Managers (AUTM), an international organization with about 3,500 members. Mirroring the global economy, 25% of the membership is outside North America and growing at 2½ times the rate of the US group. The AUTM’s *Better World Project* is an attempt to show the impact of public-sector research that is not necessarily reflected in terms of licenses, patents and revenue. Twenty-five in-depth stories of university innovation have been collated demonstrating impact regardless of financial implications. A companion piece, *Reports from the Field*, contains a hundred similar stories in vignette form. These reports are being sent to all members of Congress and to agencies in Washington, DC, to promote understanding of the important roles academic research and technology transfer play in making our world a better place in which to live.

According to Rick Welsh—based on a recently completed study—industry funding generally brings modestly less basic and more excludable (e.g., patentable) research than does NSF or NIH funding. Industry is wary of the decline in the level of basic research at universities, but contributes to it through its funding relationships. This points to the importance to a number of parties of continuing to publicly fund basic research at universities.

In addition to Q&A discussions with audience participation at the conclusion of each session, breakout workshops were held, during which delegates, in smaller groups, had the opportunity to discuss further issues raised in the presentations, to raise other related matters and to make recommendations to share with policymakers. The Q&A sessions are included in this volume as a summary of the workshops.