Using Biotechnology to Enhance and Safeguard the Food Supply: Delivering the Benefits of the Technology

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The issues facing global agriculture today are issues that have been with us for a long time: Feeding an increasing world population, preserving and protecting the environment, ensuring a safe and healthful food supply, and creating value and economic viability. Against this timeless backdrop, the real challenge for biotechnology is to determine how to best utilize these new technological tools to create sustainable solutions for enhancing and safeguarding our food supply.

The factors that will determine the success of biotechnology in meeting these challenges are technological, economic, political, and social. Safe and effective implementation of the technology is the basic requirement, but this needs to be coupled with sound economics, development of markets, continued development of appropriate regulatory frameworks, and, above all, the delivery of products that are valued and used by consumers.

New crops from biotechnological approaches have already demonstrated their value to a wide variety of customers, and have proven the technology's ability to increase yields, enhance the environment, and improve farming practices. The current generation of herbicide resistant and insect resistant crops provide examples of how this technology can be used to decrease chemical usage, allow for improved tillage practices, ease the work of the farmer, and provide for profitable business activities for many. More recently, the technology has started to provide improvements in the general quality of harvested crops, with improved nutritional and health benefits.

The focus on these harvested attributes of the crop plants has caused recognition that value can be added through this technology at many points of the food value chain. This chain is enormous on any basis — geography, people involved, infrastructure, and value. Starting with the technology providers, such as seed companies, the technology is distributed to the farm, crops are

grown, stored, and distributed through many intermediaries for use by food producers. These include feed formulators, livestock producers, meat, milk, and egg producers. Primary and secondary processors also handle the produce, making many products for the protein, oil, and carbohydrate fractions of the crop. Food ingredient manufacturers, branded products producers, and retail outlets are all involved before the consumer gets the product.

With the first generation of biotechnology focused primarily on transactions at the very early part of the chain — with the farmer/producer — the commercial transaction was fairly straightforward and could be handled in much the same way as seed, chemicals, and fertilizers had always been handled. To be sure, there was value migration, e.g. from crop protection chemicals to seeds as value delivery vehicles, and major research companies started to cooperate with and acquire seed companies to enable this delivery. As the technology finds increasing use in creating added value foods and feeds, the point of value accrual can occur anywhere along this large agriculture food chain — and the situation becomes much more complex. This is causing a number of changes in the industry, and in the relationships of industry players with each other.

Biotechnology is only the latest addition to the factors that contribute to changes in our food production systems. Major, long-term governmental policies that have induced freer flows of capital and goods throughout the world have increased competitive pressures and provided new incentives for new types of alliances and value chain organizations. Against this backdrop, biotechnology is causing value to migrate to different parts of the chain through its ability to create agricultural produce with specified characteristics through genetics. Another major factor is the increasing availability of distributed information and information services. This information is breaking down some of the walls that have existed between suppliers and customers, with the result that new bases for collaboration and alliances are becoming more apparent to all members of the chain.

Different players in the chain are making choices about how to best deliver technology, and where they need ownership or strong alliances to deliver and capture the value of the technology. Much is said these days — and some concern is voiced — about the integration and consolidation of the food supply chain. Of course, alliances and integration are nothing new to the food industry. Providers of a whole wide range of food products long ago integrated back to owning or specifying the genetics they require to produce their products. Historically, this integration has been largely driven by downstream companies integrating backwards to production through either contracts or ownership. Feed producers have integrated with previously separate animal production enterprises, and there are large, very effective and competitive enterprises that combine grain distribution/feed formulation/animal production activities. Based on U.S. Department of Agriculture/Economic Research Service (USDA/ERS)

data, the percentage of broiler production that has been done under contract or direct ownership has been rather constant at greater than 90 percent for almost 40 years, driven by the desire of producers to differentiate their products. Vertical integration in the egg industry occurred in the late 60's, and there has been a continual rise in contract production and direct ownership in fresh vegetable production.

Perhaps what is different about the discussion today with respect to biotechnology is that we're talking about a forward integration — from technology to marketplace — and this integration is being centered around large, multi-national companies that have historically participated primarily in the very front end of the value chain. In addition, much of the integration is occurring in areas related to the production of differentiated crops — such as corn and soybean — which have long been primarily undifferentiated commodities. While notable — and involving large premiums and cash outlays — this integration is rather small relative to the whole value chain. It has been driven primarily by the technology providers sensing a requirement to be able to access or own the delivery vehicles (seed) of their value-added traits, especially for traits with on-farm value. For traits that have value beyond the farm gate, alliances with and acquisitions of primary and secondary processors, provide a way to have a point of interaction (value capture) with these downstream markets and to learn about and understand these markets. Concerning these two aspects — possessing a direct-value capture mechanism and understanding the market — my personal view is that the latter will prove to be by far the most important in the long run. If one understands the market (has competitive intelligence, good information about customer needs, etc.), one is able to design products that will provide value to that market. These will include large volume/low margin and low volume/high margin differentiated products. With the current and anticipated future structure of the complex food chain, there will continue to be a number of ways to capture value from these differentiated products, without requiring ownership every step along the way. The increasing availability and use of information technology will enable the acquisition of market knowledge and enhance its value, decrease the benefits of broad ownership, and promote the development of alliances and partnerships — creating a dynamic “virtual integration” structure to deliver value-added products to the consumer. This virtual integration will extend to alliances and relationships with major, consumer-oriented food companies, providing an improved mechanism for these companies to specify the qualities they seek in differentiated raw materials for the products their customers want. And, it will extend back to farmers as the new grains and new markets will provide farmers with increased choices for what they produce.

Integration, virtual or otherwise, will also help to link specific technologies together in a very long and wide technology supply chain, providing the mechanism to deliver enhanced value to consumers. An example might be the

production of high oil corn and use of that corn in a wet-milling operation. Using corn with over twice the amount of oil of normal corn, and with major differences in physical properties, can represent quite a challenge to the wet miller. The miller may need to make additional investments to fully capture the enhanced value inherent in the proprietary grain, and the grain provider may need to alter the genetics to take into account specific processing issues. An alliance could help make this happen. Perhaps exclusivity would be given to the miller for a certain period of time so that he can recoup his investments. A premium could be made available to the grain provider to cover additional costs associated with identity preservation of the grain and to provide premiums to the farmer for growing the grain. The net result of this alliance would be the ability to deliver added value to all those who participate in the production, processing, and use of the differentiated grain.

There are a large number of products in development that add value throughout the food chain — not only to the providers of the technology, but to farmers, downstream customers, and consumers. Using soybeans as an example illustrates how biotechnology can be used to improve the healthfulness and nutritive value of products derived from this major commodity crop. For example, soybeans with high levels of mono-unsaturated fatty acids provide improved functionality, flavor stability, and health benefits. High saturated fat soybean oils — produced without trans-fatty acids — can be used in a variety of healthier foods. Soy protein with increased nutrient density and a better balance of essential amino acids will find use in improved, more nutritious animal feed. Soybeans with decreased amounts of anti-nutritional carbohydrates and increased levels of sucrose can be used to provide soybean products with enhanced flavor, palatability, and digestibility. When these soybeans are processed with new methods that accommodate their unique properties, a number of new soy-based products will become widely available to mainstream consumers. Consumers will be able to enjoy the health benefits of an increased soy protein diet in tasty, healthful products such as soymilk, cereals, and candy bars.

Our ability to provide such products requires new systems to preserve the identity of the unique grain products. These systems depend on new analytical and information systems to ensure timely and assured delivery of products from the farm to the user. These analyses include not only those for the particular trait in question, but general analyses of grain quality and specific analyses for microbial contamination. Systems are already being put into place for a variety of value-added crops — such as the high oil corn and improved soybeans mentioned previously — and require the coordinated activities of a variety of companies in the food value chain, linking farm production to consumption. Regardless of the particular nature of the grain being produced, identity preservation systems ensure the highest quality and provide a means to connect growers to end-users and consumers in a more direct manner. As we pay more

attention to our production agriculture, the general quality of the grain and food is enhanced, and this value can be delivered right through the value chain all the way to the consumer.

Biotechnology is destined to have a profound and positive effect on food production, nutrition and health, food safety, and the environment. The enhanced environmental and economic benefits of the first generation of "on farm" traits are already well established. The second generation of value-added, quality trait products for the consumer is just coming off the farm, and is driving the evolution of systems and alliances to ensure delivery of these products. Anonymous, commodity-based supply is giving way to certified, identity preserved supply. With this new system, we can look forward to secure delivery of products with enhanced nutritional value and improvements in the quality and safety of the food products delivered to consumers.