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AGRICULTURAL BIOTECHNOLOGY - MASTER OF THE UNIVERSE?

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Technological innovation is creating a catalyst for new dimensions of growth and a corporate restructuring around the value creation potential of agriculture. This paper provides an overview of the recent commercialization of agricultural biotechnology. The key strategic themes that are driving the growth and commercial potential of agricultural biotechnology are discussed. In addition, the strategic drivers behind the initial wave of corporate activity are examined, along with the rationale behind the recent valuation of seed companies. It is argued that firms will need to be strategically positioned with respect to the technology-base, and that recent corporate actions are a reflection of this.

Key words: biotechnology; strategic positioning; firm valuation; seed acquisition

Humankind stands at the gate of a new millenium. The year 2000 is noteworthy for a number of reasons. On the one hand, computer users around the world, both large and small, are bracing themselves for the Y2K problem, which could create worldwide havoc, as computers celebrate the New Year, a new decade, and a new century, with varying degrees of success. On the other hand, we believe the year 2000 will mark the beginning of the unfolding of one of the leading business and Wall Street stories of the 21st century. Technological innovation, created by breakthroughs in the biological sciences and agricultural biotechnology, will become one of the key catalysts of growth and a powerful engine driving corporate change.

We are moving into a new century in which breakthroughs in the understanding of biology at the molecular level will create waves of new technologies and products. The technologies and products are expected to redefine the growth and value creation potential of agriculture. These dynamics are expected to drive an accelerating wave of strategic corporate actions. We will witness the birth of new companies and industries, the need for companies to redefine themselves in order to remain competitive and take advantage of new business opportunities, and unfortunately, the demise of some companies and industries which do not understand the magnitude and potential impact of this developing technology wave, which is about to turn into a tsunami.

The purpose of this "big picture overview" is to focus on three key areas surrounding the corporate gold rush to commercialize agricultural biotechnology: (1) the key emerging strategic themes driving the growth and commercial potential of agricultural biotechnology; (2) the strategic drivers behind the initial wave of corporate activity; and (3) the rationale behind the valuation of companies which have been pawns on the chess board in a game to develop strategic position. Changing corporate mindsets,

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created by growing recognition of the integrative power of agricultural biotechnology, are about to unveil the creation of a new mosaic of corporate strategies. These strategies will ratchet up the long-term strategic value of agricultural biotechnology platforms and redefine the linkage of agriculture to the industrial base of the worldwide economy.

Redefining The Commercial Potential Of Agricultural Biotechnology

Advancements in science and technological breakthroughs in the understanding of the biology of plants, animals, humans, and organisms at the molecular level, combined with the power of new information technologies, are creating a new technology platform, that is, biotechnology. This powerful technology base, combined with the development of enhancing technologies, such as genomics, bioinformatics, and proteomics, is speeding up the identification of genes that control valuable traits, shrinking the timelines to commercialize new products, and expanding the commercial potential of biotechnology across a growing number of market sectors, including agriculture.

Agriculture is no stranger to technology, innovation, and change. Looking back through history, technological innovation has been the key to the growth of production agriculture. Production agriculture has been shaped by technological breakthroughs that have brought to the farm crop inputs, such as hybrid seed and crop protection chemicals. In addition, technological innovation has moved farm mechanization from the early days of the plow to today's four wheel drive tractors, outfitted with precision farming technology. These technologies have been geared toward boosting farm productivity, which has improved farmers' bottom line profits, and made farmers' lives easier. These technologies have helped shape the business structures that form the foundation of today's agribusiness infrastructure.

While most technologies have generally focused on boosting farm productivity and have impacted how farmers farm their land, biotechnology has the potential to completely revolutionize agriculture by changing what is produced. During the past century, technology adoption and product displacement has been evolutionary, as new and better technology-based products have been developed. Farmers have had time to integrate new technologies into their cultural practices and to respond to market conditions. Companies have had the time to reposition themselves, reformulate their business strategies, and readjust business structures to bring new technology-based products to the marketplace in order to remain competitive.

Sometimes technology shifts are revolutionary, becoming so powerful that their adoption triggers the need for major structural changes in the marketplace and the agribusiness infrastructure. But major technology shifts often create periods of marketplace turmoil, and sometimes create overnight product displacement cycles and corporate obsolescence. These forces set in motion not only marketplace actions and competitive reactions, they also trigger major strategic actions and a dramatic restructuring of the broader industry infrastructure. An example comes from the computer industry. International Business Systems (IBM) was forced to strategically re-engineer itself following a number of years of severe financial stress stemming from its underestimation of the impact personal and mini computers would have on its mainframe computer business.

While the technology being brought to the marketplace over the next five years will largely continue to focus on input traits, it's long-term potential lies in the development of value-added output traits that will address a wide range of needs. The needs of conventional markets like food and feed, and new markets created through the development of novel biotechnology-based value-added traits, will be addressed. The ability to create proprietary value-added traits will turn many agricultural commodities into premium-priced specialty and quasi-specialty products. This will dramatically change what farmers produce, redefine what markets demand, re-engineer the agricultural production

and distribution infrastructure to meet the new demands of the marketplace, and redefine the linkage between the farmer and the end-user.

Agricultural Biotechnology Moves To Center Stage As A Driver Of Corporate Change

Agricultural biotechnology has initiated a major "wave of change" in agriculture, and its impact is starting to ripple through the agribusiness infrastructure. Agriculture and the entire agribusiness infrastructure have entered a period which will be defined by a pace of technological innovation that will intensify structural change. Although in the early stages of commercialization, we are witnessing the beginning of the bio-transformation of agriculture. The traditional drivers of growth and value-creation, that form the foundation of the agribusiness infrastructure, are being redefined by biotechnology. Agricultural biotechnology is starting to create a broad pipeline of new products which form the basis for not only redefining today's key agricultural markets, food and feed, but also creating businesses linkages to other non-conventional markets and industries. Such non-conventional markets include: pharmaceuticals, animal health, chemicals, and a broad array of industrial markets, many of which would not be considered synonymous with agriculture today.

The application of biotechnology to agriculture will redefine the key fundamental drivers of today's agribusiness infrastructure. The development of diverse biotechnology platforms is creating new business dynamics that form the foundation of a number of new companies. These platforms act as catalysts for the realignment of existing companies and business sectors. These business dynamics are accelerating and broadening the scope of corporate strategic actions to take advantage of new and changing market opportunities.

It has been our long-held vision that agricultural biotechnology would transform and usher in a dynamic new era of growth for agriculture. As a matter of fact, the potential appears to be even greater than what we had thought just a few years ago. We continue to believe that the potential economic and business impacts of agricultural biotechnology remains severely underestimated. This new developing technology-base will not only create products that will help improve farmers' productivity, but more importantly, will dramatically expand the value creation potential of agriculture and the linkage of agriculture with our industrial-based economy. In contrast to conventional wisdom, which holds that the future of biotechnology is tied to the conventional health care industry, it has been our belief that the value of health care applications will be challenged by the value created in the application of biotechnology to agriculture; that is, as the world's industrial base moves towards a "carbohydrate- or plant-based economy." Agriculture and the agribusiness infrastructure are about to undergo multi-dimensional change, the scope of which only a few currently understand.

The Corporate Gold Rush To Build Long Term Strategic Position

We are witnessing a rapid change in corporate perceptions of the commercial potential of agricultural biotechnology and its potential long-term impact on a large number of business sectors. A broadening vision of future opportunities is catalyzing the development and execution of broad business strategies. Today, the execution of these strategies has resulted in a number of acquisitions, as well as the forging of new corporate linkages between players.

Over the last three years, recognition that there are a limited number of quality seed and agricultural biotechnology assets, combined with many companies' desires to create pre-emptive positions, have resulted in a corporate gold rush to develop long-term strategic positions around broad agricultural biotechnology platforms. Major linkages of biotechnology assets and seed companies with leading agricultural chemical companies through strategic alliances and equity ownership positions, as well as

outright acquisitions, have changed the corporate landscape of the seed, agricultural biotechnology, and crop protection industries almost overnight. Most notable among the strategic players, which represent a who's who in the crop protection, agricultural biotechnology, and seed industries, are: AgrEvo; Calgene; DEKALB Genetics; Delta and Pine Land; Dow AgroSciences; DuPont; Monsanto; Mycogen; Novartis; Pioneer Hi-Bred; and Zeneca.

If there were any question about the potential business opportunities created by agricultural biotechnology, one need only look at the recent multi-billion dollar corporate transactions to secure seed and technology assets, and downstream linkages. The price tags placed on a number of these transactions indicate the high stakes in the long-term agricultural biotechnology marathon race.

Agricultural Biotechnology's Business Potential Tied To Value Capture

Success in the commercialization of agricultural biotechnology will hinge on combining two key groups of assets and expertise. The first group is the technology and delivery vehicle, which combines the development of a leading-edge biotechnology platform with a global state-of-the-art integrated seeds business, as well as expertise in vegetative propagation for non-seed based crops. This will allow firms to effectively bring the technology to the farm level. The second group is the commercialization structure, whose focus is the development of innovative new product systems and business structures to create and capture the value generated from the farm gate all the way to the consumer or end-user. Key components rest not only on the business structure, but also on marketing and distribution power, which links the farm gate to the consumer or end-user. We expect to see the redefinition of existing linkages from the farm gate to the end-user, as well as the creation of new linkages between business sectors that are distinctly separate. We expect the new and existing linkages to ultimately converge.

We believe that changing business relationships between many diverse industry sectors, which are changing around agricultural biotechnology platforms, will create a new corporate mosaic based on multi-dimensional vertical and horizontal linkages. These linkages will be between agriculture at the farm gate and a broad spectrum of downstream industries. It has long been our view that these dynamics, evolving around developing agricultural biotechnology platforms, will form the nucleus of new technology-based business structures, or "agricultural industrial complexes."

Within the last three years we have witnessed the birth of these "agricultural industrial complexes." Growing recognition of the value creation potential of agricultural biotechnology has led to a proliferation of corporate strategies focused on creating new business linkages around agricultural biotechnology platforms. We expect to see an increasing number of corporate actions that reflect the convergence of a number of strategic drivers that will collectively increase the value of agricultural biotechnology platforms.

A new corporate mosaic, centered around agricultural biotechnology, is being formed by the growing recognition of the multi-dimensional linkages between conventional agriculture-related markets. In addition, this is combined with the prospect of using agricultural biotechnology to catalyze the strategic integration of agriculture with a broadening array of industries which, today, are not directly related to agriculture. The convergence of four key strategic drivers is magnifying the potential impact of biotechnology. First, agricultural biotechnology, seed, and crop protection chemical companies are merging together based on the recognition these technologies are complementary. Second, agricultural biotechnology companies are creating downstream linkages in order to create value-capture mechanisms in conventional food, feed, and industrial markets. Third, agricultural biotechnology is becoming a critical strategic component in the evolution and execution of companies' life science strategies. Finally, agricultural biotechnology-generated specialized traits for

non-conventional agriculture-related markets will lead to strategic linkages with a broad array of new industrial-oriented business sectors and companies.

Agricultural Biotechnology, Seed and Crop Protection Chemicals

The initial wave of corporate transactions over the last three years has been characterized by the merger of agricultural chemical companies and biotechnology-based seed companies. Strategic moves have been triggered by both defensive and offensive actions. Defensively, crop protection companies have desired to offset the potential for shrinking markets, as markets for conventional crop protection chemicals were being replaced by transgenic technologies. Offensively, agricultural biotechnology-based seed companies have been executing "cost displacement" strategies. A cost displacement strategy is best exemplified by the use of Roundup on Roundup Ready soybeans, which have replaced conventional soybean herbicides. In addition, there is the growing recognition that some agricultural biotechnology-based input traits (i.e., herbicide tolerance) and crop protection chemicals are complementary technologies from a farmers' perspective.

Mergers, acquisitions, joint ventures, and strategic alliances have changed the competitive framework in the agricultural, chemical, and seed businesses almost overnight. With the exception of Pioneer Hi-Bred, all the other major public seed companies, as well as many private ones, (not only in corn and soybeans but also cotton and vegetables) have been purchased or are about to be acquired by a small number of long-term players. These players are building broad-based strategic biotechnology seed platforms, and in so doing are redefining the structure and the linkages between the seed and crop protection industries. The continued strategic re-engineering of the agricultural chemical business around broad biotechnology-based seed platforms is expected to promote further consolidations. This could potentially prompt the formation of additional strategic relationships between agricultural chemical and agricultural biotechnology seed companies. At the end of the day, we do not believe there will be more than four or five global agricultural biotechnology seed/agricultural chemical complexes, and it is quite possible there may be only three or four.

Moving Downstream to Grain Processors and End-Users

Because the number of broad biotechnology platforms, combined with leading-edge seed operations, is limited, we expect to see an increasing number of strategic alliances between agricultural biotechnology seed complexes and grain processors on a worldwide basis. We expect downstream end-users to not be far behind. Following DuPont's move downstream in 1997 with its acquisition of Protein Technologies, a specialty soybean processor, Monsanto announced an agreement to form a joint venture with Cargill in June 1998. Novartis recently announced an agreement to form a joint venture with Land O'Lakes to produce specialty corn products. We expect a whole new group of players, comprised of downstream end-users, including food and industrial companies, such as packaged goods, animal health, chemical, pharmaceutical and other non-conventional agriculture-related companies, to join the "biotechnology party." Motivations are complementary. Biotechnology-based seed companies want to create downstream linkages to control and capture value. At the same time, downstream companies want to create preferred relationships with the upstream technology-based seed and processing infrastructure, in order to gain preferential access to value-added crops with proprietary traits. These traits can command price premiums and create competitive market advantage.

Life Science Strategies

Broad agricultural biotechnology seed platforms are critical components in the execution of life science strategies. The life science business concept includes pharmaceutical, agriculture-related (crop protection chemicals, agricultural biotechnology, seeds, and animal health), and nutrition/consumer businesses. While this concept is not new, the new generation of life science companies is focused on creating a technology and business structure that maximizes the "integrative" business opportunities between these markets. At the heart of the creation of a new generation of integrative life science companies is the direct linkage of agricultural biotechnology to food, nutrition, and health markets. The importance of agricultural biotechnology seed businesses to the new generation of integrative life science companies is highlighted by four announcements over the past six months. The first announcement was Monsanto's ill-fated merger with American Home Products. Second, DuPont announced its decision to monetize the value of Conoco so that it could aggressively build an integrative life science company. Third, Novartis recently announced that it would build a plant-genomics center in California, that will be located next to its announced human genomics center. Most recently, Hoechst and Rhone-Poulenc decided to merge their life science and agricultural businesses.

Expanding the Linkage to Industrial-Oriented Markets

While somewhat farther away in terms of major market impacts, the ability to develop specialized genetically-engineered industrial traits, such as bio-materials in crops, will expand the value creation potential of agriculture and lead to strategic linkages with a broad spectrum of non-conventional sectors. A small number of companies with agricultural biotechnology businesses, such as DuPont and Dow Chemical, are already focused on the creation of more specialized traits for non-conventional markets, such as materials, chemicals, and plastics sectors. We would expect selective corporate linkages through strategic alliances to start to occur over the next few years, as companies' strategic focus shifts to non-conventional agricultural-related markets.

The combination of the above four strategic drivers are expected to drive an accelerating level of corporate activity over the next decade, that will make the mergers, acquisitions, and joint ventures of the last few years pale in comparison.

Long Term Strategic View Boosts Acquisition Prices - Madness Or Sanity?

Recent aggressive corporate actions by agricultural biotechnology seed and agricultural chemical players have redefined critical mass issues, and created a "sense of urgency" among competitors to reassess their strategic positions. This sense of urgency has accelerated the execution of their strategies in order to remain competitive.

Some companies, such as Monsanto and DuPont, have demonstrated a degree of aggressiveness in capturing strategic technology and seed assets, the delivery vehicle for biotechnology traits, that other companies have been unwilling to match. This is exemplified by the ratcheting up of valuations companies have been willing to pay for seed assets over the past year. Prior to 1996, seed companies were generally valued at one-half or two times their revenues, with the magnitude of the multiple tied to the level of profitability, which in good part reflected market position. Within the last three years, the valuation of seed assets has skyrocketed and transaction values have risen to revenue multiples of five to ten times. These numbers are shown in the accompanying table.

The Meteoric Rise In The Value Of Seed Assets

Date	Acquirer	Target	% Share	Transaction Value ($B)	Transaction as a Multiple of Revenues
8/97[a]	DuPont	Pioneer Hi-Bred	20%	$1.7	4.7x
5/98 [a]	Monsanto	Delta and Pine Land	100%	$1.9	9.9x
5/98 [a]	Monsanto	DeKalb Genetics	60%[b]	$2.5	5.3x
6/98 [a]	Monsanto	Cargill Seeds (intn'l)	100%	$1.4	4.7x
9/98 [a]	AgrEvo	Cargill Seeds (domestic)	100%	$0.7	6.0x
10/98	Dow Agro	Mycogen	31%[c]	$0.8	3.8x

[a] Dates reflect announcement dates.
[b] Monsanto had previously purchased 40% of DeKalb Genetics.
[c] Dow AgroSciences had previously acquired 69% of Mycogen.
Source: BioScience Securities, Inc.

While the value of seed assets has been boosted by scarcity value in conjunction with the auction process for most assets, many observers have scoffed at some of the prices that have been paid, considering these prices insanity. We believe purchasers have recognized the long-term strategic importance of acquiring and enhancing their seed positions, both from a defensive, as well as an offensive point of view. These acquisition prices take into account critical mass issues, the limited number of acquisition candidates to build viable competitive positions, and the significant amount of time necessary to build businesses that are competitive with the leaders. While the acquisition prices for some companies have been questionable relative to the quality and strategic value of the underlying assets, we believe that when many of the acquisition are viewed ten years from now the price tags will prove to be great values, particularly, from the perspective of future value-capture and strategic positioning.

At the end of the day, the "agricultural biotechnology wave" is only in its infancy. The rewards from capturing the value of this broadening technology-base will go to those companies that have vision and leadership, and to those companies that recognize that the winners will be those that strategically position themselves to win in the marathon race.