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Mycogen: Building a Seed Company for the Twenty-first Century

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This decision case presents the strategic choice set and reasoning of Mycogen, an agricultural biotechnology leader, for how to grow and effectively compete in the fast-changing seed market. Use the case as a basis for discussing strategies and structural changes in the seed industry, the integration of the biotechnology industry and, even more broadly, the formation of firm agribusiness networks.

By May 1997, Jerry Caulder, the long-time chairman and chief executive officer of Mycogen, had decided to step away from the day-to-day management of the company as part of the leadership transition he had set in motion in 1995. As a board member, he would still be actively involved in the strategic direction of the company he had helped develop into a leader of the emerging biotechnology industry. Free from around-the-clock pressures, Jerry was heading to Arizona for a round of golf. On the way to the San Diego airport, the traffic was moving slowly, giving me a chance to question him about the last round of mergers and acquisitions in the biotechnology, seed, and chemical industries. "Biotechnology is forming an umbrella over the seed and pesticides industries, effectively creating a totally new business. All this commotion is just part of the structural adjustment that naturally occurs when fundamental change takes place," Caulder said.

Background

Biotechnology took almost twenty years to reach its commercial phase. In the last couple of years, however, several commercial products had entered the market and many more were waiting in the wings. Most products involved genetically engineered plants. Corn, soybeans, cotton, wheat, sunflower, canola, and a variety of other crops were genetically modified to resist pests and diseases or broad spectrum herbicides that eliminated weeds but had no adverse effect on crops. Others were engineered to have improved composition through modified oil, protein, or starch content. In all cases, the seed was the

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delivery mechanism for these advanced technologies, elevating the seed business to strategic importance. But this was not a "mom and pop" seed business.

Developing the technological base for genetically engineering plants had taken years of research and development (R&D), and continued to demand larger investments. Once developed, however, such technologies could be applied to many different crops grown in various geographic regions, giving rise to large economies of scale and scope. Globalization of agricultural markets was further expanding such economies, raising the minimum efficient size of this new breed of seed business to even higher levels. Biotechnology and seed companies were not the only companies interested in these expanding market opportunities. Chemical companies, which could eventually see much of their pesticide business transferred into the seed, were watching, while distributors, aggregators, processors, and other downstream participants were considering how these changes could affect their businesses.

Changing market conditions were motivating a flurry of mergers, acquisitions, and alliances intended to assemble the strategic assets necessary to compete in the emerging seed industry: biotechnology, germplasm, and a distribution system. Biotechnology companies were seeking high-quality germplasm to deliver their technological arsenal and access to distribution. Seed companies were searching for technological assets and size, while chemical companies were searching for ways to enter the industry. Patent disputes were motivating some of these actions. Overlapping patents and claims on the new biotechnologies were creating uncertainty about the eventual ownership of key technology assets, forcing companies to seek "freedom to operate" through mergers and acquisitions (M&A) or strategic alliances.

Mycogen's Challenge

Operating in this fast-changing and rather fluid competitive environment, Mycogen was faced with a key challenge: how to reach an appropriate size to withstand competition and capture the profits from the rich technology base it had built over the last fourteen years. Should it attempt to grow through M&A in a market where strategic assets were heavily contested, leading to enormous price tags? Should it continue its past networking approach, accessing strategic assets through alliances? Or should it focus on internal growth in a market where competition and new technology could shut the window of opportunity for profiting from current technological assets? In the past fourteen years, Mycogen had met a variety of challenges with well-timed and effective strategies, growing from startup to a $700 million company. This latest challenge could be the biggest and most weighty yet in the company's short history.

Developing Mycogen's Technology

Since the early 1980s, Caulder and Mycogen's scientific staff hypothesized that seed eventually would be the primary delivery instrument for plant biotechnologies. However, they also hypothesized that the basic technological and regulatory challenges for such delivery would not be resolved until the turn of the century. Thus, Mycogen decided to concentrate its limited resources into two strategic directions:

Exhibit 1. Ownership of *Bacillus Thuringiensis (Bt)* genes (*ESpace Patent Database, US Patent Organization, http://patents.cnidr.org/access/search-adv.html*)

	Gene Patents		
	US	**EU**	**Total**
Mycogen	21	15	36
Ecogen	5	6	11
Plant Genetic Systems		4	4
Washington Research Foundation	1	2	3
Monsanto	1	2	3
CIBA	1	1	2
Lubrizol		2	2
Repligen	1	1	2
Sumitomo		2	2
Boehringer Mannheim	1		1
Michigan State University	1		1
Prutech	1		1
Suntory		1	1

1. discovery and development of novel molecules (genes) with pesticidal action
2. development of a delivery system through spray-on biopesticides that would yield commercial products in a reasonable time

Operating on the hypothesis that a large number of genes had pesticidal action against a large number of insects, Mycogen engaged in gene discovery and development. Since early on, the company focused its attention on *Bacillus Thuringiensis (Bt)*, a soil bacterium with proven pesticidal action against insect pests. Mycogen built an extended *Bt* library by collecting samples around the world, from the Galapagos Islands to the California desert, and put its energy into discovering, isolating, and developing novel *Bt* genes with pesticidal action against commercially important insect pests.

Then, the operative hypothesis was contrary to the dominant scientific view that only a few genes control few insects. Yet, Mycogen's hypothesis was based on a simple rationale. If a protein with pesticidal action produced by the microorganism at the time of its death is so central to the survival of that species, there could have been coevolution. As insects evolved, the microorganism could have evolved to increase its repertoire of genes to kill a larger number of different insects. Mycogen's hypothesis proved correct and it gave the company worldwide dominance in the discovery and ownership of *Bt* genes and gene patents (exhibit 1).

Mycogen considered its genes and gene patents strategically important. Early on, the main objective was to use these new genes in foliar biopesticides. The long-term objective was to place them into plant genomes, thereby enhancing the plants' abilities to resist insect damage. Mycogen operated under the hypothesis that basic transformation and genetic engineering technologies would eventually become accessible, while genes and gene patents would be in short supply.

Getting into the Seed Business

Caulder remembered,

> By the early 1990s, it was apparent to us that biotechnology would be deployed in a manner that Mycogen was not organized to address. Plant transformation technology had advanced faster than we had originally predicted and transgenic plants were emerging as the preferred way to leverage advances in biotechnology. At that time, Mycogen did not have the capability to put genes into plants; it did not have the freedom to operate from an intellectual property standpoint; and it was not in the seed business in order to deliver the technology.

A fundamental decision was determined: Mycogen would not license its gene technology and gene library. Instead, it would forward-integrate. Caulder began to search for a partner in the seed business with expertise in plant transformation. Agrigenetics was an almost perfect fit.

A biotechnology pioneer with emphasis on plant transformation, Agrigenetics had developed a significant technological base financed mainly through a $55 million limited-research partnership it established in 1981. Through the acquisition of twelve regional seed companies, Agrigenetics had also built a significant seed business with almost $100 million in sales of alfalfa, soybean, hybrid corn, hybrid sorghum, and hybrid sunflower planting seed. Aggressive expansion, however, took its toll on the bottom line and forced the sale of Agrigenetics to the Lubrizol Corp. in 1985.

In 1989, Lubrizol also acquired Sungene, a California biotechnology startup that specialized in somoclonal variation and conventional breeding of corn, soybeans, and sunflower, and merged it with Agrigenetics. Mounting losses and a prolonged legal dispute with the limited partners of Agrigenetics, however, produced headaches and made it less strategic to Lubrizol. In 1992, Caulder approached Lubrizol with an offer to merge Mycogen with Agrigenetics. Lubrizol, an early investor and primary stakeholder of Mycogen, happily gave up control of Agrigenetics to Mycogen.

Creating a New Brand of Seed

Through significant in-house R&D and sponsored research with almost two hundred scientists at twenty universities and research institutes, Agrigenetics had amassed significant technology, ranging from molecular biology and cloning to tissue culture and traditional breeding. The technological complementarities with Mycogen's gene technology and patent estate were obvious.

On the seed-business side, however, the picture was less transparent. Agrigenetics was caught up in the paradigm of discounted seed and multiple brands, remnant strategies from the regional seed companies from which it was pieced together. As these regional companies operated independently, Agrigenetics had multiple sales forces with overlapping territories often calling on the same customers to sell subsets of 290 seed products it offered. Maintaining inventories for so many products further increased costs. Low-quality seed, primarily from antiquated production facilities, commanded low prices and, in combination with high costs, made margins nonexistent.

As an outsider, Caulder was using a different paradigm. Going against the conventional wisdom of the seed industry, which at that time was brand-proliferation, he thought that all existing regional companies and any other seed companies Mycogen would acquire in the future should be consolidated into a single national brand under a new name. In this way, seed quality could be controlled across the board, and when advanced biotechnology was delivered, it would become the differentiating factor. By 1997, only eighty-four products were being offered under a single brand: Mycogen Seed®.

Building the Seed Business through Acquisitions and Strategic Alliances

Having gained a foothold in the seed industry, Mycogen began to build its seed business through a network of partnerships. Using Mycogen's intellectual property rights and technology as currency, Caulder negotiated several strategic alliances and acquisitions that could be the key to Mycogen's future competitive position.

Ciba Seeds Agreement

In 1993, Ciba Seeds and Mycogen signed a cross-licensing agreement on *Bt* corn. Ciba offered Mycogen the corn seed it had genetically engineered for resistance against European corn borer and access to extended work on *Bt* toxicology in exchange for freedom to operate. Ciba's transgenic seed corn was infringing on Mycogen's patented technology. Through this agreement, Mycogen leapfrogged the competition and in 1995, along with Ciba, was first to market with its transgenic *Bt* corn, capturing market share and some of the excitement associated with the introduction of this important new product.

Acquisition of the Delta and Pine Land Corn and Sorghum Business

In 1994, Mycogen acquired the Delta and Pine Land's corn and sorghum business, expanding Mycogen's germplasm pool and greatly enhancing its distribution system in the southern Corn Belt.

Cargill Agreement

In 1995, Mycogen signed a distribution agreement for its *Bt* corn with Cargill Hybrid Seeds, a large seed distributor. With this agreement, Mycogen significantly improved its distribution system and gained access to Cargill's tropical germplasm.

Pioneer Agreement

In 1995, Mycogen signed a ten-year product-development agreement with Pioneer Hybrid, the overwhelming worldwide leader in corn and other seed markets. Under this agreement, Mycogen would contribute its *Bt* gene technology in exchange for Pioneer's expertise in plant transformation and its enormous capacity for product development. Mycogen's genes would be placed into each company's proprietary germplasm across many crops of interest. For each transformed product, both companies were obligated to reach the market at the same time. This long-term strategic alliance greatly expanded Mycogen's

product development capacity, allowing it to genetically engineer multiple crops and parent lines simultaneously. It effectively shortened Mycogen's timeline of new product introduction by several years.

Dow Elanco Agreement

In 1996, Mycogen acquired United Agriseeds from Dow Elanco. The acquisition contributed added sales, high-quality proprietary germplasm and, most important, much-needed production expertise and modern factories. Given that advanced production technology and factories are a key to high-quality seed, the acquisition was a significant step toward upgrading Mycogen's seed quality. The acquisition also joined Mycogen and Dow Elanco, a $2 billion chemical company and a subsidiary of pharmaceutical giants Dow and Elli Lilly, in a close relationship. Dow Elanco received Mycogen stock instead of cash for the sale of United Agriseeds, and it further enhanced its ownership position by buying Lubrizol's interest in Mycogen. At the end of the three-way negotiations, Dow Elanco owned 46% of Mycogen.[1] In Dow Elanco, Mycogen was getting a partner with large capital resources and, importantly, a significant presence in the entrenched agrichemical industry.

International Agreements

In 1996, Mycogen negotiated two additional agreements that expanded its international presence. It first acquired Morgan Seeds, Argentina's third-largest seed company with $25 million in sales. It subsequently merged its European subsidiary with Verneuil, a $62 million, French seed company, in exchange for a 19% interest in the new entity. Both agreements improved Mycogen's reach to the European and South American seed markets.

The Competition

Through strategic alliances and acquisitions, Mycogen had, in just a few years, achieved significant presence in the seed market (exhibit 2). Yet, Mycogen's swift transformation from a biopesticide company to an integrated biotechnology and seed company produced, for the most part, little reaction on Wall Street (exhibit 3). This may have, in part, affected the riskiness of Mycogen's new strategy. Others could follow the same forward integrating strategy and, depending on their capital resources, they could outdo Mycogen. One case in point was Monsanto, a chemical giant and a leader in biotechnology research. Monsanto followed strategies parallel to those of Mycogen and within eighteen months—beginning in mid 1995—it spent more than $2 billion acquiring large planting and foundation seed companies and striking alliances with companies owning complementary assets.

In addition to Monsanto, other key players had made aggressive bids for a position in the emerging seed industry, including the following:

[1] In March 1997, in an effort to block an acquisition bid by a third party, Mycogen allowed Dow Elanco to become majority owner of the company, raising its stake to 52%.

Exhibit 2. Market Share[+] (Industry Sources, Doanes, 1994 Successful Farming Survey)

Corn		Soybeans	
Pioneer	41.0%	Pioneer	22.0%
DeKalb	10.1%	Asgrow	15.0%
Northrup King[*]	5.0%	DeKalb	19.0%
Mycogen	**4.3%**	Stine	4.0%
Cargill	3.3%	FS	3.9%
Ciba[*]	3.1%	**Mycogen**	**3.7%**
ICI	2.9%	Public	3.2%
Golden Harvest	2.3%	Others	41.2%
Asgrow	2.0%		
Others	25.6%		

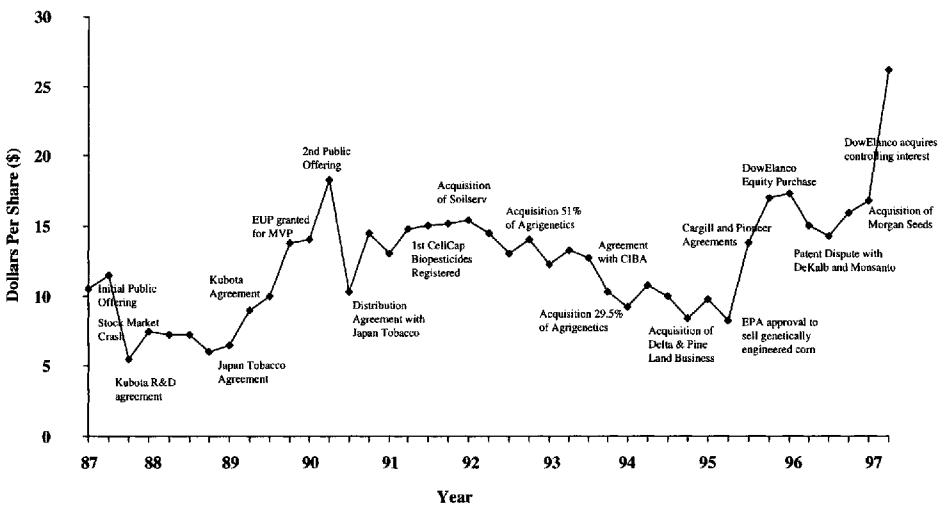
Oil Sunflower		Grain Sorghum	
Mycogen	**33.0%**	Pioneer	19.0%
Cargill	30.0%	DeKalb	19.0%
Interstate	16.0%	NC[+]	12.0%
Pioneer	12.0%	**Mycogen**	**10.0%**
Others	9.0%	Others	9.0%

[+]All figures for 1996 except for Soybeans (1994)
[*]Now merged to form Novartis Seeds

- Novartis, a $23 billion company created by the megamerger of pharmaceutical and chemical giants Ciba and Sandoz, which had a significant position in the seed and agrichemical industries and aggressively pursued additional assets in the seed industry;
- AgrEvo, a subsidiary of chemical and pharmaceutical giants Hoesct and Shering, which, through its $770 million acquisition of Plant Genetic Systems of Belgium in 1996, made a significant commitment to biotechnology and aggressively pursued assets in the seed industry;
- DuPont, an early investor in its own biotechnology R&D, which had a significant technology base, primarily in value-added traits, and pursued assets in the seed industry;
- Pioneer and DeKalb, both with significant biotechnology capability and rich germplasm pools, which had brand-name recognition, and extensive distribution of assets in the seed industry;
- ICI-Zeneca, Limagrain, Cargill, Golden Harvest, and a variety of other smaller companies, including five hundred regional seed companies in the United States and about seven hundred more worldwide, which had some assets in the seed industry.

Although biotechnology was creating significant economies of scale and scope in seed production and distribution, the breadth and depth of the strategic assets needed to capture such economies could overwhelm even large

Exhibit 3. Mycogen quarterly stock prices



players. M&A, joint ventures, and a host of contractual agreements connected many firms attempting to garner critical mass in a timely manner. These actions had transformed the competitive environment into one where networks or clusters instead of individual firms were often competing. Strategic positioning in such a competitive environment was complex because one had to consider the response of not only competitive firms but also allied firms.

Key Strategic Assets in the Twenty-First Century Seed Industry

Given the stage of technological development and the makeup of key players, three asset classes had become important for establishing a competitive position in the emerging seed industry: intellectual property rights (IPR), a germplasm pool, and an effective distribution system.

IPR

In the new seed business, IPR figured to be of strategic importance. In the long run, intellectual property claims could provide competitive advantage. In the short run, they could separate players from nonplayers. While science had advanced quickly to make many biotechnology tools and processes increasingly accessible, they were not free because of IPR coverage. Companies with a weak IPR base would have to pay significant licensing fees to operate with obvious effects on their profitability. Such companies could exit the industry, releasing assets for the growth of the remaining firms.

Overlapping patents, claims, and counterclaims on a variety of transformation processes, genes, gene constructs, and other essential biotechnology tools had produced a barrage of lawsuits among firms who sought technological dominance or simply freedom to operate. If the history of the mechanical and

chemical industries, however, had any lessons for biotechnology, they would suggest that most lawsuits and patent disputes could eventually be negotiated and cross-licensed to allow freedom to operate. Firms could be willing to negotiate mutually agreeable solutions instead of basing key business decisions on highly unpredictable and time-consuming outcomes of litigation. A few patents, however, could have fundamental value and could prove strategic.

By the end of 1996, Mycogen held more than four hundred U.S. and foreign patents and had filed an additional 115 patent applications. The company was also the owner of what could be a landmark patent. In the early 1980s, when *Bt* genes were first successfully inserted into plant genomes, it was observed that transformed plants produced small amounts of pesticidal protein, but not at levels to be commercially significant. Different solutions were proposed for this expression problem. Plant Genetic Systems truncated the *Bt* gene; DeKalb used an improved transformation process that "stuffed" more of the *Bt* gene into the plant genome; Mycogen synthesized a new gene by replacing specific nucleate in the native gene. Mycogen's approach to modifying *Bt* gene sequences made them resemble those of the plant into which they were inserted, thereby improving the gene's efficiency in producing pesticidal protein. This synthetic-gene technology has since been broadly used by many biotechnology companies, including Monsanto and DeKalb.

In 1995, the company received U.S. and European patents, covering its method of modifying *Bt* genes to make them more "plantlike." In October 1996, Mycogen received two additional patents relating to synthetic *Bt* gene technology. These later patents include "composition of matter" claims to modified *Bt* genes, plant cells transformed with such genes, and transgenic planting seeds containing the modified genes. If such claims could withstand challenges from competitors, Mycogen could end up the undisputed leader in *Bt* technology.

Germplasm

Biotechnology delivery through the seed had renewed the importance of germplasm as a centerpiece in the seed business. While many new traits added to plants through genetic engineering had visual (aesthetic) effects, their separate effect was difficult to evaluate outside the controlled environment of a laboratory. Yield was still the most dependable yardstick of performance in the field. As a result, high-yielding, high-quality germplasm adapted to a variety of geographic locations was essential for effective biotechnology delivery. And even with the latest breeding methods, developing germplasm was still a time-consuming process. Pioneer Hybrid and Holdens had the deepest germplasm pools, followed by DeKalb, Asgrow, and Novartis. Much of the germplasm small regional companies used was licensed from Holdens, although regionals still owned packets of high-quality proprietary germplasm. In corn, Mycogen had a good position in proprietary germplasm of early maturities, but still needed to expand its germplasm pool in other maturity zones. In the other seed markets, Mycogen was well-endowed with high-quality proprietary germplasm.

Distribution System

The distribution system for seed was undergoing its own transformation.

Most industry observers argued that the farmer-dealer network, the industry's dominant distribution system, was becoming less relevant. Some type of store-front distribution system, which could bundle seed, fertilizer, and chemicals with services and expert advise, could emerge as the dominant distribution system. Agricultural chemical companies were accustomed to delivering their products through such a system and might have an implicit advantage from previous knowledge and logistical support. As farms were growing larger, direct delivery could also be possible.

Choices

In the past few years, Mycogen made significant progress toward building a seed company for the twenty-first century. For the company to be competitive in the emerging seed industry, however, size was essential. But what approach to growth would leverage Mycogen's technology in the best way?

- Should it attempt to grow through M&A, and who should be the primary targets? Should Mycogen focus its attention on small, regional companies or key, large purchases?
- Should it attempt to grow through strategic alliances, and who were some key partners?
- Could it afford to wait and grow internally?
- What was the importance of Dow Elanco's majority ownership:
  - Would Dow Elanco's majority ownership damage the entrepreneurial spirit that had made Mycogen so successful?
  - Or would this majority provide Mycogen the capital resources and complementary expertise, giving it extra spring in its market positioning?

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