## CASE STUDY

# MONSANTO AND INTELLECTUAL PROPERTY

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Jim Tobin, director of Biotech Business Development at Monsanto, had to prepare for a planning meeting with Management. He was part of a team whose functions included marketing, breeding, microbiology, entomology, regulation, public affairs, and product development. Monsanto already had a contract with Delta & Pine Land (D&PL), the largest breeder and producer of cottonseed, to market a genetically modified form of cotton that manufactured its own insecticide. These cotton plants, which would be marketed under the name Bollgard®[1], had been genetically modified by the addition of *Bacillus thuringiensis* (Bt), a soil bacterium that produced a protein toxic to the cotton bollworm. Organic farmers had used Bt as an alternative to chemical pesticides.[2] Monsanto researchers led by Ernest Jaworski took the gene that produced the protein and inserted it in plants like tomatoes, corn, and cotton.

The agreement with D&PL called for Monsanto to do market research in order to find out what premium farmers were willing to pay for the modified seed. A typical price was about $8 to $10 an acre for seed, and, on average, the farmer would have to spray four times during the year with each spraying costing about $8 to $10. Any price below $32 an acre would be a competitive price for farmers. If, however, they used the seed from one generation of Bollgard to plant the next, such a price would not be profitable for Monsanto, especially given the costs of research and development.

The stakes were high, because whatever solution Tobin and his team evolved for Bollgard could be applied to other genetically modified (GM) crops, such as soybeans made genetically resistant to Monsanto's herbicide Roundup.

## Betting the Company

Monsanto established itself as a leader in the pesticide business in the 1970s with their flagship product, Roundup herbicide.[3] Beginning in the 1980s, Monsanto executives, speculating that the chemical business was not the best option for long-term success, began the reorganization of Monsanto as a "life sciences company."[4] Thus, Monsanto became the first major corporation of its kind to devote itself fully to the newly emerging field of biotechnology. Beginning in 1979, the corporation devoted immense capital specifically to plant biotechnology. Even with this specialization, however, Monsanto did continue to keep exploring other avenues of general biotechnology, acquiring the pharmaceutical giant, Searle, in 1985.

During the mid-1980s, the work of industry and academic research scientists materialized in the form of several key agricultural products. At Monsanto, Ernest Jaworski headed a research team investigating the modification of plants at the genetic level.[5] The goal of the Monsanto team was to produce seeds with desired traits that would not otherwise be obtainable through conventional breeding by using genetic manipulation.

CEO Dick Mahoney later acknowledged, "We didn't have a good business plan on how to make money out of this stuff, [but] the science was so intriguing, it was my feeling we ought to just keep going."[6]

The expense related to this research was substantial. Monsanto executives were literally "betting the company" that their investments in the life sciences business, and in genetically modified (GM) seeds in particular, would pay off richly by the mid-1990s.[7]

By 1996, the cumulative research tab was approximately $1.5 billion.[8] As Monsanto switched its emphasis to the life sciences, the goal of maintaining its leading industry status required sustaining considerable "criticism from Wall Street that Monsanto's R&D spending was profligate," while at the same time satisfying "requests from the scientists for more money."[9]

## Premier Products

By the late 1980s, Monsanto's emphasis turned to the commercialization and "value capture" of these new technologies. The company began testing GM tomatoes in 1987.[10] The first traits developed commercially were herbicide resistance, virus resistance, and insect resistance. Plants with these traits were approved for commercialization in late 1995.

One of Monsanto's goals was to produce Roundup Ready™ (RR) crops, resistant to the herbicide glyphosate, the active agent in Monsanto's lead herbicide Roundup™. Roundup was a broad-spectrum herbicide that would kill most plants with which it came in contact. This meant that Roundup could only be used before crop emergence with traditional crops because it would kill a growing crop as well as the weeds. With a RR crop, however, Roundup could be used for weed control throughout the growing season. Monsanto scientists first made tomato plants partially resistant to Roundup in 1985.[11]

That kind of expense, in time and money, was not unusual in the development of GM crops because for every "new kind of engineered seed that makes it to field trials, 10,000 have failed somewhere along the development pipeline."[12] Insect-resistant crops required eight years to move from their laboratory beginnings to the first planting of Bollgard Cotton™ in 1996.[13]

Bollgard Cotton™ was a genetically modified plant that utilized a common soil bacterium, *Bacillus thuringiensis*, used previously by organic farmers who sprayed it as a natural and environmentally safe insecticide. Monsanto had manufactured an insect-resistant cottonseed by inserting the gene into an older variety, Coker 312, which was easier to transform. The result was a cotton plant that produced a protein toxic to Lepidopteran insects. The protein worked by entering the gut of the insect and binding together cell parts, which, by interfering with the receptors, effectively shut down the digestive process, causing the insect to starve to death. Additionally, the protein was not harmful to humans or animals.

After its success with the Coker 312 variety, the plant had to be backcrossed with modern varieties in order to achieve the superior qualities that would make the cotton plant viable in a commercial market. D&PL and Monsanto breeders did this by backcrossing the Coker 312 variety with several new varieties. Those offspring retaining the Bt gene were then re-crossed with the Deltapine® variety, and this procedure was repeated until all the resulting plants carried the Bt gene.[14]

## Commercializing Biotechnology

Monsanto's major challenge was to prove that they could make money on this new technology. Roger Krueger remembered, "[at the time] the view from industry, outside of Monsanto, was don't even try [to market it] . . . 'no one's going to make money on this, because it's not in a jug and you can't resell it, growers are just going to save the seed.'"[15] Jim Tobin and his team needed to demonstrate that this particular project could make money and sustain the value they were delivering. Their biggest challenge was the risk of farmers saving seed.

In industry parlance, Monsanto needed a "value capture strategy," a way to recoup the numerous and varied investments leading to the product. To be effective, the value capture strategy would need to include (1) developing stewardship recommendations, often in conjunction with the Environmental Protection Agency (EPA) and other regulatory bodies, (2) working with the established practices of farmers, and (3) attending to market demands and profit considerations.

Value capture strategies would also need to vary for specific crops, with special attention paid to the established grower practice of planting saved seed. Soybean, rice, and cotton farmers viewed the seeds they produced as their property. "Take Roundup Ready wheat as another example . . . where ninety percent of the people save their seed. . . . We have to go back and say 'what's the value capture technique for that?'"[16] (Seed saving was not a concern for hybrid crops such as corn, because hybrids do not perform as well after the first season; consequently, these growers typically purchased new seed from distributors annually.)[17]

## Strategies

Jim Tobin and his team had a variety of strategies for realizing profits from GM plants.

### *Patents*

The initial consideration Monsanto faced was whether or not to patent their processes and products. Patenting required that the company make public its methods. An alternative was for Monsanto to keep the agricultural processes and products developed by the company as trade secrets. Examples of trade secrets included the Coca-Cola formula and dye formulas used by chemical companies. Tobin knew that patenting was an integral part of Monsanto's strategy for protecting its R&D investments.

### *Licensing strategies*

Monsanto did not sell its own products directly to consumers; instead, they licensed other chemical and seed companies, like D&PL, to sell their products. Jim Tobin knew that whatever licensing strategy he and his team evolved with D&PL would serve as a model for licensing GM seeds to other companies.

*Paid-up Licensing*: A paid-up license required that a company pay an up-front licensing fee to Monsanto for the right to use a process patented by Monsanto to develop a GM seed of their own.[18] This strategy can generate revenue during the early stages of technological development, rather than after a product has successfully proceeded through regulatory approval and marketing. Thus, revenue gained from a paid-up license could be used to generate immediate monies needed to finance continuing research. However, a paid-up license was a finite agreement. Monsanto would profit only once using this strategy, and give up profits from any future sales covered by the agreement.

*Royalty Fee*: A second version of a licensing strategy would allow the same type of patent usage, but the payment would be based on the seed company's per unit seed sales. Doug Dorsey recalled, "in the early 1990s . . . Monsanto's strategy to capture value from the Roundup Ready trait was to collect a royalty from seed companies using the trait and to sell incremental volume of Roundup herbicide for use over RR crops. [But] for Bt crops, there was no opportunity to capture value from increased pesticide sales."[19]

Delta & Pine Land Company could utilize Monsanto's proprietary Bt cotton technology in their seed germplasms and in exchange pay Monsanto a royalty based on the per-unit sale of these seeds.[20] This type of royalty agreement would leave Monsanto in a position of realizing a profit in the future rather than generating immediate revenue.

*Technology Fee*: Another type of strategy employed a technology fee that would be listed directly on the product or invoice, where it would be visible to all parties involved, including seed retailers and growers. Separating the cost of the seed germplasm from the technology fee could serve an informational role. Monsanto could demonstrate to growers that the technology fee was part of the cost of weed control (for the Roundup Ready trait) or insect control (for the Bt trait). "For example, in the Roundup Ready soybean system, [growers see that] the weed control cost is [equivalent to] the Roundup Ready technology fee plus the cost of Roundup herbicide . . . [rather than just a] part of the seed/germplasm cost."[21] Similarly, in the case of Bt cotton, Monsanto could add a technology fee to the price of the GM germplasm and keep a percentage of that fee as a royalty. The royalty sharing that Monsanto had proposed to D&PL was 29 percent after distribution fees.

But what if farmers saved seeds for replanting? If a technology fee amounting to a few dollars per acre was charged only when the product was bought, and a farmer bought new GM seeds every few years rather than annually, Monsanto would not be paid every time a farmer used the product. This problem became worse when one considered important international markets like China, where seed saving was common practice.

### *Contracts*

Monsanto could decide to license use of the seed directly to the farmer. This strategy would communicate the value of the trade, as well as commit the farmer to signing enforcement language.

The EPA had asked Monsanto to plant non-Bt crop refuges to protect against insect resistance. These contracts could make it possible to enforce the EPA agreement as well, by insuring that growers were committed to using the technology appropriately.[22]

Monsanto employees believed that the contracts had an educational role.[23] The status of GM seeds as a new technology required a significant investment of time and resources and special stewardship practices. This could be facilitated through contracts. Eric Sachs, a Monsanto employee since 1978 and in the year 2000 a lead in the Scientific Outreach department, believed that the stewardship program, employed in conjunction with the GM seeds, was a great benefit to their growers.[24]

Perhaps contracts could also be used to prevent farmers from reusing seed. Monsanto could make a contract with each farmer, licensing her or him individually, and not just the company, to sell the seeds. Monsanto could offer the seed companies a larger portion of the technology fee in exchange for helping with farmers' signatures.

Tobin knew from market research with farmers that those who signed the contract and agreed not to save seed did not want to discover their neighbors were using Monsanto seeds and violating the contract. Any farmer who paid the technology fee only once and reused seed would have a significant advantage over other farmers who honored the contract. Monsanto had to be ready to prosecute those who violated the contract, which meant the company would have to be ready to inspect the farmers' fields.

*End-use fee*

Another form of the royalty strategy was to charge a fee after the crops were harvested. In this case, an "end-use fee" (EUF)—a sort of royalty paid directly by the farmer—would be collected when the crop was sold to the grain elevator. The end-use fee differed from the technology fee in that the grower paid the royalty directly, unmediated by a seed distributor. With an EUF, GM seed would be sold at a price reflective of the quality of the germplasm. "At the end of the season, [the crop] is certified that it has that trait in it, and then a royalty is put on top of [the selling price]."[25 26] Put simply, the grower pays a per-bushel technology fee when they sell their crop, though this fee could vary.[27]

The EUF that a grower paid would not be standardized on a per-acre basis, but could vary by crop yield. "The scheme has to vary because, the guys that do well, you don't want to penalize them more than the ones that don't do well."[28] For example, there would be a set royalty fee per bushel based on expected crop yield; if the crop produced less than expected, the

EUF fee would be reduced on a per-acre basis.[29] Both the grower and the technology provider would "share in risk and benefit."[30] The EUF strategy ensured that the patent owner profited and limited the seller's involvement in the grower's affairs. Monsanto would not need to hire inspectors or prosecute farmers for contract violations. However, this strategy would not necessarily prohibit seed saving.

*Technical solutions*

One way of avoiding contracts or end-user fees was to adopt a technological solution. D&PL was working with the USDA on a Technology Protection System (TPS) that would involve adding a gene to GM seeds that would render them sterile after the first generation. The goal of TPS was to develop a seed "that will grow normally until the crop is almost mature. Then, and only then, a toxin will be produced in the (seed) embryos, specifically killing the entire next generation of seeds."[31][32]

The grower's crop would produce crops with sterile seeds, preventing him or her from saving the crop's seed for replanting. This was a technological strategy that had the potential to replace the use of a contract forbidding seed saving and ensure that a technology fee was collected with each planting of GM seeds. Though seemingly simple, this was an intricate process.

TPS could be a simple solution to the problematic international market in developing nations, such as China and Brazil. The markets in developing countries had the potential both for enormous growth and profit for Monsanto and D&PL, but had also shown themselves to be potentially unreliable when it came to respecting intellectual property rights.

If Chinese farmers violated contracts and patents and pirated the expensive technology by saving seeds, cotton prospects in China could be ruined. Misuse of the Bt cotton technology could lead to insects building up resistance to the crops, destroying the technology's effectiveness. Pirated seeds could also be sold on a black-market across international borders.[33] However, if the TPS technology were in place, the problem of seed saving would become a non-issue.[34]

Using TPS could address environmentalists' concern about possible "gene migration" from GM plants to non-GM plants, creating what environmentalists called "superweeds"—weedy relatives of RR crops that were resistant to Roundup herbicide. As Tom McDermott, vice president of Global Industry Affairs at Monsanto, noted, "sterile seed technology eliminates the concerns of out crossing and gene flow."[35] Sterile Seed Technology, when used in conjunction with another GM trait such as the RR gene, might prevent the migration of the RR gene to weedy relatives.

However, should the TPS be developed and utilized, it was possible that the "toxin gene" could migrate to a nearby field, making the non-TPS plant sterile, because these seeds were visibly indistinguishable from others. Since the mutation would not be detected, the sterile seeds would reduce crop yield for a neighboring farmer.[36]

## A Decision

Jim Tobin had to choose among these different options in order to make a profitable launch of Bt cotton. He knew that whatever he decided would serve as a model for other GM products Monsanto would bring to market, both domestically and internationally[37].



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## Notes

[1]Bollgard is a registered trademark of Monsanto.

[2]Interview with Douglas Dorsey, Monsanto, 2000.

[3]Daniel J. Forrestal. *The Story of Monsanto: Faith, Hope, and $5000: The Trials and Triumphs of the first 75 Years* (New York: Simon & Schuster, 1977).

[4]Luna Mya Magpili Magliaro, Unpublished interview with Ernest Jaworski at Monsanto Headquarters, 1999.

[5]Karen Keller Rogers, "Fields of Promise: Monsanto and the Development of Agricultural Biotechnology," Part 2 of 2 "Creating the Future," *Monsanto Magazine*, 1(1997).
<http://www.monsanto.com/ag/articles/FieldsOfPromise/framemonmag.html>.

[6]Karen Keller Rogers, "Fields of Promise: Monsanto and the Development of Agricultural Biotechnology," Part 1 of 2: "Creating the Future," *Monsanto Magazine*, 4(1996).

[7]Rogers (1997).

[8]Ron Stodghill II, "So Shall Monsanto Reap? Its Biotech Bet Must Pay Off Big to Pay Off At All," Business Week (April 1, 1996).

[9]Mahoney cited in Rogers (1996).

[10]Rogers (1997).

[11]Ibid.

[12]Rick Weiss, "Gene Police Raise Farmers' Fears," Washington Post, 3 February, 1999. p. A1 (also available at <http://www.purefood.org/Monsanto/harassfarm.cfm>).

[13]Robert Steyer, "Monsanto Cotton Gets Green Light: New Pest-resistant Plants to be Ready by Spring Planting," *St. Louis Post-Dispatch*, 1 November, 1995, p. 1C.

[14]Charlotte A. Tasker, (prepared under the supervision of Professor Ray A. Goldberg, Harvard Business School), "Delta & Pine Land: Measuring the Value of Transgenic Cotton," Harvard Business School Case Series, 9-597-005, (revised May 6, 1997).

[15]Interview with Roger Krueger, Monsanto, 2000.

[16]Krueger interview.

[17]Martha Crouch, "How the Terminator Terminates: An Explanation for the Nonscientist of a Remarkable Patent for Killing Second Generation Seeds of Crop Plants," Edmonds Institute, Edmonds, Washington, 1998 (also available at <http://www.purefood.org/Monsanto/howterm.cfm>).

[18]Virgina Baldwin Gilbert, "Jury Rules for Monsanto Against Pioneer Hi-Bred: Corn-Seed Company Will Pay Royalties for Future Sales of YieldGuard," *St. Louis Post-Dispatch*, 25 August, 2000, p. C1.

[19]Dorsey interview.

[20]Robert Steyer, "EPA Approves Field Test of Gene-Altered Cotton," *St. Louis Post-Dispatch*, 13 April, 1992. p. 6.

[21]Dorsey interview.

[22]Interview with Eric Sachs, Monsanto, 2000.

[23]Krueger interview; Sachs interview.

[24]Sachs interview.

[25]Krueger interview.

[26]Standards determining what ratio of GM to non-GM seed was considered a GM certified crop and thus subject to the EUF would need to be established. According to one concerned farmer, "Roundup Ready pollen from other farmers' fields is blowing everywhere in the wind . . . and he's seen big brown clouds of canola seed blowing off loaded trucks as they speed down the road around harvest time." At least a small percentage of unintentional cross-pollination was likely to occur. However, Monsanto informants maintained that cross-pollination would result in negligible contamination of neighboring farmers' crops and so would not be charged the fee (Krueger interview).

[27]Dorsey interview.

[28]Krueger interview.

[29]Dorsey interview.

[30]Krueger interview.

[31]Crouch, p.4.

[32]This is only one example of how technology might work or could be used. These technologies were transformation and crop specific. For example, Roger Krueger noted, "ideally, only the gene of interest would be turned off in the second generation and the remaining genes would work normally," preventing such a scenario as discussed here (2000).

[33]S. Stecklow, and M. Moffett (1999). "Soys from Brazil: A Latin Nation's Beans are Sold as 'Non-GM,' But Don't Ask Farmers," *Wall Street Journal*, New York, p. A1.

[34]Tasker.

[35]Interview with Tom McDermott, Monsanto, 2000.

[36]Crouch.

[37]This case was written with the assistance of Jim Tobin, Doug Dorsey, and Roger Krueger of Monsanto.