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ZENECA AGROCHEMICALS

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Zeneca's agrochemical strategies had two major strands: developing the profit potential from existing patented and off-patent chemicals where this was feasible; and major investment in discovery of new, patented products. In developing genetically modified (GM) crops, managers were mainly focusing on output rather than input characteristics. The new "whole crop strategy" was based on an understanding that agrobiotechnology markets are likely to be based on a combination of chemicals and transgenic methodology, and included the assumption that GM-based output traits would enhance the economic value of the crop, increasing the demand for effective crop protection from a combination of chemicals and GM input traits.

Key Words: innovation; pesticides; GM crops; sustainable development; strategy.

At the time of carrying out interviews for the Policy Influences on Technology for Agriculture project (or PITA), Zeneca was the third largest producer of agrochemicals, after Novartis and Monsanto. Zeneca Agrochemicals was one of the constituent parts of AstraZeneca, together with AstraZeneca Pharmaceuticals. The Dutch/British seed company Advanta, in which AstraZeneca had a 50% share, reported directly to the AstraZeneca board of directors. Zeneca Plant Science was a subsidiary of Zeneca Agrochemicals which also included Mogen. This Dutch plant biotechnology small-to-medium enterprise (SME), with strengths in genetic modification for fungal and nematode resistance and in the production of enzymes and carbohydrates in plants, was acquired in 1997. In plant biotechnology, Zeneca Agrochemicals also had important formal collaborations with over 50 academic and industrial partners, in addition to its own major research and development (R&D) facilities at Jealott's Hill in the United Kingdom (UK) and Richmond, California. Table 1 gives the key financial figures for Zeneca Agrochemicals and table 2 presents the company's sales by main pesticides group. Approximately 7,000 staff worked in Zeneca Agrochemicals' business worldwide.

This paper describes the strategies developed by Zeneca for the production of agrochemicals and GM crops, given the complex European policy environment for both pesticides and GM crops and the European public's increasing opposition to them.

Agrochemical Strategies

Given the slow growth rate in most agrochemical markets, increases in sales to compensate for contraction elsewhere was expected to come mainly from developing countries. The Chinese market, for example, was expected to equal that of the United States (US) in 30 years time. Agrochemical strategies had two major strands: developing the profit potential from existing patented and off-patent chemicals where this was feasible; and major investment in discovery of new, patented products.

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Table 1: Key Figures for Agrochemicals (Million GBP).

	1994	1995	1996	1997	1998
Agrochemical Sales	1,521	1,639	1,801	1,631	1,738
Operating Profit[1]			224	223	216
R&D Expenditure[2]			162	163	172

Note. [1]Before exceptional items. [2]Including specialties. From "Zeneca Annual Report," by Zeneca Agrochemicals, 1999.

Table 2: Pesticide Sector Sales (Million GBP).

	1996	1997	1998
Herbicides	1,033	1,025	974
Insecticides	377	329	314
Fungicides	176	204	395
Other Agrochemicals	98	73	55
Total	**1,800**	**1,631**	**1,738**

Note. From "Zeneca Annual Report," by Zeneca Agrochemicals, 1999.

Developing New Pesticides

For agrochemicals R&D, Zeneca, like most other leading agrobiotechnology companies, had developed high-throughput screening facilities (Steinrucken & Hermann, 2000) to identify new products. The process uses combinatorial chemistry to provide the large numbers of chemicals for testing, and genomics to provide insights into plant and animal biology to enable rational targeting and design of pest control products (Evans, 2000). These innovations had enabled Zeneca to screen over 100,000 new chemicals per year, compared to the previous 15,000, but the end result from the new system was still likely to be just one successful product on the market every one or two years. High-throughput screening was more efficient at identifying potential new leads than previous systems so the end products would have the quality needed to meet today's more discriminating regulatory standards. Getting improved products to market by this means was a key component of Zeneca's strategy for maintaining and increasing its market share.

Zeneca saw good opportunities for new technology in future markets, for example, products such as its fungicide Amistar which has a superior environmental and toxicological profile compared to competing products, is applied at lower rates and has less effect on the water table and non-target species. In the company's opinion, growth in value has to come from innovation and if a company has new and better technology there would be no problem in getting market share. On the other hand, although new products are not necessarily more expensive to begin with, older competing products tend to become cheaper when faced with improved technology and this could cause problems for all pesticide companies in their attempts to market products with a better environmental and toxicological profile. On the whole, where a product had environmental advantages, Zeneca considered that the policy and regulatory environment was more supportive than before in most countries.

Supporting The Existing Product Range

The question of how to continue to extract value from off-patent products is a major issue for multinational companies. Zeneca had scrutinized its product portfolio for chemicals with a poor return on net assets and had made major savings by withdrawing altogether from insufficiently profitable markets or by sales of some product rights to other companies. By 2003, 85% of the agrochemicals business was expected to be concentrated in approximately 12 products, compared to 50% of the business in 40-42 products in 1994 to 1995. Support was only given to off-patent products if they fitted into the portfolio at certain stages of development.

An important factor in decisions about defending an off-patent product was the existence of special circumstances which would enable the company to retain control over the product and prevent it from becoming a target for commodity producers. For example, Zeneca decided to build a paraquat production facility in China, costing US$ 42 million, after the chemical had lost its patent protection. Relevant considerations in this decision were the rapid growth in Gross Domestic Product (GDP) in East Asia; the Chinese policy of attracting foreign manufacturers; the fact that paraquat is strongly regulated worldwide making it more difficult for generic manufacturers to produce; the need for large scale production to exploit economies of scale; and the likely important role for a chemical like paraquat in the early stages of development of Chinese agriculture. Growth in the biotechnology sector was also expected to contribute to the squeeze on some chemical products.

GM Crop Strategies

Zeneca thought in terms of waves of product development from biotechnology, 5-10 years from now and 10-15 years from now. The portfolio of products that are now in the final stages of research was expected to be launched beyond 2005 and these products would need a significant amount of development. A major planning exercise was under way looking at the value of the biotechnology business over the next 20 years and the necessary time scale for investment, and this was expected to lead to an increased Zeneca commitment to biotechnology.

Zeneca had invested in some seed companies in order to acquire the germplasm base for GM crop development, some gene effects, and patent rights and, hence, to access markets. However, the price of these investments had been more reasonable than investments made by some other companies, such as Monsanto, because of the timing of the purchases. It was more characteristic of Zeneca's approach to seek collaborations with other companies, as had been done in the development of the GM tomato paste product, protecting the technology base and the channel to market by means of legal contracts with other players.

In developing GM crops, managers were mainly focusing on output rather than input characteristics, for example, nutritional characteristics of cereal products and trends in the food industry. Input and output-related crop characteristics were seen as different businesses, the former having the grower as the customer while the latter went right along the market chain. However, for crops with output traits, farmers would also want crop protection elements, either genetic or chemical.

Output traits change commodity crops into specialties which can then be segmented in the market place, providing an "engine of value." The company would then get its rewards in two ways: for the trait itself and also for protecting a more expensive crop. Farmers were expected to prefer to have this combined in a single package so that output traits will be complemented by both agrochemicals and input traits, hence, the combined agrobiotechnology strategies noted below.

Zeneca's GM tomato was a good example of a set of development decisions where the consumer did see a benefit. The product was labeled as being genetically modified and people did buy it. In

developing this product, Zeneca learned a lot about working with food companies, retailers, consumer, and grower groups, and what needed to be done to launch and get acceptance for a GM product. The same degree of close attention was not given by other companies, for example, to the launch of soybeans in Europe, and Zeneca's tomato product has suffered as a result (Tait & Chataway, 2000).

For other GM products the benefits will be mainly agronomic, for example, animal feed tailored to meet the nutritional needs of different species, or "low phytate" products with the ability to reduce the environmental impact of the feed by reducing the phosphate content of effluent from intensive animal husbandry.

Zeneca had no projects for which the intention was to stop farmers saving seed. The development of the so-called "terminator" technology was possible but it would be expensive and, given public worries and Third World issues, companies would not spend the money. Hybrid seed would give similar benefits and some crops, such as soy and maize, are currently grown as hybrids because the yield and quality are better. However, the same is not yet true of cereals in Europe.

Zeneca also had projects based on chemical switching to regulate the terminal output of the genes. For example, in anti-sprouting potatoes a "switch" placed in front of the gene is regulated chemically or by some other means. For ware potatoes, the gene remains switched off; for seed potatoes the sprouting gene can be switched on when needed. This technology seemed to managers to be logical, legitimate, and defensible but it also had connotations of attempting to control farmers' use of the crop. As a second example of the use of switching technology, on *Bacillus thuringiensis* (Bt) cotton, rather than creating refuges to prevent the spread of insect resistance to Bt, the gene could be part of a controllable system, with a chemical spray used to activate the gene to give better resistance management.

Combined Agro-Biotechnology Strategies

Strategic planning in all the multinational agrochemical companies surveyed for the PITA project combined both chemical and biotechnology developments with varying degrees of synergistic interaction. Companies did not envisage a future without biotechnology, including products based on biotechnology, as well as using biotechnology to develop better chemicals. The predicted overall value of the agrochemical/biotechnology sector was US$ 75 billion by 2020, compared to the current agrochemicals world market of US$ 30 billion.

Zeneca described the strategies of Monsanto and Dupont as "buying the channel to market," investing major amounts of shareholder funds in acquisitions as well as investing heavily in building up their technology base. Its own approach, on the other hand, aimed to capture value by investing in the technology base, making more targeted acquisitions to give a reasonable route to market, but relying more on partnering than acquisitions for downstream developments of the technology.

In making decisions about GM crop development Zeneca selected at two levels of detail. Some of the more interesting and creative thinking was done at the broader level, by global teams, looking at where a crop as a whole is going, what the outputs are used for, how farming is changing, what are the trends in the crop worldwide, and what competitor companies are developing. A different group then considered more detailed targets—candidate products, benefits, cost effectiveness, and the crop-pesticide-GM mix for a range of markets.

The important long-term question for managers in this area was, "How will mainstream food be produced?" The emerging scenarios in response to this question were as follows,

- Using pesticides, along with non-GM crops (this seems to be the current publicly acceptable approach).
- Using pesticides along with GM crops (prognosis unknown).
- Organic crops (without pesticides or GM crops).

Subsidiary questions then evolved as follows,

- How many of these sectors are there and how big are they?
- What types of GM are acceptable (e.g., extra carotenoids in food)?
- Does the company have something which provides a recognized consumer benefit?

Within the company, in the early stages of GM crop developments, and with two potentially separate businesses, there were concerns that GM products could damage the prospects for an interesting chemical. The view now is that if Zeneca does not do this somebody else will. Zeneca's strategy was to optimize the combination of chemicals, genes, and information, as in the fungus resistance-fungicide combination. As with Novartis, Zeneca was aiming for crop leadership, having a superlative offer on a limited number of strategic crops. On bananas, for example, a large number of fungicide sprays are used each year and any contribution from GM control would be beneficial in terms of reducing the use of chemicals and also allaying onset of resistance to chemicals. The company's aim is to reduce fungicide inputs by 50% and also to provide a health benefit, as well as more effective crop protection.

One strand of Zeneca's combined agrobiotechnology strategy was, thus, based on an understanding that agrobiotechnology markets are likely to be based on a combination of chemicals and transgenic methodology (as opposed to conventional breeding) for decades to come. The second strand of this 'whole crop' strategy was based on the assumption that GM-based output traits would enhance the economic value of the crop, increasing the demand for effective crop protection from a combination of chemicals and GM input traits.

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