A PROFILE OF MONSANTO IN SOUTH AFRICA

An information document produced by African Centre for Biosafety

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SUMMARY

MONSANTO is a globally dominant company in the agrochemical, seed and agricultural biotechnology sector. Its herbicide, Roundup, is a best seller and has helped the multinational to become the third largest agrochemical company in the world. The rapid acquisition of seed companies around the world from the mid-1990s has made it the biggest seed company in the world. Monsanto is a pioneer of genetic modification in agriculture. As a result of its early R&D, the corporation has around 90% of the commercial agricultural biotech market globally. It makes profit from this by licensing out the technology to other corporations to use, and by charging farmers technology fees for genetically modified seed.

Monsanto has generated much of its profits in questionable ways. It profited from a number of chemical products that are now banned in many places – including PCBs, DDT and rBGH – and other chemicals with recorded negative effects on humans or animals – including aspartame and glyphosate. The company has also profited from selling chemicals to the US military for use in warfare in Vietnam and Columbia, and from polluting water supplies in the US.

Despite its business successes, Monsanto faced instability when consumer resistance, in the European Union in particular, and the high costs of R&D squeezed returns on investment. Monsanto was forced into a merger with Pharmacia & Upjohn but came out the other side with a focus on agricultural chemicals and biotechnology. The corporation identified Brazil, India and South Africa as continental focal points in its efforts to expand into the developing world.

South Africa is the first country in Africa to permit commercial growing of GM crops. Estimates place the area to GM crops at 300-500 000 ha under GM cotton, maize and soy beans in 2004-05. An estimated 75-80% of cotton plantings, 6-20% of maize plantings and 22-30% of soy plantings are GM varieties.

Monsanto is absolutely dominant in the GM crop market in South Africa, with almost all traits based on Monsanto-owned GM events. Syngenta and other multinationals are trying to enter the market with their own GM varieties. Monsanto's GM technology is licensed to other companies in South Africa including Pannar (maize and soya), Pioneer Hi-Bred (maize) and Delta & Pine Land (cotton). A wide range of companies have imported GM maize and soya into the country for commodity purposes (mainly animal feed), including grain multinationals Cargill, Louis Dreyfus and Seaboard and local processors such as Meadow Feeds, Epol, Bokomo and Ruto Mills.

Monsanto has been active in the agrochemicals market in South Africa since 1968, with 19 registered herbicides. Glyphosate, the active ingredient of Roundup, has been off-patent in South Africa since 1990 and Monsanto has faced competition from a number of other producers of the chemical since then. Monsanto has maintained market dominance

by obliging farmers using its Roundup Ready GM crops to use only Monsanto's herbicides on the crops.

Monsanto's purchase of local seed companies Sensako and Carnia in the late 1990s has given the multinational an estimated 40% share of the grain seed market in South Africa. Apart from a large number of registered wheat, maize, soy and sunflower seed varieties, the recent acquisition of global giant Seminis has given Monsanto plant breeders rights to 60 varieties of vegetable seeds in South Africa.

Future developments are likely to focus on extending the number of crops with input traits (with wheat and potatoes closest to commercialisation) and further R&D on output traits such as high starch maize for biofuel, pharmaceutical crops and nutritionally enhanced crops. Globally, protein enhanced soybeans and soybeans modified to reduce or eliminate trans fats, are closest to commercialisation.

In South Africa, Monsanto has used a number of front organisations, such as AfricaBio and the International Service for the Acquisition of Agri-biotech Applications (ISAAA), to generate positive publicity and attack those raising public concerns about the technology. As part of its propaganda Monsanto uses the small-scale African cotton farmers of Makhathini Flats in KwaZulu-Natal to argue that GM technology is scale-neutral. Academic and NGO research has shown that not all Monsanto's claims about the farmers are correct or accurate, and there is some cause for contemplation before the wholesale adoption by resource poor farmers of GM technology.

The South African government supports genetic modification in agriculture, and has also used its own infrastructure and resources to encourage positive attitudes in the public about genetic modification. The state's support for genetic modification has allowed South Africa to become a base for expansion into Africa, for the export of GM seed around the world, and as an experimental base for new GM crops not approved elsewhere.

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A CORPORATE HISTORY: FROM CHEMICALS TO AGRICULTURE

Until the 1980s Monsanto was primarily a chemicals company. The company was registered in the US in 1901. In the 1940s Monsanto began producing its first agrochemicals. Together with synthetic fertilisers, agrochemicals resulted in a rapid expansion of agricultural production after the Second World War, and the growth of industrial monocrop agriculture. Agrochemicals generated enormous profits for Monsanto, but from the 1970s the realisation that the agrochemicals were highly damaging to the environment and human health alike forced Monsanto to look in other directions for future profits. Although the outcomes were not clear at the time, Monsanto turned to biotechnology. Agricultural biotechnology resulted in a growing merge between the once separate crop protection (agrochemicals) and seed industries. In biotechnology, the seed itself contains and becomes the means of distributing crop protection technology (or components of it). Statistics show the extent of the shift in Monsanto's thinking about the source of potential future profits. Since 1980, Monsanto has only introduced 3 new agrochemical products, with no new products at the late R&D stage in 2003. This can be compared to Bayer/Aventis with 39 new products since 1980 and 13 new products in the late R&D stage in 2003[1]. Once potentially commercial biotech products were developed, and the regulatory and legal framework was in place to permit the release of GM seeds into the open in the early 1990s, Monsanto moved quickly to acquire plant breeding rights and seed distribution systems. For a massive corporation, the easiest way to do this was to buy entire companies.

Until the mid-1990s Monsanto was barely active in the seed industry. But a series of mergers and acquisitions saw Monsanto become one of the world's top three seed companies by the end of the decade. In 1997 Monsanto bought Asgrow (4th largest share of US maize seed market and 2nd largest share of US soya bean seed market at the time) and Calgene. In 1998 Monsanto bought Dekalb Genetics (2nd largest share of US maize seed market and 3rd largest share of US soya bean seed market at the time) and Cargill's international seed business. The acquisition of Cargill gave Monsanto a quick route into global seed markets, with seed research, production and testing facilities in 24 countries and sales and distribution operations in 51 countries[2]. In the same period, Monsanto purchased a number of biotechnology research companies, including Ecogen, Agracetus and the Plant Breeding Institute in the UK[3].

In 1996, in a collaborative agreement with Delta & Pine Land, Monsanto released its first commercial genetically modified seeds – NuCOTN Bt cottonseed. GM maize, soybean and canola followed. Take-up by US farmers was rapid, because the seed promised to make farming easier and reduce chemical costs. By 1999, 56% of soybeans were herbicide tolerant GM varieties; 42% of cotton was herbicide-tolerant and another 32% was Bt cotton (total 74% of US cotton planted was GM by 1999); and 26% of corn was genetically engineered with Bt, with slightly less than 10% of the total corn planted being

[1] Enigma Marketing Research 2003, p.6
[2] Consumers International 2003 'Corporate control of the food chain: the GM link', p.13 (http://www.consumersinternational.org)
[3] USDA Economic Research Service 2002 'The Seed Industry in US Agriculture' Report AIB 786 http://www.ers.usda.gov/publications/aib786/aib786h.pdf

herbicide resistant[4]. The US is the globally dominant producer of all these crops, so adoption of GM technology in the US was highly significant for the rest of the world.

Despite Monsanto's dominance in the GM seed market, the company's biotech strategy was not as strong as it might appear. High research costs, growing resistance to its products from consumers and farmers, and Monsanto's inability adequately to manage the public relations associated with opposition all placed the multinational in an unstable financial position. At the end of 1999, the century-old company was forced to merge with Pharmacia & Upjohn, a pharmaceutical giant, to become Pharmacia.

At the time, Monsanto had been bidding to acquire Delta & Pine Land (D&PL), the world's largest cottonseed company with 70% of the giant US cottonseed market. After the merger with Pharmacia & Upjohn, the sale was called off because it was not part of the plans of Pharmacia. Since Monsanto had sold its shares in Stoneville Pedigreed (acquired when it bought Calgene) to make way for the deal, it was left without any direct share of the cottonseed market after the D&PL merger was called off.

The merger stabilised the company. Monsanto's non-agricultural chemical interests had been spun off in 1997 into a company called Solutia (facing bankruptcy in 2005). Pharmacia held onto Monsanto's pharmaceutical interests, including Searle. The combined agribusiness, named Monsanto Company, was made into a stand-alone subsidiary of Pharmacia and then spun off as a separate entity in 2002. The agribusiness included the combined agrochemicals, seed and biotechnology interests. In 2002, Monsanto was the world's second largest seed company and the largest agricultural biotech company with more than 90% of the global agbiotech market. The recent acquisition of Seminis, a global vegetable seed company, is likely to make Monsanto the largest seed company in the world[5]. Monsanto and its seed partners have received government approval to plant GM crops in 17 countries, including South Africa.

HOW DOES MONSANTO MAKE ITS MONEY?

Monsanto makes its profits from the sales of agrochemicals, genetic technology and seed.

Despite its focus on biotechnology, in 2002 Monsanto was still the third largest agro-chemicals company in the world, with an estimated 11% global market share and crop protection sales of $2.7 billion a year[6]. Just before the end of the US patent on glyphosate in 2001, Roundup accounted for 67% of Monsanto's total sales[7]. Although glyphosate, the active ingredient of Monsanto's Roundup herbicide, has been off-patent in the US since 2001, Monsanto retains a 65-80% share of global sales. Sales of Roundup still contribute 40% of Monsanto's operating profit[8]. Nevertheless, declining total sales of agrochemicals has seen Monsanto continue with its shift towards biotechnology. In 2004, the company aimed to allocate 80% of R&D to biotech and seed and only 20% to

[4] Jorge Fernandez-Cornejo & William D. McBride 2002 'Adoption of Bioengineered Crops', USDA Agricultural Economic Report 810, p.ix
[5] ETC Group 2003 'Oligopoly, Inc. Concentration in Corporate Power 2003', ETC Communique 82, p.6 Nov/Dec 2003 (http://www.etcgroup.org)
[6] Enigma Marketing Research 2003 'Development of a Generic Agrochemical', p.3
[7] Agrow 2001 Crop Protection News, cited in Pesticide Action Network ((http://www.panna.org/resources/documents/monsanto.dv.html)
[8] Tamar Kahn 2004 'A growing taste for genetically modified food', *Business Day*, 24 Aug 2004, p.2

agrochemicals. In 2004, for the first time in its history, Monsanto earned more from biotech traits and seeds than from Roundup sales[9].

Monsanto generates income from its genetic technology in two ways. On the one hand, it licenses the technology to other companies to use. The technology is patented and protected by intellectual property rights (IPR) systems. The expansion of IPR has provided the biotechnology companies with the legal foundations for rapid expansion. In 1987, the US Patent and Trademark Office ruled for the first time that all multicellular organisms were eligible for patent protection. The patenting of plant varieties is only permitted in the US, Japan and Australia. Biotech companies and supporting governments have been pushing hard to harmonise minimum levels of patent protection of global biotechnology through the WTO Trade Related Intellectual Property rights (TRIPS) agreement. This would allow patent protection of living organisms around the world.

In a number of cases, including some involving WR Grace Corporation and Agracetus, Monsanto initially opposed a plant variety patent. But once it acquired the company owning the patent, it then defended the patent. Seventy five percent of Bt patents controlled by the big biotechnology companies in 1999 were acquired through buying previously independent companies that owned the patents[10]. Much of the initial research and development of the patented products was funded by public institutions and universities. These public research institutions are increasingly becoming servants to the agendas of the multinationals that pay them.

Patenting of germplasm is another way Monsanto protects its intellectual property. Constantly improved germplasm remains the basic raw material for the seed business. Monsanto and other biotechnology corporations have been raiding public gene banks to acquire improved seed, identifying the combination of genes and then patenting them as an 'invention'. An example of this is Monsanto's attempts to patent Nap Hal wheat seed, long used to make chapattis, the staple food in India[11]. There are many other examples involving Monsanto, including attempts to patent traits of tumeric, neem and other plants that have long been developed and used for pharmaceutical purposes in India and elsewhere.

Patents do not only cover traits and germplasm, but also the technology used to carry out genetic modifications. For example, Monsanto recently received a patent in the US covering "all practical methods of making modified plant cells that employ anti-biotic resistance markers", and another for the *Agrobaceterium tumefaciens* vector system for transforming cotton plants[12]. These are both widely used techniques for modifying plants. A patent permits Monsanto to acquire royalties from any other company or institution wanting to use these technologies. Monsanto is one of four large corporations or

[9] ETC Group 2003 'Oligopoly, Inc. Concentration in Corporate Power 2003', ETC Communique 82, p.8 Nov/Dec 2003 (http://www.etcgroup.org)
[10] De Janvry, A., Graff, G., Sadoulet, E. & Zilberman, D. 2000 'Technological Change in Agriculture and Poverty Reduction', concept paper for World Bank World Development Report 2000/01; p.6 (http://www.worldbank.org/poverty/wdrpoverty/background/dejanvry.pdf)
[11] Randeep Ramesh 2004 'US multinational patents northern India's staple crop', *Mail & Guardian* 6-12 Feb 2004
[12] Michael R. Taylor & Jerry Cayford 2003 'American Patent Policy, Biotechnology, and African Agriculture: The Case for Policy Change', Resources for the Future Report Nov 2003, p.33 (http://www.rff.org/rff/Documents/RFF-RPT-Patent.pdf)

institutions that share more than 25% of all agricultural biotechnology patents in the US[13]. A patent search for Monsanto reveals 323 patents, including 192 that involve methods of genetic modification and an additional 56 under the names of some of the seed and biotechnology companies purchased by Monsanto in the 1990s[14]. In 2002 Monsanto and Du Pont entered into an agreement to share their proprietary agricultural biotechnologies with one another. Between them, they held 41% (566) of all significant agricultural biotechnology patents[15].

The second way Monsanto generates income from genetic technology is through seed sales accompanied by mandatory technology user agreements - contracts that aim to protect the company's property rights to the technology and guarantee chemical sales. Monsanto sells genetically modified seed with an attached technology fee – a premium that farmers pay to be allowed to use the seed. In the US, farmers had to sign contracts guaranteeing that their production would not get into products destined for the EU market; a US$6.50 'technology' fee per 50 lb bag and contracts allowing Monsanto to enter farmers fields to make sure seed was not saved from the previous year[16]. US growers were initially charged US$80/ha in technology fees for Bt cotton, and Australian farmers were charged US$245/ha. Roundup Ready cotton, introduced a year later, had technology fees of between US$12 and US$20/ha depending on variety. Stacked gene varieties would have a technology fee of US$100/ha[17]. If GM seed becomes more popular, corporations can be expected to increase prices to raise their own profits. In 2005 Monsanto was set to raise prices for certain Roundup Ready soybeans by $4 to $5 an acre and by $2 an acre for Roundup Ready corn[18]. These technology fees are over and above the higher cost of transgenic varieties.

The introduction of Monsanto's Bollgard II in West Africa will not attract a technology fee of anything less than US$50/ha. In Mali, the total price of insecticides averages 37 600 CFA/ha (US$62/ha). So even if Bollgard II cuts insecticide use in half (and international evidence suggests this is optimistic), the cost of seed will outweigh the savings in pesticide use[19]. In South Africa, Roundup Ready maize seed costs R230/bag more than conventional seed, and still requires the same amount of chemicals[20]. While Bollgard cotton costs just 8% more than traditional varieties, there was an additional technology fee of R600/bag in 2002[21]. In 2005, a 25kg bag of cottonseed cost R433.20. But a licensing fee for Roundup Ready cotton was an additional R416.10 and for Bollgard an additional R894.90[22].

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[13] Taylor & Cayford 2003, p.22. The others are Pinoeer Hi-Bred, Mycogen and the USDA.
[14] Paterra patent search (http://cxp.paterra.com), accessed 24 Apr 2005
[15] ETC Group 2002 'Du Pont and Monsanto – "Living in Sinergy"?', news release, 9 Apr 2002 (http://www.etcgroup.org)
[16] William Heffernan 1999 'Biotechnology and Mature Capitalism', paper presented to 11th Annual Meeting of the National Biotechnology Council on World Food Security and Sustainability: The Impacts of Biotechnology and Industrial Consolidation. Lincoln Nebraska, 6-8 June 1999; p.1
[17] Leon, C. 1997 'Technology fee for Bt cotton', *The ICAC Recorder*, Vol XV, No 2, June 1997; p.15
[18] New York Times 2004 'Modified-Seed Sales Help Monsanto Surpass Forecasts', *New York Times*, 1 July 2004, (http://www.nytimes.com/2004/07/01/business/01seed.html)
[19] GRAIN 2004 'Bt Cotton at Mali's Doorstep: Time to Act!', press release, February 2004 (http://www.grain.org/ publications/btcotton-newsrelease-feb-2004-en.cfm)
[20] Biowatch 2003 'GM crops in South Africa', unpublished report
[21] Johan Kirsten & Marnus Gouse 2002 'The adoption and impact of agricultural biotechnology innovations in South Africa', Working Paper 2002-09, Dept of Agricultural Economics, Extension and Rural Development, University of Pretoria; p.6
[22] Raj Patel, personal communications, 8 Mar 2005

In order to access Monsanto's GM seed, farmers must contractually agree to use the seed containing Monsanto gene technologies for planting a commercial crop only in a single season; to not supply any of this seed to any other person or entity for planting, to not save any crop produced from the seed for replanting, or supply saved seed to anyone for replanting; and to not use the seed or provide it to anyone for seed production. If growers want to use glyphosate, they must agree only to use Roundup herbicide on Monsanto crops. In the licence agreement for Bt cotton, growers must undertake not to ratoon any Bollgard cotton. Ratooning involves propagating a plant from a root cutting. In 2001, Monsanto included a clause in the technology agreement that prevented growers from suing Monsanto should the seed fail to perform.

Monsanto hasn't been shy to chase up its intellectual property rights. In Canada and the US in particular, Monsanto has used the clause in the contract to go onto farms to inspect crops of farmers who have signed agreements with the company. Private detectives and the Royal Mounted Police have been employed to catch farmers using Monsanto's technology illegally. By the end of 1999, Monsanto had initiated more than 475 lawsuits for alleged patent infringement and violations of the technology user agreements. In one case, a farmer in Tennessee in the US was sentenced to eight months in prison after Monsanto took him to court for saving GM cotton and soybean seed[23]. Percy Schmeiser, a Canadian farmer, was found guilty of using Monsanto's seed illegally when tests showed he had Roundup Ready canola in his fields without signing an agreement with Monsanto. Schmeiser insists GM plants on neighbouring farms contaminated his crops. The subsequent court victory over Schmeiser has allowed Monsanto to pursue another 2000 similar lawsuits[24]. This suggests the squeeze on farmers is part of a global strategy to ensure Monsanto gets the necessary returns from the technology.

In short, growers must give up the age-old practices of seed saving, on-farm plant propagation and seed sharing. That means farmers must buy new seed every season. Growers are also required to use only Monsanto's brand pesticide, even if other glyphosate-based products are available elsewhere. In this way, Monsanto is guaranteed to make pesticide sales in addition to the seed sales.

Monsanto's heavy reliance on pesticide sales and the associated reliance on a narrow range of agrochemical products are seen as two of the company's key weaknesses. This dependence could become a problem for Monsanto's profits if there is accelerated weed resistance to the herbicide, as evidence is beginning to suggest.

A HISTORY OF SELLING QUESTIONABLE PRODUCTS

MONSANTO has a history of selling questionable products for questionable ends. The company has historical links as a supplier of chemicals to the US military, including the defoliant Agent Orange (containing the chemical compound 2,4-D) in Vietnam that devastated the environment and the lives of countless innocent people, and Roundup for use in the "war against drugs" in Colombia that has destroyed thousands of hectares of food crops[25]. In 1984, Monsanto and other companies agreed to a US$180 million court

[23] Polaris Institute 2004 'Monsanto: Behind the Scenes – A corporate profile'; p.5
[24] E. Ann Clark 2002 'A fanciful tale…On the Appeal of the Percy Schmeiser Decision' (http://www.plant.uoguelph.ca/research/homepages/eclark/judge.htm)
[25] Polaris Institute 2004 'Monsanto: Behind the Scenes – A corporate profile'

settlement to thousands of veterans who blamed Agent Orange for cancers, birth defects and other illnesses. No Vietnamese victim ever received compensation.

For nearly 40 years, between the mid-1930s and the early 1970s, while producing the now-banned industrial coolants known as Polychlorinated Biphenyls (PCBs) at a local factory, Monsanto routinely discharged toxic waste into a creek outside the town of Anniston in Alabama in the US. The company dumped millions of pounds of PCBs into open-pit landfills. In 2002, Monsanto was found guilty of knowingly poisoning residents of. Company documents revealed during the court case showed that Monsanto knew the chemicals were being discharged with a toxic effect[26].

Along with 15 other companies, Monsanto began manufacturing DDT in 1944. DDT laid the basis for a massive expansion in the use of chemical insecticides, as well as the culture of eradication rather than management of pests. But problems quickly emerged with DDT, including insect resistance, a rise in premature births in humans, association with the degeneration of the liver and kidneys and disruption of the central nervous system, and vast environmental damage including high levels of toxicity towards fish and birds[27]. In 1968, DDT was banned in Europe. In 1972, the U.S. Congress banned the use of DDT in domestic agriculture (although it still allowed production for export). DDT's irreversible built-up in water has meant that negative impacts on fish are still being felt today[28].

In 1965 G.D. Searle and Company (purchased by Monsanto in 1985) developed an artificial sweetener named aspartame. This was a highly profitable invention, and is one of only four chemical inventions to generate more than US$1 billion since 1975[29]. Aspartame is a highly contentious product. Allegations against the additive include holding it responsible for more than 50 adverse effects, some of which are very serious, such as: multiple sclerosis, lupus erythmatosus, brain tumours, epileptic seizures, and complications of diabetes[30].

In 1976, the company's flagship product, Roundup (glyphosate) was commercialised in the US. Glyphosate is marketed as being safe and environmentally friendly, but exposure to glyphosate has been associated with an increased risk of miscarriages, premature birth and the cancer, non-Hodgkin's lymphoma[31]. Research finalised in 2005 found that the surfactant, or detergent, that allows the herbicide to penetrate the waxy surfaces of plants is extremely lethal to amphibians[32].

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[26] Michael Grunwald, *Washington Post* reprinted in AgriBusiness Examiner, No 138, Jan 2002; No 145, March 4, 2002

[27] Brian Tokar 'Agribusiness, Biotechnology and War' (http://www.social-ecology.org/learn/library/tokar/biotech_war.html)

[28] http://www.chem.ox.ac.uk/mom/ddt/ddt.html

[29] Andrew Liveris, speech to European Association of Chemical Distributors, 6 March 2002, (http://www.dow.com/../../dow_news/speeches/20020603a.htm). Another of the four, the herbicide glyphosate, later plays a very big role in generating profits for Monsanto.

[30] http://www.greenfacts.org/aspartame/l-3/aspartame-1.htm#3

[31] Herbicide Factsheet: Glyphosate (Roundup), Journal of Pesticide Reform, Fall 1998, updated November 1998 (http://www.pesticide.org)

[32] University of Pittsburgh Medical Centre, press release 1 April 2005**, '**Roundup® highly lethal to amphibians, finds University of Pittsburgh researcher' (http://www.eurekalert.org/pub_releases/2005-04/uopm-rhl040105.php)

In the 1980s Monsanto made a strategic shift into biotechnology. In 1994 its first biotech product, Posilac, a bovine somatotropin (BST) for dairy cows was marketed. Cows naturally produce BST, or Bovine Growth Hormone (BGH) as it is also known, to stimulate milk production. The insertion of a genetically engineered hormone (rBGH, for recombinant BGH) increases milk production by 10-15% by stimulating the production of another growth hormone called IGF-1 (insulin-like growth factor-1). The only purpose for using rBGH is to force cows to produce more milk. There are no benefits to cow or consumer. The use of rBGH has been shown to result in poorer health for cows, including a significant increase in mastitis infections. But it also has negative health risks for humans by increasing the amount of IGF-1 in the human body. There is evidence to support an association between IGF-1 and breast and prostate cancer. The 15-member European Union has banned rBGH, as have Australia and New Zealand. In 1999, Canada banned rBGH because of the adverse health effects on cows. Canadians also had unanswered questions about long-term human health. The United Nations' food safety organisation, Codex Alimentarius, has refused to approve the use of rBGH[33].

In each case where a product is later found harmful and banned, industry's defence is that this was not known at the time. Many medical drugs have been through supposedly exhaustive tests, released onto the market and only once they have had obvious negative impacts on the environment or human health have they been withdrawn. The tobacco industry for decades sold cigarettes knowing that their chemical additives had poisonous effects. Monsanto has had its share of profiting off some very dubious products. Given this history, it is a good idea to be very cautious before embracing genetically modified organisms, the latest 'miracle' product to roll off Monsanto's production lines.

GROWING RESISTANCE…AND NEW STRATEGIES

The European Union is a major market for US grain and oilseed exports. The EU's attitude to genetic modification in agriculture is a key to the future of the technology. Unfortunately for Monsanto, the company entered the European market in an aggressive and dominating way that hardened consumer attitudes against it and GM technology in the early stages of commercialisation[34]. The industry suffered a number of scandals related to the technology, including the contamination of the food supply by Starlink, a GM maize variety only approved for animal feed, in 2000. The contamination resulted in a plunge in exports to Japan, the biggest export market for the US and the banning of US maize imports to South Korea. Some of the biggest grain merchants, such as Archer Daniels Midland and ConAgra started testing shipments and rejecting tainted loads[35]. Ultimately, the contamination cost the US grain industry US$1 billion in lost revenues.

The hardening of attitudes to GM technology in the biggest export markets has made some export-oriented farmers wary of buying into the new technology. In Canada, plantings of herbicide tolerant canola dropped from 14 million acres to 9 million acres as farmers felt there were no yield advantages and costs did not decline once technology

[33] Vermont Public Interest Research Group 'An rBGH overview', (http://www.vpirg.org/campaigns/geneticEngineering/rBGHOverview.html)
[34] See Bill Lambrecht 2001 *Dinner at the New Gene Café*. St Martin's Press, New York for details of Monsanto's public relations failures in the EU.
[35] Bill Lambrecht 2001, p.54

fees were taken into account[36]. Monsanto was forced to back down on plans to release herbicide tolerant GM wheat because farmers felt it threatened their ability to export. In 2003, the Canadian Wheat Board, the largest wheat and barley marketer in the world, opposed the premature unconfined release of Monsanto's GM wheat variety[37].

In other countries there is also widening resistance from farmers who feel that control over production decisions and choices are being concentrated in the hands of the large corporations such as Monsanto. In India, France, the Philippines, Ireland, England, Brazil and other countries, anti-GM coalitions have invaded test fields and destroyed GM crops.

Coupled with this surge of resistance, Monsanto was facing high costs that had to become profitable quickly if the company was to survive. Publicly traded biotechnology companies in the United States were estimated to have suffered cumulative losses of more than US$41 billion from 1990-2003. Only 12 of the 50 largest biotechnology companies posted a profit in 2003[38]. Although Monsanto's seed and biotech sales continued to rise, costs outstripped sales. This was particularly so for R&D costs and seed company acquisitions. Monsanto spent around US$10 billion from the mid-1990s to acquire seed companies and to market GM seed around the world[39].

In 2000 Monsanto was forced into a merger with Pharmacia & Upjohn to stabilise financially. Since emerging anew from the Pharmacia merger in 2002, Monsanto has become more tightly focused on agriculture - agrochemicals, biotechnology and seed. There has also been a strong emphasis on reaching into markets in developing countries, seen as the areas for the rapid growth of GM technology. In 2001 former Monsanto CEO, Hendrick Verfaillie, laid out his three wishes for the new year as: "The first is (approval for) Roundup Ready soybeans in Brazil. The second is making progress in Europe – specifically around Roundup Ready corn. Number three is Bt cotton in India"[40].

Although China is the dominant country adopting GM crops in Asia, it has a significant internal biotechnology sector and relies less on Monsanto and other private companies than most other countries. This makes India the key for Monsanto in Asia. In the words of Clive James of ISAAA, "What China is to Asia, Brazil is to Latin America, and South Africa is to the continent of Africa"[41] – that is, the leading country on the continent in facilitating the expansion and acceptance of GM crops. Although the African share of the global commercial seed market is small (estimated at just 8% in the mid 1990s, including seed saved on the farm), the introduction of GM crops could increase their value of by 50%, making even the relatively small African market quite valuable[42].

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[36] Canadian farmer Lyle White, quoted in Alistair Driver & David Burrows 2003 'Canadians 'Lose Faith' in GM Technology 'Religion'' *Farmers Guardian* (UK), 11 July 2003

[37] Canadian Wheat Board 2003 'Canadian Scientists Find Roundup Ready (RR) Wheat Poses Environmental Risk', news release, 9 July 2003 (http://www.cwb.ca/en/news/releases/2003/070903.jsp)

[38] Chee Yoke Heong 2004 'Biotech investing - a high-risk gamble', *Asia Times*, 30 July 2004 http://www.atimes.com/atimes/Asian_Economy/FG31Dk01.html

[39] David Barboza 2002 'Monsanto Struggles Even as It Dominates' *New York Times*, 31 May 2003

[40] Cited in Corporate Watch 2003 'Monsanto: Corporate Watch biotech briefings 2003' (http://www.corporatewatch.org.uk)

[41] Clive James 2004 'Preview; Global Status of Commercialized Biotech/GM Crops: 2004', ISAAA Briefs No 32. ISAAA, Ithaca, NY (http://www.isaaa.org/kc/CBTNews/press_release/briefs32/ESummary/Executive%20Summary%20(English).pdf)

[42] Devlin Kuyek 2002 'Intellectual Property Rights in African Agriculture: Implications for Small Farmers'. GRAIN, Barcelona, p.4

GM technology continues to be sold as the answer to world hunger. The argument goes that since Africa missed the Green Revolution (hybrid seeds, irrigation and chemical inputs) and therefore continues to have low yields, the continent cannot afford to miss out on the new wave of technological development that is genetic modification. Coupled with this is the attempt to portray the technology as being 'scale neutral' and of benefit to small and big farmers alike. Monsanto even goes so far as to claim that "today, 90% of farmers planting biotech crops are resource poor, small-holder farmers in the developing world"[43]. The company conveniently neglects to inform us that by acreage and turnover, the massive industrial farms in the US, Argentina, Canada, South Africa and elsewhere are by far the largest adopters of GM technology.

The one thing missing to make the public relations strategy work was a showcase of the benefits of GM technology for small-scale farmers. If Monsanto could show this, they could say that the farmers of the developing world, where most operate on a small scale, stand to benefit from the technology. This strategy has been able to take root in South Africa, assisted by a regulatory environment friendly to the multinational.

MONSANTO AND GENETICALLY MODIFIED CROPS IN SOUTH AFRICA

Genetically modified crops have been commercially grown in South Africa since 1997 when Bt cotton was introduced. In 2004, South Africa planted an estimated 500 000 ha of GM crops according to the pro-biotech International Service for the Acquisition of Agri-biotech Applications (ISAAA). This makes South Africa the seventh largest producer of GM crops in the world. GM maize, soybeans and cotton are planted around the country, with field trials on canola, sugar cane, potato and strawberry.

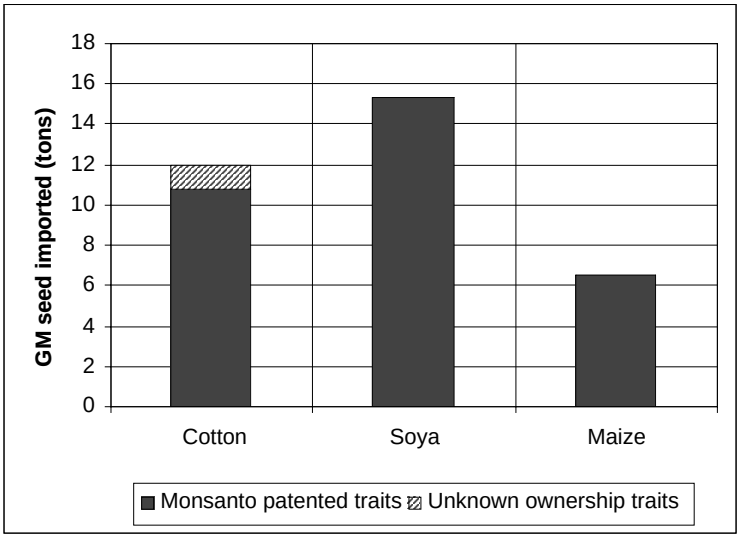
Most commercially available GM seed varieties are based on a small number of genetically modified organisms that the patent holder licences seed companies to use on their own seed. Seed companies purchase rights to use the GMO to cross with their own hybrids. Two maize "events" (GMOs) form the basis for the majority of GM maize varieties available in South Africa. MON810 (Bt for use against European Corn Borer) was approved in South Africa for food and feed in 1997, and launched commercially under the Yieldgard label with Pannar as the first South African licensee. The NK603 (glyphosate tolerant/Roundup Ready) event was approved for commercial use in South Africa in 2002. Monsanto holds the patents for both of these, although other companies operating in South Africa are licensed to use the modification. Syngenta owns two other events, Bt11 and Bt176, which have entered South Africa, and is also trying to get approval for herbicide tolerant GA21.

Monsanto's dominance of the global GM market means that almost all GM seed imported into South Africa contains Monsanto technology. The graph below indicates the dominance of the Monsanto patents in South African field trails and commercial plantings to date. Monsanto's main GM imports into South Africa are from the US, followed by Argentina and France, and a small number of imports from Romania and the Philippines. A growing number of companies are importing Monsanto seed in to South Africa, either for use as a commodity or for field trials. More than 6 tons of GM maize

[43] Monsanto 2005 'A Decade of Biotechnology' (http://www.monsanto.co.za/en/layout/biotech/10_years.asp)

seed has been imported into South Africa for bulking up and crossing with other varieties. Importers for trials or commercial plantings include Monsanto itself, multinational (Pioneer Hi-Bred, Advanta) and local seed companies (Pannar and Afgri[44]), as well as local millers Bokomo, Ruto Mills, Epol and Meadow Feeds. The World Food Programme, Rennies and the Canadian company Brisen have also used South Africa as a base for bringing GM food aid into Africa[45].

Figure: GM seed imported for trials/commercial planting, 2001- Mar 2005



Source: Derived from NDA GMO permits, 2000-2005
Note: Maize includes 2000 data for Monsanto's MON810 but not for NK603 or Bt11 for that year because information not provided in available permit data

In 2003, an estimated 15-20% of all maize grown in South Africa was genetically modified. GM maize is more readily taken up where maize is irrigated, because this gives higher yields and allows growers to cover the technology costs more quickly. Of the maize grown in 2003, an estimated 40% of irrigated maize was GM, compared to 20% of dryland maize[46]. Most GM maize planted is insect resistant (Bt), with herbicide tolerant maize (Roundup Ready) only released for commercial use in 2003. Monsanto's Wally Green offered a broad estimate of 150 000 ha of Bt and 50-70 000 ha of RR maize planted[47]. Using 2004 production figures, this comes to a combined total of 6-7% of the area under maize.

A large quantity of GM maize for commodity use has been imported into the country in the past few years. The two main categories of imports are a mix of MON810, Bt11, Bt176 and TA25 mainly from Argentina. According to GM permit data, more than 1.5 million tons of this mix has been imported between 2001 and March 2005. Monsanto, Syngenta and Aventis hold patents to the events. The second category of imported GM maize is white maize from the US that contains less than 1% GMOs. Almost 1.36 million tons were imported between 2001 and March 2005. These imports are equivalent to just over 7.5% of domestic maize production in South Africa in the 2001-2004 seasons. The GMO permits do not specify in what form the maize entered the country, so it is difficult

[44] A rapidly expanding company that emerged from the privatisation of the Oos-Transvaalse Ko-op (OTK) in the early 1990s.
[45] National Department of Agriculture (http://www.nda.agric.za/GMO/GMOpermits), various years
[46] Biowatch 2003 'GM crops in South Africa', unpublished report
[47] Personal communication, 18 April 2005

to work out GM maize as a percentage of total maize imports. Commodity importers include the giant grain multinationals Louis Dreyfus, Cargill and Seaboard.

Cotton is not a major sector in South Africa, finding root only in a few fertile areas of the country. As a result, South Africa does not produce enough cotton for domestic needs and has to import the shortfall each year. In 2003/04 the area planted to cotton was less than one-fifth of the area under cotton in the late 1980s. The decline in production has also seen imports rise. Since 2002, more than half of all cotton lint consumed in South Africa has been imported[48]. A number of cotton events have been approved for commercial use or trial in South Africa. These are all based either on Bt events or herbicide tolerance. Bt cotton includes a number of lines of Monsanto's Bollgard (budworm and bollworm resistance) and Bollgard II cotton (same as Bollgard plus resistance to secondary leidopteran pests), RR1445 (Roundup Ready) commercialised in 2001, MON88913 (glyphosate tolerance) and BXN (bromoxymil tolerance, developed by Calgene). Stoneville and Delta & Pine Land were the main importers of GM organisms for cotton trials or planting in South Africa. Syngenta and Monsanto also imported a small number of organisms for trial or planting.

Adoption of GM cotton varieties has been rapid in South Africa. Bt cotton had an estimated 35% of the cottonseed market in 2003, cotton with stacked GM traits had a 30% share of the market and RR cotton had a 10% share – giving all types of GM cotton a 75% of total cottonseed planted in that year. In 2003, two out of three recommended varieties were GM[49]. Cotton was only grown on 36 000 ha in 2003, placing area under GM cotton at no more than 30 000 ha. South Africa does not usually export cotton so all of the GM cotton is consumed locally. Some of it goes into the food supply in the form of oils for flash frying.

Like cotton, the soybean industry in South Africa is small. However, unlike cotton, it is a growing industry. Only one soya event, GTS40-3-2 (glyphosate tolerance), has been approved in South Africa. It was commercialised in 2001 and Monsanto holds the patent. Genetic modification of soybeans is for herbicide tolerance (RR), and the market share of GM soya was estimated at between 22% and 30% in 2004[50]. Even at the upper limit, this would be 41 000 ha under GM soya in 2004. Between 2001 and March 2005, 15.3 tons of GTS 40-3-2 was imported for planting (field trials or commercial use). Monsanto was the applicant for all GTS 40-3-2 imports for planting. Slightly over 67 000 tons was imported for animal feed in the same period[51]. This is equivalent to about 8% of domestic soya bean production over the same period.

Adding up the area of the different crops brings a total of less than 300 000 ha, suggesting that ISAAA's figures are inflated, perhaps for propaganda purposes. It serves the biotech industry well to be able to claim that the take-up of GM production is rapid, widespread and irreversible. The truth is, no one really knows precisely how much genetically modified crops are being planted because each company holds their own information and there is no regulatory requirement to pool the information and make it

[48] Cotton SA 2005 'Cotton Lint Production, Imports, Consumption and Exports for South Africa' (http://www.cottonsa.org.za/production.html)
[49] Apart from one variety specifically bred for use in a small part of the Northern Cape. Biowatch 2003 'GM crops in South Africa', unpublished report
[50] Melanie-Ann Feris 2004 'They're trying to dump GM wheat on SA', *Cape Times*, 23 Jan 2004, p.5
[51] There were also commodity imports in 2000, but available permit data does not indicate quantities.

public. Nevertheless, the planting of GM crops in South Africa is the first in Africa and a significant development.

What is genetic modification?

Deoxyribonucleic acid (DNA) contains the genetic instructions that a living cell carries out to keep the body alive. If a foreign instruction can be read and accepted by the cell, the cell will carry out the instruction. Genetic engineering is the science of inserting foreign instructions into host cells. A plasmid, which is a molecule of DNA, is cut and a gene is spliced into the cut. This is like inserting a new scene into a reel of film. The result is called recombinant (newly-combined) DNA. The recombinant DNA is then transported into the host cell, bringing a new characteristic to that cell. The two main commercially available recombinant DNA products in agriculture are for tolerance to herbicide and for resistance to certain species of insects.

Roundup Ready (RR) seed is genetically altered to tolerate the application of glyphosate (the active ingredient of Roundup, produced by Monsanto). Glyphosate kills plants and is used to kill weeds. Before the introduction of GM seed, it could only be sprayed at certain times (before sowing, and just before harvest) otherwise it would kill the crop. With the introduction of RR seed, glyphosate can be applied after the emergence of seedlings. Monsanto has genetically modified maize, soy beans, cotton and canola to tolerate Roundup.

Bt modifications involve the genetic insertion of the free-living soil bacteria *Bacillus thuringiensis* into the host plant. Bt has been used since the start of the 1900s as a naturally occurring pesticide to control various species of lepidoptera, including corn borer, one of the most damaging insects to maize. Commercially available genetically engineered Bt crops include maize and cotton.

MONSANTO IN SOUTH AFRICA

Monsanto South Africa has been registered in South Africa since 1968 as a producer of chemicals. Monsanto Agriculture (Pty) Ltd was registered in 1997 to acquire local seed companies. Monsanto has ten offices around South Africa, in Bethlehem (Free State), Brits, Klerksdorp, Lichtenburg (North West), Endicott, Fourways, Springs and Petit (Gauteng), and Paarl & Napier (Western Cape). Monsanto's laboratory in Bethlehem in the Free State is one of just five crop analytics laboratories globally that Monsanto uses to do its research.

In South Africa, Monsanto is involved in both the agrochemicals and seed markets. The agrochemicals market is broadly divided into pesticides, herbicides and fungicides. An estimated 895 584 metric tons of agrochemicals were used on South Africa cropland yearly from 1994 to 1996[52]. Retail sales of chemicals for crop protection were valued at R1.3 billion in 1997[53]. Market share information is difficult to come by. Glyphosate, and Roundup in particular, is the best selling herbicide globally. Glyphosate, the active

[52] EarthTrends 2003 'South African Country Profile' (http://earthtrends.wri.org)
[53] Johann Kirsten & Marnus Gouse 2002 'The adoption and impact of agricultural biotechnology innovations in South Africa', Working paper 2002-09. Dept of Agricultural Economics, Extension & Rural Development, University of Pretoria, p.4

ingredient in Roundup, has been off-patent since 1990 in South Africa[54]. This has allowed other manufacturers to produce cheaper generics that could be used instead of Roundup but to same effect. Sanachem, a South African based company that was absorbed into Dow Agrosciences in 1997, is the world's third largest manufacturer of generic agrochemicals, including glyphosate. There are at least sixty-nine glyphosate-based products on the market, produced by 26 companies including Syngenta, Dow Agrosciences, Bayer, Volcano Agroscience and Kynoch Agrochemicals[55]. This suggests that Monsanto faces a lot of potential competition in the herbicide market.

Monsanto has a number of factories in the US and Europe where it manufactures glyphosate. The active ingredient is imported but mixed locally by contracted companies to produce herbicides. Monsanto distributes its agrochemicals through three chemical agents in South Africa. These are Qwemico, Technichem and Wenkem. In South Africa, Monsanto markets 19 herbicides under its own name, and has no registered insecticides or fungicides. Active ingredients of the herbicides include acetachlor (mostly combined with other chemicals), alachlor, glyphosate (including seven under the Roundup label), propachlor and sulfosulfuron. Roundup Ready and Harness (acetachlor) are the only herbicides marketed by Monsanto for use on cotton. Monitor 75 WG (sulfosulfuron) is Monsanto's only herbicide for use on wheat.

One strategy to retain market share is contractually to bind growers of Monsanto's genetically modified seeds to use only Monsanto's herbicides. Monsanto insists that if herbicide containing the same active ingredient as Roundup Ultra herbicide (or one with a similar mode of action) is used over the top of Roundup Ready crops, growers will agree to use only Roundup brand herbicide[56]. By including its herbicide in the contracts, Monsanto is relying on the extension of GM seed to generate further sales of its agrochemicals.

While Monsanto focuses R&D attention on GM seed, it has a wide range of hybrid seed varieties that it sells through its own subsidiaries or licenses for distribution to seed companies and agents around the world. Seed companies breed commercial quantities of GM seed for sale to commercial farmers under license from Monsanto. Monsanto also owns a number of seed companies in South Africa.

Maize seed (66%) and wheat seed (10%) constituted more than 75% of the total commercial seed market in South Africa in 2003[57]. South Africa has always relied on the private sector for maize breeding. In 1998, there were no open-pollinated maize varieties and there were 68 hybrid maize varieties available. In 1996, between 92% and 94.5% of area planted to maize was hybrid seed[58]. At the time, there were just 3 national and 2 multinational private seed companies and two NGOs selling maize seed in South Africa.

[54] Wally Green, personal communication, 17 April 2005
[55] National Department of Agriculture (http://www.nda.agric.za/act36/AR/Herbicides.htm) – accessed Mar 2005
[56] Monsanto technology agreement for Bollgard, Roundup Ready and YieldGard seeds, 1998 (http://www.mindfully.org/GE/Monsanto-Technology-Agreement-1998.htm)
[57] US Dept of Agriculture 2004 'RSA Planting Seeds Annual 2004' GAIN Report SF4031, p.3
[58] Rashid Hassan, Mulugetta Mekuria & Wilfred Mwangi 2001 'Maize Breeding Research in Eastern and Southern Africa, 1966-97', CIMMYT p.26

In 1999 Monsanto purchased majority shares in Sensako and Carnia, two of the South Africa's largest seed companies, and bought the remainder in 2000. This gave Monsanto 45% of South Africa's maize seed market and almost the entire market in wheat seed[59]. According to Wally Green, the Biotechnology Regulator Manager for Monsanto in sub-Saharan Africa, in 2001 Monsanto controlled 40% of the total seed market in South Africa[60]. Despite claiming that the deal would lead to "potential job creation", the first thing Monsanto did on acquiring an initial 51% of the companies in 1999 was to cut 25% of the jobs, apparently to allow them to become "effective and globally competitive"[61].

In 2004, Monsanto merged its Carnia and Sensako summer crop seeds (maize, soybean, sunflower) under the Dekalb brand. The name comes from Dekalb Genetics, the US seed company purchased by Monsanto in 1998. Dekalb was the world's first seed company to sell maize hybrids and is one of the largest maize seed companies in the world. In South Africa, in 2005 Monsanto had at least 15 yellow maize, 11 white maize, 17 wheat, 4 soya bean and 5 sunflower varieties on the market. Included in this number were 6 Bt maize varieties (DKC 78-15B, SNK 7811B, SNK 6326B, DKC 61-25B, CRN 4760B and DKC 80-12B), 3 Roundup Ready maize varieties (DKC 78-35R, DKC 63-28R and DKC 80-30R) and 3 Roundup Ready soya bean varieties (A 5409AG, AG 5601, AG6101). Monsanto has licensed its maize and soya GM technology to Pannar (maize & soya) and Pioneer Hi-Bred (maize) in South Africa. In 1999, Pannar was responsible for 112 (76% of the total) GM maize field trials in South Africa, using Monsanto's technology as the base. Monsanto itself was conducting another 10 (7% of the total) GM maize field trials at that time[62].

Apart from these varieties that are currently being marketed, Monsanto owns a number of other seed varieties. Monsanto Agriculture has 29 wheat varieties, with plant breeders' rights on 21 of these[63]. In South Africa, plant breeders' rights rather than patents protect genetically modified seed varieties. Monsanto Agriculture also owns a smaller number of registered winter grain varieties (oats, rye, barley, triticale), and has registered varieties of soya beans, lupins, dry beans and grasses. None of the varieties registered by Monsanto Agriculture are genetically modified.

Monsanto South Africa holds ownership of the GM varieties of soya beans (9 GM varieties), yellow maize (13 GM varieties) and white maize (4 GM varieties). Monsanto also holds an additional 36 non-GM yellow maize hybrid varieties, 18 white maize hybrid varieties and 2 soya bean varieties. Eleven sunflower varieties and a small number of other winter grains, lupins, lucerne and grain sorghum constitute the remainder of Monsanto's registered varieties in South Africa.

Monsanto's recent international purchase of Seminis (one of the world's largest vegetable seed companies) gives Monsanto South Africa an entry point into the vegetable seed market, with nearly 60 vegetable and melon seed varieties registered by Seminis in South

[59] Louise Cook 2000 'Monsanto of the US buys all of Sensako', *Business Day*, 14 Dec 2000
[60] Contact Trust summary of Environmental Affairs & Tourism Portfolio Committee hearings on GMOs, 30 Oct 2001
[61] Peter Turner, Monsanto SA CEO, quoted in Louise Cook 1999 'Seed firm to lose staff', *Business Day*, 25 Aug 1999
[62] Kirsten & Gouse 2002, p.10
[63] Registered variety information from National Dept of Agriculture Registrar of Plant Improvement (http://www.nda.agric.za/variety/SAVL_Oct04.pdf)

Africa. This gives Monsanto the potential to begin challenging Syngenta's dominance to date amongst the multinationals in South Africa's vegetable seed sector. Syngenta has 72 registered vegetable and fruit varieties. Potatoes are likely to be the first GM vegetable crops to be commercialised in South Africa.

Cotton is a small sector in South Africa. Delta & Pine Land (D&PL) South Africa, a wholly owned subsidiary of the multinational parent D&PL, licensed Monsanto's GM cotton technology for use in South Africa in 1993. In 1995, cottonseed for the first commercial release of Bollgard (insect protected cotton) in the US was produced by D&PL in South Africa and exported to the US for sale. D&PL has also crossed the technology into local varieties, and is the dominant player in the South African cottonseed market. Monsanto itself does not market GM cottonseed in South Africa, but benefits from licensing fees.

To date, most genetic modification of plants has focused on so-called input traits – insect resistance and herbicide tolerance – that aim to reduce production costs or make production easier. Some have argued that consumer resistance to GM crops in the food supply has heightened because consumers are expected to bear the risk while gaining no direct benefits. Partly for this reason, but also partly because there may be a market, Monsanto and other biotech companies have suggested they will be using genetic modifications to enhance output traits in future. These would include nutritional value, for example inserting vitamin A genes into rice DNA, or modifying cotton plants to increase fibre length. Monsanto is already working on protein, lipid and carbohydrate enhancements. Protein enhanced soybeans and soybeans modified to reduce or eliminate trans fats are in advanced development and pre-launch stages respectively[64]. Renessen, a joint venture between Monsanto and Cargill, is developing these products.

A key output trait where lots of research effort has been expended already is high starch corn for biofuel production. The use of grain, sugar cane and cassava for the production of ethanol is significant in many parts of the world from Brazil to Germany. The US and the EU have both set targets, albeit modest, for the use of biofuels by 2010, a development that will stimulate growth in the industry. The issue has been raised that using corn instead of fast-growing grass and trees is less energy efficient and requires the use of agrochemicals[65]. The adoption of GM biofuel production is highly dependent on price. Even with oil prices skyrocketing, crop modification is "a huge and poorly mapped quagmire of intellectual property rights"[66]. This morass significantly increases the cost of using genetically modified crops and may slow the growth of modification for biofuels.

Another output trait receiving attention is the use of plants as factories for the production of inputs into pharmaceutical manufacture. It is predicted that 10% of all corn grown in the US will be biopharmaceutical by 2010[67]. In South Africa, the Centre for Scientific and Industrial Research (CSIR) has entered into an agreement with a European consortium to grow "pharm crops' with first pharmaceuticals crop likely to be either GM

[64] Monsanto 2005 'Product pipeline' (http://www.monsanto.com/monsanto/layout/sci_tech/prod_pipeline/productpipeline.asp)
[65] Polaris Institute 2004 'Monsanto: Behind the Scenes – A corporate profile'; p.8
[66] Economist 2004 'Non-Food GM: The Men in White Coats Are Winning, Slowly', *Economist*, Oct 7th 2004 (http://www.organicconsumers.org/ge/economist101204.cfm)
[67] Carmelo Ruiz-Marrero 2005 'The Biopharmaceutical Harvest', circulated on Debate list server, 29 March 2005

maize or GM tobacco that will be engineered with a set of genes for making prototype vaccines against either HIV or rabies[68]. Pharmaceutical crops have raised issues of safety, including questions about what happens if they get into animal or human food supplies, and issues of cross-pollination, and unknown deleterious effects on insects, soil microbes and other native organisms[69]. This is not purely an imagined threat. In 2002 in Nebraska, corn genetically engineered to produce a pig vaccine got mixed into half a million bushels of soybeans that had to be destroyed[70]. Genetically modified pharmaceutical crops are already grown on thousands of hectares in the US and other countries. These include the introduction of trichosanthin, a drug that induces abortions, into tobacco by means of an engineered virus also known to infect tomatoes, peppers, and other tobacco relatives. Other drugs engineered into plants are the research chemical/insecticide avidin that causes a vitamin deficiency, and the blood clotter aprotinin, that can cause pancreatic disease in animals and perhaps humans. Both have been engineered into corn grown out-of-doors[71].

However, the technology for many of these modifications is still a long way from commercialisation and the most immediate new products will involve adaptations of the existing, or new, input traits. In some instances these will be introduced into new plant varieties. Monsanto has sought approval for RR wheat in South Africa, having failed to get approval in the US or elsewhere. Consumer resistance to genetically modified wheat in the core capitalist countries may be directly proportional to the amount of wheat consumed by humans compared to maize. In the early 1990s, only 10% of all maize in the US, Canada and Western Europe was used for human consumption, compared to 72-80% in Africa[72]. In these countries, maize is not associated in the public mind with food in the same way as it is in Africa. The top three uses of US maize are animal feed, exports and biofuels[73].

Drought resistant maize is another input trait where Monsanto is making a heavy investment. Although more arid regions in Africa and other parts of the world may have more trouble with drought, the U.S. Midwest is the world's biggest seed grain market, and that is where seed companies want to deliver this product first[74]. Combining more than one genetic modification in a single plant – 'stacked' genes – is near commercialisation, with some varieties combining Bt and RR awaiting regulatory approval in South Africa and elsewhere. These include Monsanto's stacked gene cotton and maize varieties.

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[68] Independent Online 2004 'South Africa may test first "pharming" crop', *Independent Online*, 13 July 2004, p.3

[69] Carmelo Ruiz-Marrero 2005

[70] Jeffrey Smith, 2004 'The Myth and Necessity of GM Free Zones', Spilling the Beans, 1 Oct 2004

[71] GE Food Alert 2001 'Manufacturing Drugs and Chemicals in Crops: Biopharming Poses New Risks to Consumers, Farmers, Food Companies and the Environment – Executive Summary', p.7 (http://www.gefoodalert.org)

[72] Christopher Dowswell, R.L. Paliwal & Ronald Cantrell 1996 *Maize in the Third World*. Westview Press, Boulder, Colorado, p.7

[73] Council for Biotechnology Information 2005 'Biotech Biofuels FAQ' (http://www.whybiotech.com/index.asp?id=1645)

[74] Anne Fitzgerald and Jerry Perkins 2005 'Farmers' Weather Worries: Hot, Dry or Wet?', The Des Moines Register, 29 Mar 2005 (http://www.checkbiotech.org/root/index.cfm?fuseaction=news&doc_id=9989&start=11&control=220&page_start=1&page_nr=101&pg=1)

SOUTH AFRICA: SPEARHEADING A PUBLIC RELATIONS DRIVE

In trying to sell the story that GM crops are good news for the world's poor, Monsanto will refer you in particular to TJ Buthelezi. Buthelezi is a successful cotton grower on the Makhathini Flats in northern KwaZulu-Natal. He credits Monsanto's Bt cotton for his success even though he is relatively well off in the area, with 66 acres to his name. Of all the areas under GM crops in Africa, Makhathini Flats has generated the most interest. It has been used as a battleground in the struggle over genetic modification.

The Makhathini Flats are located in an area formerly under the KwaZulu homeland government. The traditional authority controlled access to the land, overseen by white officials from the apartheid government. Cotton had been produced in the area for some decades, but with limited institutional or infrastructural support. In the 1980s, as part of a general government strategy to create a commercial layer of farmers in the bantustans, the area was developed for cotton production. Credit, seed and agrochemical distribution, and marketing support were concentrated in the area. There are a potential 4500 farmers producing rain-fed cotton on between 1-3 ha each. The number of producers rises and falls depending on commodity markets and access to credit and other inputs. There was a rapid adoption of GM (mainly Bt) cotton in the area, with up to 90% of growers planting GM cotton by 2001. However, these growers only comprised 5% of the district's population and their cotton farms covered just 0.7% of the land on the Flats[75].

Key reasons given for the adoption of GM cotton by the Makhathini Flats farmers were pesticide savings and increased yields[76]. Reduction in the use of pesticides is not only an economic and environmental benefit, but it also makes farming easier. A number of studies showed that there was an overall income advantage for small-scale farmers adopting GM cotton[77]. However, a case has been made that smallholders adopted the GM technology because they have had no real choice. Farmers favour planting sugarcane and vegetables, at least on some of their land, but there is no market and no credit for these crops[78]. One of the main constraints amongst smallholder farmers in the area is credit. Yet until 2003, credit was only available through Vunisa, a cotton company with an interest in spreading Bt cotton[79]. Infrastructure exists to sell cotton. The replication elsewhere of the short-term successes of the Makhathini smallholders would require a reproduction of the intensive infrastructural and institutional support that is far from likely in other parts of Africa. Coupled with this, Makhathini's farmers had limited access to conventional cottonseed[80]. The use of GM technology may spark short-term success stories. But it papers over some of the structural cracks in the economy, including

[75] Aaron de Grassi 2003 'Genetically Modified Crops and Sustainable Poverty Alleviation in Sub-Saharan Africa: An Assessment of Current Evidence', Third World Network – Africa, p.23 (http://allafrica.com/sustainable/resources/view/00010161.pdf)
[76] M. Gouse, J. Kirsten & L. Jenkins 2002 'Bt Cotton in South Africa: Adoption and impact on farm incomes amongst small-scale and large scale farmers', Department of Agricultural Economics, Extension & Rural Development, University of Pretoria, p.6-7
[77] Gouse, Kirsten & Jenkins 2002; Andrew Bennett 2001 'The Impact of Bt Cotton on Smallholder Production in Makhathini Flats, South Africa' (http://www.monsantoafrica.com/report/bt_report/BtCottonReport.html); Yousouf Ismael, Richard Bennett & Stephen Morse 2002 'Benefits from Bt Cotton Use by Smallholder Farmers in South Africa', Agbioforum 5(1)
[78] Raj Patel, personal communications, 8 Mar 2005
[79] Aaron de Grassi 2003, p.36
[80] Raj Patel, personal communications, 8 Mar 2005

limited secure access to productive land, lack of access to credit and continued lack of control over production decisions and resources.

Basic problems of GM seed from a resource poor farmers' perspective

In its public relations, Monsanto conflates small-scale agriculture and resource poor agriculture. It's true that most resource poor farmers are also small-scale farmers. But it's not true that all small-scale farmers are resource poor. Monsanto's argument is that GM technology is scale neutral. That is, it can be adopted equally well by small-scale and large-scale farmers. But it certainly cannot be adopted equally well by resource poor and well-resourced farmers. The technology requires inputs and precision in applying those inputs. Resource poor farmers cannot afford irrigation, seed, fertilisers or crop protection chemicals. They do not always have individual ownership of the land they work on. They cannot get credit because they have no collateral. Even if they are able to scrape together enough resources to purchase the needed inputs, input distribution systems often do not deliver on time, and timing of input application is critical.

The adoption of GM seed by small-scale farmers means an end to mixed cropping and the benefits associated with it. Compared to the industrialised monocropping of maize in the US and Europe, intercropping is a very significant practice in Africa. Data (somewhat dated but based on production methods that have not changed significantly) indicates that 70-80% of maize production in sub-Saharan Africa is intercropped, mainly with beans, cowpea, groundnut, cassava and squash. In the Eastern Cape the provincial government has launched a farmer support programme called Massive Food Production Programme (MFPP) that provides a small grant to finance inputs. Monsanto has taken the opportunity offered by collapse of the public extension service and lack of knowledge about the potential dangers of GM seed to use the MFPP to distribute GM seed to farmers in Flagstaff and elsewhere in the Eastern Cape. But in order to use the seed (together with Roundup herbicide), farmers have been informed that they should no longer follow the traditional practice of planting i.e. intercropping with beans and pumpkins, as the herbicides would kill these plants. Traditional intercropping practices, used for generations past, not only provide a balanced diet for villagers but are also a form of insurance because even if the maize crop fails, the other crops usually survive.

A key issue for both Bt and RR modified seed is rising resistance in insects and weeds alike. For this reason, farmers are meant to plant a portion of their land with non-GM varieties where insects can feed or weeds can grow, to reduce selection pressure. This portion is called a refuge, and is meant to occupy at least 5-10% of the land. In 2001, the US Environmental Protection Agency indicated that, in order to be successful, non-GM refuges would need to be increased from 20% to 50% of the total area under crops. For small-scale farmers this all but eliminates any potential benefit of planting GM seed.

Monsanto is using South Africa's favourable regulatory environment to increase adoption of GM seed by small-scale farmers. As in the case of Makhathini, this is then used to assert the important role of GM seed in developing countries, especially in Africa and Asia. But despite the emphasis on the benefits for small-scale growers, Kobus Lindeque,

Monsanto's southern African MD, says that more than 95% of Monsanto's business is with large-scale commercial growers[81]. Large-scale commercial growers make decisions based almost entirely on short-term economic benefit, especially in the climate of harsh competition they face today. But this means not considering other social or ecological factors unless these have a direct impact on income. According to Andrew Bennett of Monsanto, small-scale farmers without a readily accessible market for excess production are not likely to benefit from GM technology[82]. This means providing ongoing infrastructural and marketing support, something Monsanto will be unable or unwilling to do across Africa. Makhathini Flats is an abnormal situation in the sense that intensive support has been provided that most small-scale and resource poor farmers will not be receiving. Without this support, the technology cannot provide benefits.

Together with other biotechnology multinationals, Monsanto has assisted in creating a number of front organisations that spread an uncritically positive message about genetically modified crops. Monsanto provides funding for apparently neutral non-government organisations and research institutes including the African Agricultural Technology Foundation (AATF) and the International Service for the Acquisition of Agri-biotech Applications (ISAAA). The Institute aims to promote biotech and create partnerships between research institutes, and is in favour of genetic modification in agriculture. ISAAA has research links with the universities of Cape Town and KwaZulu-Natal.

AATF and ISAAA have links to AfricaBio, a front organisation for the biotech industry that presents itself as a non-political organisation interested in informing the public about biotechnology. However, an extremely one-sided picture is shown. Any opposition to GM crops is attacked as ignorant and misleading, as if the whole truth lies with AfricaBio and the biotechnology industry. Repeatedly in press statements, AfricaBio lashes out at critics of GM crops, claiming they are deliberately misleading people. This approach has reached a point where industry consultants baldly state that no-one other than genetic scientists have any business talking about the technology. In one response to a critic of GM crops, Hans Lombard, a consultant to the biotech industry says "he is neither a scientist nor an agriculturalist and is not qualified to speak on behalf of South African or African farmers concerning GM crops". In another attack, Lombard says of a critic of GM crops "It is clear he knows little about political science, economics and least of all agriculture" [83]. Lombard is involved in public relations work for AfricaBio. This idea that the people who must eat the food at the end of the day should be quiet and accept what industry-paid scientists tell them is good for them, is typical of a mindset that sees high technology as the unquestionable answer to all the world's ills. Dare anyone ask for more information or suggest alternative solutions, they are branded ignorant trouble makers.

AfricaBio responded to Biowatch South Africa's recent court victory, that obliged government to reveal information to the public about the way permits for GM are made, with unhappiness. Instead of seeing it as a step on the road to supporting rounded and informed public debate about a very contentious issue, AfricaBio expressed its concern about how the information would be used. "In the past we've seen organisations

[81] Tamar Kahn 2004 'A growing taste for genetically modified food', *Business Day*, 24 Aug 2004, p.2
[82] Devlin Kuyek 2002 *Genetically Modified Crops in Africa: Implications for Small Farmers*. Genetic Resources Action International, Barcelona, p.15
[83] Hans Lombard 2004 'Letter to the editor: Demand for GM Crops Escalating Worldwide', *Farmer's Weekly*, 3 Sept 2004, p.6; 'GM Crops a Major Boost to Development', *Farmer's Weekly*, 15 Oct 2004; p.6

misinterpret information and use it to create unfounded concern among the public," says Jocyelyn Webster, director of AfricaBio[84]. Apparently, there is only one way to interpret the information, and that's in favour of the continuation and expansion of GM cropping. This despite a general recognition that the majority of the public in South Africa doesn't know about biotechnology or genetic modification at all, and that there is a need for an open and informed debate about the issue.

A number of the biotech companies had voluntarily joined the court action on the side of the state to oppose access to the information Biowatch sought. All but Monsanto dropped demands for their costs to be reimbursed by Biowatch. The court ruled that Biowatch, a small NGO, was liable for Monsanto's court costs, even though Biowatch had won the case. In the same way as Monsanto uses its legal power to force farmers to stop saving seed, the multinational is using its wealth and legal power to crush opposition to its activities in South Africa.

Unfortunately, the South African state is participating in the public relations effort. An apparently neutral body funded by the Dept of Arts, Culture, Science & Technology, called the Foundation for Education, Science and Technology (Fest) has provided propaganda for biotech companies. For example, in a survey conducted in 2002, the Foundation asked whether consumers would buy GM food if it tasted better[85]. They then used the results (just 45% of respondents said yes) to claim that there was public support for GM production, despite the fact that no commercially grown GM crops are modified to improve taste.

The public relations strategy being spearheaded by the state and the multinationals is to inform people about biotechnology in general, giving it a positive spin. For example, in a recently published survey of public perceptions of biotechnology, respondents were given a list of practices that included 'making foods such as bread and cheese' and 'making biodegradable plastics that are not harmful to the environment'. It is no surprise that more than 60% of respondents said these practices should continue[86]. In this way, a general biotechnology is associated with positive advances in nutrition and safety. Once there is public acceptance that these are necessary human interventions, genetic engineering is introduced as just another example of biotechnology.

THE SOUTH AFRICAN STATE: PAVING THE WAY FOR MONSANTO'S CORPORATE STRATEGY

South Africa's permissive regulatory system and its technologically advanced agriculture system make the country an ideal gateway into Africa for the spread of genetically modified crops. South Africa has gone against the grain of the general distrust of GM foods in Africa. In the early years of this decade, Zambia, Zimbabwe, Angola and other southern African countries have refused genetically modified food aid. Yet South Africa has been used as a base from which to distribute GM food aid into the region.

South Africa's commercialised seed production and distribution system has for a long time been under control of the private sector. Commercial seed systems are skewed

[84] Jocelyn Webster 2005 'We are beginning to see the benefits', *Farmers' Weekly*, 15 Apr 2005, p.24
[85] Tamar Kahn 2002 'Consumers say proof in the pudding for GM food', *Business Day*, 2 April 2002
[86] HSRC 2005 Report on 2004 survey to Public Understanding of Biotechnology, 16 Feb 2005, p.8 (http://www.pub.ac.za)

towards crops and production methods that are profit making rather than survivalist or subsistence based. In Africa, only about 20% of grain seed is distributed through the commercial seed system. The remainder is farm saved and shared between farmers. South Africa is the engine for the distribution of commercial seed into southern Africa. Control over South Africa's seed supply is control over southern Africa's commercial seed supply.

South Africa has also become a base to produce GM seed for international distribution of GMOs, whether for experiment or consumption. South Africa's willingness to approve seed not in commercial production anywhere else in the world makes the country a base for GM experimentation. Countries that have received GM seed from Monsanto in South Africa include the Philippines, France, Argentina, US, China, Indonesia, Egypt, Colombia, Romania, Spain, Belgium and Chile. This seed has been exported for commercial planting as well as field trials, backcrossing and research. The vast majority of exports have been three maize varieties (MON810, NK603 and GA21), with 2 permits granted for soybean exports (CTS40-3-2) to Romania and China. MON810 has been exported to the Philippines in bulk (more than 820 metric tons) for planting, suggesting that Monsanto in South Africa is a big GM seed supplier to the Philippines.

Controversy has surrounded some exports. In 2001, GM cottonseed produced in South Africa by Delta & Pine Land South Africa under license from Monsanto, was secretly shipped to Indonesia and driven under armed guard from the airport in boxes marked "logistic depot rice". In 2005, Monsanto was fined for bribing government officials to waive environmental requirements to get GM cottonseed into Indonesia. Bribes included the purchase of land and the design and construction of a house in the name of a wife of a senior Ministry of Agriculture official.

The South African government's biotechnology strategy is unequivocally in favour of the use of genetic modification in agriculture. South African universities and parastatals have long been involved in agricultural biotechnology research and development. There were an estimated 911 biotechnology projects underway in South Africa in 2003[87]. About 18% of commercialised biotech products were plants and another 8% were food and beverage products. Most of these products were first generation biotech products (the use of natural biological organisms to produce a product), with around 10% involving genetic modification techniques[88].

Monsanto has an ongoing relationship with parastatals and universities to carry out biotechnology projects. Parastatals in South Africa are increasingly using public research infrastructure to further the private profit ends of biotech corporations. The state contributes funding to assist in biotechnology research and development, but biotech companies get the benefits if a product is commercialised. Monsanto has a close working relationship with the Agricultural Research Council (ARC), a publicly funded research institution that nevertheless has been forced to enter into partnerships with the private sector as state funding for agricultural research has been privatised.

[87] eGoli Bio 2003 'National Biotech Survey 2003', p.5 (http://www.pub.ac.za/resources/docs/egolibio_survey_2003.pdf)
[88] eGoli Bio 2003, ibid. p.47

RESOURCES

In South Africa

African Centre for Biosafety (http://www.biosafetyafrica.net)
Biowatch South Africa (http://www.biowatch.org.za)
Earthlife Africa (http://www.earthlife-ct.org.za)
GM Free Africa (http://www.gmfreeafrica.org/gmfa_main/)
South African Freeze Alliance on Genetic Engineering (Safeage)
(http://www.safeage.org)

Other useful info on Monsanto

Badcorp.org (http://www.badcorp.org)
Consumers International (http://www.consumersinternational.org)
Corporate Watch (http://www.corporatewatch.org)
Corporate Dirt Archives (http://www.corporations.org/corplist.html)
GeneWatch (http://www.genewatch.org)
GMWatch (http://www.gmwatch.org)
GRAIN (http://www.grain.org)
Monsanto (http://www.monsanto.com)
Monsanto South Africa (http://www.monsanto.co.za)
Monsanto Watch (http://www.monsantowatch.org.uk)
Multinational Monitor (http://www.multinationalmonitor.org)