

Annotated Bibliography for GE3LS Essay for the Canadian Potato Genome Project

1. A.A. Araji and S.L. Hafez. *The economic and environmental impacts of nematode biocontrol methods: An ex-ante approach.* Nematropica, 2001; 31(2): 181-193.

Summary: The objective of this study is to evaluate the economic and environmental benefits of investment in coordinated diagnostic-research-extension program to manage nematodes on potatoes, sugar beets and alfalfa. Nematodes in sugar beets and potatoes in the Pacific Northwest are presently managed with expensive and toxic soil fumigants. The new method reduced nematode numbers by more than 90 percent, improved yield, and eliminated the need for fumigants. Investment in the development of the nematode biocontrol methods will eliminate an estimated 6.17 million kilograms (13.6 lb million) of active toxic material from the environment in Idaho. Idaho producers of potato, sugar beets, and alfalfa will have an estimated gross annual benefit of \$43 million. It will cost potato and sugar beet producers about \$14 million annually to implement the biocontrol method. The projected present value of the flow of gross annual benefits over the life expectancy of the technology is dollar sign217.63 million. The projected present value of cost over the life expectancy of the technology is dollar sign71.77 million. The internal rate of return is estimated at 81 percent.

2. Alison Pierce. *Bioscience Warfare: UC professor Tyrone Hayes found that a highly profitable weed killer causes sexual abnormalities in frogs. Then he found out how nasty a biotech multinational can be.* SF Weekly, LP (California), June 2, 2004. Available through NEXUS – LEXUS.

3. Andrew Pollack. *UN joins crop debate.* The New York Times; The International Herald Tribune, May 19, 2004. Available through NEXUS – LEXUS.

4. Andy Holloway. *Welcome to the bioeconomy: advances in biology are changing the way the world does business, and Canada could rise to the top of the food chain in the new biotech economy. The missing link is money.* Canadian Business, Toronto, Sep 2, 2002, Vol. 75, Iss. 16; pg. 28.

Summary: Commercializing research projects is the No. 1 concern of the biotech industry, says Janet Lambert, president of BioteCanada. There's a lead time of about 10 years between finding a gene, cultivating it, jumping through regulatory hurdles and marketing an end product. In Canada, just getting a health-related product through the

regulation and approval process can take up to 800 days--double what it usually takes in the US--and can cost at least \$20 million.

Lambert, whose association represents about 85% of the Canadian biotech sector, says most of her members burn through their available finances in 12 months. Since it takes a decade to get a product to market, that means those companies require repeated and consistent financing--not easy in today's market. "There's no shortage of ideas, and there's no shortage of potential products," says Lambert. "There is a shortage of cash to go around." Private investors simply don't have enough money to sustain every company for 10 years while it develops a product that may never get to market.

As biotech proponents like David Dennis point out, there's a lot of misinformation out there. At a Scottish research institute in Aberdeen, for instance, experimental raw potatoes, engineered to be resistant to insects, were fed to rats. The researcher came to the conclusion that potatoes impaired the rats' immune systems and their growth. He made his conclusion public without any peer review. The experiment could not be repeated, but the press and environmental activists jumped on the story, declaring that genetically engineered crops were unsafe for human consumption even though the findings were invalid. That angers Dennis, president and CEO of Performance Plants Inc., a Kingston, Ont.-based agri-biotech that is inserting genes into traditional crops to improve yields. He says biotech-developed products are the most tested food products ever. In Canada, testing can often cost more than a product's R&D costs. "One of the problems for a company like us is that we'll probably never be able to afford the tests on a product," says Dennis. "We'll have to go with a big partner to take it through the regulatory process because it's so strict and so stringent."

5. Anonymous. *Biotechnology Industry Convention (BIO) 2003 Annual Convention.* Available at:

<http://www.bio.org/events/2003/intl/profile2.asp?id=104>

6. Anonymous. *Britain gives go-ahead for first GM crop.* GM Food Special Report, New Scientist, March 2004. Available at:

<http://www.newscientist.com/hottopics/gm/gm.jsp?id=ns99994754>

7. Anonymous. *Development and transfer of genetically modified virus-resistant sweet potato for subsistence farmers in Kenya Wambugu FM.*

Nutrition Reviews, June 2003, 61 (6): S110-S113 Part 2.

Summary: Up to 80% of the yield of sweet potato, the major root crop in East Africa can be destroyed by crop diseases such as the sweet potato feathery mottle virus (SPFMV). A sweet potato that is resistant to SPFMV is being developed through the combined efforts of non-governmental agencies, biotechnology groups, and agricultural entities. Even small improvements in crop yield, owing to this new technology, will feed countless people in Africa.

8. Anonymous. *Fight Hunger with Science.* The State Journal-Register, Springfield, IL, July 12, 2004. Available through NEXUS – LEXUS.

- 9. Anonymous. *GM crops can be worse for environment.* GM Food Special Report, New Scientist, October 2003. Available at:**
<http://www.newscientist.com/hottopics/gm/gm.jsp?id=ns99994283>
- 10. Anonymous. *GM wheat put on hold.* GM Food Special Report, New Scientist, May 2004. Available at:**
<http://www.newscientist.com/hottopics/gm/gm.jsp?id=ns99994977>
- 11. Anonymous. *ICMR Wants Overhaul of Foods Regulation.* Financial Times Information; Global News Wire - Asia Africa Intelligence Wire; The Indian Express Online Media Ltd., Financial Express, July 25, 2004. Available through NEXUS – LEXUS.**
- 12. Anonymous. *India to Approve GM Potato.* Asia Pacific Biotech News, July 2003, Vol. 7 Issue 15, p910, 1/3p.**
Summary: Reports on the approval to be given by the Indian government for the commercial growing of potato, a genetically modified (GM) potato with more protein, within the next six months, as of July 21, 2003.
- 13. Anonymous. *Politics and current affairs: Food fight.* The Economist, London, Dec 31, 1999, Vol. 353, Iss. 8151; pg. S22, 1 pgs.**
Summary: McCain Foods, a New Brunswick firm that is one of the world's largest suppliers of frozen chipped potatoes, revealed that after January 1 it would no longer buy any genetically modified spuds. Then, the federal government said it would set up a committee of experts to review its system for approving GM foods.
- 14. Anonymous. *The case for/against GM foods.* Moscow News (Russia): Ecology; No. 16, April 28, 2004. Available through NEXUS – LEXUS.**
- 15. Anonymous. *The truth about biocrops.* The State Journal-Register (Springfield, IL), May 24, 2004. Available through NEXUS – LEXUS.**
- 16. Anonymous. *Three Years Later: Genetically Engineered Corn and the Monarch Butterfly Controversy.* Pew Initiative on Food and Biotechnology. Available at: <http://pewagbiotech.org/resources/issuebriefs/monarch.pdf>**
- 17. Anonymous. *Tomatoes may offer edible AIDS vaccine.* AIDS Weekly & Law via LawRx.com, August 12, 2004. Available through NEXUS – LEXUS.**
- 18. Anonymous. *U.N. Food And Agriculture Organization: U.N. food agency still supports genetically modified crops.* Lab Business Week via IncRx.com, June 13, 2004. Available through NEXUS – LEXUS.**
- 19. Anonymous. *West African Leaders Embrace U.S. Biotechnology.* The New Farm, The Rodale Institute, 2004. Available at:**
http://www.newfarm.org/international/news/060104/061404/af_bio.shtml

20. Anonymous. *20,000 Biotech Executives Gather at BIO in San Francisco: Biotech on Track for Success.* PR Newswire Association, Inc., June 10, 2004. Available through NEXUS – LEXUS.

21. A.S. Rishi, N.D. Nelson, and A. Goyal. *Molecular farming in plants: A current perspective.* Journal of Plant Biochemistry and Biotechnology, January 2001, 10 (1): 1-12.

Summary: The low cost of production makes plants an ideal candidate for producing many high value compounds through genetic engineering. Expression of vaccines, therapeutic proteins, nutraceuticals, industrial enzymes, and other bio-polymers has been achieved in different plants. A few products for human health care that have been produced in plant systems are currently undergoing human clinical trials. Some recombinant molecules produced in plants for diagnostic use are currently available in the market and several other compounds are in the pipeline for commercialization. The involvement of several biotechnology companies and the successes achieved provide promise for the growth of this emerging field, "Molecular Farming".

22. Australia's Biotechnology Organization. *Backing Innovation: the way forward for Australian agriculture.* AusBiotech Ltd., 2004. Available at: <http://www.ausbiotech.org/policy/pdf/backing.pdf>

Summary: Australian agricultural biotechnology is at a 'cross-roads'. Highlighted as the top area of national strength in biotechnology research (Commonwealth of Australia 2003) and recognized globally, agricultural biotechnology and the investment, innovation and skills that underpin it are in crisis.

Five Australian states have placed moratoriums on the development of GM food crops for the next two to four years despite their strategic plans to develop the biotechnology industry as a whole. This sends a confused and uncertain message to the global community and investors in Australian innovation, as the moratoriums go against both National safety assessments and global trends. Australia now has an urgent choice to make – whether to back innovation and *lead* as an agricultural nation, or remain a commodity-based community.

The moratoriums were imposed following two varieties of genetically modified canola crops being approved as being safe for humans and the environment by the Australian Government's Office of the Gene Technology Regulator (OGTR) and for human consumption by Food Standards Australia New Zealand, following extensive consultation and evaluation. While the states and territories are bound by the decisions of the OGTR through an intergovernmental agreement, the legislation contains a provision for state governments to implement further restrictions for marketing purposes only.

The moratoriums on GM food crops are contrary to the policy intent for the national coordinated regulatory system as agreed by the Council of Australian Governments and has effectively created a fragmented and inconsistent two-tiered regulatory system. The inconsistency in the regulatory system is a disincentive for investment in agricultural biotechnology research and development in Australia and will have a far reaching impact on innovation.

The decisions by State Governments to impose moratoriums sent a shock-wave throughout the industry, research and agricultural communities. The introduction of

moratoriums without clear consultation creates a number of immediate and indirect consequences for Australia.

These moratorium decisions will:

- Reduce investment in biotechnology and other life sciences research and reduce capacity to undertake research and development in Australia, which is essential to the growth and development of the agricultural sector and the broader biotechnology industry;
- Reduce opportunities for university students to make a career in the agricultural life sciences;
- Reduce the competitiveness of Australia's farmers while allowing other countries (e.g. Canada) to gain entry into Australian markets;
- Lessen Australia's standing in the international community and put Australia at risk for future World Trade Organization (WTO) challenges because of the compromise of our science-based regulatory system;
- Put future agricultural breakthroughs at risk by diverting research resources into other areas; and
- Compromise the intent of the joint state-Commonwealth regulatory system as agreed by the Council of Australian Governments.

The way forward for Australian agriculture:

- By early 2005, State Governments to put in place, as a matter of priority, a pathway forward from research and development to commercialization;
- For canola, this pathway would facilitate reasonably sized co-existence trials in more than one location to test the protocols and capabilities of the supply chain in 2005;
- Develop a coordinated State Government approach to issues such as adventitious presence and liability;
- Provide reassurance to the science/investment and international communities that Australia is moving forward with Agricultural science, technology and commercialization; and
- Develop a unified and coherent approach to assessments and approvals for Agricultural products through an independent Advisory Group, chaired by Industry in partnership with the OGTR.

AusBiotech seeks to provide agricultural biotechnology with the same opportunities that have been provided to medical biotechnology developments – notably a unified and coherent approach, based on consistent, science based assessments and approvals.

23. Bernardo Lopez. *Upshot*. Financial Times Information; Global News Wire - Asia Africa Intelligence Wire; BusinessWorld (Philippines), August 4, 2004. Available through NEXUS – LEXUS.

24. Brian Halweil. *Monsanto drops the terminator*. World Watch, February 2000, Vol. 13 Issue 1, p8, 2p.

Summary: Reports that Monsanto Corp. has decided not to commercialize its terminator technology which would prevent harvested seed from germinating. Aim of preventing farmers from saving seed for future planting; Prohibition of the re-planting of patented seeds; Concerns about the impact of the terminator technology on farmers in Africa, Asia and Latin America.

25. Cynthia Reynolds. *Frankenstein's harvest: in country after country, consumers are turning against genetically modified foods. Now the battle for public opinion has broken out in North America.* Canadian Business, Toronto, Oct 8, 1999, Vol. 72, Iss. 16; pg. 64.

Summary: Suggests that anti-GM campaigns have caused several producers and manufacturers to stop using GM foods. Shows that pressure from consumers and farmers have resulted in a massive phasing out of GM products and a call for labeling of GM products.

26. Dennis Olson and Ben Lilliston. *New Survey Indicates Strong Grain Elevator Concern Over GE Wheat.* Press Release from the Institute for Agriculture and Trade Policy, April 8, 2003. Available at: http://www.agobservatory.org/library/uploadedfiles/New_Survey_Indicates_Strong_Grain_Elevator_Con.pdf

27. D. Koyek. *Intellectual property rights: ultimate control of agricultural R&D in Asia: IR and PVP - undermining farmers' rights in Asia.* Institute for Agriculture and Trade Policy (IATP), 2001. Available at: http://www.gefoodalert.org/library/admin/uploadedfiles/Intellectual_Property_Rights_Ultimate_Control_.pdf

Summary: Discusses the pressure on Asian countries to adopt plant variety protection (PVP) systems based on Union for the Protection of New Varieties of Plants UPOV. Gives the arguments against PVP, and includes a 'people's perspective'.

Looks at PVP and patents, and finds that they:

- undermine farmers' rights, as, whilst breeders get exclusive commercial control over the reproductive material of their varieties and the right to enforce licenses, farmers planting PVP-protected varieties are prohibited from saving seeds for replanting except under highly restricted conditions. These rights, which cannot be protected by IPRs, form the basis of sustainable agriculture and recognize the importance of farmer innovation to global food security and well being
- ensure that farmers come to rely on foreign companies
- give foreign companies control over germplasm that has been developed by Asian farmers
- exacerbate the erosion of biodiversity

Conclusions

- whilst proponents of IPR claim that it is important for access and innovation, this is a smokescreen. If access was the issue, then the evidence stands against IPR: it restricts the flow of germplasm, reduces sharing between breeders, erodes genetic diversity, and, all in all, stifles research
- IPRs are suited to the profit strategies of the global seed conglomerates that want to dominate agricultural production worldwide. The transnational seed companies are building vast industrial breeding networks in all major crops and, with their economies of scale and ownership over technology through IPR, they will shut local private and public breeders out of the commercial market. For them, IPR is simply a means for controlling the market and extracting more profit from it

- Contrarily, by their very nature, IPRs inhibit and easily destroy innovation on farms – the centres of research and development for sustainable agriculture. There are plenty of options for rewarding innovation that encourage pro-farmer research and development, but IPR is not one of them. These options are being articulated by farmers and organizations working with them but disregarded by governments rushing to comply with TRIPS – with severe implications for the region’s long term food security
- Asian governments urgently need to wake up to the inherent threats of IPR over genetic resources, take a look at other options which would better serve the interests of their people, and start implementing a truly pro-people agricultural R&D agenda.

28. Dr. Charles M. Benbrook. *When Does it Pay to Plant Bt Corn? Farm-Level Economic Impacts of Bt Corn , 1996-2001.* Benbrook Consulting Services, 2001. Available at:

http://www.gefoodalert.org/library/admin/uploadedfiles/WhenDoes_It_Pay_to_Plant_Bt_Corn_Farm-Level_Ec.pdf

29. Emily S. Plishner. *A new leaf.* FW, September 1995, Vol. 164 Issue 20, p16, 2/3p, 1 cartoon.

Summary: Examines how Monsanto has been investing \$8 billion-in-revenues in agricultural biotechnology, since 1985. The vision of a three-phase transformation producing annual growth in excess of 20% for more than 20 years; An insect-resistant potato called NewLeaf; Planning to market bioengineered plant qualities directly to the consumer.

30. Emmanuel Duguet and Megan MacGarvie. *How Well Do Patent Citations Measure Flows of Technology? Evidence from French Innovation Surveys.* Revised, September 2003. Available at:

<http://cisad.adc.education.fr/reperes/telechar/wp/eurequa/dug0399.pdf>

Summary: Patent citation data are used on a growing body of economics and business research on technological diffusion. Research in this area uses “backward” citations to measure technological knowledge acquired by the patenting entities studied. “Forward” citations (citations to the firm’s patents made by other patents) have been interpreted as a measure of the knowledge diffusing outward from the patenting entity. Until now, there existed little evidence on whether or not patent citations were a good measure of knowledge flows. This paper assesses the legitimacy of using European patent citations as a measure of technology flows. It uses information from the Community Innovation Survey (CIS) collected by the French Service des Statistiques Industrielles (SESSI), which contain firms’ responses to questions about their innovative activity. We show that patent citations are indeed related to firms’ statements about their acquisition and dispersion of new technology, but that the strength and statistical significance of this relationship varies across geographical regions and across channels of knowledge diffusion.

31. FAAR Biotechnology Group Inc. & Auditor Bioconsulting. *Canadian Biotechnology Strategy: Opportunities and Challenges for Application of*

Biotechnology in the Canadian Agri-food Sector. Summary Document and Recommendations, April 28, 1998. Available at:

http://www.carccrac.ca/english/cdn_biotech_strategy/cbs.htm

Summary: Within the total of economic activity associated with biotechnology in Canada, agri-food biotechnology (est. \$319 M) ranks second only to pharmaceutical biotechnology (est. \$396 M) in terms of overall revenues. It is important to fully appreciate the benefits biotechnology has provided the agri-food sector, the Canadian economy and most importantly Canadian society. Food quality, safety and affordability are now a fixture of the Canadian way of life. With these standards in hand, the agri-food sector approaches the millennium with a significant opportunity for growth domestically and internationally in traditional and value-added products. Capitalizing on these opportunities will require vision and leadership.

It is clear that as biotechnology influences food quality, composition and spans across numerous disciplines, new issues will arise which will need to be addressed in the same fashion that has ensured the high level of trust and confidence enjoyed by the present regulatory system. Additionally there will be need to further encourage private sector involvement in supporting and bringing to market the knowledge generated by biotechnology research. In order to fully capitalize on opportunities and address these issues, a number of recommendations are proposed as part of the renewal of the *Canadian Biotechnology Strategy*. These recommendations provide an opportunity for the public sector to assume a leadership role in developing a proactive climate for investment and private sector expansion in this area. These recommendations further identify research areas of emphasis that will ensure a strong and self-sustaining sector.

It is recommended that the Canadian Biotechnology Strategy should be targeted to effect changes that provide a positive atmosphere for investment in research and development by business. This includes support of programs to encourage industry investment in knowledge generating basic research, emphasis on using existing government programs to support projects in the agri-food sector and *harmonization of the Canadian Intellectual Property laws with major trading partners*.

It is further recommended that the government should recognize that stable long-term investment in the agricultural sector will require a "Business point of view" which may include government initiatives in tax incentives, financing, education, training and communication. Additionally the government should maintain and fully support a visible "Champion" at the cabinet level to promote biotechnology in agri-food. In terms of this study, "government" represents a broad term that includes all public sector activity which may include universities as well as federal and provincial departments. Along with promotion of biotechnology, efforts should continue to ensure the public has access to balanced information on risks and benefits. Combined, these activities will nurture the growth of biotechnology in the sector while maintaining the current standards of quality and safety.

In view of Canada's export activity, it is recommended that the government take advantage of the current standards of quality and safety enjoyed by the agri-food sector as a "window to the world" for export growth. The "critical mass" needed to compete and triumph on the world stage must be drawn together through cooperation and support of the basic research community.

It is recommended that the government provide leadership to ensure the growth of research, both private and public sector, through support of cooperative efforts, training and effective communication among researchers. Finally, government support of basic research should be predicated on cooperative, rather than competitive efforts of the research community mirroring the successes seen for the Network Centres of Excellence in other sectors. This will require efforts to increase communication among federal agencies, universities and company research departments.

32. Graham Laurie. *Intellectual Property Protection of Biotechnological Inventions and Related Materials*. Innogen Working Paper 4, 2003. Available at: http://www.innogen.ac.uk/ownPubs/G_Laurie_2003.pdf

Summary: This paper offers an overview of patenting practices in Europe, the US and elsewhere in respect of biotechnological inventions. It considers pertinent legal instruments and rulings over the past few decades as these have been influenced by and have influenced in turn, policy matters surrounding, on the one hand, the encouragement of biotech patents for economics reasons, and on the other hand, moral concerns about such practices. The paper assumes no specialized knowledge about patenting or the patent systems of the world and accordingly begins with an introduction to the global patent regime. The paper ends with a brief account of other intellectual property rights that might also be claimed in respect of biotechnological advances. A series of detailed case studies forms the Appendices of the paper and there is a selected bibliography and webography of additional relevant material.

33. Hari C. Sharma, Kiran K. Sharma, Nadoor Seetharama, and Rodomiro Ortiz. *Prospects for using transgenic resistance to insects in crop improvement*. *Electronic Journal of Biotechnology*, 2000. Available at: <http://www.ejb.org/content/vol3/issue2/full/3/index.html>

Summary: Genes conferring resistance to insects have been inserted into crop plants such as maize, cotton, potato, tobacco, potatoes, rice, broccoli, lettuce, walnuts, apples, alfalfa and soybean. Genetically transformed crops with Bt genes have been deployed for cultivation in USA, China and Australia. However, very little has been done to use this technology for improving crop production in the harsh environments of the tropics, where the need for increasing food production is most urgent. International agricultural research centres, advanced research institutes and the seed sector should make an effort to use these new tools for increasing food production in poorer regions of the world. There is an urgent need to develop a scientifically sound strategy to deploy exotic and plant derived genes for minimizing the extent of losses caused by insect pests. Equally important is the need for following the biosafety regulations, more responsible public debate, social attitude and better presentation of the benefits for a rational deployment of the genetically transformed plants.

34. Hari Sharma, Kiran Sharma, Nador Seetharama, and Jonathan Crouch. *The utility and management of transgenic plants with *Bacillus thuringiensis* genes for protection from pests*. *Journal of New seeds*, 2003; 5(1): 53-76.

Summary: While several transgenic crops with insecticidal genes have been introduced in the temperate regions, very little has been done to use this technology for improving

crop production in the harsh environments of the tropics, where the need for increasing food production is most urgent. This may be due to the lack of infrastructure, biosafety regulations, intellectual property rights, or market potential. There is an urgent need to develop a scientifically sound strategy to deploy exotic and plant derived genes through transgenic plants for minimizing the extent of losses caused by insect pests. Equally important is the need for observance of biosafety regulations, a responsible public debate, and a better presentation of the benefits to sustainable crop production of a rational deployment of genetically transformed plants.

35. International Council for Science (ICSU). *Agricultural Biotechnology, Biodiversity and the Environment*. Companion Publication: *Biotechnology and Sustainable Development*, Chapter 4. Available at:

http://www.icsu.org/1_icsuinscience/GMO/html/WSSD%20chapter_4.htm

36. Jos W. Bijman. *Biotechnology and Vertical Integration in the Dutch Potato Chain*. Economics of innovation: The case of the food industry, 1996, pp. 307-17.

Summary: This report is part of a Technology Assessment process. It analyzes the state of the art in genetic engineering of potatoes. It discusses the perspectives and barriers for commercial introduction of transgenic potatoes in the Netherlands. The information is based on documentary analysis and interviews. Emphasis is put on the interaction between the development of transgenic potatoes and the restructuring of the potato chain. The introduction of transgenic potatoes will further the vertical integration in the product chain, but economic effects are hard to quantify. Public attitudes towards genetically engineered food products are still rather reserved.

37. J. Raloff. *Taters for tots provide an edible vaccine*. Science News, March 1998, Vol. 153 Issue 10, p149, 1/2p, 1c.

Summary: Provides details of a project at Loma Linda University School of Medicine in California that has added a gene to potatoes that enables them to make a nontoxic component of the cholera toxin. How the enhanced potato potentially works in the body to create a vaccine; March 1998 publication of results in 'Nature Biotechnology'; Comments from researcher William H.R. Langridge; Dangers; Other comments.

38. Kate Madigan. *Risky Business: Financial Risks that Genetically Engineered Foods Pose to Kraft Foods Inc. and Shareholders*. National Association of State PIRGs, As You Sow Foundation, April 2003. Available at:

http://www.gefoodalert.org/library/admin/uploadedfiles/Risky_Business_Financial_Risks_that_Genetically_Engineered_Foods_Pose_to_Kraft_Foods_Inc_and_Shareholders.pdf

Summary: Genetically engineered foods have the potential for detrimental impacts on public health and the environment, which in turn pose significant financial risks to food companies and investors. Strong regulatory oversight of these crops is essential to prevent health impacts for which food companies could be liable. However, concerns

about the adequacy of these regulations have been raised from sources inside and outside of these agencies, including from food companies themselves. In order to clearly illustrate the financial risks of genetically engineered foods, this report will focus on the particular financial risks that genetically engineered ingredients pose to Kraft Foods, the largest food company in the country.

The StarLink contamination of the food supply demonstrated the financial risk that genetically engineered foods can create and the inadequacies of current regulations to protect food companies from liability. StarLink corn is a variety of genetically engineered corn not approved for human consumption because of risk of allergic reaction. In Fall 2000 StarLink was found in Kraft's Taco Bell taco shells and then in hundreds of other products in the food supply, spurring recalls, lawsuits, lost sales, and consumer rejection that is estimated to have cost the food industry a billion dollars.

StarLink is just one of many unapproved varieties of genetically engineered crops with the potential to contaminate the food supply and lead to financial risk to Kraft. Between 1987 and 2000, for instance, there have been nearly 30,000 reported open-air plantings of experimental genetically engineered crops across the United States. Unfortunately, many other varieties are approved for planting and consumption despite their potential for harming human health or the environment.

Contamination of Kraft products by approved or unapproved crops could create significant financial liabilities for companies if they did not act to prevent contamination. This report details the financial risks that genetically engineered foods pose to food companies, with Kraft Foods as the primary example. These risks include:

- Product Liability
- Biopharm Contamination
- Consumer Rejection of Kraft Products
- Loss of Competitive Advantage
- Damage to Reputation
- Insurance Industry Concerns
- Shareholder and Analyst Concerns
- Risk of Sudden Regulatory Changes

In response to these financial risks and to the growing consumer demand for non-genetically engineered foods, many food companies in Europe have stopped using genetically engineered foods, including Kraft Foods in Europe. Many U.S. food companies have also decided not to use genetically engineered ingredients in their products, including Gerber, Heinz, McDonald's, Frito-Lay, and supermarket chains Whole Foods, Wild Oats, and Trader Joe's. We found that these companies did not report financial difficulties as a result of this shift, and in most cases sales increased in the years following the switch.

In addition, genetically engineered foods offer no marketable benefit to food companies. The potential for Kraft and other food companies to experience future financial risk is great if they continue to use genetically engineered ingredients, yet these foods offer no marketable benefits. Studies have even documented that genetically engineered crops may cost more to produce than their non-genetically engineered counterparts. Without clear benefits, the financial risks that food companies bear by continuing to use genetically engineered ingredients are difficult to rationalize.

Kraft faces unnecessary financial risk by continuing to use genetically engineered ingredients. The potential for Kraft and other food companies to experience future financial risk is great if they continue to use genetically engineered ingredients. Oversight by government regulatory agencies is not adequate to protect Kraft from these risks. To reduce financial risk from genetically engineered ingredients, we recommend that Kraft take the following steps:

1. Phase out genetically engineered ingredients.
2. Disclose to shareholders all financial risks posed by genetically engineered ingredients.

39. Keith Aoki. *Neo-colonialism, Anticommons Property and Biopiracy in the (Not-So Brave) New World Order of International Intellectual Property Protection*. *Global Legal Studies*, 1998, 11, 34–35.

40. Kim Gloria. *Chew on this! Ottawa is still pumping tax dollars into GM foods*. *Canadian Business*, Toronto, Oct 1, 2001, Vol. 74, Iss. 18; pg. 14.

Summary: Never mind that Monsanto Canada is a division of a US multinational with a market cap of US\$8.5 billion. Why, though, when the Canadian Wheat Board's own analysis has shown that Canadian farmers could conceivably lose hundreds of millions of dollars, would Ottawa be so generous? Bradford Duplisea of the Canadian Health Coalition, an Ottawa-based watchdog, estimates that the government has spent more than \$1 billion in agricultural biotech, much of that going to controversial projects such as Monsanto's. Between 1997 and 1998 alone, the biotech industry claimed \$314 million of your tax dollars on such projects as Monsanto's Roundup Ready canola (which has been found to have an unapproved extra gene) and Monsanto's transgenic potatoes (which have found their way to Ukraine and Georgia in unauthorized field tests).

41. Lara E. Ewens. *Seed Wars: Biotechnology, Intellectual Property, and the Quest for High Yield Seeds*. *Boston College Law School Student Publications*. Available at:

http://infoeagle.bc.edu/bc_org/avp/law/lwsch/journals/bciclr/23_2/05_FMS.htm

Summary: The intellectual property paradigm that determines international protection and control over biotech innovations in plant varieties and genetic resources that form the basis for those innovations employs western definitions of property in order to provide a framework in which to allocate rights. This has resulted in serious distributive problems: western-specific ideas about property, authorship, and individual creative inventors do not translate well to areas where cultural knowledge or generational innovation form the basis of important societal achievements. The default solution in the international agricultural context has been to almost entirely forego any sort of property protection for cultural and indigenous knowledge and innovation. Until international intellectual property law increases awareness of the importance of the public domain in preserving genetic diversity, protecting the global food supply, and safe-guarding genetic resources, intellectual property law will under-value and under-compensate the contributions and agricultural concerns of the developing countries that safeguard the vast majority of the world's plant genetic resources.

42. Larry D. Makus, Joseph F. Guenther, and Biing-Hwan Lin. *Factors Influencing Producer Support for a State Mandatory seed Law: An Empirical Analysis.* Journal of Agricultural and Resource Economics, December 1992, v.17, iss. 2, pp. 286-93.

Summary: A probit model identifies characteristics influencing Idaho potato producer support or opposition to a state mandatory certified seed law. Economic self-interest appears to be the most important influencer. Current users of certified seed and growers of certified seed are strong supporters. However, producer attitudes about the impact of seed-borne diseases and effectiveness of certified seed as a control mechanism also are important. Respondent characteristics (gross farm income, potato acreage, and geographic region of the state) seem to be less important influencers.

43. L.R. Lasota. *Evaluation by the United States Environmental Protection Agency of pesticidal substances produced in plants.* Field Crops Research, 1996; 45(1-3): 181-186.

Summary: The legislative mandates and proposed scope of the U.S. Environmental Protection Agency's (EPA) regulation of pesticides produced in plants are described. The first three Experimental Use Permits (EUPs) granted by EPA for field testing of plant-pesticides were for delta endotoxins from *Bacillus thuringiensis* expressed in cotton (*Gossypium hirsutum* L.), potato (*Solanum tuberosum* L.) and maize (*Zea mays* L.). In each instance, an environmental-fate assessment by the Agency found no significant risk of gene expression beyond the spatial and temporal limits of the proposed field tests.

44. Maggie Farley. *The World; Altered Crops Backed by U.N.; Genetically modified foods are safe, but staples should be stressed, agency says.* The Times Mirror Company; Los Angeles Times, May 18, 2004. Available through NEXUS – LEXUS.

45. Marcella Athayde. *Monsanto drops its biotech potato.* World Watch, December 2001, Vol. 14 Issue 6, p5, 2p.

Summary: Reports the move of biotechnology firm Monsanto to withdraw the genetically modified Newleaf potato from the United States and Canadian market. Impact of reduced order from McDonald's; Question over the safety of genetically modified foods; Focus of the company on key agriculture crops.

46. Marc Ghislain, Aziz Lagnaoui, and Thomas Walker. *Fulfilling the promise of B.t. potato in developing countries.* Journal of New seeds, 2003; 5(2-3): 93-113.

Summary: B. t. potato technology, if properly managed, offers substantial benefits for developing countries. For many poor farmers potatoes represent a staple food and an important cash crop. Potato insect pests have a substantial negative impact on the livelihood of farmers. B. t. potatoes have been effective on a commercial scale in controlling Colorado potato beetle in North America. Small-scale tests have demonstrated B.t.'s efficacy in controlling potato tuber moth.

Reductions in insecticide use would provide significant economic, health and environmental benefits. Unintentional B. t. gene escape into wild relatives of cultivated

potato should be rare and unlikely to persist. However, a monitoring system should be in place in areas where sexually compatible relatives of potato occur. The potential of B. t. varieties to displace land races or reduce crop genetic diversity should be addressed by the creation of sanctuaries or germplasm banks. Because farmers in developing countries exchange their seeds and mandatory labeling would likely exclude small-scale farmers, B. t. genes should be introduced only into varieties handled through the formal seed systems, providing the basis for a variety-based system for segregating genetically engineered (GE) and non-GE produce.

47. Martin Qaim. *Potential Benefits of Agricultural Biotechnology: An example from the Mexican Potato Sector*. *Review of Agricultural Economics*, fall-Winter 1999, v. 21, iss. 2, pp. 390-408.

Summary: The study analyzes ex ante the socioeconomic effects of transgenic virus resistance technology for potatoes in Mexico. All groups of potato growers could significantly gain from the transgenic varieties to be introduced, and the technology could even improve income distribution. Nonetheless, public support is needed to fully harness this potential. Different policy alternatives are tested within scenario calculations in order to supply information on how to optimize the technological outcome, both from an efficiency and an equity perspective. Transgenic disease resistance is a promising technology for developing countries. Providing these countries with better access to biotechnology should be given higher political priority.

48. M.G. Paoletti and D. Pimentel. *The environmental and economic costs of herbicide resistance and host-plant resistance to plant-pathogens and insects*. *Technological Forecasting and Social Change*, September 1995, 50 (1): 9-23.

Summary: Sustainable agriculture and biodiversity maintenance would be central to a desirable development of genetic engineering. Biotic diversity on the planet is the base for all food chains, including human ones: in particular, diversity is incredibly high in tropical areas in which 30-100 million living species have been forecast. Options for genetic engineering, in order to be desirable, have to meet two needs: improve sustainability and promote biodiversity, and reduce environmental stress. Most of the current field trials that have been approved are focused on traits such as herbicide resistance, which in most cases could promote more intensive use of herbicides hazardous to the environment. Extensive research on risk assessment is either limited or nonexistent on nontarget organisms in agroecosystems in which genetically modified organisms are expected to be released. The following options are discussed in detail: (1) the B.T. endotoxine problem and the ecology of B.T. strains; (2) crops modified for herbicide resistance; (3) plants resistant to pests and diseases; (4) transfer of resistance genes from wild varieties, which are resistant, to commercial ones. Traditional breeding of promising cases (potato, apple, grape) as source ideas for sustainable agriculture and genetic engineering trends are discussed, together with some desirable and undesirable aspects of the development of genetic engineering.

49. Michael Blakeney, Joel I. Cohen, and Stephen Crespi. *Intellectual Property Rights and Agricultural Biotechnology*. Available at: http://www.isnar.cgiar.org/publications/pdf/biobook/V_18.pdf

Summary: Scientists, research directors, and policymakers face complex questions and decisions when managing intellectual property rights (IPR) for agricultural research. This chapter discusses the impact of IPR in a biotechnological context. It explains differences between principal categories of IPR relevant to agricultural research: plant variety rights, patents, trademarks, confidential information, trade secrets, and copyright. Material transfer agreements and farmers™ rights are also discussed. National, regional, and international dimensions of these various forms of protection and agreements are reviewed, as well as the interrelationship between intellectual property and biodiversity rights.

50. Michael Fumento. *Seeds of fear*. News World Communications, Inc.; The Washington Times, May 16, 2004. Available through NEXUS – LEXUS.

51. Michael McCarthy. *UN backs GM crops despite concerns that benefits do not reach the world's poor*. Financial Times Information; Global News Wire - Europe Intelligence Wire; The Independent Newspapers (UK), May 19, 2004. Available through NEXUS – LEXUS.

52. Michael Meacher. *Comment & Analysis: GM food is heading for your fridge. It may well be dangerous - and it is about to enter our food chain*. Guardian Newspapers Limited, London, June 25, 2004. Available through NEXUS – LEXUS.

53. Monsanto Canada Inc. v. Schmeiser. Available at:
<http://www.lexum.umontreal.ca/csc-scc/en/rec/html/2004scc034.wpd.html>

54. Mudur Ganapati. *Controversy grows over India's genetically modified potato*. British Medical Journal, June 2003, Vol. 326 Issue 7403, p1351, 1/6p.

Summary: A genetically modified potato developed in India to contain extra protein is under attack, with opponents claiming that it will result in the neglect of traditional sources of protein and thus exacerbate protein deficiency. A senior Indian biotechnology official said last week that the potato, which has undergone nearly three years of field trials, could be approved for commercial cultivation before the end of this year.

55. Murray Fulton, Hartley Furtan, Dustin Gosnell, Richard Gray, Jill Hobbs, Jeff Holzman, Bill Kerr, Jodi McNaughten, Jan Stevens, Derek Stovin. *Transforming Agriculture: the Costs and Benefits of Genetically Modified Crops*. Prepared for the Canadian Biotechnology Advisory Committee Project Steering Committee on the Regulation of Genetically Modified Foods, March 2001. Available at:

<http://strategis.ic.gc.ca/epic/internet/incbac-cccb.nsf/en/ah00388e.html>

Summary: The use of transgenic processes — often referred to as genetic modification — to produce new crops has spawned considerable public debate over the costs and benefits of these crops. Those who are strongly opposed to genetic modification (GM) argue that these new life forms pose a threat to food safety, the environment, and the social structure of agriculture. Those who come down in favour of GM crop production

argue that these technologies present minimal risks, and have the potential to create more plentiful, high-quality food at a lower cost to the environment, and to the benefit of farmers, consumers, and society in general. The purpose of this report is to examine a number of important issues that are related to GM technology and to summarize what is known about these issues to this point. A general economic framework will be used, examining the social costs and benefits related to each issue. Chapter 2 assesses the impacts on GM technology of the structure and control of the crop genetic research industry. Chapter 3 reviews the environmental costs and benefits associated with GM breeding and farm production. Chapter 4 assesses the agronomic impacts of GM technology on farmers, both those growing GM and non-GM crops. Chapter 5 deals with the cost and benefits to consumers of GM and non-GM products. Chapter 6 addresses the segregation costs that may be required to keep GM products separate from non-GM products throughout the marketing chain. Chapter 7 explores the issues related to the international trade of GM and related non-GM products. Chapter 8 examines the impacts on less-developed countries. Finally, Chapter 9 provides a brief summary of the report and some general conclusions.

56. Niels Louwaars, Derek Eaton and ArndJan van Wijk. *Framework for the Introduction of Plant Variety Protection in Developing Countries. North-South policy Brief, 2003. Available at:*

http://www.northsouth.nl/files/policy/policy_brief_2003_2.pdf

Summary: The Agreement on Trade Related aspects of Intellectual Property Rights (TRIPs) requires member states of the World Trade Organization to comply with basic rules on intellectual property rights. The Agreement, which provides for the protection of plant varieties by “patents or an effective sui generis system”, has initiated the development of their legal protection systems for plant varieties by many developing countries.

Most international discussions on this issue fully concentrate on the legal issues. We, however, stress that more emphasis is needed on the institutional options, technical issues and commercial aspects of plant variety protection, including the costs involved for governments and other stakeholders.

Legal issues concentrate around the balance between the rights and obligations of breeders and farmers, and in creating a mutually reinforcing system of national regulatory systems derived from the TRIPs Agreement, the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Agriculture (IT/PGRFA). We conclude that the patent system is not suitable for developing countries to protect plant varieties.

57. Padmashree Gehl Sampath, Richard G. Tarasofsky. *Study on the Inter-Relations between Intellectual Property Rights Regimes and the Conservation of Genetic Resources. Prepared for the European Commission Directorate-General, Environment. Final Report, December 2002. Available at:*
<http://www.biodiv.org/doc/meetings/abs/abswg-02/information/abswg-02-inf-ext-en.pdf>

Summary: It is now commonly agreed that intellectual property rights (IPRs) are part of the economic and policy landscape in which the conservation of genetic resources takes place. This paper will assess the linkages between intellectual property rights (IPRs) and the conservation of genetic resources, and make recommendations on harnessing the positive elements, while militating against the negative ones.

So far, a string of competing policy perspectives has emerged, as have numerous initiatives. More often than not, the focus has been on benefit sharing, technology transfer and conditions of access, rather than on ensuring that intellectual property rights act as an effective incentive for the conservation of genetic resources.

Creating the most appropriate balance between conservation of genetic resources and intellectual property protection primarily revolves around two main questions: (a) whether, and to what extent, the conservation of biological diversity provides a justification for IPRs, or their limitations, which goes beyond their classic economic justifications; and (b) whether, and to what extent, it is necessary to create a *sui generis* right for traditional ecological knowledge. This inquiry should shed light on how, if at all, biodiversity conservation could be integrated into intellectual property protection, such that adequate social and economic incentives are provided to corporate entities, as well as to local and indigenous communities.

58. Paul Thompson. *Food and Agricultural Biotechnology: Incorporating Ethical Considerations*. Prepared for the Canadian Biotechnology Advisory Committee Project Steering Committee on the Regulation of Genetically Modified Foods, October 2000. Available at:

<http://strategis.ic.gc.ca/epic/internet/incbac-cccb.nsf/en/ah00447e.html>

Summary: Many of the expressed concerns about food and agricultural biotechnology are described as 'ethical'. Decision leaders should interpret the expression of ethical concerns as a demand for competing visions of nature and the public good to be expressed in public dialog about food and agricultural biotechnology, for those who feel that their values have been neglected to have an adequate opportunity to express their concerns in their own words, and for their voices to be heard. This White Paper provides a framework for understanding the force of these concerns and a summary overview of them, but it should not be interpreted as a substitute for actual public dialog on ethical concerns.

Those who call for attention to ethical issues appeal to many diverse values. Their concerns can be classified into two broad categories. On the one hand, some see the very act of using genetic technology to raise ethical issues that would not apply to other applications of food and agricultural technology. On the other hand, some believe that specific applications of biotechnology raise ethical issues that are not being adequately addressed, even if these issues may be raised in connection to other, more conventional types of agricultural technology, as well.

Special Arguments Pertaining to the Use of rDNA Technology. There are several types of concern noted by those who question whether the use of biotechnology may be intrinsically questionable based on genes and essences, species boundaries and natural kinds, religious arguments and emotional repugnance.

General Technological Ethics. There are a number of ethical questions that can be raised with respect virtually any new food or agricultural technology. As they are raised

in connection with biotechnology, these questions suggest the following types of ethical concern: environmental ethics, food safety, moral status of animals, impact on farming communities, and shifting power relations.

Responses to These Issues. This section of the paper discusses several approaches that have been discussed as a possible response to these various ethical issues: uncertainty and the precautionary principle, labels and consumer choice, and methods in applied ethics.

Conclusion: Ethical issues associated with food and agricultural biotechnology must be regarded as open-ended and in great need of more structured and serious dialog. The issues sketched in this White Paper are only an overview. Both specialists and members of the public should be encouraged to articulate their concerns, and to respond to the views of others in a considered and respectful manner.

59. P.G. Pardey, B.D. Wright, C. Nottenburg, E. Binenbaum, and P. Zambrano. *Intellectual Property and Developing Countries: Does IPR regulation restrict research and development into new food crops?* International Food Policy Research Institute (IFPRI), 2003. Available at: <http://www.eldis.org/static/DOC11378.htm>

Summary: Concern is arising in the worldwide agricultural research community that IPR policies now threaten to block access to new developments to public and nonprofit researchers. This concern about current developing-country access to essential intellectual property is exaggerated and largely misdirected. The relationship between IPRs and agricultural research in developing countries is poorly understood. International and national agricultural research centers currently have far greater freedom to operate the ability to practice or use an innovation in agricultural research on food crops for the developing world than is commonly perceived.

This brief is number 3 in the volume “Biotechnology and Genetic Resource Policies (Briefs 1-6)”. The briefs present syntheses and synopses of research conducted by a team from IFPRI’s Environment and Production Technology Division and several collaborators. The team focuses on issues related to intellectual property rights, genetic resource management and conservation, biodiversity, and biotechnology.

60. Philip G. Pardey, Brian D. Wright and Carol Nottenburg. *Are Intellectual Property Rights Stifling Agricultural Biotechnology In Developing Countries?* IFPRI Annual Report, 2000-2001. Available at: http://www.ifpri.org/pubs/books/ar2000/ar2000_essay02.htm

Summary: Critics of the newest tool in the agricultural researchers’ toolbox — genetic engineering — argue that the new environment for agricultural research may leave farmers in the developing countries out in the cold. Developing countries rely for sustenance on crops that are largely beyond the focus of the private research sector, and that have modest future commercial prospects. In addition, poor producers often face production problems different from those of commercial farmers in wealthier countries.

Freedom to operate depends upon specific circumstances. An investigation of the intellectual property rights assigned to the key enabling technologies used to transform crops revealed that these rights are mainly held in, and are therefore primarily relevant to, rich-country jurisdictions. Thus, for most of the crops that matter for food security in poor countries, researchers’ freedom to operate is not impeded — much of the needed

technology is unencumbered by intellectual property rights in developing countries and little of the developing-country production gets shipped into developed-country jurisdictions where intellectual property rights may prevail. This does not mean, however, that freedom to operate is not a problem for developing-country research on export-oriented cash crops such as horticultural products, tropical beverages like coffee or cocoa, or dessert bananas.

During the 1990s, growth in investment in agricultural research in and for developing countries stalled. For some regions like Africa it even began to shrink. Furthermore, many developing countries lack the scientific skills to effectively access the rapidly advancing stock of complex modern biotechnologies, whether they are protected by patents or not. As a matter of fact, most are not protected in these developing countries. Failure to invest in developing the domestic expertise needed to evaluate, access, and regulate the new technologies is currently a far greater constraint than freedom to operate.

61. Richard Caplan. *Antibiotic Resistance and Genetically Modified Plants.*

June 2002. Available at:

http://www.gefoodalert.org/library/admin/uploadedfiles/Antibiotic_Resistance_and_Genetically_Engineer.pdf

62. Richard Carew. *Intellectual Property Rights: Implications for the Canola Sector and Publicly Funded Research.* Canadian Journal of Agricultural Economics, July 2000, v. 48, iss. 2, pp. 175-94.

Summary: The paper highlights how publicly funded research has responded to greater investments in private plant breeding and suggests what policies may be necessary to ensure that maximum public benefits are achieved as a result of strengthened intellectual property right protection.

This paper reviews various vehicles to protect intellectual property in Canada including Plant Breeders' Rights. The experience to date following implementation of the Canadian Plant Breeders' Rights Act indicates that for crop agriculture, the majority of plant protection certificates were granted to canola, followed by potato and soybean. Fewer protection certificates were granted to wheat, barley, apples and berries. Several canola protection certificates consisted of hybrid varieties that were developed by private breeders. Ten private companies accounted for most of the plant protection certificates issued for canola. For canola patents, over 200 were filed in Canada during the 1986-97 period. Biotechnology patents numbered slightly over 100, with most of them comprising new plants, hybrid processes, nucleotide sequences, polypeptides, plant promoters, regulators and methods to produce improved fatty acid profiles. A large proportion of patent owners were transnational corporations or joint venture operations that controlled the distribution of identity preserved products from seed to end user.

63. R.M. Babu, A. Sajeena, K. Seetharaman, and M.S. Reddy. *Advances in genetically engineered (transgenic) plants in pest management - an overview.* Crop Protection, November 2003, 22 (9): 1071-1086.

Summary: Transgenic plants are produced via Agrobacterium mediated transformation and other direct DNA transfer methods. A number of transgenes conferring resistance to

insects, diseases and herbicide tolerance have been transferred into crop plants from a wide range of plant and bacterial systems. In the majority of the cases, the genes showing expression in transgenic plants are stably inherited into the progeny without detrimental effects on the recipient plant. More interestingly, transgenic plants under field conditions have also maintained increased levels of insect resistance. Now, transgenic crops occupy 44.2 million hectares on global basis. During the last 15 years, transformations have been produced in more than 100 plant species; notable examples include maize, wheat, soybean, tomato, potato, cotton, rice, etc.

Genetic transformation and gene transfer are routine in many laboratories. However; isolation of useful genes and their expression to the desired level to control insect pests still involves considerable experimentation and resources. Transgenic technology should be integrated in a total system approach for ecologically friendly and sustainable pest management. Issues related to Intellectual property rights, regulatory concerns, and public perceptions for release of transgenics need to be considered.

64. Robert B. Horsch. *Commercialization of genetically engineered crops.* Philosophical Transactions of the Royal Society of London B Biological Sciences, 1993; 342(1301): 287-291.

Summary: More abundant harvests from insect- and disease-resistant crops, vine-ripened tomatoes, or less oily potato chips or french fries are some of the benefits that will result from single gene improvements under development today. These single gene traits will be combined with the best new varieties produced by traditional plant breeding and will accelerate the pace and the scope of our ability to develop even better and more productive crops in the future.

The high value of some single gene targets and the possibility for patent protection of the processes and final products provide the incentive for private investment in this area. The value to farmers, consumers, the environment and society in general is very high because the problems being solved are those that have resisted previous attempts through conventional means. Public investment in basic plant science research and private investment in product development is a powerful combination for continual improvement in lowering the cost and improving the quality of the world's food supply.

65. Robert Lenzner and Bruce Upbin. *Monsanto v. Malthus.* Forbes, March 1997, Vol. 159 Issue 5, p58, 3p, 1 diagram, 2c.

Summary: Focuses on Monsanto Co. and its chairman Robert Shapiro in early 1997. Shapiro's belief that the boost in food production that increasing global populations will require can be achieved with biotechnology; Details on Monsanto's NewLeaf Plus potato and Roundup herbicide; Monsanto's intent to spin off its chemicals business; Share price; The amount Monsanto spent buying ownership interests in other biotechnology companies.

66. Ronald Hirshhorn and Jock Langford. *Intellectual Property Rights in Biotechnology: The Economic Argument.* Prepared for the Canadian Biotechnology Advisory committee Project Steering Committee on Intellectual property and the Patenting of Higher Life Forms, March 2001.

Available at: <http://strategis.ic.gc.ca/epic/internet/incbac-cccb.nsf/en/ah00386e.html>

Summary: Intellectual property laws are a core component of the broad policy framework the government has put in place to foster a more innovative economy that will support continuing improvements in Canadians' living standards. In the absence of government intervention, firms would have a limited incentive to invest in the production of knowledge since many of the benefits accrue to others. Intellectual property laws attempt to remedy this market failure by granting property rights that recognize an inventor's exclusive right to make, use or sell an invention for a fixed term. Besides stimulating the production of new knowledge, the IP system facilitates its dissemination. In return for a period of market exclusivity, for example, patentees must provide a clear and complete description of their invention in the patent application, which, in Canada, is published 18 months after the filing date.

Governments face a number of difficult policy decisions in the design and employment of IP policy. They must determine to what extent to rely on IP as opposed to other policy instruments, such R&D tax incentives and public subsidies to promote innovation. They must also decide how provisions with respect to such matters as the scope, length and nature of IP rights can be set so as to maximize the benefits and reduce the costs of IP policy. A highly protective regime that restricts access to new technologies could reduce follow-on developments and slow the pace of innovation. On the other hand, a weak regime may be ineffective in promoting R&D and also impair a country's ability to license foreign technology and attract foreign investment. For Canada, the design of IP policy must be made with particular attention to this country's strong economic ties with the U.S. There is a need to consider how changes in IP policy will affect the commercial connections - including the strong trade and investment links and the other well developed mechanisms facilitating access to the results of U.S. innovation - that have played such an important role in Canada's growth.

Patent protection is crucial in helping firms raise needed capital. Successful biotechnology firms have effectively used patents to attract financing, especially important venture capital support. Patents have also provided a basis for establishing alliances that help firms share R&D costs or that provide the latter-stage support firms need as they approach commercialization. Biotechnology firms generally patent first in the U.S. and then in Canada, which is a reflection of the greater size and importance of the U.S. market. As both significant buyers and sellers of intellectual property, biotechnology have an interest in strategic alliances, collectives and other arrangements with the potential to reduce the costs involved in negotiating and collecting royalties and enforcing IP rights.

There remains considerable scope for debate about the features of an optimal IP policy for the Canadian biotechnology sector. Recent surveys and reports have focused on issues such as the application of patent protection to higher life forms, the scope of the research use defense and the methods of medical treatment exemption, and the appropriate interface between the Patent Act and the Plant Breeders' Rights Act. Canada's current IP policy is different than that of its main trading partners on some of these issues, such as the patenting of higher life forms and patent term restoration. The resolution of questions that have arisen with respect to these and other matters requires a

careful weighing of economic tradeoffs, along, in some cases, with an assessment of social and other public policy considerations.

67. Scott Kilman. *Monsanto's Biotech Spud Is Being Pulled From the Fryer at Fast-Food Chains.* Wall Street Journal – Eastern Edition, April 2000, Vol. 235 Issue 85, pB4.

Summary: Focuses on the move of McDonald's Corp. in telling their french-fry suppliers to stop using potato from Monsanto Co. Question raised on the safety of crop biotechnology distributed by Monsanto.

68. Scott Kilman and Susan Warren. *Dupont, Monsanto Going to Seed.* Wall Street Journal. May 28, 1998, at C7.

69. S.D. Atkins, I.M. Clark, D. Sosnowska, P.R. Hirsch, and B.R. Kerry. *Detection and Quantification of Plectosphaerella cucumerina, a Potential Biological Control Agent of Potato Cyst Nematodes, by Using Conventional PCR, Real-Time PCR, Selective Media, and Baiting.* Applied & Environmental Microbiology; August 2003, Vol. 69 Issue 8, p4788, 6p, 5 charts, 2 graphs.

Summary: Potato cyst nematodes (PCN) are serious pests in commercial potato production, causing yield losses valued at approximately \$300 million in the European Community. The nematophagous fungus *Plectosphaerella cucumerina* has demonstrated its potential as a biological control agent against PCN populations by reducing field populations by up to 60% in trials. The use of biological control agents in the field requires the development of specific techniques to monitor the release, population size, spread or decline, and pathogenicity against its host. A range of methods have therefore been developed to monitor *P. cucumerina*. All methods enabled differences in the activity of *P. cucumerina* to be detected, and the results demonstrated the importance of using a combination of methods to investigate population size and activity of fungi.

70. Shafer Parker Jr. *Superspud flexes its muscles.* Alberta Report / Newsmagazine, January 1996, Vol. 23 Issue 3, p18, 4p, 1 chart, 1 cartoon, 3bw.

Summary: Explains biotechnology innovations of Saskatchewan farmers and companies. Seven genetically engineered foods for human consumption approved by Health Canada, including the NewLeaf potato; Daniel Nathans and Hamilton Smith cutting strands of DNA in 1970 making genetic engineering possible; Saskatoon's Philom Bios Inc.'s president, John Cross, and 'Provide,' the world's first commercial phosphate inoculant.

71. S.I. Warwick, H.J. Beckie and E. Small. *Transgenic crops: new weed problems for Canada?* Phytoprotection, August 1999, 80 (2): 71-84.

Summary: Over 25 000 transgenic field trials were conducted globally from 1986-1997, and many transgenic crops, including soybean (*Glycine max*), maize (*Zea mays*), tobacco (*Nicotiana tabacum*), cotton (*Gossypium hirsutum*), canola (*Brassica napus*, *B. rapa*), tomato (*Lycopersicon esculentum*) and potato (*Solanum tuberosum*) have been commercially released. There has been a high adoption rate, with at least 28 million

reported for 1998, with herbicide- and insect-resistant plants occupying 71 and 28% of the releases, respectively. The current status of commercial production of transgenic crops in Canada is summarized.

Transgenic crops have the potential to change weed communities/populations in three principal ways, via: 1) escape and proliferation of the transgenic plants as 'weedy' volunteers with subsequent displacement of the crop, weed and/or natural vegetation; 2) hybridization with and transgene infiltration into related weedy and/or wild species, resulting in invigorated weeds and/or alteration of natural gene frequencies in these species; and 3) genetic changes in populations of unrelated species, as a result of changes to the environment, in particular herbicide-resistant (HR) transgenic crops and the development of HR weeds. Potential risk can be estimated a priori using knowledge of the systematics of crop/wild/weed complexes. Risk must be assessed on a case-by-case basis for each crop, each country/ecological region, and for each trait. Potential weed risks will be greater if crop volunteers are predisposed to becoming weedy, are well adapted to the Canadian climate and if sexually compatible wild species are present.

72. Steve Abel. *Non-consenting subjects of a global experiment.* The New Zealand Herald, May 24, 2004. Available through NEXUS – LEXUS.

73. Steve Dube. *Blair accused on GM Agenda.* Financial Times Information; Global News Wire – Europe Intelligence Wire; The Western Mail, May 11, 2004. Available through NEXUS – LEXUS.

74. Thomas Clarke. *Impact of Canada's Patent System and Public Sector Technology Transfer System on the Growth of the Biotechnology Industry in Canada.* Prepared for the Canadian Biotechnology Advisory Committee Project Steering Committee on Intellectual Property and the Patenting of Higher Life Forms, February 2001. Available at:

<http://strategis.ic.gc.ca/epic/internet/incbac-cccb.nsf/en/ah00403e.html>

Summary: Governments around the world are focusing their attention on what they can do to encourage the growth of their biotechnology-based industries, and the adoption of biotechnology-based products and services. In doing so, they are, at the same time, taking social and ethical considerations into account.

Canada is no different in its goals to encourage the creation and growth of new biotechnology firms. Unfortunately, we do not appear to be keeping up with our international competitors. The Sixth, and last report, of the National Biotechnology Advisory Committee (NBAC) pointed out that “in the early 1990s, Canada had as many biotech companies as Japan and as many as the whole of Europe” (NBAC, 1998, p.9). This, according to the NBAC Report, “has abruptly changed” (NBAC, p. 9). Canada is now third behind the U.S. and Europe in terms of the number of biotechnology companies (p. 10). To improve this situation, the NBAC report called for public policies that are consistent, effective and supportive of the biotech industry in Canada if it is to achieve a world leadership position (p. 11).

An earlier 1997 Ernst and Young study entitled, “Canadian Biotech’97: Coming of Age”, conducted for the Department of Foreign Affairs and International Trade, placed Canada fourth behind the U.S., U.K. and Australia in a list of countries with a business

climate that encouraged the development of biotechnology. The report also noted that Canada under invests in biotech R&D relative to its U.S. and European competitors. One of the important elements of a supportive environment for biotechnology, or indeed any technology-based industry, is a strong patent system. In the area of biotechnology, Canada's patent system differs from those of our competitors in a number of important aspects. The NBAC report (p. 51) noted the following differences between what is patentable in Canada and what is patentable in other jurisdictions in the areas of:

- patenting of multicellular life forms (e.g., plants and animals)*;
- patent term restoration to compensate for regulatory delays in marketing approval; and
- lack of administrative procedures for opposing patents once they have been issued.

Many of these "shortcomings" were reiterated during a briefing in September, 2000 on the patenting of higher life forms to the CBAC steering committee by Presidents and CEOs of Canadian biotech firms (Gold, (a), 2000). The Presidents and CEOs believed very strongly that Canada's patent system was conveying a message that Canada was unsupportive of, or even hostile to, biotechnological innovations. They feared that this would influence potential investors in Canadian firms. They also considered that Canada was five years behind the U.S. in establishing rules and regulations with respect to genetically modified animals.

Another important element in the supportive environment for biotechnology firms is the efficiency and effectiveness of the technology transfer activities of universities and government departments. These organizations can be an important source of biotechnological discoveries/inventions that can be exploited by Canadian industry. If the transfer process is flawed, however, these inventions may remain on the shelf or opportunities to create new businesses might be lost.

Thus, this background paper was commissioned to determine what policy/program initiatives might be recommended to the federal government so that patent and technology transfer environment are more supportive of the creation and growth of biotechnology firms in Canada. This background paper will draw heavily on previous reports and studies, and on the results of interviews with twenty-seven key, knowledgeable individuals in government, university, biotech associations and IP patent offices/associations that took place in November and December of 2000.

75. UNCTAD-ICTSD International Centre for Trade and Sustainable Development. *Food, agriculture and biodiversity. Project on IPRs and Sustainable Development, Chapter 7. Available at:*

http://www.ictsd.org/pubs/ictsd_series/iprs/PP/PP_3CH_07.pdf

Summary: Food, agriculture and biodiversity, as IPR-related issues, are closely related. Apart from the TRIPS-related interrelationships, they are also the subject of three very important international agreements, described in chapter 2 whose coverage overlaps to a significant degree. These are the Convention for the Protection of New Varieties of Plants (UPOV Convention), the FAO International Treaty on Plant Genetic Resources for Food and Agriculture, and the Convention on Biological Diversity (CBD).

76. Uwe Sonnewald. *Control of potato tuber sprouting. Trends in Plant Science, 2001; 6(8): 333-335.*

Summary: Potatoes can be used in many different ways, but most involve the use of fresh tubers. Because producing fresh potatoes throughout the year is unfeasible, long-time storage is essential. Unlike cereal seeds, tubers are not dehydrated and active metabolism occurs. Consequently, sprout growth is initiated following a period of endodormancy. Therefore, controlling the length of the dormancy period is of considerable economic importance. New strategies are needed because current cold storage techniques or treatment with sprout inhibitors are often problematic. Recently, an interesting alternative approach has been developed involving the production of genetically engineered potatoes with altered metabolic pathways to prolong the dormancy period of the harvested tuber.

77. World Intellectual Property Organization (WIPO) and the International Union for the Protection of New Varieties of Plants (UPOV).

Dissemination of Plant Biotechnology – An African Perspective: WIPO-UPOV Symposium on Intellectual Property Rights in Plant Biotechnology. Geneva, October 24, 2003. Available at:

http://www.upov.int/en/documents/Symposium2003/wipo_upov_sym_05.pdf

Summary: Takes a look at Africa's position and concludes that they desperately need agricultural biotechnology. More importantly, these tools for plant biotechnology and crop improvement should be made available to low-scale farmers. This would be an effective dissemination of plant biotechnology. African countries depend heavily on foreign aid for agricultural research and development. In fact, many of the continent's agro-biotech institutions are founded and funded essentially by international or donor organizations. Unfortunately, many indigenous food-crops that feed a large percentage of the African population (such as yams, millet, sorghum and cassava), represent little commercial interest to the multinational companies that invest in R&D. Thus, the extension of modern biotechnology tools to the improvement of these food crop species have been minimal, and in some cases, non-existent. Africa lags dramatically behind all other regions of the world in the overall application of agricultural biotechnology and food production. In order to avert the dangers posed by under-nutrition, governments of African countries must invest in agricultural R&D for crop improvement through genetic manipulation.