Biotechnology Myths and Facts

Introduction

On the 30th of July 2001, the New Zealand Royal Commission on Genetic Modification (RCGM) finally released its recommendations to the Cabinet. The 1200-page report was the outcome of 14 months of consultation with advocates and opponents of genetic modification (GM). The Commission was an independent review panel set up to report to the government on the options available to New Zealand to deal with genetic modification, and to advise on appropriate changes to government policy, regulatory legislation, public institutions, and the future direction of biotechnology and associated research. This inquiry was a first of its kind in the world.

Briefly, it stated that "genetic modification (GM) holds exciting promise, not only for conquering diseases, eliminating pests and contributing to the knowledge economy, but for enhancing the international competitiveness of the primary industries so important to our country's economic well being". The Commission said that it would like to see this happen in an atmosphere that "encourages the coexistence of all forms of agriculture". Nevertheless, it stressed that "we should proceed carefully by minimizing and managing risks". Its consultation process involved many public meetings, workshops, youth forum, and series of hearings from various interested persons. The Commission also received more than 10,000 public submissions and conducted a public opinion survey of 1153 New Zealanders.

A free copy of the report is available at http://www.gmcommission.govt.nz

In the report, the Royal Commission addressed and responded to some of the popular myths surrounding genetic modification. As part of the International Service for the Acquisition of Agri-biotech Application (ISAAA), the Global Knowledge Center on Crop Biotechnology is committed to share information to as many people as possible. It is for this reason that we are providing you with this booklet. Most of its contents were taken from the actual RCGM report although we have also included additional and latest information where relevant. Life Sciences Network (http://www.lifesciencenz.com) synthesized the RCGM report in the context of myths and facts which this booklet used with their permission.

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Myth 1: GM potatoes had toxic effects on rats that may also affect humans

FACT:

The Royal Commission says:

Dr. Arpad Pusztai, a senior scientist at the Rowett Institute, Aberdeen, Scotland, came to international attention when he announced to the media that eating genetically modified potatoes depressed rat immune systems and caused changes in their intestinal tract.

Lori Alden Photo

Dr. Pusztai and his colleague, Dr. Stanley Ewen, tested the dietary effects of potatoes genetically modified to contain and express a gene for snowdrop lectin, called alanthus nivalis agglutinin (GNA). Lectin was introduced to potatoes as an insecticidal protein, but is also an antimetabolite, i.e. it slows down cell growth. Dr. Pusztai and co-workers compared rats fed genetically modified potatoes with those eating non-modified potatoes, with and without added GNA. The genetically modified potatoes appeared to cause changes in the rats' immune response and the structure of the intestinal lining. They asserted that this outcome was the result of the way the lectin gene had inserted into the potato genome, rather than the expression of lectin by the potatoes.

While the experimental design appears to be correct for this type of feeding study, there were difficulties with the use of a raw potato diet. Rats do not like to eat raw potato, and a standard 110-day trial had to be abandoned after 67 days, because the rats were starving. Starvation affects gut histology, and the lining of the gut of control rats eating unmodified potatoes was shown to be abnormal. This led to confusion regarding the significance of Dr. Ewen's histological results, particularly to the reported 'over growth' of gut epithelial cells of rats eating genetically modified potato. The presence of other potato toxins could also have had a confounding effect on cells in the intestine, especially since the potato lines were not substantially equivalent:

"... we couldn't come to any other conclusion but this, that the GNA gene insertion into our potatoes induced changes in the levels of all these things ... So we had to say at the end, the GNA GM potato lines were, therefore, not substantially equivalent to the appropriate parent tubers. And I can take it further, that the two lines of genetically modified potatoes were not substantially equivalent to each other".

It is also noteworthy that the evidence used by Dr. Pusztai to indicate that the rats had depressed immune systems was not the result of standard immune response tests.

Within the scientific community there is general agreement that the results of Dr. Pusztai's experiment are inconclusive insofar as there were flaws in the process, and the project was incomplete. Extensive testing carried out by Chinese researchers, similar to that described by Drs. Pusztai and Ewen, has not replicated their results.

The Commission, having heard evidence directly from Dr. Pusztai and his colleagues, is also of the view that the results are inconclusive. It was unfortunate that the process of peer review was pre-empted by premature media release, thus preventing further scientific assessment.

(Chapter 8 of the RCGM Report, 2001)

Myth 2: L-tryptophan produced from GM bacteria caused death of humans in the US

FACT

The Royal Commission says:

L-tryptophan is an amino acid, one of the building blocks of proteins. Tryptophan is important for brain function and is normally obtained from dietary protein. In the 1980s tryptophan became popular as a dietary supplement for such conditions as insomnia and depression. Tryptophan can be purified from plant and animal proteins, but is obtained more economically by vat fermentation. In this process, tryptophan-producing bacteria are fermented in tanks with sugars and a nitrogen source. When the tryptophan levels in the vat are high enough, the solution is purified by filtration. The bacteria used may be genetically modified. At the time, several companies, including Showa Denko KK, used vat fermenters and genetically modified bacteria to produce tryptophan.

Late in 1989, people consuming high doses of L-tryptophan began showing up with eosinophilia-myalgia syndrome (EMS), a new illness characterised by painful and swollen muscles, rashes, gastro-intestinal problems and large numbers of white blood cells in the body. In the United States 37 people died, 1500 were disabled and around 5000 were affected. These patients were all taking tryptophan from a single Showa Denko KK batch that used not only a new genetically modified organism producing a more concentrated product but also a different filtration system using less charcoal, which bypassed a membrane filtering step to purify the product.

The batch was found to contain 60 contaminants of which six were responsible for causing EMS. Three toxins (a dimer of tryptophan, along with two others) were identified by 1993, but it was not until 1999 that the remaining three toxins were identified accurately.

The United States courts decided that the manufacturing process rather than genetic modification was at fault. It is unclear whether the high concentration of tryptophan made by the genetically modified bacteria or the changes in the filtering system were responsible for the build up of contaminants. Attempts were made without success to reproduce possible faults in the filtration system. At the time, other tryptophan products made using genetically modified organisms were available on the market, but no problems were reported with them, suggesting that the use of genetically modified organisms alone was not to blame.

Although the first cases of EMS were not noticed until late 1989, by early 1990 the Food and Drug Administration had recalled all dietary supplements containing manufactured L-tryptophan.

(Chapter 4 of the RCGM Report, 2001)

Myth 3: Genetic modification is the cause of "Mad Cow Disease"

FACT:

The Royal Commission says:

Bovine spongiform encephalopathy (BSE), widely known as "mad cow disease," is a chronic, degenerative disease affecting the central nervous system of cattle. Worldwide, there have been more than 178,000 cases since the disease was first diagnosed in Great Britain in 1986. Although the disease has also been confirmed in native-born cattle in other parts of Europe, over 95% of all BSE cases occurred in the United Kingdom. Epidemiologic data suggested that BSE in Great Britain is a common-source epidemic involving animal feed containing contaminated meat and bone meal as a protein source.

In 1988, the UK Government introduced legislation that required all cattle suspected of suffering from BSE to be destroyed and sent for diagnosis. In 1989, controls were imposed that banned from the human food chain tissues of cattle, sheep and goats known to, or that might potentially, harbour detectable BSE infectivity.

USDA Photo

Bovine spongiform encephalopathy (BSE), widely known as "mad cow disease", is a chronic, degenerative disease affecting the central nervous system of cattle.

In 1996, BSE was linked with a new variant form of Creutzfeldt-Jakob Disease (CJD).

Classical CJD, which was first diagnosed in the 1920s, is a slow degenerative human disease of the central nervous system, which occurs sporadically worldwide at a rate of one case per one million people per year.

On 20 March 1996, the UK's Spongiform Encephalopathy Advisory Committee (SEAC) announced the identification of 10 cases of a new variant form of CJD (vCJD). All the patients developed onset of illness in 1994 or 1995 and the features of CJD in these 10 cases differed from the sporadic form of CJD. The SEAC concluded that, although there was no direct scientific evidence of a link between BSE and vCJD, based on current data and in the absence of any credible alternative, the most likely explanation at that time was that the cases were linked to exposure to BSE before the introduction of control measures, in particular the specified bovine offal ban that had been imposed in 1989. Research reported later in 1996 and in 1997 found further evidence to support a causal association between vCJD and BSE.

The official report into BSE strongly criticized government ministers and officials for consistently playing down the risk to humans and for failing to coordinate properly a government response.

(Chapter 8 of the RCGM Report, 2001)

Myth 4: The Starlink corn incident proves the crop industry cannot be trusted

FACT:

The Royal Commission says:

USDA Photo

In 1998, and subsequently in 1999 and 2000, the US Environmental Protection Agency approved for use as animal feed a corn modified by insertion of the Cry9C gene from *Bt* encoding for an insecticidal crystal protein endotoxin. The corn was marketed as StarLink™. Because of concern that the protein Cry9C could be allergenic, the Agency could not find that there was a reasonable certainty of no harm to humans. Therefore, the corn was not approved for use as human food.

In September 2000, a coalition of environmental and food safety groups announced that Cry9C DNA fragments had been found in a popular brand of taco shells sold in the United States. In addition, the Cry9C protein was discovered in some non-StarLink™ seed corn. As a result, there was a voluntary recall of corn-derived food products in the United States by manufacturing companies, some of whom took steps, such as mandatory testing requirements, to ensure no further contamination.

Late in 2000, a further review of the potential allergenicity of Cry9C, and of mechanisms for assessing suspected allergenic reactions to StarLink™ corn concluded that the Cry9C protein had a medium likelihood of proving to be a potential allergen and that seven out of 34 reactions to a meal containing corn products were probably allergic. A definitive conclusion would have required further studies.

The presence of Cry9C protein in seed corn was thought to be a result of physical contamination, although cross-pollination from StarLink™ corn could not be ruled out as the source. The StarLink incident illustrates a number of issues relating to genetic modification of food and crops:

- The difficulties of restricting a genetically modified food for use for animals or industrial purposes when there are almost indistinguishable unmodified counterparts available for human consumption.
- The difficulty of preventing accidental contamination of human foods by imposing segregation requirements on modified food crops.
- The difficulty of ensuring adherence to separation requirements to prevent cross pollination of genetically modified and unmodified crop species, and the failure of the companies promoting genetically modified crops to require or ensure proper growing practices.
- The need for appropriate labelling, and for post-market monitoring to identify allergic reactions rapidly and accurately.
- The externalisation to producers and to consumers of costs created by growing genetically modified crops.

(Chapter 8 of the RCGM Report, 2001)

Additional Information

How has Aventis CropScience, the developer of Starlink Corn, responded?

- Voluntarily withdrew the registration to provide additional assurance that no StarLink corn is sold or grown in the future
- Reached agreement with federal agencies to locate and contain 2000 StarLink corn and direct it to approved uses
- Stopped sales for 2001 season
- Facilitated the release of Cry9C protein test kits to assist in identifying StarLink corn
- Submitted a petition to EPA recommending a time-limited approval for the presence of StarLink corn in human food that might have resulted from 1999 and 2000 StarLink production
- Worked with other countries to gain import-only clearances
- Established a website to inform the industry and the public
- Reached agreement with a group of State Attorneys General to implement claims processes for farmers and elevators
- Worked to settle claims by farmers, elevators, food companies and others affected by StarLink
- 42% of StarLink corn and buffer corn within the StarLink Enhanced Stewardship (SES) Program has already been fed on-farm or delivered to USDA approved destinations
- All but 30,000 bushels of StarLink corn which left the farm prior to the SES Program has been directed to approved uses
- Over 2.2 million Protein Strip Tests have been used by the grain industry to locate Cry9C-containing corn
- As a result of testing, over 437 M bushels of commingled corn containing low levels of Cry9C grain has been redirected to approved uses
- US corn seed industry tested 2001 corn seed according to USDA protocol and is destroying any seed testing positive for Cry9C
  - *Less than 1% of total 2001 corn seed was affected*

There is now increasing confidence that Cry9C corn is NOT moving into food products

Myth 5: GM soybean containing a Brazil-nut protein causes allergy

FACT:

The European Association of Bioindustries says:

Lori Alden Photo

As a way to develop soybeans with a raised methionine content (methionine is an essential amino acid for animals and humans), the American company Pioneer Hi-Bred International introduced a gene of the Brazil nut that codes for a methionine-rich protein into the soybean.

The transgenic soybean was meant for use as an animal feed to make the addition of methionine to conventional animal feed unnecessary. Pioneer Hi-Bred considered the possibility that the nut protein might find its way into human nutrition and therefore commissioned investigations to clarify whether the Brazil-nut-gene product was potentially allergenic.

After the studies confirmed allergenic potential, the company immediately cancelled the breeding programme. **The soybean was never put on the market. No soybeans with the Brazil nut protein are currently, or have ever been, in animal or human food streams.** This serves to illustrate how allergenic hazards associated with transgenic plants can be precisely investigated.

Additional Information

According to the latest report published by the Royal Society, United Kingdom's independent national academy of science, "there is at present no evidence that GM foods cause allergic reactions. The allergenic risks posed by GM plants are in principle no greater than those posed by conventionally derived crops or by plants introduced from other areas of the world".

(Source: Genetically modified plants for food use and human health - An update, February 2002, Royal Society, UK)

A complete copy of the report is available at: http://royalsoc.ac.uk/files/statfiles/document-165.pdf

"We have looked at all of the available research, and found nothing to suggest that the process of genetic modification makes potential foodstuffs inherently unsafe. However, we fully support the public's right to know that all new foods, regardless of whether they contain GM ingredients, are subjected to rigorous safety and nutritional checks... The rather piecemeal approach to the regulation of GM foods in the UK, and EU in general, means that there may be some gaps and inconsistencies. It is obvious that consumers want their food to be safeguarded by rules that are rigorous enough to prevent any loopholes. But the legislation must not be so restrictive that it removes any incentive for introducing new food products that are potentially beneficial to society."

Professor Jim Smith FRS
Chairman of the working group on
"Genetically modified plants for food use
and human health - An update"
Royal Society, UK, 2002

Myth 6: The increase in phytoestrogen levels in herbicide tolerant soybeans can cause breast cancer

CLAIM

USDA Photo

"We fear that the Roundup Ready® soybean produces large quantities of pseudoestrogens* when it is sprayed with Roundup herbicide. Today it is assumed that estrogen hormones play an important role in the emergence of breast cancer ..." (letter to the Swiss Confederate Councilor Mrs. Ruth Dreifuss, February 4, 1997, signed by the SAG, Basler Appell gegen Gentechnologie, Basle Appeal against Genetic Engineering)."... yet all risk-evaluation investigations were conducted on modified soybean plants that had never been treated with Roundup. The question was never asked as to what consequences the treatment of the modified plants with Roundup might have ..." (Florianne Koechlin, Switzerland, Gen-Schutz-Zeitung No. 7/January 1997).

"The foreign gene for herbicide tolerance triggered an additional metabolic process in beans so that these produced a hormonally effective substance in its leaves and fruit. This substance went on to alter uterus-growth parameters in mice, even in low quantities" (Naturschutz 1/1997).

FACT:

The European Association of Bioindustries says:

In their pamphlets, readers' letters, and correspondence to the Swiss Confederate Councilor Mrs. Ruth Dreifuss, the Swiss Working Group on Genetic Engineering (SAG) and its related organizations are constructing a scientifically weak causal relationship between the genetically modified Roundup Ready® soybean produced by Monsanto and phytoestrogen-related health risks, especially for women and children. However, the source of their information, (according to which the Roundup Ready® soybean produces large amounts of phytoestrogens after being treated with the Roundup herbicide), is quoted by the SAG as being a study in 1988 - at which time the Roundup Ready® soybean did not yet exist.

The section of the study that makes the claim states that conventional French beans (*Phaseolus vulgaris*) - which are not soybeans, and certainly not transgenic soybeans - produce an oestrogenically effective (hormone-similar) isoflavonide (coumestrol) after the application of glyphosate (the active ingredient of Roundup). Investigations carried out by Monsanto have revealed no indication that genetically modified soybeans exhibit any raised concentrations of phytoestrogens following treatment with the Roundup herbicide.

Some plant-protection agents contain pseudoestrogens although Roundup herbicide, by contrast, contains none at all. This fact has been confirmed by the Freiburg Ecological Institute.

** Pseudoestrogens - substances that occur in the natural environment and influence or mimic the function of hormones.*

Myth 7: *Bt* corn threatens the existence of Monarch butterfly populations

FACT:

The Royal Commission says:

Bacillus thuringiensis (Bt) is a soil bacterium that produces a protein with insecticidal qualities. Traditionally, a fermentation process has been used to produce an insecticide spray from these bacteria. In this form, the *Bt* toxin occurs as an inactive protoxin, which requires digestion by an insect to be effective.

Crop plants have now been engineered to contain and express the genes for *Bt* toxin, which they produce in its active form. *Bt* corn is used primarily to control corn borer (a Lepidopteran insect), which is difficult to control by spraying. *Bt*-corn strains are toxic to Lepidoptera (moths and butterflies).

Photo by Oscar Gutierrez

Monarch butterfly larvae feed exclusively on the leaves of milkweed plants, which are commonly found in and around cornfields in the United States. Pollen from nearby corn can become distributed on the leaves of these plants, and therefore be eaten by these larvae.

In 1999, two studies showed that Monarch butterfly larvae, and larvae from related species, had lower survival rates eating leaves dusted with *Bt*-corn pollen than after eating leaves dusted with non-*Bt* corn pollen. People used these studies to suggest that *Bt* corn was responsible for the recently observed decline in the Monarch butterfly population. However, the Environmental Protection Agency (EPA) noted that these preliminary controlled study data were not useful for risk assessment of widespread or recurring *Bt*-corn pollen effects on Monarch butterflies without additional field study information.

As a result the EPA issued a call-in of data on this topic. Shortly thereafter the data was presented to a scientific advisory panel for their recommendations. This resulted in a report evaluating many studies on the effects of *Bt*-corn pollen on Monarch larvae mortality.

Investigations have revealed that while a large percentage of Monarch butterfly larvae may feed on milkweed found in the corn belt region of the US, there is no overlap between breeding time and time of pollen shed through most of this region. Other studies have shown that corn pollen does not move far from the field, and that the quantity of pollen settling on an area decreases rapidly with distance. Together with toxicity studies showing low toxicity of many major *Bt*-corn strains, this implies that pollen densities that could represent significant exposure to feeding larvae are found only within five meters of cornfields, and then rarely. Even within corn fields, pollen densities were usually found to be too low to cause mortality in Monarch larvae. Some preliminary investigations have suggested that Monarchs may avoid laying eggs on milkweeds surrounded by corn plants.

These findings indicate that, outside corn fields, Monarch larvae exposure to *Bt*-corn pollen is minimal, and that, within fields, Monarchs will have a low probability of encountering a toxic level

of pollen. The report also suggests that the elimination of pesticides through the use of *Bt* corn may be beneficial to Monarch butterfly populations, and concludes that there is not sufficient evidence to support the belief that there is significant risk to Monarch butterflies from *Bt*-corn use. The EPA is however continuing to monitor this situation.

(Chapter 4 of the RCGM Report, 2001)

Additional Information

New studies show that *Bt* corn poses "negligible" threat to Monarch butterflies (September 2001).

A collaborative research effort by scientists in the US and in Canada has produced information to develop a formal risk assessment of the impact of *Bt* corn on Monarch butterfly populations. Mark Sears, a University of Guelph entomologist, and his colleagues conducted a two-year study on the toxic effects of *Bt* corn pollen and the degree to which Monarch larvae would be exposed to toxic amounts of *Bt* pollen on its host plant, milkweed, found in and around cornfields. They found that in most commercial hybrids, *Bt* expression in pollen is low, and laboratory and field studies show no acute toxic effects at any pollen density that would be encountered in the field. Sears was quoted as saying, "In most cases, there was no effect whatsoever… It would take a lot of pollen for any caterpillar to succumb to it. Each grain is not very toxic".

Six new papers* discussing the results of these studies have been published in the Journal Proceedings of the National Academy of Sciences (http://www.pnas.org/papbyrecent.shtml)

*Titles:

1) Impact of *Bt* corn pollen on Monarch butterfly populations: A risk assessment. (Sears *et al.*)
2) Assessing the impact of Cry1AB-expressing corn pollen on Monarch butterfly larvae in field studies (Stanley-Horn *et al.*)
3) Effects of exposure to event 176 *Bacillus thuringiensis* corn pollen on Monarch and black swallowtail caterpillars under field conditions (Zangerl *et al.*)
4) Monarch larvae sensitivity to *Bacillus thuringiensis*-purified proteins (Hellmich *et al.*)
5) Temporal and spatial overlap between Monarch larvae and corn pollen (Oberhauser *et al.*)
6) Corn pollen deposition on milkweeds in and near cornfields (Pleasants *et al.*)

Myth 8: GM crops containing viral sequences can generate new super viruses

FACT:

The Royal Commission says:

The major perceived risk arising from the use of DNA from viruses or other microorganisms as transgenic vectors is the possibility of the generation of new diseases through recombination of the vector sequences with DNA from known pathogens.

Dr. Robert Anderson, a retired scientist with the Physicians and Scientists for Responsible Genetics New Zealand, wrote: Genes, like viruses, can infect the body, which should warn of the potential risks of transgenic organisms serving as a reservoir for new diseases and as a medium for the evolution of new pathogens because of their altered physiology and biochemistry.

Dr. Mae-wan Ho, Visiting Reader at the Open University in the United Kingdom, speaking by video link as a witness for GE Free New Zealand (RAGE) in Food and Environment, described the creation of a new mouse pox virus by Australian researchers who were trying to make a vaccine for fertility control. The issue was raised by other submitters as an example of the lack of safety of genetic modification.

What they did was supply a gene from the protein Interleukin 4 into the vaccine, and this succeeded. It was made from the relatively harmless mouse pox virus, which was used just as a vehicle to carry egg proteins into the mice. The hope was that the Interleukin 4 would induce the immune system to make more antibodies against the mouse egg, thereby killing it. When the researchers injected the vaccine into the mice, however, all the mice died. In fact, this synthetic virus was so lethal that it also killed half of all the mice that had been vaccinated against mouse pox.

It is clear that such experimental work requires rigorous containment and careful controls, but the Commission received no evidence suggesting that the new virus had escaped from containment or had infected any mice not involved in the experiment. Unexpected results such as these are a part of and, to some extent, the purpose of research.

(Chapter 4 of the RCGM Report, 2001)

Additional Information

Plant viral DNA sequences are commonly used in the construction of the genes inserted into GM plants, and concern has been expressed about this. Having reviewed the scientific evidence, the Royal Society (see Myth 5) concluded that the risks to human health associated with the use of specific viral DNA sequences in GM plants are negligible.

(Source: Genetically modified plants for food use and human health - An update, February 2002, Royal Society, UK)

A complete copy of the report is available at: http://www.royalsoc.ac.uk/files/statfiles/document-165.pdf

Myth 9: The horizontal gene transfer from GM rapeseed to bacteria in the gut of a bee has occurred posing serious issues about dangerous transfers of GM material

FACT:

The Royal Commission says:

Various submitters described a case of apparent horizontal gene transfer of a herbicide resistance gene into the intestinal microflora of honeybees. The Pacific Institute of Resource Management said:

The German Television station ZDF reported on Sunday May 21, 2000 that a German researcher found a gene transfer from genetically engineered rapeseed to bacteria and fungi in the gut of honeybees. Professor Hans-Heinrich Kaatz from the Institut für Bienenkunde (Institute for Bee Research) at the University of Jena experimented during the last three years with honeybees on an experimental field with transgenic rapeseed in Saxony, Germany.

USDA Photo

The German Television Station ZDF reported on Sunday May 21, 2000 that a German researcher found a gene transfer from genetically engineered rapeseed to bacteria and fungi in the gut of honeybees.

The rapeseed was engineered to resist the herbicide glufosinate. Professor Kaatz built nets in the field with the transgenic rapeseed and let the bees fly freely within the net. At the beehives, he installed pollen traps in order to sample the pollen loads from the bees' hind legs as they entered the hive. This pollen was fed to young honeybees in the laboratory. Professor Kaatz then took the intestine out of the young bees and spread the contents on growth medium to grow the microorganisms. He probed the microorganisms for the pat-gene, the gene that confers resistance to glufosinate. In some bacteria and also in a yeast he found the pat-gene. This indicates that the gene from the genetically engineered rapeseed was transferred in the bee's gut to the microbes.

Dr. Beatrix Tappeser described this result as a "clear indication of horizontal transfer which has been, and is still, characterised as highly improbable". This case became a rallying point around which the discussions of horizontal gene transfer flowed. However Professor Klaus Ammann suggested that the results described were far from conclusive. Professor Ammann stated that he knew Professor Kaatz's work well and was "one of the committee members to revise his projects". He told the Commission that the research was a long way from being completed and had never been published in a scientific peer-reviewed journal.

The scientific world awaits the publication of the final results of Professor Kaatz's research with interest. Until then, this remains an unproven case of horizontal gene transfer between a plant and intestinal microorganisms.

(Chapter 4 of the RCGM Report, 2001)

Myth 10: Field trials of GM crops will result in uncontrolled release of GM organisms

FACT:

The Royal Commission says:

The RCGM considers that "Field trials are an essential part of risk/benefit analysis prior to any release into the wider environment. Without field trials it is not possible to assess safety". THE RCGM also said that "The safety of field trials and the adequacy of methods to contain risk, can be adequately assessed and dealt with through risk management programmes by the Environmental Risk Management Authority (ERMA)".

The Commission had considered that "rigorous monitoring of field trials is essential and that material associated with the trial must be removable from the site".

The Commission also noted that no one argued for completely unregulated research. "Even the most enthusiastic supporters of genetic modification were clear it was vital that research was conducted within the context of a robust regulatory framework and that risks should be carefully managed."

(Chapter 6 of the RCGM Report, 2001)

Myth 11: The release of the GM soil bacteria *Klebsiella planticola* would result in the extinction of all terrestrial plant life

FACT:

The Royal Commission says:

The use of genetically modified microorganisms such as *Klebsiella plantico*la, a lactose-fermenting bacterium that converts agricultural waste into alcohol from crop residues, was described by Dr. Roberts in her background paper prepared for the Commission on the Environmental Aspects of Genetic Modification. She quoted a study which found that crops grown in soil containing genetically modified *Klebsiella planticola* died. Dr. Elaine Ingham, a Canadian soil scientist and author of that study, and a witness called by the Green Party, referred to a potential catastrophe from this use, claiming that the level of alcohol per gram of soil produced by the engineered bacterium could kill all terrestrial plants. However, soon after this evidence was presented, the Green Party withdrew the essential parts, accepting that Dr. Ingham's assertions went beyond the published literature. The Royal Commission does not give any credence to Dr. Ingham's evidence.

(Chapter 7 of the RCGM Report, 2001)

The Royal Commission also saw it fit to comment:
Dr. Elaine Ingham, a witness for the Green Party, suggested research she had conducted showed that a bacterium designed to digest crop remnants to produce alcohol, *Klebsiella planticola,* could have catastrophic consequences had it escaped into the ecosystem, but **this evidence was discredited.**

(Chapter 4 of the RCGM Report, 2001)

Myth 12: The promotion of GM crops is due to the greed and self-interest of multinational companies

FACT:

While it is true that multinational companies benefit from the new technology, they are not the only ones. Several economic studies of farm level impacts have shown that farmers in both industrial and developing countries have gained the lion's share of financial benefits from GM crops. This is due to fewer chemical controls used and increased yields. For example, in the US, the use of herbicide resistant soybean resulted in 19 million fewer herbicide applications while the use of insect protected corn resulted in a yield increase of 66 million bushels of corn1. In Canada, GM canola farmers experienced a reduction in herbicide costs by 40% and an increase in yield by 10%2.

Similarly, resource-poor farmers in developing countries have experienced financial gains from the adoption of GM crops. The use of *Bt* cotton has resulted in many benefits to farmers in China3, Mexico4, and South Africa5. In China, approximately 85% of the 1999 benefits from the adoption of *Bt* cotton went to small-scale farmers. They gained almost twice as much income per unit of land as larger farmers and those with higher incomes. Their costs of production were reduced by 20-23%. In Mexico, cost savings in pesticide use and higher yield resulted in higher profits to *Bt* cotton farmers. Net profit advantage amounted to US$600/ha. In the two years of growing *Bt* cotton in North Central Mexico, US$5.5 million economic surplus was generated, of which 84% accrued to farmers and 16% received by seed developers. Finally, in South Africa, the use of *Bt* cotton resulted in higher yields (40% over traditional varieties), reduced chemical application costs, higher profit margins, and increased production efficiency.

References:

1 Carpenter, J.E., and Gianessi, L.P. 2001. Agricultural biotechnology: Updated benefit estimates. National Center for Food and Agricultural Policy.

2 2001. An agronomic and economic assessment of transgenic canola. Canola Council of Canada: 1-95. www.canola-council.org/manual/GMO/gmo_main.htm.

3 Pray, C., Ma, D., Huang, J., and Qiao, F. 2001. Impact of *Bt* cotton in China. World Development, 29 (5): 813-825.

4 Traxler, G., Avila, S.G., Zepeda, J.F. and Arellano, J.E. 2001. Transgenic cotton in Mexico: economic and environmental impacts. Paper prepared for the 5th International Conference, Biotechnology, Science and Modern Agriculture: a New Industry at the Dawn of the Century, 15-18 June 2001, Ravello, Italy.

5 Ismael, Y. and Piesse, J. 2001. Efficiency effects of *Bt* cotton adoption by smallholders in Makhatini Flats, KwaZulu-Natal, South Africa. Paper prepared for the 5th International Conference, Biotechnology, Science and Modern Agriculture: a New Industry at the Dawn of the Century, 15-18 June 2001, Ravello, Italy.

Myth 13: Multinational companies disregard the rights of farmers (e.g., Percy Schmeiser vs Monsanto)

FACT:

The Royal Commission says:

Percy Schmeiser and his litigation with Monsanto had become familiar to the Commission long before his appearance as a witness for the Bio Dynamic Farming and Gardening Association. Anti-genetic modification campaigners mentioned his case as an example of the perceived evils of genetically modified crops and multinationals in the genetic modification business. In the event, the Canadian court held that Mr. Schmeiser had knowingly used genetically modified seeds without authority, thus infringing Monsanto's patent. Although the Commission mentions the case because of the frequency with which it was brought to its attention, the Commission does not consider that the case helps solve any of the issues before it.

(Chapter 7 of the RCGM Report, 2001)

Note:
Percy Schmeiser became the focus of international attention after he was taken to court by Monsanto, a biotech seed company, for using their patented Roundup Ready Canola seeds illegally. Schmeiser claimed pollen had drifted onto his property and he had merely replanted its seed next season. The judge explicitly rejected the pollen-drift tale because the facts did not support it*. The court ruled that Schmeiser knew or should have known he was illegally using the protected plant variety and ordered him to pay damages of $40,000.

Additional Information

*Judge W. Andrew MacKay's 62-page decision dated March 29, 2001 can be found at http://decisions.fct-cf.gc.ca/fct/2001/2001fct256.html

"Samples from the 1,030 acres of canola planted and grown by Schmeiser Enterprises, Ltd. in 1998 (para. 32) consisted of 95% to 98% pure Roundup Ready plants as determined by independent testing (para. 58), which could not have come from natural causes such as wind drift, spillage, etc. (para. 118).

There were no close neighbors who grew Roundup Ready canola when Schmeiser's lawyers claimed wind blew it on the Schmeiser Enterprises, Ltd. farms. The closest neighbor was five miles away. (para. 33)".

Myth 14: Organic farming can displace all other production types by 2020

FACT:

The Royal Commission says:

The RCGM noted "that economic reasoning suggests that it is not a realistic option for New Zealand to develop its organic sector at the expense of conventional farming and/or the use of genetic modification techniques, as in the long run it is unlikely that abnormal levels of profit would be made. We also note that while organic products may always sell at a price premium, one of the reasons for this is likely to be their higher production costs".

(Chapter 5 of the RCGM Report, 2001)

and

Some submitters called for New Zealand to become 100% organic. In the Commission's opinion "this subset of a 'genetic modification free New Zealand' is not economically viable. Organic foods may indeed attract a premium. However, world markets are uncertain, and it is unlikely that organic exports would attract a sufficient premium in the near or medium future to offset to any degree the contractionary effect of not allowing any genetic modification in the country".

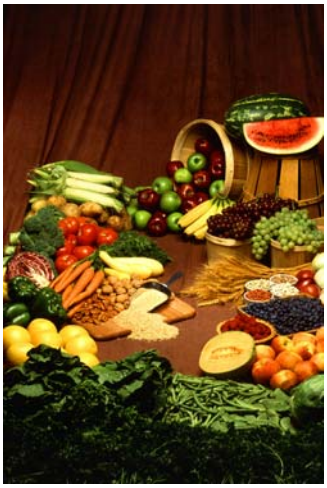
(Chapter 13 of the RCGM Report, 2001)

Myth 15: Because of modern biotechnology, people will be able to patent nature

FACT:

The Royal Commission says:

An inventor can register an Intellectual Property Right only over a new, non-obvious, inventive and useful idea. Anything that is in nature is part of the public domain. Traditionally a basic test of patentability has been whether the product or process has arisen from "a product of human ingenuity".



USDA Photo

A further point is that "invention" is not the same thing as "discovery". For example the identification of a cell line or other genetic material is a discovery. To be granted a patent or other intellectual property over that discovery requires the application of that discovery to create a new product or process. This means there is a distinction between a life form or its DNA and an industrial, agricultural or technological use of that life form or DNA. This leads to the distinction between the ownership of genes, as they exist in nature and a patent or other IPR over a gene or gene sequence. It has long been a feature of the patent system that naturally occurring products or "laws of nature" cannot be patented because they are not new or inventive and patentees could not describe how to make them.

Furthermore the grant of a patent does not give immunity from a challenge. If any part of a patent is shown to be invalid, the whole patent is invalid. Patents are also contestable. If a patent application is too wide, it can be challenged for "covetous claiming".

On the other hand, the issue of a patent does give force to the patented product or process. This means people may choose to pay for licences to use potentially invalid patents rather than challenge the patent itself. This is often a commercial decision based on the cost and benefits of a challenge against negotiating a licence and using the possibility of a challenge as a bargaining tool…

The exercise of a patent is also limited to commercial activities. Generally, information disclosed in a patent can be the basis of further experimentation or research without the authorization of the patentee. This is subject to some limitations: if the patent is for a research application or tool, then research is also the commercial use and must be licensed, and if the research user of information disclosed in a patent later wishes to market their invention which uses the first invention, they would need a licence from and pay royalties to the patent-holder.

(Chapter 10 of the RCGM Report, 2001)

Myth 16: Golden Rice will not produce the health benefits its advocates publicize

FACT:

The Royal Commission says:

Rice is the staple food for two billion people. It is usually milled to remove the outer seed layers to prevent their high oil content causing spoilage. The remaining grain is low in ß-carotene (Vitamin A). Some 400 million people world-wide suffer from vitamin A deficiency and over 3.7 billion people are iron deficient. These deficiencies lead to poor development and increased susceptibility to disease. Vitamin A deficiency causes five million deaths annually, and blindness in a further 500,000 people, while iron deficiency causes anaemia and birth defects.

Golden Rice is a transgenic crop created by Dr. Ingo Potrykus and his colleagues to improve the nutritional quality of rice, by increasing the quantities of ß-carotene, the precursor to vitamin A, and improving its iron content.

USDA Photo

Rice is the staple food for two billion people. It is usually milled to remove the outer seed layers to prevent their high oil content causing spoilage.

The Golden Rice project is trying to achieve the strategy of the FAO and WHO to "ensure that sustainable food-based strategies are given first priority particularly for populations deficient in vitamin A and iron, favoring locally available foods and taking into account local food habits". The research was funded by the Rockefeller Foundation, the Swiss government and the European Union. The Golden Rice project hopes to provide a cheap form of vitamin supplementation to help prevent these deficiencies. It is not the product of profit-seeking companies. When viable, the rice is to be freely distributed with no patents blocking access to it…. Currently, intellectual property issues are being resolved*.

Some believe that Golden Rice is being over-hyped, because it allays public fears about genetic modification, and that it is not the best solution to the nutritional problems in developing countries. They point out that, despite all the time and money spent on Golden Rice, it is not yet available to those it was designed to help, and in fact is several years away from commercial production. It is also argued that problems with malnutrition have little to do with the nutritional value of the food consumed. Rather the problems have to do with food distribution, food preferences, food variety, etc.

(Chapter 8 of the RCGM Report, 2001)

Conclusion

The RCGM report has been favorably received by the international scientific community. Many have commented that "an admirable level of scientific rigor was applied to the vast pile of submissions received by the RCGM, which consisted of a retired chief justice, a cleric, a scientist, and a teacher. The RCGM process afforded all sides to present their best case, and exposed factual error and unfounded hyperbole when it was encountered". The RCGM did not endorse GM technology entirely or ban it completely. It has recommended that research on GM crops and animals "proceed with caution".

After three months of intense discussion, the New Zealand government finally responded to the RCGM report. It has decided to lift the ban on field trials for GM crops, but imposed tough new rules on any new trials and banned the commercial release of GM products for two years.

Prime Minister Helen Clark said "science and research must continue with strict controls in place to protect the health of New Zealanders and our environment".

For more on the discussion, please visit http://www.gmcommission.govt.nz

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The Global Knowledge Center on Crop Biotechnology is a science-based information network responding dynamically to the needs of developing countries on all aspects of crop biotechnology. Its activities include maintenance of an internet website, expert networking, continuous scanning of the agri-biotech environment, and multi-media communication.

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