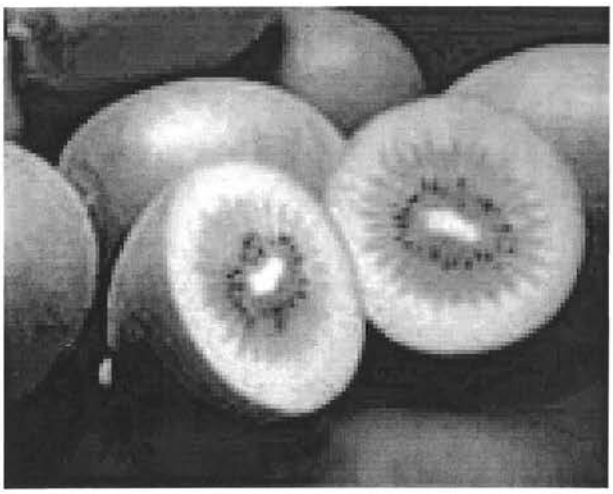
GENETIC MODIFICATION AND THE KIWIFRUIT INDUSTRY



The Risks and Rewards of Participation and Non-Participation

A report by
Grant Eynon

Contents

Introduction

Genetic Modification and the Kiwifruit Industry

Report on the risks and rewards of participation and non-participation

This report aims to look at several aspects of the genetic modification debate.

It is a brief overview of some of the issues and challenges facing industries involved in genetic research including the benefits and risks (perceived and otherwise).

It will look at the kiwifruit industry and see how that industry fits in the overall picture.

It will give some examples of what is happening, and what possibly may happen, some consumer perceptions, some industry views, and will touch very briefly on ethical and moral issues as they apply to people of New Zealand.

It will make conclusions as to the position we are in now, and the issues that are to be faced, as huge advances are made in the technology that is available.

Genetic Modification

Background & History – What is it, & how has it developed

Genetic modification sometimes called **genetic engineering** is a branch of a science known as **Biotechnology**. Although the term biotechnology refers to a much older and broader technology than genetic modification, the techniques now being employed are of such great importance and are of such a high profile, that to many people the two terms have become virtually synonymous.

Biotechnology is a name given to a wide range of agricultural, industrial and medical technologies that make use of living organisms (microbes, plants etc) or parts of living organisms (cells or proteins) to provide new products. It's origins lie in the ancient crafts of brewing and the production of fermented foods such as yoghurt. It was in 1859 that microbes were identified as the cause of both desirable and undesirable changes in food.[1] Towards the end of the 19th century it was realised that non-living extracts from, for example, yeast cells, could also bring about these changes. These extracts were named 'enzymes' (literally, 'in yeast'). We now know that all living things produce enzymes – proteins that are responsible for many of the processes of life.

Biotechnology has been used in agriculture for many years, in various crude, and sometimes unpredictable forms. Farmers have a long tradition of introducing desired qualities into their crops by plant cross breeding. This is a very slow and relatively labour-intensive process, sometimes taking many plant generations to introduce the desired characteristic and 'breed out' any undesirable ones.

In 1953 scientists discovered the structure of the genetic material, DNA molecules. Found inside all living cells, these DNA molecules make up chromosomes which are strung together to form genes which contain sets of instructions to make proteins. The genetic information packaged in these chromosomes contains the 'blueprint' for any living thing, whether it be animal, plant or the tiniest bacterium, determining the individual characteristics of the organism.

In 1973 two scientists managed for the first time to make very specific changes to the genetic make-up of microbes by means of what has now been termed genetic modification. Methods were developed for cutting and splicing or recombining DNA. This became known as recombinant DNA or rDNA. The techniques developed rely on scientists' ability to isolate specific stretches of DNA using specialised enzymes, which cut the DNA at precise locations. Selected DNA fragments can then be transferred into other cells. This makes it possible to change the pattern in genetic material, and thus countless characteristics, in any living organism, and also to isolate a known trait from any living species and incorporate it in any other species.

What are the goals of GM?

There is a whole range of advantages when looking at GM. GM is much more precise than selective breeding. By transferring only certain genes from one plant or animal to another, researchers can introduce one specific trait without also transferring dozens of unwanted ones, as often occurs in selective breeding. This precision also speeds up the process considerably. There are also certain vaccines, drugs and diagnostics, which can only be produced by GM.

Since the early 1980's research has been carried out, particularly in Europe and the USA into the application of genetic modification techniques in various crop plants, building in improved qualities and removing unwanted ones. About 80% of current research in plant biotechnology is directed towards food plants, the remaining work is concerned with non-food crops such as cotton, tobacco, ornamental plants and pharmaceuticals. The initial emphasis has generally been on the improvement of qualities of value to the farmer. The majority of this work has been initiated and funded by the seed industry.[1] The second and third generations of GM food plants will bring benefits that more directly affect commercial food processors and consumers. Many thousands of field trials of GM plants have already been carried out, and although many modified food plants are approaching commercial use, only a few have so far been approved. (e.g. yeasts – for beer and bread making – soya beans, maize and tomatoes). These would be termed GM foods or GMOs (genetically modified organisms), terms most commonly used to refer to crop plants created for human or animal consumption.

In crop production, research is being carried out in the following areas:

- Pest resistance
  Crop losses from insect pests can be staggering, resulting in huge financial losses for farmers and starvation in developing countries. e.g. - Bt maize has been genetically modified to make it produce a protein from the bacterium *Bacillus thuringiensis*. This protein kills the corn borer insect, which in other countries, is a major threat to maize crops.
- Herbicide resistance
  For some crops it is not cost effective to remove weeds by physical means, so farmers will often spray large quantities of different herbicides to destroy weeds, a time consuming and expensive process requiring great care so that the herbicides don't harm the crop plant or the environment. e.g. - Soya that is modified to be tolerant to the herbicide glyphosate. This means the variety and volume of herbicides needing to be applied to these crops can be greatly reduced.
- Disease resistance
  There are many viruses, fungi and bacteria that cause plant diseases. Much research is being carried out to create plants that are resistant to these diseases

- Cold Tolerance
  Unexpected frost can destroy sensitive seedlings. An 'antifreeze' gene has been introduced into plants such as tobacco and potatoes enabling them to tolerate temperatures that normally would kill unmodified seedlings.
- Drought / Salinity tolerance
  Plants are being created that can withstand long periods of drought or high salt content in soil and groundwater, which will allow crops to be grown in formerly inhospitable places.
- Improved nutritional quality
  Malnutrition is common in third world countries where impoverished peoples rely on a single crop such as rice for their staple diet. However, rice does not contain the necessary nutrients to prevent malnutrition. Rice can be genetically modified to contain additional vitamins and minerals, thus alleviating this problem. e.g. – Blindness due to vitamin A deficiency is a common problem in third world countries. Researchers have developed 'Golden' rice, containing an unusually high content of beta-carotene (vitamin A).
- Improved plant qualities for harvesting, shipping and storage
  Some crops e.g. tomatoes, if picked ripe, rot quickly and do not store or travel well, so they are harvested while they are still green resulting in poor taste and texture. The enzyme that causes the spoilage can be suppressed by genetic modification allowing the tomato to be picked ripe and shipped without spoiling.
- Production of pharmaceuticals, novel oils and plastics
  Medicines and vaccines often are costly to produce and sometimes require special storage conditions not readily available in third world countries. Work is being carried out on the development of edible vaccines in tomato and potatoes, which are easier to ship, store and administer than traditional injectable vaccines.

Other areas include :

- Work on genes regulating the timing of flowering in some crops, giving potential for big improvements in profitability.
- Reducing the starch content in potatoes.
- Using genetically modified trees to clean up pollution from contaminated soil.

In animal studies, the research is aiming to:

- Develop new vaccines, diagnostic tools and medicines for animals and humans
- Develop animal models for studies of diseases.
- Increase the nutritional quality of meat, milk and other animal products.
- Increase yields of animal products.

What is happening:

Around the world ?

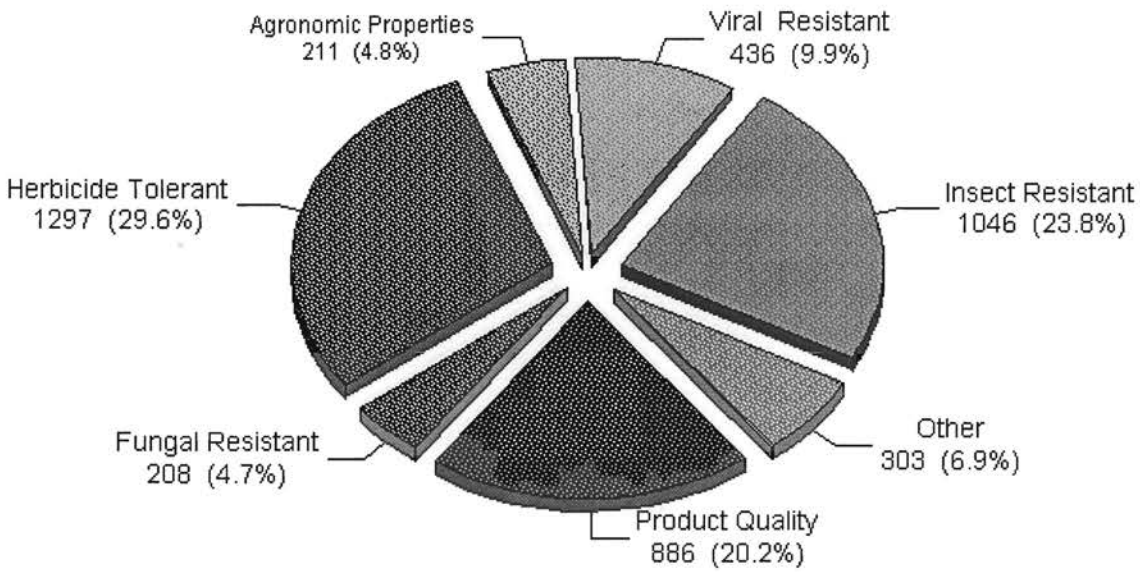
GM crops are widely grown throughout the world. In 1998 in excess of 27 million hectares of GM crops were grown world wide (excluding China); three quarters of that, in the US. The other major growers are Argentina, Canada and China, with significant expansion in Mexico and South Africa. GM crops are now being grown either in field trials or on a commercial scale in over 40 countries including Nicaragua, Honduras, Swaziland and Vietnam. In Europe commercial growing of GM Bt maize is already underway in Spain, France and Germany.[1]

The following chart, from the US Dept. of Agriculture shows the number of permits issued for field trials and gives a breakdown of the different types of trials that have been carried out in the USA.

From this chart it can be seen that the majority of trials being carried out are in the areas of Herbicide Tolerance and Insect Resistance which between them comprise over 50% of the total number of permits issued.

US Dept of Agriculture

Field Releases*: Most Frequent Categories
1987 to 1998 4/30/98



**** Permits Issued and Notifications Acknowledged***

BSS Biotechnology update May 1998

Although GM crops are not grown commercially in the UK, a number of trials are underway on crops such as oilseed rape, sugar beet and potatoes. The modifications are designed to make these plants herbicide tolerant and pest or insect resistant. Ingredients from GM soya and maize have reached the market in the UK, coming from the US, as does the tomato puree made from GM tomatoes.[1]

In the US, while there are very few GM whole fruits and vegetables on produce stands, highly processed foods, such as vegetable oils or breakfast cereals, most likely contain some percentage of GM ingredients because the raw ingredients have been pooled into one processing stream from many different sources. The widespread use of soybean derivatives as food additives in the US virtually ensures nation wide exposure to GM food products.

The first genetically modified **whole product** went on the market in the US in May 1994 when the Flavr Savr tomato first appeared on supermarket shelves. Using recombinant DNA techniques the enzyme that results in the tomato rotting is suppressed, allowing the tomato to be picked ripe and stay ripe, but not rot, and therefore be shipped without spoiling.[2]

By early 1997, eighteen foods had been cleared for use by Food and Drug Administration as well as Environmental Protection Agency and US Department of Agriculture. By April 2000 there were over forty plant varieties that had completed all the federal requirements for commercialisation.[3]

In New Zealand ?

GM technology has been used since 1982 to produce insulin for diabetics, and other medicines including hepatitis B vaccine, human growth hormone and cancer drugs. There are also contained scientific trials of GM plants and animals in New Zealand, but there has been no general release of GMOs into the environment.

In particular there are many organisations involved in specific areas:

Agresearch[4] are involved in many areas of research including:

- Breeding sheep without the gene myostatin, which regulates muscle growth in most mammals. These animals will be used to aid research into heart disease and muscular dystrophy, the meat never entering the food chain.
- Cattle are bred that excrete myelin basic in their milk, from which it may be purified and used in treatment of multiple sclerosis.
- Work is being carried out with a white clover that is resistant to porina, grass grub and clover root weevil. Nutrient values of these clovers are also being improved.

Wrightson[1] has a research interest in the following:

- The genes which make Aries HD and Quartet ryegrass palatable for animals;
- The combat of rust in ryegrass;
- Transgenic plants which secrete natural insecticides;
- The alleviation of allergies caused by ryegrass pollen;
- The increase of magnesium levels in pasture;
- The decrease of nitrates in pasture to prevent stock from being poisoned;
- The reduction of methane levels.

The Foundation for Research Science & Technology[2] have invested approximately $6.4 million in research contracts that are specifically targeted at producing a particular GM-related product or solution. For example research targeted at :

- Producing a GM crop plant with increased pest resistance to improve crop performance;
- Generating GM cows with improved casein content in their milk to develop a premium-earning product that has improved nutritional qualities for human health;
- Developing vaccines against bovine tuberculosis (Tb) to help farmers control Tb in cattle and deer;
- Producing novel, high value ornamental species;
- Developing a GM vaccine to cause infertility in possums.

HortResearch[3] is involved in gene technology, and many areas of research, but not in gene transfer. Their work consists of DNA "fingerprinting" of apples, DNA probes for mealybugs, virus resistant tamarillos and gene marking. Apples are being produced that are leaf roller resistant and herbicide tolerant.

Forest Research Institute, with some of the big forestry corporations, is working on pines that are herbicide tolerant, have improved lignin and reduced flowering.[4]

Crop and Food are researching potatoes that are insect tolerant and soft rot resistant.[5]

All of this research comes under the definition of **containment**, which consists of laboratory or glasshouse testing, or **contained field testing**, which tries to determine how the GMO will respond to conditions in the environment, but with the organism and all reproductive material retrieved or destroyed at the end of the trial.

In October 2000 two varieties of GM corn were declared safe for human consumption by the Australia New Zealand Food Authority (ANZFA). One produced a natural insecticide, the other was herbicide-resistant. This brought to twelve the number of GM ingredients that had passed the ANZFA food safety tests.[6]

The Debate

The whole subject of GM has become a very emotional one. The visions of mad scientists at work in laboratories creating "Frankenstein foods" or splicing "bits of frogs into apples" stir up public debate and make for very exciting news.

In reality the debate is actually about some very simple questions :
"What is to be gained?"
"What is at risk?"
"Is the scenario reversible?"
"Who should decide if the risks are worth taking?"

Some of these questions, by their very nature, cannot be answered to the satisfaction of either side of the debate for a very long time.

Rewards

As discussed in the 'Goals of GM' there are many and obvious benefits when looking at particular crops and their related problems. These are scientific facts and are not really part of the debate. The real question is - how do these benefits translate into helping the world?

Through the improvements that can be achieved, GM foods have the potential to solve many of the world's problems relating to hunger and malnutrition. These benefits would come through reduction in water use, developing plants that are productive in marginal farmland, and increasing nutritional qualities of foods. By increasing yield and reducing reliance upon chemical herbicides and pesticides there is potential to help protect and preserve the environment. There are many new developments in the phamaceutical industry which simply would not have happened, and could not carry on without GM. Some vaccines can only be produced by GM.

Risks

Against all of these benefits there are of course the balancing risks. Environmentalists, religious organisations, public interest groups and some scientists and government officials have all raised concerns about GM foods, criticising businesses for pursuing profit without concern for potential hazards, and governments for failing to exercise adequate restrictions.

Much of this debate again deals in potential risks and therefore cannot be quantified, with both sides vigorously defending their views, data and information. Most concerns fall into three categories: environmental hazards, human health risks, and economic concerns:

Environmental hazards

- Unintended harm to other organisms.
  A laboratory study was published in *Nature* in 1999 showing that pollen from Bt corn caused high mortality in monarch butterfly caterpillars. The fear is that if pollen from Bt corn is blown by the wind onto plants in neighbouring fields the caterpillars could eat them and perish. Bt toxins do kill many species of insect larvae indiscriminately, but there is no current agreement about the potential harm to non-target organisms. Research done at the University of East Anglia published in *Science* magazine – August 2000, also shows potentially negative effects on farmland birds in the UK.

- Reduced effectiveness of pesticides
  Many people are concerned that insects will become resistant to crops that have been genetically modified to produce their own pesticide.

- Gene transfer to non-target species
  Crop plants engineered for herbicide resistance could cross breed with weeds, resulting in the transfer of the herbicide resistant gene producing 'superweeds.'

There are several possible 'solutions' to the three problems mentioned above, including buffer zones and creating plants that are male sterile (not pollen producing).

Human Health Risks

- Allergenicity
  Many children have life-threatening allergies to peanuts and other foods. There is a fear that introducing a gene into a plant may create new allergens or cause allergic reactions in susceptible individuals.

- Unknown effects on human health
  The concern in this area is there may be unexpected and negative impacts on human health due to foreign genes being introduced into food plants.

Economic concerns

- Third world access to new technology.
  Consumer advocates are worried that patenting of new plant varieties will raise the price of seeds so high that small farmers and third world countries will not be able to afford GM seeds, thus widening the gap between the rich and poor.

- To combat possible patent infringements, companies can introduce 'suicide genes' into GM plants. These plants are viable for only one growing season and would produce sterile seeds that do not germinate. Farmers would be forced to buy a fresh supply of seeds each year.

The politics of GM

Where does the government stand?

In early October 2000 the Government set up a Royal Commission on Genetic Modification who's chief objective is to inquire into and report on the strategic options available to New Zealand to address genetic modification issues both now and in the future. It will have 12 months to report, having received submissions from interested parties, on a wide range of issues relevant to New Zealand.

A voluntary moratorium on all applications for the release of GMOs has been negotiated between the government and relevant industry and research groups. This moratorium will be in force for the length of the Commission's inquiry.

"Any decision to allow a general release of a GMO may be irreversible" Marion Hobbs – Minister for the Environment stated. "In order to keep our options open, we want to ensure that there will be no GMOs released until the Royal Commission has completed it's report and the government has considered it's findings."[1]

Minister of Research, Science and Technology – Pete Hodgson said "The point of the commission is to help New Zealanders decide the future of genetic modification in this country. Keeping our options open means preventing the release of GMOs into our environment as well as preventing the inadvertent destruction of our research capacity. New Zealand's legislative regime governing GM experiments and field trials..... is already one of the strictest in the world. It included the precautionary principle, which required caution if any risk was uncertain because of lack of information." He said that Crown Research Institutes would comply with the moratorium, whilst rejecting the Green Party's call for publicly funded scientists to withdraw from all GM research.[2]

Others Parties?

Green Party health spokeswoman Sue Kedgley said the party opposed GE technology in food production, but supported it's use in medicine. Unlike GE foods, GE medicines faced stringent clinical testing, had specific benefits and people could choose whether to use them.[3]

GE-Free New Zealand spokeswoman Susie Lees said her organisation opposed using genetically engineered animals in medical research. Animals with implanted genes could interbreed with other animals and affect the environment.[4]

Major Industry
Gene Technology Policy: Federated Farmers

Humans have been practising genetic manipulation for centuries. We have sought to improve the characteristics and yields of plants and animals by selection and breeding. Modern advances in gene technology have taken this further by providing new ways of improving plants and animals. Many of these results could be achieved by traditional breeding methods, but gene technology is a faster and more specific method of achieving a desired modification. Gene technology has the potential to benefit New Zealand producers, providing appropriate controls exist to ensure the safety of human health and the environment.

- Federated Farmers supports the principle and application of gene technology within agriculture, providing appropriate controls exist. Gene technology involves altering the genetic material of organisms to introduce desirable characteristics.
- Federated Farmers recognises that this technology can provide benefits to New Zealand producers. These benefits include the potential for: higher yields, precisely determined product attributes, higher quality and safer food, more sustainable environmental management practices, improved input efficiencies, better understanding of plant and animal functions, improved animal disease management tools.

So while the Federated Farmers policy supports the use of gene technology in principle, whether a specific application is supported would depend on the risks it presents, what benefits there are to agriculture and whether the risks can be managed appropriately.
Rather than ban gene technology outright, Federated Farmers of New Zealand (Inc) believes it is better to ensure that farmers continue to have production choices, that the Government provides a sound regulatory process to determine the safety of genetically modified food and organisms and consumers have information to make their own choices.[1]

New Zealand Dairy Board

"Biotechnology offers the industry and the nation an opportunity to enhance economic wellbeing and potentially its environment. The world is rapidly moving on and New Zealand cannot afford to be left behind. In recognition of the importance of biotechnology to the dairy industry, the Dairy Board has recently established a company specifically to drive biotechnological research. It should be noted that:

1. we are only doing research at this stage;
2. this is being done so we can stay in the race;
3. commercialisation will be dictated by customers and consumers."[2]

Other views from around NZ

In December 1999 the Government's Independent Biotechnology Advisory Council (IBAC) released a discussion paper focusing on the economic impact of a release of GMOs for food production in NZ :

> " It is clear that many New Zealanders hold the view that our comparative trade advantage lies in strategic development of clean green biologically based production in conjunction with green eco-tourism. The proponents of this view consider that the release of GMOs is incompatible with the country's clean green image and that the production and export of GM food would undermine our most promising future trade advantage."

In June 1999 Philip Anstey, grain division manager for Pyne Gould Guinness (a large NZ seed company) told the Federated Farmers grain industry conference:

> "New Zealand grain farmers should not be looking at switching to certified organic production, but rather should be open to the use of seeds genetically modified to be herbicide resistant."

Dr Campbell a University of Otago expert on 'green' crops told the same conference:

> "New Zealand's export trade of organic and 'low input' products, which were produced using minimal amounts of chemicals, was worth almost $1 billion a year. Questions still remain over the long-term effects of GM crops. Among the threats associated with GM crops was the possibility their pollen would contaminate organic crops. The 'green' export trade was helped by New Zealand's clean, green image, and could be threatened if genetically modified crops were introduced."

Dr Allan Freeth, Wrightson's CEO, addressing Young Farmer of the year Contest, Lincoln University 9/7/00 stated:

> "The so called knowledge economy of New Zealand has it's heart in Agriculture and New Zealand's primary industries. But a future as an agricultural nation depended upon New Zealanders recognising and facing up to the challenges like bio-technology …….…… appropriate and safe biotechnology would be of fundamental importance to the future."
>
> "….I think there will be a point in the next three to five years, where every year delayed by New Zealand could end up costing it five to ten years loss (of competitive advantage)"

Mike Berridge, Acting Director of Malaghan Institute of Medical Research in Wellington, putting his submission to the Royal Commission said:

> "Continual restrictions on GE research would isolate New Zealand scientists from developments occurring overseas, and it could spell a 'death sentence' for scientists wanting to work here."

Chris Dennison, North Otago Federated Farmers retiring arable section chairman said :

> "The acceptance of genetically engineered plants into Otago crop farming could cost the opportunity to sell product to wealthy European markets. GMOs were causing anxiety throughout the world, but while the Europeans were turning against the technology the Americans were wholeheartedly embracing it.
>
> As growers and marketers we must remember 'the customer is always right' and then consider who are our current and future customers.
>
> I accept there are many real advantages in the GM technology, ...but the concern is that once modified plants were in the wider environment they could not be cleaned up. Once the genie is out of the bottle, there is no going back."

Prof. PA Sullivan, Head of Institute of Molecular Biosciences, Massey University in a submission to IBAC stated:

> "DNA and genetic technologies, developed during the past thirty years, have proven to be completely safe in routine use in biological and biomedical research throughout the world. Further, the research undertaken with these technologies has contributed enormously to scientific knowledge which has in turn has yielded a variety of technologies (applications) and products embraced by society."

Murray Wilcocks, NZ representative for Monsanto appearing before the Royal Commission said:

> "It comes down to a choice New Zealanders must make, whether they want an economy based on organics or on genetic engineering. The amount of export from organics is tiny compared to New Zealand's total agricultural and forestry output.
> I am not surprised at opinion polls which show that 70% of farmers in New Zealand prefer organics to GE. The results would change if there was informed debate and the royal commission will achieve this."

Dr Jacqueline Rowarth, spokeswoman for Institute of Agricultural Science regarding the Foundation for Research, Science and Technology review of state science funding:

> "It appears to be trying to reduce public investment in agricultural science, and diverting money to genetic engineering and other biotechnology innovation, which is already soaking up nearly a third of the state's science funding. The document appears to be saying science funding has to make a profit. Crown Research Institutes could most easily make a profit in areas involving gene technology – the area most likely to be funded by industry.....Increasingly, nobody in agricultural science is working for the good of New Zealand."

What are the social and ethical implications of GE?

The issues can be broken down into two areas: intrinsic and extrinsic. Intrinsic concerns are those that have to do with moral concerns about the very process of GE: that it is unnatural or against religious views for one or more reasons.

If intrinsic objections are held, then the extrinsic ones are irrelevant, in the same way that if you object to capital punishment on moral grounds, you don't argue about the methods by which it should be carried out.

In New Zealand, Maori do not approve of mixing genes from different species. Their objection is a spiritual one, based on their belief that ancestors are like gods—to be revered—and ancestral heritage and inheritance are therefore also sacred. However, the Maori culture never had to deal with such complexities as GE until recently. It is fair to say that an 'intrinsic' spiritual argument is the only one which cannot be refuted by an ethics committee.

Other 'intrinsic' objections include: GE is unnatural; trying to play God; arrogating to ourselves historically unprecedented levels of power; disrespecting life by patenting it; "commodifying" life; illegitimately abrogating species boundaries or exhibiting arrogance, hubris, and disaffection. Such objections are difficult, if not impossible to refute, because they rest on strongly-held beliefs, rather than on facts.

Extrinsic objections, which rest more on facts and reasoning, have to do with consequences arising from the application of the technology.

Such objections include claims that GE organisms may have disastrous effects on animals, ecosystems, and humans. Potential harms to animals include unjustified pain to individuals used in research and production. Potential harms to ecosystems include possible environmental catastrophe, inevitable narrowing of germplasm diversity, and irreversible loss or degradation of air, soils, and waters. Possible harms to humans include perpetuation of social inequities in modern agriculture, a growing gap between well capitalized economies in the Northern hemisphere and less capitalized peasant economies in the South, risks to the food security of future generations, and the promotion of reductionistic and exploitative science.

However genetic engineering is merely the latest in a long line of technologies that humanity has devised to improve its prospects, and putting passions aside, most agree that societies would be far better served by carefully using technology, while critically monitoring its progress and performance.[1]

The Kiwifruit Industry

There is a lot of genetic technology research work being carried out in the kiwifruit industry in New Zealand, although none of it actually involves genetic modification.

HortResearch by using gene marker technology to determine the sex of kiwifruit plants long before they flower, are already saving considerable amounts of time and money. Male and female vines can be told apart only by their flowers, so have to be grown for several years until they bloom, when most of the males are dumped. Now male kiwifruit can be identified at cellular level while they're seedlings, and only the females need to be grown on and assessed for fruit quality.

As work is done developing markers for other important attributes such as fruit size and eating quality, breeders will be able to reduce the number of generations required to produce new cultivars. Reducing the number of generations required by just one, will save five years on the development time of a new variety.[1]

Potential benefits of participation in GM development

- The ability to make a giant leap forward and gain major advantage over other kiwifruit producing countries.
- Increase in production per hectare. If average production per hectare was doubled, NZ could and would have the ability to sell for less, but still have a major lift in net dollars per hectare.
- The ability to grow kiwifruit in a far wider geographical area. If kiwifuit was modified to be frost resistant, land could be utilised in areas such as Otago or King Country.
- Kiwifruit could be altered to provide nutritional and medical benefits e.g. high calcium content, high Vitamin C content, enzymes that aid in the treatment of cancer.
- Ability to produce completely new varieties with regard to taste, texture and colour.
- Pest and disease resistance, eliminating the need for sprays, perhaps enhancing New Zealand's clean, green image and making kiwifruit production more environmentally sustainable and safe for consumers.
- The ability to regulate the timing of the flowering. If fruitgrowers could control the exact timing of their crops, there would be potential for big improvements in profitability.

Industry Views on the issues !

Zespri International Ltd is the global marketing division of Kiwifruit New Zealand, the 'governing body' of the kiwifruit industry. Zespri Innovations Ltd is the research and development arm of the company. Most orchardists are, as with most members of the public, without enough information to come to any firm conclusions.

Zespri Innovations Ltd. (Research and Development)

In my interview conducted on 13th November 2000 with Nigel Banks the General Manager of Zespri Innovations Ltd, he explained some of his viewpoints and made the following points:

"We (the research company) are working on genetic technology that, in line with Zespri company policy does not involve GM. We are looking to develop technology that will enhance New Zealand products in terms of environmental sustainability.

Our clean green image is absolutely essential, but we need to keep a balance. By using technology such as gene markers, we can identify the genes which give certain characteristics, such as taste, and then look for this in new varieties created by traditional methods, rather than having to wait for years to see if the taste is suitable. This is using the technology to our advantage, and 'keeping up with the play.' A big effort is put into finding out, through genetics, what is the make-up of our existing kiwifruit varieties, so we are doing the base work. If the environment, the market, and/or the company changed, we are not in danger of being left too far behind.

There is no actual GM work going on in the kiwifruit industry in New Zealand, although there is possibly some happening in Japan. GM is basically a short cut method, the same results being achieved with present methods, (for example, fruit that tastes good and is high in vitamin C), only they take somewhat longer.

GM work is mushrooming and very dramatic breakthroughs are possible using GM, in fact 'quantum leaps' can be made. Identifying all the gene functions is a very important step in the process. Some possible benefits are things like – easy peel kiwifruit, edible skin, and certain health benefits.

Against all the perceived benefits the risks have to be balanced. The research technology is very expensive and very long term. For many reasons, including mainly bad market reception, the work may not pay off.

Zespri Innovation spend $5 million per year on research and development, and it is a risk putting money into GM work with no definite payback. I think that the government should look at this whole area and recognise the work that needs doing and possibly look at funding."

Kiwifruit New Zealand & Zespri International (Marketing)

KNZ's views have been well documented during the last couple of years. Doug Voss Chairman of Zespri International and Director of KNZ Marketing has been quoted -

> "KNZ has resolved not to fund research, include within it's inventory, or market genetically modified kiwifruit " - BOP Times April 1999
> "KNZ & Zespri International…….reject any involvement in genetic engineering" - Letter to Ms Fitzsimmons (Green Party) Sept. 1999

In my interview with Mr Voss conducted in October 2000, he made the following points in answer to several questions I put to him :-

"We, as an industry must listen to what the customer has to say. We are involved in a specialist, high value, niche market and as such we have made a submission to the Royal Commission documenting our concern that the Government should not be pushing NZ as out in front in GM until all the information is available. We do not want to be dragged in to any aggressive policy in this area.

The markets in East Asia and Japan in particular are very concerned over food safety issues, and the big debate in Europe is over the unknown effects of GM foods. We are enhancing our "green" image and product value by not participating in GM. This comes across loud and clear. For instance we have had to make it very clear that Zespri^{TM} Gold definitely did not come about as a result of GM !

Our policy is to watch what is happening in the whole field of genetics. We are very much involved in the area of genetic research, but we are clearly wanting to distance ourselves from genetic engineering. It is very important for us as an industry to understand DNA composition and research genetic mapping to get the full picture regarding the make up of, and differences between, the many varieties of kiwifruit.

We must maintain the research processes because we do not want to lose key people in these areas, and we also have to keep up with the latest developments. If we did nothing we could put ourselves at a real disadvantage, but we are doing our homework and we are ready for the next step as we get a full understanding of the NZ and global position.

We could well be using the things we are learning from the genetic mapping to screen and breed certain characteristics within the existing varieties. We are already doing this naturally, but could possibly in the future be doing it more precisely, through gene transfer within a species. However, boundaries need to be set as most concern from the public seems to be in the area of breeding across different species and the unknown effects that will have."

Summary

In the wider sense there appears to be compelling moral arguments to make GM crops readily available to developing countries who want them, to help combat world hunger and poverty. There appears to be no evidence to suggest that GM foods are harmful to human health, GM in most respects being just an extension and refinement of what has been happening for thousands of years.[1]

While some genetic modifications are truly novel, there is no clear dividing line which prescibes what types of modification are unacceptable because they are thought by some to be 'unnatural.'

In summarising the arguments in regard to the kiwifruit industry, there are two areas to consider, the risks and rewards of participation, and the risks and rewards of non-participation.

Participation has many and varied rewards when looking at the improvements that could be made to the actual plants, all of which could be very expensive to achieve, but could have huge impact on the kiwifruit industry. The risks are, all the unknown effects, to the environment and to human health, and the possible negative effects if the market turned dramatically against GM, as is happening in some European countries in particular. This could cause major harm to an industry such as kiwifruit, as it could dramatically affect it's export potential. However none of these risks can actually be defined or quantified.

Non-participation could have one major reward apart from the 'no risk' scenario. The clean green image that New Zealand has worked so hard to cultivate, would be preserved, but if other industries moved forward in the GM field, that could be lost, regardless of the kiwifruit industry's stance. The risks of non-participation are all 'perceived,' and as such are particularly influenced by the economical situation. There is much concern over being 'left behind,' both commercially and scientifically. If other countries gained the advantages, it could have disastrous effects on the New Zealand kiwifruit industry, leaving it stranded, with no option other than buying the technology from overseas.

Conclusions

Time magazine has already labelled this century as the 'Biotechnology Century' and *Science* magazine has described biotechnology as the third revolution after the industrial and information technology revolutions. These issues are not going to go away.

Much of the concern that the public has, arises from lack of information, misinformation or alarmist exaggeration. The Royal Commission and the formation of organisations such as IBAC should go a long way to overcoming those problems. Reliable information must be given to the public, to resolve argument and reduce uneasiness.

Intrinsic concerns however cannot be overcome, and people must be given the option regarding GMOs, just as they have been given options regarding 'organics.' In the final analysis, if consumers are given all the facts, they will all be influenced by different aspects of the debate, such as cost and taste, as well as environmental or moral arguments. Unfortunately, overselling of benefits only results in increased mistrust by the community at large of all that the scientists are trying to achieve.

Despite any community resistance to the concepts involved in GMOs, the horticultural industry in general and the kiwifruit industry in particular cannot afford to ignore the issues. A 'proceed with caution' attitude must be adopted, keeping options open, as dialogue and debate continue.

The government has a responsibility in both of these areas and should be willing to fund the necessary research to keep New Zealand up with the play, as well as keeping the people of New Zealand fully informed of all the issues.

Whilst firm guidelines need to be set for industry, any legislation that is put in place should not be too restrictive and costly, because whatever the government and ultimately New Zealand decides, advances in biotechnology will continue overseas, and at a very minimum, research must be maintained to interpret these advances and effectively maintain an 'educated workforce.'

In summation, the benefits that could be gained from this new technology could be so immense that the kiwifruit industry should be fully involved in ongoing research and development, including contained field trials. All work should proceed in an open and responsible manner, whilst being kept totally separate from present market strategies. This would not affect the stand the industry is making in keeping with a 'clean green New Zealand,' but would guarantee keeping the options open for the future of the industry.

Source Notes

Page 3	1 -	Page 1, GM Food Techniques - NCBE
Page 4	1 -	Page 2, GM Food Techniques - NCBE
Page 6	1 -	Page 2, What are GM Crops - Foodfuture
Page 7	1 -	Page 2, ditto
	2 -	Page 5, 'A new tomato', GE Fast forwarding to future foods – J Henkel , US FDA Consumer
	3 -	Page 2 'Present Situation', ditto
	4 -	Submissions to Royal Commission
Page 8	1 -	ditto
	2 -	ditto
	3 -	Sensational Science – HortResearch
	4 -	Clive Ronson, Otago University to Otago Federated Farmers 15/6/99
	5 -	ditto
	6 -	Hortnews – 6/10/00
Page 11	1 -	Page 1, Statement from Marion Hobbs – www.morst.govt.nz/royal/environ_statement.htm
	2 -	Statement from Pete Hodgson www.morst.govt.nz/royal/environ_statement.htm
	3 -	Hortnews – 9/9/00
	4 -	Hortnews - 9/9/00
Page 12	1 -	Federated Farmers GT Policy adopted National Conference
	2 -	Page 1 - NZ Dairy Board submission to IBAC
Page 15	1 -	Question 23 – 31 Critical Question in Agricultural Biotechnology
Page 16	1 -	Gene Technology in Kiwifruit Breeding – Alan Seal
Page 19	1 -	Page 2 – Media Release – Nuffield Council on Bioethics Report – 27/5/99

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