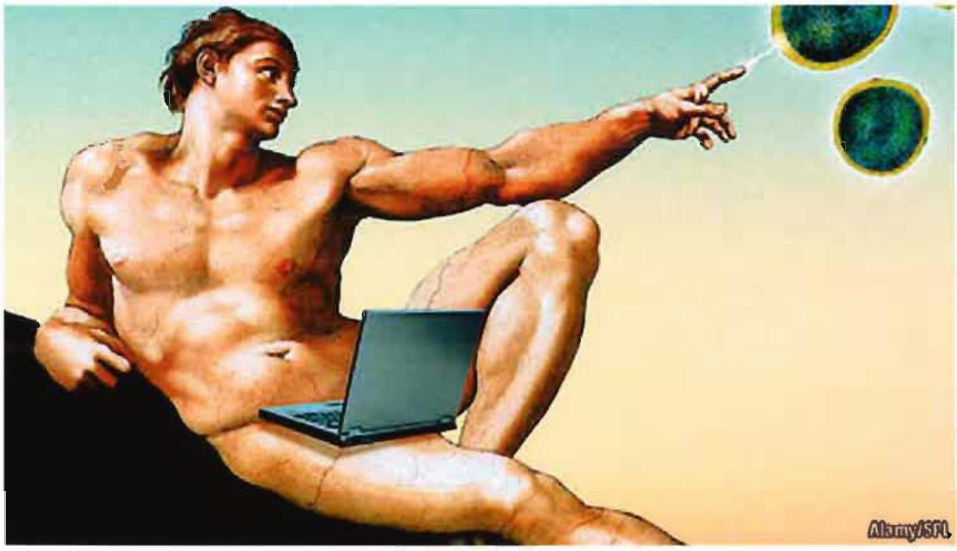
# BIOTECHNOLOGY
## Creating Innovative Solutions




***Will we have the courage to embrace it?***

**Research Project**

**Primary Industry Council/Kellogg Rural Leadership Programme**

**Steve Poole**
2010

# Contents

| | Page |
|---|---|
| Executive Summary | 3 |
| Introduction | 5 |
| Purpose of report | 6 |
| Investment in research, science and technology | 7 |
| World attitudes to genetic modification | 11 |
| Classical v molecular techniques of genetic alteration | 15 |
| Review of NZ biotechnology research and achievements | 17 |
| Demonstrated benefits of GM forages in NZ | 19 |
| Precautionary principle – a handbrake to progress | 21 |
| DDT – a case study in scientific fraud | 23 |
| Anti-science, anti-progress | 24 |
| Conclusion | 26 |
| References | 28 |
| Definitions | 29 |

# Executive Summary

World agricultural systems are faced with the seemingly insurmountable challenge of feeding a global population estimated, on current growth standards, to reach 8 to 10 billion people by 2035.

The quantum of the challenge becomes even more urgent and overwhelming when one considers that this needs to be achieved on an already limited and indeed reducing arable land area, using less energy, less fertiliser, less water and producing fewer emissions under a more variable climate.

It is inconceivable that we can achieve this by conventional methods alone and ludicrous to think that inefficient, low producing 'organic' methods can play a part, unless we are prepared to cultivate increasing areas of the world's woodlands and savannahs.

Biotechnology and, increasingly, genetic modification (GM) are some of the most powerful tools we have to keep ahead of the demands of an ever growing and increasingly health conscious population, while maintaining our global competitiveness.

Technologies already exist that can, not only substantially increase crop and animal yields, but also produce foods with specifically enhanced nutritional and health benefits.

The challenge lies not only in continuing these developments through well funded scientific research but also in changing perceptions, often grounded in ignorance, fear, prejudice and intolerance, which threaten to block or slow groundbreaking scientific discoveries such as GM.

My concern is that New Zealand will lag behind our competitors in allowing the uptake of such technologies, and in total spend on R&D, and in the process lose our competitive advantage as a low cost exporter of quality food.

The Environmental Risk Management Authority (ERMA) strictly controls GM in New Zealand and while I concede that such an authority is essential I believe that, due to changing world attitudes and large-scale global uptake of GM, we need to revisit our current regulations and restrictions.

There are many historical examples of various groups with different agendas that have used fear, emotion and false science to alienate the public towards products and methods which actually stand-up very well to critical scientific analysis. Conversely there are examples where science and scientists have created a deep-seated mistrust amongst the public through misrepresenting actual findings to support their own hypothesis.

This report has a dual purpose - to enlighten the general public but more specifically the farming community and its future leaders of the incredibly powerful tools that currently exist for us to greatly improve our on-farm productivity and profitability and subsequently our competitiveness in the world agricultural marketplace.

The stunning thing is that many of these groundbreaking developments, although discovered and developed by scientists within New Zealand in contained facilities, will not receive permission for field trials in our country.

It is critical that the agricultural and science communities work to establish a new sense of trust in science and the solutions and potential benefits which ensue from research, and look at funding of research, science and technology as an essential investment in our future rather than a cost to be minimised.

At the very least we need to thoroughly debate the immediate and future consequence of the path we take as a country on the uptake of GM. This debate needs to be based on scientific facts not emotion and hysteria and should look at social, economic and environmental impacts in a balanced way.

| |
|---|
| *"Should we force science down the throats of those that have no taste for it?*<br>*Is it our duty to drag them kicking and screaming into the 21st century?*<br>*I am afraid it is."*<br>Sir George Porter, 1920. |

# Introduction

It is fair to say that we are living in a period of 'genetic revolution' driven forward by biotechnology.

Since the start of the human genome project some 10 years ago, the capabilities and knowledge developed around the sequencing of genomes of any species is staggering. What once took years and cost millions of dollars now takes days and costs thousands.

As with any new technology, especially when linked to science, public scepticism and mistrust is common. The problem of public acceptance and resistance to change is all too apparent.

In this report, I want to examine the amazing opportunities available to the global agricultural scene through the implementation of some of the biotechnology developments currently available, and then look at where New Zealand sits in this picture.

Biotechnology is one of the major tools of the gene revolution and deals with much more than genetically modified organisms (GMOs).

While the potential risks and benefits of GMOs certainly need to be fully investigated and understood, we should not let the controversy surrounding transgenics and cisgenics distract us from the potential offered by other applications of biotechnology such as genomics, marker assisted breeding and animal vaccines.

New Zealand's economic development going forward is heavily dependant on science and innovation working within an economically free environment.

The country needs to focus in the areas where we have a natural advantage; I see this as a synergy between the biotechnology revolution and the primary resource sector. Our farmers are currently world leaders at converting pasture to high value proteins, be that milk or meat, and are very quick to adopt new more efficient methods or technology when presented with the opportunity.

The biotechnology revolution is occurring in conjunction with Asia becoming a consumer power. World markets require high quality healthy food without seasonal restriction and New Zealand is well positioned to take advantage of this.

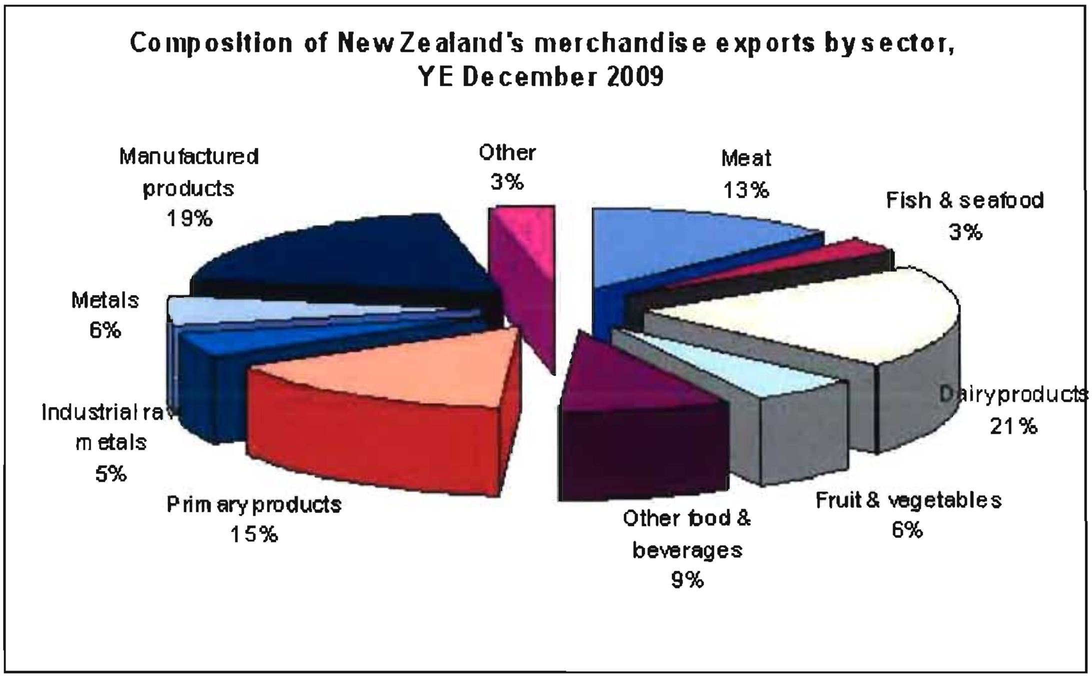
# Purpose of report

The objective of this report is to

- Outline a few of the exceptional gains already made in agriculture through biotechnology.
- Examine the vast potential for further gains possible if we can change our perceptions around GM acceptability and safety.
- Look at some of the issues that may have influenced our thinking over time and attempt to dispel some of the myths put forward by anti-science, anti-progress organisations.
- Reiterate the importance of increased and continued investment in our research, science and technology institutions in New Zealand, and
- Attempt to provide a clear pathway to commercialisation for the technology they develop.

# Investment in research, science and technology

Science will play an essential role in any economic transformation of New Zealand and the pastoral sector will play a very significant part.




The pastoral sector has been outstanding in its economic contribution to New Zealand's economy providing 40% of the country's export earnings, and has the potential to achieve even more.

We are fortunate to have a well educated farmer base with an appetite for rapid adoption of new technologies and methods. Our ability to grow forages and ruminants in a clean, green and environmentally sustainable manner is beyond peer. We are very well positioned to take advantage of emerging Asian markets.

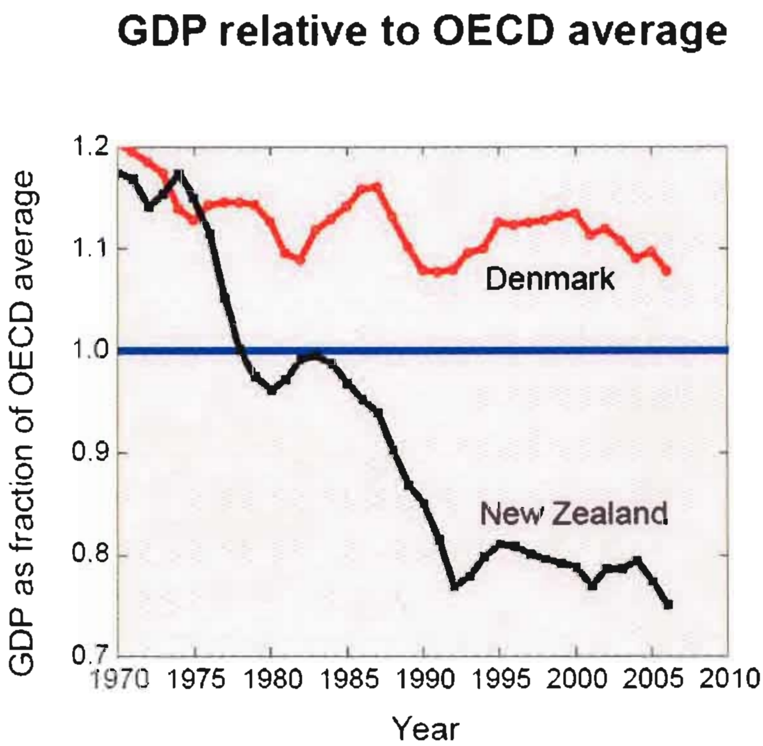
There have been some extraordinary global events in recent times that have given us cause to refocus, the most obvious being human population predictions of 8 billion by 2030 and the food production demands that will result, new concerns about food security and the threat of climate change.

Realisation of these factors has lead to commentators pointing out that the world has been caught off-guard, having more-or-less ignored agricultural science for the last 25 years. It appears that New Zealand is not exempt from this accusation. Dr Stephen Goldson, recently addressing the Council of Federated Farmers said, "right now we have a fragile and battered science system that is over-managed, splintered, subject to excessive competition and lacking in clear direction. It is very focused on institutional survival rather than science-for-New Zealand and quite wrongly revenue generation has for a long time been seen to be a proxy for science value".[1]

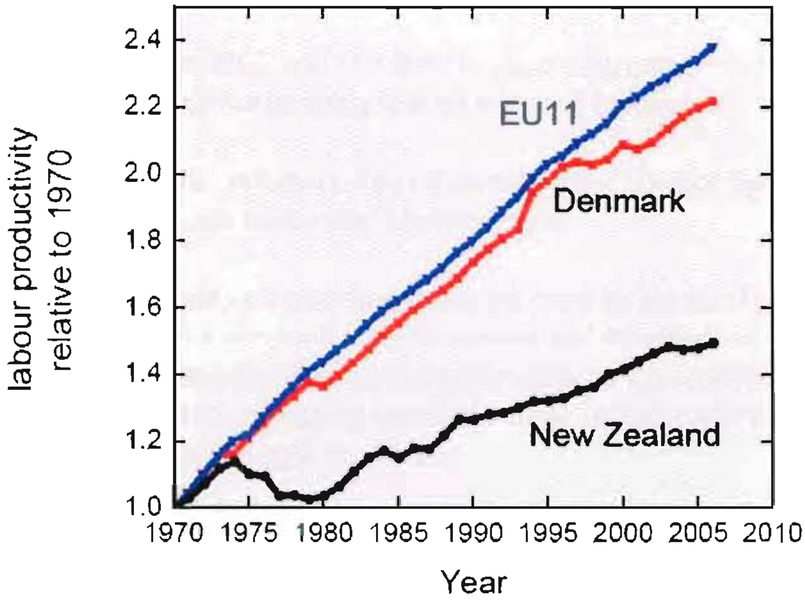
It is now glaringly obvious, as the following charts demonstrate, that in comparison to similar countries our productivity is struggling;  this issue is a national challenge and our chronically low investment in science is now acknowledged as playing a significant role in this productivity lag.

Denmark provides a point of comparison with New Zealand, being of similar size with, just two decades ago, an economy based on agriculture.

In 1980 New Zealand and Denmark spent similar amounts on research, science and technology.  However that is where the comparative spend ends.  In the 30 years from 1980 to 2010, Denmark outstripped us in their investment in science by a staggering 44 billion New Zealand dollars; 60% of that coming from the private sector.

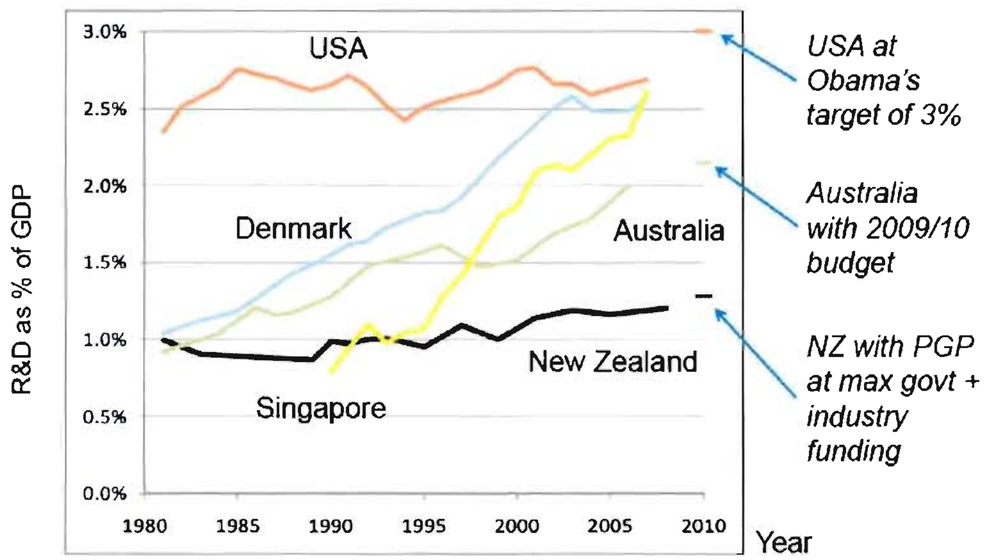


## Labour productivity




New Zealand's current investment in research, science and technology is around 1.2% of GDP of which approximately 50% is from the public sector and 50% from private.[2] Other countries, of comparable geographic, economic and population size, invest two to three times above this level.

## Countries increasing investment in R&D




*[Sources: gross expenditure on R&D and GDP data – OECD Stat, except: Singapore data before 2000 – National Survey of R&D in Singapore (2004); NZ data for 2008 – Statistics New Zealand Research & Development Survey 2008]*

Are we, in New Zealand, held back by the popular perception that we are innovative? We have a No. 8 wire approach, we punch above our weight, so surely we're doing all we can in terms of leveraging-off our natural advantages and strengths?

Reports from the OECD and The New Zealand Institute show we are not. Globally New Zealand ranks surprisingly low on scales of innovation.

Investment is often influenced by electoral cycles; science operating on much longer timeframes than our three year election cycle.

If we are to reverse this worrying trend we need to act quickly and decisively. We need to establish a renewed trust in science and its solutions. We need to view investment in research, science and technology as essential to ensuring transformational change going forward and not be satisfied with the incremental gains we currently struggle to achieve.

# World attitudes to genetic modification

World opinion on the use of genetic modification is changing as evidence of its safety and benefits are realised.

Between 1997 and 2009 the total surface area of land cultivated with genetically modified organisms (GMOs) increased by a factor of 80 from 1.7 million hectares to 134 million hectares in 2009. The maps and graphs below demonstrate this staggering growth and where it is occurring.

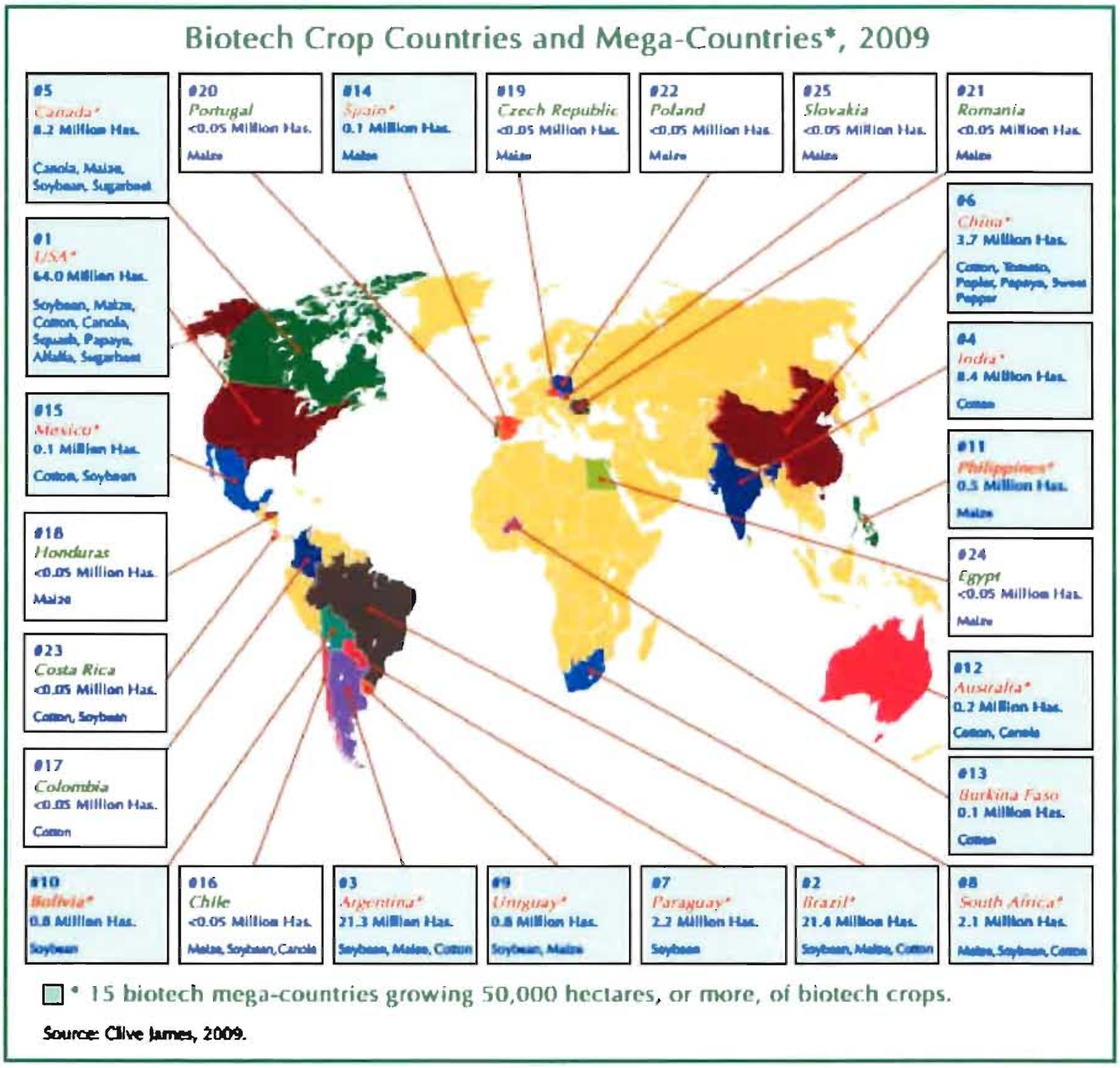
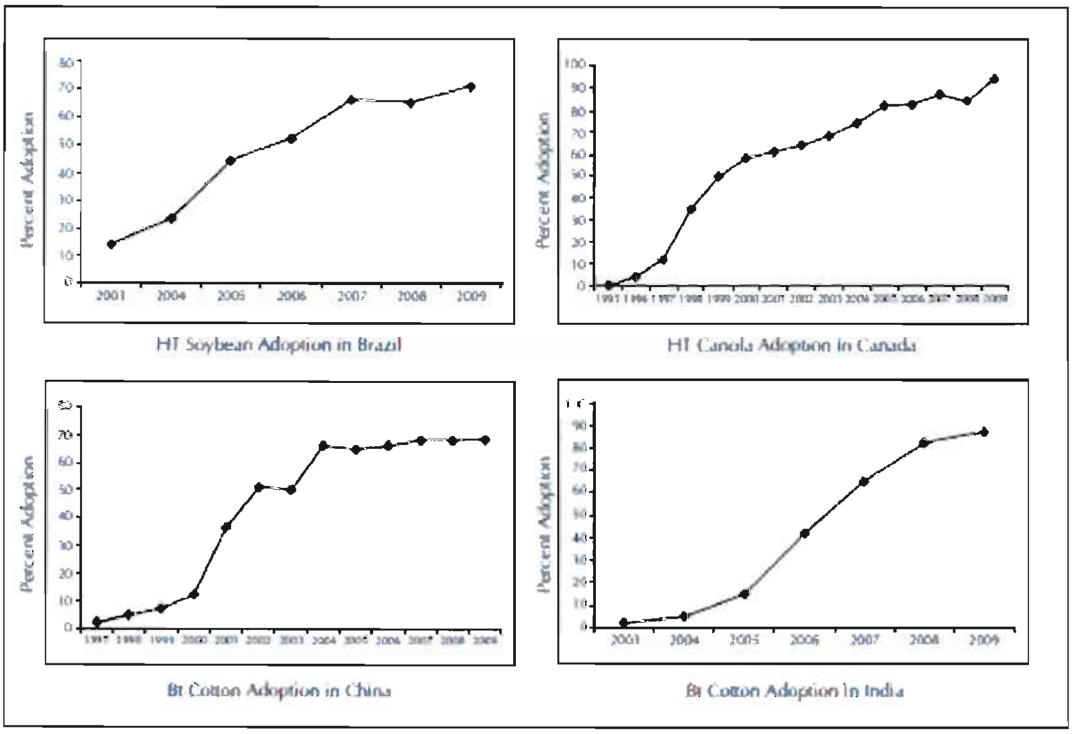


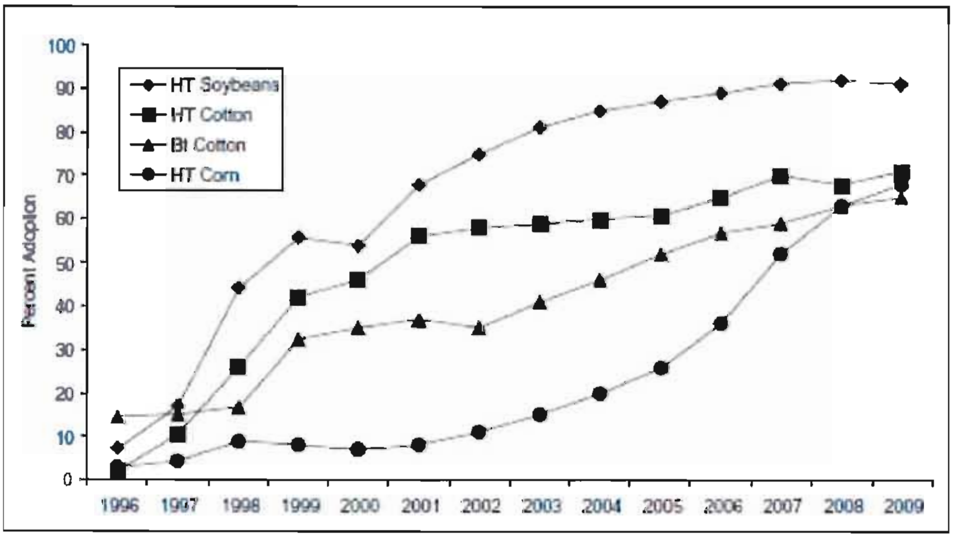

Figure 1. Global Map of Biotech Crop Countries and Mega-Countries in 2009

**Figure 3. Percent Adoption of Biotech Crops in Brazil, Canada, China, and India**




Source: Compiled by Clive James, 2009.

**Figure 2. Percent Adoption of Biotech Crops in the USA, 1996 to 2009.**




Source: USDA's National Agricultural Statistics Service (NASS), 2009a.

•

A noticeable shift in focus on the traits now being pursued has certainly helped with this. Originally the traits pursued were producer-centric such as round-up ready and insect resistant varieties which were very attractive to farmers making them easier and cheaper to grow.

Now traits more important to the consumer are becoming increasingly important such as enhancing the nutritional value of foods, improved flavours, extended shelf life and foods aimed at preventing disease in humans and animals.

In addition, the environmental benefits available through this technology (such as reduced pesticide use, soil conservation through "no-till" planting, reduced carbon footprint through less fossil fuels use, more efficient use of phosphate and nitrogen and reduced methane emissions) are all aspects that are helping turn the tide of public opinion.

In July 2010 the EU Commission adopted a comprehensive proposal to allow individual member states to make their own decisions on the cultivation of GM crops. This is a major shift from its traditional staunch opposition to GM. Two GMO seeds were also recently allowed into Europe, the first to be approved in 12 years.

While 25 countries planted commercialised biotech crops in 2009, an additional 32 countries (totalling 57) have granted regulatory approvals for biotech crops for import for food and feed use and for release into the environment since 1996.

With over 1 billion hectares of GE crops planted over the last 12 years and no health issues in humans or animals attributable to their consumption, it appears that any questions of food safety have been answered.

Consumer purchasing patterns today don't appear to be aligning with earlier survey results which indicated a reluctance to buy GE products. Price and product traits are becoming more important, especially where health benefits of the new products can be demonstrated.

Extending public understanding and appreciation of the available and potential uses of this technology and allying the irrational fears surrounding it is a critical part of the process of establishing an objective foundation for informed decisions on biotechnology and its application to everyday life.

The Royal Society of New Zealand in its 2001 report on GM forages recommended that we "should proceed carefully, minimising risk". However in its most recent paper 2010 "Genetically Modified Forages" Emerging Issues, it acknowledges that "since then issues of food security have grown in significance internationally. For New Zealand a number of factors have arisen that may influence opinion about the release of genetically modified forages".

These include

- Ongoing intensification of pastoral farming, and the need to transform the sustainability of agriculture.
- Increasing costs of farm inputs e.g. fertiliser and fuel, and corresponding concerns about the potential limits of 'business as usual' agriculture.
- Mitigating agricultural greenhouse gas emissions.
- Adapting to climate change e.g. more frequent and intense droughts.
- Growing competition from low cost producers overseas.
- Increasing animal welfare concerns, particularly the nutrition of pasture fed animals.
- Improving precision of GM techniques.

# Classical v. Molecular Techniques for genetic alteration

If we examine "conventional breeding techniques" that are largely acceptable, we find that as early as the 1940s, agronomists began using x-rays, gamma-rays, and caustic solutions on seeds and young plants to induce random genetic mutations.[17] Occasionally this resulted in desirable mutant traits being displayed such as altered height, more seeds or larger fruit. However the breeders had no real knowledge of the exact nature of the genetic mutation that produced the trait or what other mutations might have occurred in the plant.

*Modern corn varieties on the right bear no resemblance to their ancient parent plant teosinte on the left.*(achieved through classical techniques)

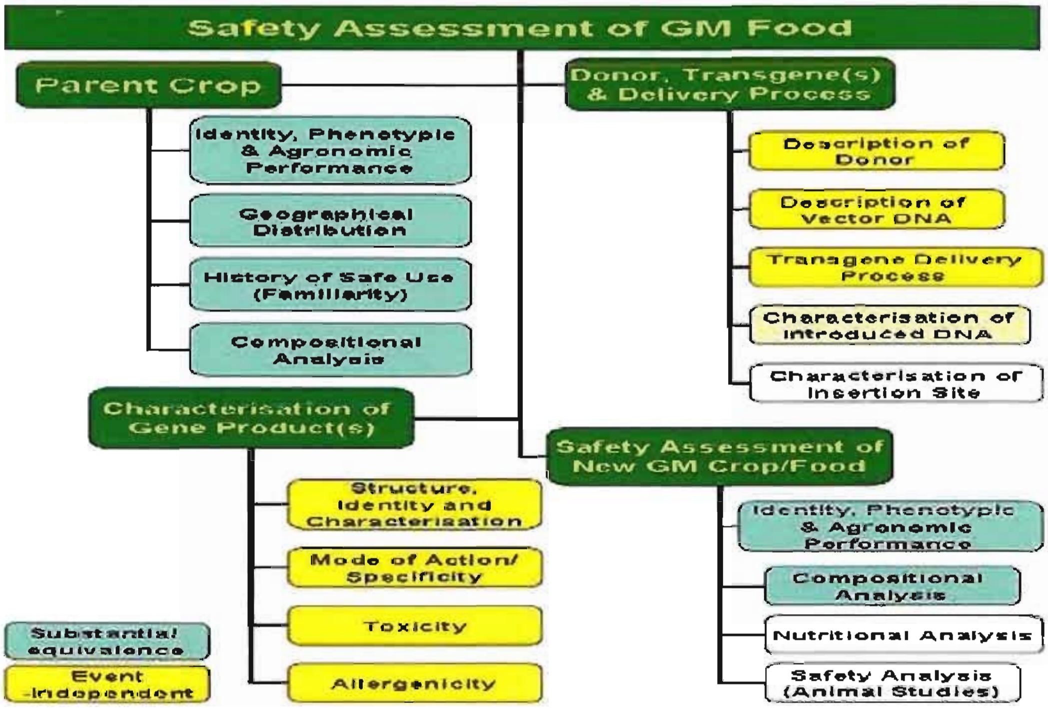
More than 2,250 mutation-bred varieties of corn, wheat, rice and many other varieties have been commercialised over the last half century and are grown in more than 50 countries around the world.[15]

More sophisticated breeding techniques have also been introduced such as protoplasm fusion and embryo rescue, which join cells from sexually incompatible plants in the lab overcoming their natural inability to produce offspring.

These techniques permit the artificial hybridisation of plants of the same species, different species and even different genera.[16]

"Wide Crosses" of plants from different species or genera allow scientists to add into an existing crop species, traits for disease and pest resistance, increased yield, or different nutritional qualities.

Yet none of these techniques are considered to be bio-engineering so have never been subject to the same restrictive policies and rigorous and costly testing processes.




It appears misguided that we mistrust and restrict the use of modern biotechnology in instances when plant breeders could be more precise with trait selection. They now have the capability to transfer specific genes by molecular methods with far better ability to predict the characteristics and far less likely to produce unanticipated effects in crops.

As US biotech researcher Nina Federoff stated, *"This is like the difference between having to depend on a lightning strike for the fire to cook your evening meal and learning how to make matches to be able to make a fire when and where you want it."*

Human nature tends to generate an exaggerated fear of new innovations while perceiving older or "natural" products as more benign.

*"If current regulatory standards imposed on GM crops were to be invoked for traditional crops, most of them would fail to meet their requirements."*
Prakash, Plant physiology. Vol.26,2001.

# Review of NZ biotech research and achievements

- Animal Genomics - the discovery of genes and gene functions in cattle, deer and sheep.
- Animal reproductive technologies - fertility, ovulation control, reproductive physiology, pregnancy establishment, and embryology.
- Asthma and Tuberculosis research, including the patenting of an asthma vaccine.
- Bioprocessing research – biochemical extraction, separation and the manufacture of molecules.
- Biomaterials research – manipulating plant cells into other materials such as bioplastics and biopolymers.
- Cloning – NZ is one of the world leaders in cattle cloning.
- Development of new foods and flavours.
- Development of pro-drugs for the treatment of cancer.
- Extraction and development of nutritional supplements to improve and maintain muscle growth.
- Functional genomics, research into plant signalling genes which control growth, quality and yield.
- Research into bioactives for use in organic pesticides.
- Research into the development of new medicines for infectious diseases.
- Transgenic research - especially in cattle and sheep.

Agricultural biotechnology accounts for 41% of New Zealand's total biotechnology expenditure, and 35% of the New Zealand's biotech workforce.

Because we are free of animal diseases like BSE and scrapie, New Zealand has Category One status in Europe. For this reason Invitrogen manufactures animal derived products here and Schering Plough Animal Health's Global Vaccine Unit also manufactures in New Zealand, exporting 80% of production.

New Zealand company Livestock Improvement Corporation (LIC) is one of the first companies in the world to offer genomic selection technology to identify elite sires as yearlings. The potential for this technology to increase the rate of genetic gain in the dairy industry is huge and is expected to be worth between $1.9 billion to $3.9 billion in extra profit to New Zealand dairy farmers over the next 20 years.

Biotech in forestry falls into three main areas: use of vegetative reproductive methods, the use of genetic markers, and the production of (GMOs) or transgenic trees. Only the first two are used in New Zealand.

If we wish to maintain our position as world leaders in the area of pastoral farming performance and productivity we need to be prepared to take the next step and allow the use of the tools developed by science. New Zealand currently has very well advanced trial work (in GM forages) in contained facilities which are demonstrating huge potential for our farming systems. We appear to be paralysed by fear (of success or failure) and tied up in red tape.

Even if we were given the green light to go forward from today with the next stage (field evaluation and cultivar development) and all things went according to plan, no GM plants would be available commercially until 2017-2018.

# Demonstrated benefits of GM forages in NZ

New Zealand forage research has made demonstrable progress towards the discovery and incorporation of useful traits. For example those in ryegrass and clover plants (in containment) now include –

- Drought resistance and improved performance under moisture stress that will increasingly arise from climatic change.
- Improved balance of soluble carbohydrate and protein levels for increased available energy, higher productivity and better nitrogen use efficiency.
- Higher levels of condensed tannins for the elimination of bloat and optimal protein uptake leading to less nitrogenous waste and possibly less methane production.
- Changed lipid content leading to higher available energy and reduced methane production.

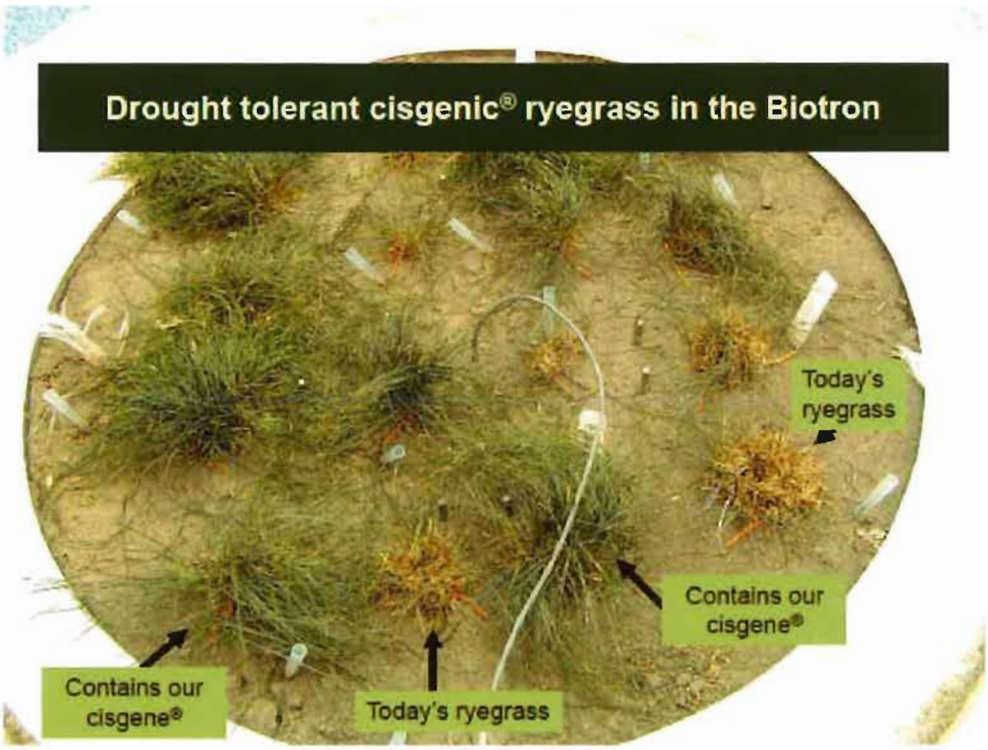
Other Traits under development include:

- Reduced lignin for more digestibility and improved nitrogen efficiency.
- Improved efficiency in the plants use of water and nutrients.
- Encapsulated lipids to increase the level of Omega 3 unsaturated fats in the grazing animal, with potential human health benefits.
- Improved growth at lower temperatures for increased production outside of the peak growth period.

If these benefits are ever allowed to flow through to production systems the on-farm effect should be increased productivity while providing more options to manage the environmental effects of intensification.

New Zealand Scientist Mike Dunbier (past Chief Executive of Crop and Food Research) says the economic benefit of traits such as drought resistance could depend on adoption rates and uptake and increase this country's GDP by between $75 million and $1.5 billion a year.

*"All significant breakthroughs were breaks with the old ways of thinking"*
Thomas Kuhn


Drought tolerant cisgenic® ryegrass in the Biotron
Today's ryegrass
Contains our cisgene®
Contains our cisgene®
Today's ryegrass

# Precautionary principle – a handbrake to progress

The **precautionary principle** states that if an action or policy has a suspected risk of causing harm to the http://en.wikipedia.org/wiki/Public">public or to the http://en.wikipedia.org/wiki/Natural_environment">environment, in the absence of http://en.wikipedia.org/wiki/Scientific_consensus">scientific consensus that the action or policy is harmful, the http://en.wikipedia.org/wiki/Burden_of_proof">burden of proof that it is *not* harmful falls on those taking the action.

The Precautionary Principle appeals to the common sense idea that it is better to be safe than sorry. However, in its application it can seriously restrict the development and introduction of new technologies.

Proving that a new technology or product will cause no harm requires proving a negative, something that science cannot do.

The scientific process can test the robustness of a given hypothesis - such as substance A causes tumors in mice but it cannot prove that a given substance is risk-free. Substance B may not cause rodent tumors, but it could always cause something else. For this reason, scientists fear that the precautionary principle could "block the development of any technology if there is the slightest theoretical possibility of harm."[9] Indeed taken literally the directive would be 'Don't do anything'.

However the precautionary principle, as devised in Europe, has now spread to international environmental agreements.

The Rio Declaration, agreed to at the 1992 United Nations Earth Summit, declares that "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities."[10] Similar language can be found in other environmental treaties and agreements.

In January 2000 more than 150 nations, New Zealand included, agreed to a protocol to the United Nations Convention on Biological Diversity (*The Cartagena Protocol)* to regulate international transport and trade of genetically engineered products.

This is the first global environmental agreement to incorporate the principle into its operative provisions.

The Biosafety Protocol creates an international framework for the regulation of bioengineered products "that may have adverse effects on the conservation and sustainable use of biodiversity, taking also into account risks to human health."
It enables national governments to restrict or even prohibit, the importation of genetically engineered crops stating specifically that "lack of scientific certainty"

about potential risks of biotech products “shall not prevent” a member nation from limiting, or prohibiting, the importation of a given biotech product.

This marks a significant departure from traditional international trade rules. Under Article XX of the General Agreement on Tariffs and Trade, countries cannot have a “disguised restriction on international trade” nor may it be “applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination.”[11]

What this means in practice is that nations could regulate importation of goods based on their actual characteristics, but not simply because it was produced using particular methods or technologies. Under these new rules this is no longer the case.

The precautionary principle rests upon the illusion that actions have no consequences beyond their intended ends. In reality the most well-intentioned precautionary measures can have terrible results. The precautionary principle’s threat to technological progress is itself a threat to public health and environmental protection. The world would be safer without it.

# DDT – a case study in scientific fraud

> *"I cannot give any scientist of any age better advice than this:*
> *the intensity of the conviction that a hypothesis is true*
> *has no bearing on whether it is true or not.*
> *The importance of the strength of our conviction*
> *is only to provide a proportionately strong incentive*
> *to find out if the hypothesis will stand up to critical evaluation."*
> Sir Peter Medawar 1915-87

The chemical compound that has saved more lives than any other in history, DDT, was banned by order of one man, the head of the US Environmental Agency (EPA).

Public pressure was generated from one popular book, *Silent Spring* by Rachel Carson, and sustained by faulty and fraudulent research.

Widely believed claims of carcinogenicity, toxicity to birds, anti-androgenic properties, and prolonged environmental persistence have been proven to be false or grossly exaggerated.

Post World War II DDT became the ultimate weapon in the battle against malaria. It was so effective that in Ceylon (now Sri Lanka) it reduced malaria cases from approx 3 million in 1946 to approx 7,300 in only a decade.

In India malaria cases dropped from an estimated 75 million in 1951 to approx 50,000 by 1961.[12]

In little more than two decades DDT prevented 500 million human deaths due to malaria that would have otherwise been inevitable.[13]

One would think that with such an amazing track record of tangible benefits to mankind that some real hard evidence of harmful effects would be needed to have this miracle chemical banned. Not so - especially if you happen to be an advocate of the precautionary principle. Indeed, Harvard University's Amir Attaran notes that "the scientific literature does not contain even one peer-reviewed, independently replicated study linking DDT exposures to any adverse health outcome" in humans.[14]

Malaria still kills an African child every 30 seconds.

## Anti-science, anti-progress

Worldwide, farmers already use approximately one third of the earth's land surface area (excluding Antarctica) for agriculture,[3] of which about one-third, or 9.28 million square kilometres, is dedicated to growing crops.[4]

If the per hectare productivity gains for cereal grains remains at around 1% the world will have to bring more than 283 million hectares of new land into agriculture use by 2050 to meet projected demands.[5]

Nobel peace prize-winning plant scientist, the late Norman Borlaug argued that "extremists in the environmental movement, largely from rich nations and/or the privileged strata of society in poor nations, seem to be doing everything they can to stop scientific progress in its tracks."[6]

Jeremy Rifkin, a notorious and long-time opponent of all forms of genetic research, calls the introduction of bioengineered plants "the most radical, uncontrolled experiment we've ever seen."[7]

Mae-Wan Ho, a biologist at London's Open University, argues that biotech crop plants are "worse than nuclear weapons or radioactive wastes."[8]

Ever since the 1962 publication of Rachel Carson's *Silent Spring,* ideological environmentalists have warned that mankind's use of modern farming technologies would lead to widespread ecological and human health catastrophes.

*Imagery is everything.*
*We define the technology by the extreme cases*
*and then exaggerate these with frightening images.*

**'Factoid'-** A piece of unverified or inaccurate information that is presented in the media as factual, often as part of a publicity effort, then becomes accepted as fact because of frequent repetition.

In reality calling alternative agriculture "sustainable" does not make it sustainable.

Alternative agriculture may rely less on chemical inputs, but this is not a prerequisite for sustainability. It could actually make farming less sustainable by increasing land requirements.

Today's modern, high-yield farming practices are the most sustainable we've ever had.[18] They will continue to change and improve in efficiency, safety, and sensitivity to the environment in direct proportion to our investment in agricultural research and technology.

If the environmental movement understood agricultural production systems, they would be on the side of both high-yield farming and free trade in farm products, as what they both aim to achieve is to supply the world's food needs with as little environmental and economic cost as possible.

Environmental lobby groups continue to challenge field trials of GM plants. They feel current regulations are ineffective and seek to reduce public comfort even further in the hope regulations will get tighter, thereby increasing compliance costs, driving our scientists overseas and stifling development.

Unfortunately increasing compliance costs does not necessarily increase the margin of safety. It costs as much as NZ$100,000 to obtain approval for a field trial in New Zealand and as little as US$15.00 in the United States.

# Conclusion

Current statistics tell us that 40% of our exports are dependant on grass.
I believe this puts New Zealand in a very unique position to achieve substantial gains through the adoption of the GE grasses and clovers which it has in fact already developed in containment facilities.

New Zealand has the science capability but is currently constrained by over restrictive legislation and a general lack of urgency. Disruptive legal challenges to GE trial work by organisations such as 'GE free NZ' and the Green Party positions itself as an opponent to all things GM, choosing to ignore or refute objective and scientifically sound evidence of benefit to humankind.

For a significant period we seemed to lose sight of the critical importance of the pastoral sector and placed insufficient pressure on governments to invest in this sector.

Changes appear to be on the horizon with a realisation at Government level of the primary sector's importance to New Zealand's economic health and recovery.

The recently announced Primary Growth Partnership (PGP) is an example of their renewed commitment. This is a co-investment plan in research and innovation to boost the economic growth and sustainability of New Zealand's primary, forestry and food sectors and contributes dollar for dollar to the tune of $170 million over the next four years.

We need to invest in seriously compelling science to underpin sustainable pastoral farming systems that can perform to current and future demands and withstand competition from lower cost producers.

The very real prospect of second generation GE traits adding nutritional value and other health benefits to foods should lead to the development, in the future, of high value markets for these foods that deliver consumer benefits. Therefore a national strategy of moving from being the lowest cost producer to becoming the highest premium producer is not synonymous with remaining GE-free for ever.

Some would argue that a moratorium on the release of GMOs will cause effects that are irreversible - scientific talent going offshore and the loss of benefits from patenting GE innovations thus undermining competitive advantage in our core sectors. This is certainly a view that I concur with having spoken to a number of those involved in this area of research. Others are of the opinion that New Zealand's export prospects will be enhanced by remaining GE free.

As Sir Peter Gluckmen points out, "we need to use our skill to start addressing the association between food and health. Where the evidence to support the health benefits could be provided the potential for high-value add premiums was "very large".

New Zealand already has interaction between agriculture and medical research communities which gives us a competitive advantage. Research strategies have to be shaped to bring profit to the farmer and grower as well as those beyond the farm gate.

As mentioned earlier, world attitudes to GM appear to be changing due to issues such as climate change, food security and numerous other environmental issues.

Consumer buying patterns around GM are not particularly obvious and world markets seem minimally concerned about the difference between the perceived value of non-GM products sourced from GM-free countries or GM-using countries.

Strictly speaking NZ is not "GE-free" now, for example we:

- Allow the use of drugs produced by GE bacteria that contain a human gene e.g. "human insulin" for diabetes.
- Use an enzyme produced by GE bacteria as a rennet substitute in cheese making.
- Use a transgenic line of sheep to produce a protein in their milk that is extracted to treat cystic fibrosis sufferers.
- Import GE foods.
- Incorporate imported GE ingredients into some of our food exports.
- Permit laboratory research using GMOs.
- Permit contained trials of GE plants and animals (subject to ERMA approval).

It appears to currently be far more acceptable to use this technology in the medical industry where the results can be directly linked to immediate health benefits, often life saving.

The prospect of hunger is foreign to New Zealanders, with more than 90% of the food we generate, being exported, so there is not the same urgency, experienced by developing nations whose actual lives depend on technologies capable of increasing food production. For these countries sufficient food for survival ranks well above some downstream medical breakthrough, this may explain the rapid uptake and growth of GE crop technology in such countries.

If we remain too fearful to use the mighty tools that we have developed, by integrating them into our farming systems, we run the risk of becoming 'ideological orphans' in the fast moving highly competitive, free market world.

# References


1. Dr Stephen Goldson speech at the Council of Federated Farmers 18 Nov 2009
2. Statistic New Zealand, R&D survey 2004
3. Indur M. Goklany, "Meeting Global Food Needs: The Environmental Trade-offs between Increasing Land Conversion and Productivity," Technology, vol. 6
4. World Resources Institute, 2000-2001
5. Goklany, "Meeting Global Food Needs."
6. Norman Borlaug, "Ending World Hunger: The Promise of Biotechnology and the Threat of Antiscience Zealotry"
7. Siobhan Gorman, "Future Pharmers of America,"*National Journal* (Feb 6 1999)
8. Quoted in Pat Murphy, "The Raging Debate over Biotech Foods," *Environmental News Network (March 5, 2000)*
9. Soren Holm and John Harris, "Precautionary Principle Stifles Discovery," *Nature vol 400 (1999),*p.398
10. Cartagena Protocol on Biosafety, Article 4
11. General Agreement on Tariffs and Trade, Article XX
12. Richard Tren and Roger Bate, *Malaria and the DDT Story* (London: Institute of Economic Affairs.2001), pp36-37
13. National Academy of Sciences: *The Life Sciences*. Washington,DC. 1970:432
14. Quoted in Ronald Bailey, "Greens vs. the Worlds Poor," *Reason Online (November 29, 2000)*
15. International Atomic Energy Agency, *Officially Released Mutant Varieties: The FOA/IAEA Database*
16. Goodman,Hauptli,Crossways,and Knauf, "Gene Transfer in Crop Improvement".
17. Ibid
18. John English, " Does Population Growth Inevitably Lead To Land Degradation?" *Agriculture and Environmental Challenges, Proceedings of the 13th World Bank Agriculture Symposium,* Washington DC., 1993 p.6

Other material gathered from-

- The Skeptical Environmentalist (Bjorn Lomborg)
- Saving the Planet with Pesticides and Plastic (Dennis T. Avery)
- Global Warming and Other Eco-Myths (Ronald Bailey)
- The Impact of Genetically Engineered Crops on Farm Sustainability in the United States. (National Research Council)
- Statistics New Zealand Research and Development Surveys
- pmcsa.org.nz

# Definitions

**Biotechnology -** "Any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use."

**Cisgenic -** A genetic modification in which genes fromother species are not involved.
http://en.wiktionary.org/wiki/genetic"> http://en.wiktionary.org/wiki/modification">
http://en.wiktionary.org/wiki/gene">
http://en.wiktionary.org/wiki/species">

**Genetic Engineering (GE) -** *noun*
The technology entailing all processes of altering the genetic material of a cell to make it capable of performing the desired functions e.g. producing novel substances.
http://www.biology-online.org/dictionary/Technology
http://www.biology-online.org/dictionary/Genetic_material
http://www.biology-online.org/dictionary/Cell
http://www.biology-online.org/dictionary/Functions
http://www.biology-online.org/dictionary/Novel
http://www.biology-online.org/dictionary/Substances
or
The alteration of the DNA of a cell for the purposes of research, as a means of manufacturing animal proteins, correcting genetic defects, or making improvements to plants and animals bred by man.

**Genetically Modified Organism-**
A genetically modified organism (GMO) or genetically engineered organism (GEO) is an organism whose genetic mateiral has been altered using genetic engineering techniques. These techniques, generally known as recombinant DNA technology, use molecules from different sources, which are combined into one molecule to create anew set of genes. This DNA is then transferred into an organism, giving it modified or novel genes.
http://en.wikipedia.org/wiki/Organism
http://en.wikipedia.org/wiki/Gene
http://en.wikipedia.org/wiki/Genetic_engineering
http://en.wikipedia.org/wiki/Recombinant_DNA
http://en.wikipedia.org/wiki/Molecule
http://en.wikipedia.org/wiki/Gene">
**Transgenic -** of, relating to, or being an organism whose genome has been altered by the transfer of a gene or genes from another species or breed: *transgenic mice; transgenic plants.*