

## 2. Zespri's KiwiGreen programme - world firsts in this vital crop management system

In 1990-1992 the New Zealand kiwifruit industry was confronting a crisis. Italy was a crucially important market taking 3 million trays of fruit per year worth \$20 million to \$30 million (fob) to the NZ industry. Italian retailers were threatening to take the NZ industry to court as they claimed that chemical residue levels on fruit exceeded local maximum allowed levels, even though they were well within the EU guidelines. The USA had applied anti-dumping restrictions on kiwifruit imports from New Zealand; prices fell and industry confidence fell. Facing these strong threats to its export trade, the kiwifruit industry made a bold decision to move towards implementing an eco-friendly orchard management system.



Basic research on the ecology of kiwifruit orchard pests was well advanced, having been undertaken by DSIR (later HortResearch) scientists during the previous 15-20 years. The long-term aim of that research was to develop an integrated pest management (IPM) programme for orchardists that would lead to reduced and more targeted chemical applications based on careful monitoring.

In a unique and innovative partnership between the kiwifruit industry and HortResearch scientists, large-scale orchard trials were undertaken using IPM in 1991 and 1992. The decision was made to convert all orchards exporting fruit to this new 'KiwiGreen' system as soon as practicable and in a remarkably short period of just five years, this was complete. In 1992 an industry trial produced 262,000 trays of fruit successfully under this new management system, 4.7 million trays in 1993, 6.8 million trays in 1994, and 100% of the export crop in 1996/97 (63 million trays). Such a rapid adoption of a new crop management system for an entire industry, and without government subsidy, has never been accomplished anywhere else in the world. Since 1997 100% of kiwifruit exported from New Zealand has been produced by growers using this eco-friendly production system known as 'KiwiGreen'.

Critical features of the 'KiwiGreen' programme include (i) the value of already having basic scientific information available to be implemented with industry when a specific issue or problem arises; (ii) synergy from collaboration between scientists and industry personnel in transferring technology; (iii) a co-ordinated and singularly managed industry that was capable of making a unified commitment; (iv) reduction of 'hard' sprays and hence improved environmental and health benefits; (v) retention of market access initially in Europe and later in many other markets; (vi) increased food safety and hence (vii) heightened consumer acceptability of product; (viii) a world first in speed and comprehensiveness of introducing a new and significantly different management system to an entire industry.

The internal rate of return (IRR) on R&D costs for development and implementation of 'KiwiGreen' programme has been calculated at between 31% and 79% depending upon the assumption of how much world prices would have been depressed had the 'KiwiGreen' programme not succeeded. The net present value (NPV) calculation for the programme is \$196,500,000.

Implementation of the 'KiwiGreen' programme was market driven by commercial reality. It was made possible by Government funded science over a long period of time (15-20 years prior to implementation), and grower funded development and commitment during implementation. In 2000, and as part of an evolving process, the very successful 'KiwiGreen' programme was expanded to include environmental factors, ethical trading practices and hygiene. This expansion became the *ZESPRI™ System*, a world-leading environmental management system that maps, measures and monitors the entire progress of kiwifruit from orchard to retail outlet and can trace product all the way back again.

## 1. Background

Kiwifruit is the largest export horticultural crop from New Zealand. The crop was worth \$539 million (FOB) in 2003 and comprised 27% of total horticultural exports to more than 60 countries. Kiwifruit are grown from Kerikeri in the north, through Auckland, Bay of Plenty, Waikato, Hawkes Bay, Horowhenua, Wanganui and Nelson/Golden Bay, with about 85% of the crop produced in the Bay of Plenty. In 1992 there were 3,327 growers on 14,594 hectares planted; this had declined to 2,719 growers on 10,376 ha in 2003.

The kiwifruit industry is based on a handful seeds of *Actinidia deliciosa* brought from China to Wanganui by Elizabeth Fraser in 1904. From these humble beginnings has grown a new fruit industry, originating in the Bay of Plenty, and reaching into many countries around the globe today. China and Italy are now the largest producers, but New Zealand remains the most dominant exporter of the fruit and the brand ZESPRI™ has attained international status and recognition as the market leader in provision of high value, premium quality fruit to consumers.

**Pre-KiwiGreen:** Research on all aspects of kiwifruit production, management, postharvest physiology and technology, pests and diseases and breeding has been undertaken at an increasing rate since commercial production commenced in the late 1950s and 1960s. Government research institutions, universities, private companies and individuals, as well as the industry itself, have carried out research of an applied and more basic nature.

Initial kiwifruit plantings during the 1950s and early 60s required few if any sprays, as there were virtually no damaging pests and diseases for the crop. However, as the area planted in kiwifruit increased, and clusters of orchards developed during the late 1960s and 70s, orchards began to suffer attacks from a range of insects, in particular a number of leaf roller species, scale insects and two-spotted mite. As yields increased and more fruit was exported and maintained for longer times in coolstore, losses from the fungus *Botrytis cinerea* became more serious.

To obtain fruit free from pests and diseases orchardists increased their spraying from 2 to 3 times per season to 10 to 12 times per season. Sprays used were those permitted in the pipfruit industry, principally the organophosphate insecticides.

Scientists, particularly Dr Howard Wearing in Entomology Division DSIR, had commenced research on *Integrated Pest Management* (IPM) of apples in the late 1960s. (IPM is best described as a broad programme invoking pest control using biocontrol measures through parasites and predators, cultural or management controls, monitoring pest populations and timing spray use to pest levels measured.) This was because scientists knew that insect resistance to the then current sprays would eventually occur. Also, the scientists were well aware of the health and environment risks associated with use of the sprays then accepted in orchard management programmes. Brenda May and Lee Ferguson commenced research on kiwifruit during the 1970s and this continued through the 1980s under scientist Dr David Steven, who in 1979 had taken over leadership of the programme from Howard Wearing.

Research at this time concentrated initially on developing biological and ecological data for the major pests to determine critical stages for spray application and threshold infestation levels. This research was championed within the kiwifruit industry by Bob Martin (NZ Kiwifruit Marketing Board - NZKMB) who recognised its long-term potential. Pat Sale in MAF was also a strong supporter. Initial research on IPM was undertaken at the HortResearch Te Puke Research Centre, and on grower properties throughout the regions.

At that time growers were using broad-spectrum sprays, mainly the organophosphate insecticides such as diazinon, azinphos-methyl and phosmet, which killed all insects, both pests and beneficials. Experiments began using 'soft sprays' including the bio-sprays based on the bacteria *Bacillus thuringiensis* (Bt) (registered for use in the early 1980s) to kill leaf

roller caterpillars. The research team identified that the critical time for best control to minimise damage to fruit caused by leaf rollers was within the 6-8 weeks of fruit set when the young fruit has formed and the flower was about to lose its petals.

In the late 1980s a joint DSIR and MAF project involving David Steven, Garry Hill, Roddy Blank and Andrew Tomkins, together with the kiwifruit industry, undertook supervised spray trials at selected orchards throughout New Zealand, from Kerikeri to Nelson. The programme involved development of a monitoring system for determining scale populations, then using minimal spray applications only when insect populations attained pre-determined thresholds.

At the same time trials were undertaken on a new and highly refined mineral oil to control scales. In 1991 the science and industry team set up the prototype *KiwiGreen* programme across 23 orchards (56 ha) in the Bay of Plenty.

**The stimulus for change:** In 1990/91 the New Zealand kiwifruit industry faced a market crisis that arose following Italian retailers concern about residue levels in kiwifruit exceeding their local standards even though they fell well within the requirements for the European Community. They threatened a boycott of New Zealand kiwifruit and the NZKMB faced prosecution, thus jeopardising the market for 3 million trays of kiwifruit fruit that needed alternative outlets in an otherwise oversupplied market.

Faced with the challenge of losing the market for this amount of fruit, the industry sought an alternative strategy and committed itself rapidly to work with DSIR (later HortResearch) scientists to explore solutions based on scientific information already available. In 1991 the industry led by Peter Bull (NZKMB), after consultation with David Steven who believed that there was enough scientific information available to put together a viable 'new' system, started the ball rolling.

**Implementation of *KiwiGreen*:** In 1991 the science and industry team set up the prototype *KiwiGreen* programme across 23 orchards (56 ha) in the Bay of Plenty. Growers involved took a high risk in unproven practices but were committed to the philosophy of minimising hazardous sprays, reducing fruit residues and environmental risks, as well as reducing spray costs. In 1992 this industry trial produced 262,000 trays of fruit successfully under this new management system.

In 1992 a bold decision was made for the unified kiwifruit industry to commit itself to implementing the *KiwiGreen* management programme.

A major implementation programme was initiated in a co-ordinated, complementary way involving technical specialists from the kiwifruit industry, consultants, packhouse personnel, and scientists from HortResearch. They all had a common goal and were well aware of the beneficial outcomes that would flow from adoption of the programme.

The industry funded intensive training programme for pest scouts with two people employed to act as a link between all participants. This provided for a very effective, fluid communication system where politics did not intrude. Some monitoring costs were subsidised during this initial uptake.

A comprehensive manual on procedures for implementing *KiwiGreen* was developed by industry and HortResearch (Catherine Richardson, Cathy McKenna and Philippa Stevens). An intensive grower-training programme funded by industry and fronted by Mike Muller, a well respected and trusted local consultant, enabled growers to adopt the new system rapidly with minimal risk.

By the 1996/97 season fruit from more than 2,000 growers and 10,000 ha was produced using this system and all kiwifruit exported from New Zealand was grown under the *KiwiGreen* banner. This had increased from 262,000 trays in 1992, to 4.7 million trays in 1993, 6.8 million trays in 1994, and 100% of the export crop in 1996/97 (63 million trays).

This extraordinarily rapid uptake of the new *KiwiGreen* System was possible because of the closely co-ordinated and integrated industry structure and the user-friendly collaborative inclusive design of the technology transfer system.

Refinements to the *KiwiGreen* System continue to be made. In 1994 the postharvest fungal disease, *Botrytis cinerea*, caused direct losses estimated to cost \$0.28/tray submitted (\$15.5 million) and in 1995 losses were estimated at \$0.25/tray (\$16 million).

Plant pathologists from HortResearch (Mike Manning and Henry Pak) working within the *KiwiGreen* programme, using information obtained in earlier research (Shaun Pennycook, Nagin Lallu), as well as current experimental results, instigated 'curing' of fruit immediately after harvest. Curing involves holding fruit at ambient temperature for 48 to 72 hours after picking and before it is packed. This, coupled with changes to modify vine management systems, including 'opening up' the canopy and reducing leaf and branch density to allow more air movement through the vine and around the fruit, and a technique to assess the risk of *Botrytis* incidence, eliminated the need for fungicide sprays at harvest. The practices substantially reduced, and in most instances eliminated the *Botrytis* problem such that kiwifruit losses have been minimal since the full adoption of the *KiwiGreen* programme.

David Steven, operating as a private consultant, took over from Pat Sale, and incorporated new information into the crop protection programme using research by Stephen Hoyte, Cathy McKenna and others from HortResearch, and Bruce Chapman from Lincoln University. Practical advice came from many growers and consultants such as Ian Stephens and Peter Mulligan as well as technical personnel from Pest Monitoring Centres. Within Zespri, Bob Martin continued to provide leadership, with support from other staff including Stuart Kay.

#### Key elements of *KiwiGreen*:

The highly successful and innovative *KiwiGreen* programme comprised key elements of:

- monitoring pest populations to decide on timing of spray applications,
- preferred use of 'soft' chemicals wherever possible (to promote biological control),
- risk assessment,
- canopy management to minimise disease and "curing" fruit at harvest to prevent storage rots,
- operating a continuous improvement programme that continues to be refined as improved practices evolve.

The speed of adoption of *KiwiGreen* by New Zealand growers was extraordinary, with industry conversion being 5% in 1991 rising to 100% in 1996. This rate of adoption has not been matched by any agricultural industry anywhere in the world. It was facilitated by the perception and vision of the kiwifruit industry aided by having a closely co-ordinated and integrated industry. It was achieved within the industry, without Government subsidies, and the result of synergistic collaboration between growers, scientists, and consultants and co-ordinated by key individuals within the New Zealand Kiwifruit Marketing Board (later to become ZESPRI Group Ltd with its associated infrastructure). The *KiwiGreen* system became an international benchmark that other countries strive to attain.

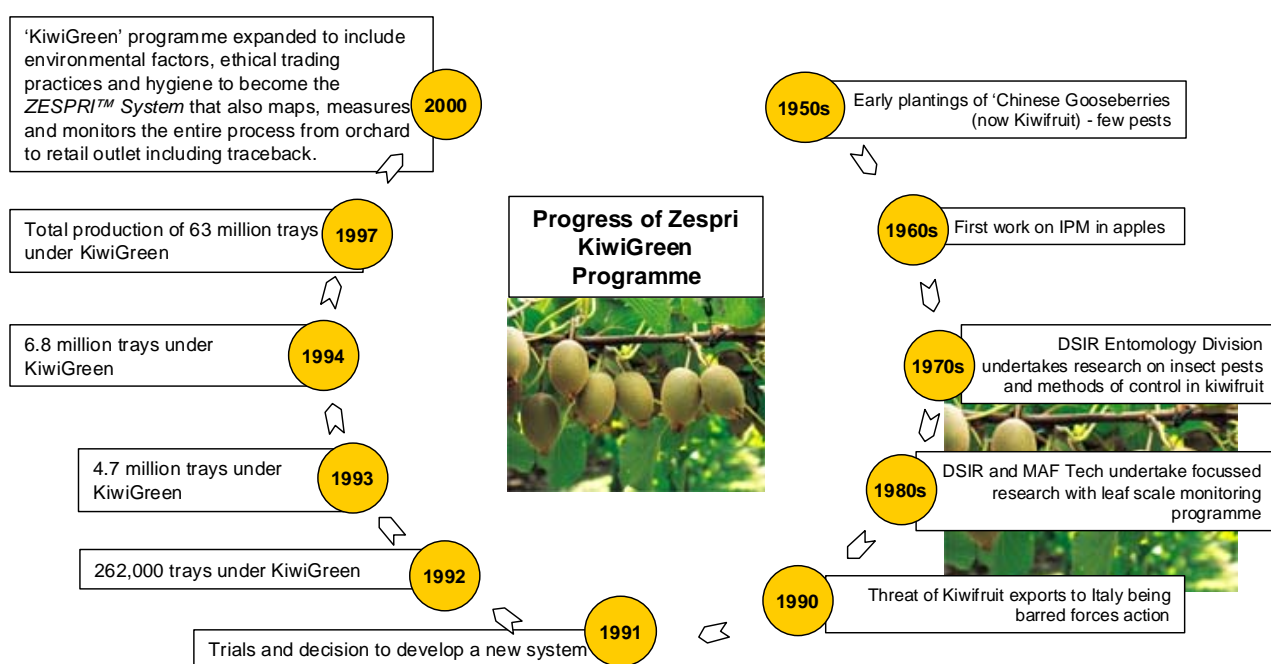
*KiwiGreen* moved growers from a 'calendar spraying mentality' whereby insecticides were applied every 21 to 28 days, to one based on 'results from monitoring' with applications being made when damaging populations of pests were present in the orchard, thus reducing spray costs, fruit residues and environmental contamination.

Outcomes of the programme included:

- reduction of 'hard' sprays and hence increased environmental and health benefits,
- retention of market access initially in Europe and later in other markets,
- increased food safety and hence
- heightened consumer acceptability of product.

When major retailers in Europe adopted tougher requirements for fruit quality in the late 1990s, introducing standards such as *EurepGAP*, the *British Retail Consortium (BRC)* and the *Global Food Safety Initiative (GFSI)*, Zespri International was able to meet these standards with minimal additional effort because the *KiwiGreen* programme was already in place for all export fruit.

## 2. Timeline



## 3. Science and innovation features:

Implementation of the *KiwiGreen* system was a major feature in the continued and sustained success of the kiwifruit industry in New Zealand.

The success in implementing the programme so quickly, with adoption by 100% of growers within 5 years from the decision to proceed, is unparalleled anywhere else in the world. The *KiwiGreen* system has set an international benchmark for the innovative, comprehensive, collaborative, interactive and inclusive methods employed by scientific and industry sectors in introducing and implementing the programme.

This project is characterised by having the majority of the fundamental biology and ecology research completed in the years prior to the emergence of the substantive industry problem. When the problem arose, and key industry personnel recognised the value of the prior research, an immediate decision was made to proceed by both industry and science providers. The intimate and collaborative involvement of growers, scientists and industry personnel from the very beginning of the project was an essential element in its eventual success.

**Product Champions:** Another key element was the presence of ‘product champions’ at the right place at the right time. The first was a committed applied scientist (Dr David Steven) who had done much of the prior research, and who was prepared to work closely with industry and growers in the field to ensure the further development of the *KiwiGreen* programme was very important. The second was the involvement of a prescient, visionary and articulate representative of the kiwifruit industry (Peter Bull), who was prepared to recommend that the *KiwiGreen* project should commence. The third was critically important participation of a respected industry consultant (Mike Muller) who was available to work with growers as an intermediary between science and industry organisation as in the transfer of the science, technology and methodology. The fourth was the involvement of a combined team of industry and science personnel (including Catherine Richardson, Cathy McKenna and Phillippa Stevens) who put into place the monitoring systems and the user-friendly manual that was used by growers as they learned to master the new technology and information involved.

**Other important features** are as follows:

- *Sprays can only be applied in response to a demonstrated need based on vine monitoring.*
- *Use of conventional sprays is restricted by long ‘export withholding periods’*
- *Choice of sprays is limited with an emphasis on safer, more selective products.*
- *Entire system is audited as required by major supermarket chains in Europe*
- *Spray operators must be trained and hold a nationally recognised GrowSafe certificate.*
- *Spray diaries must be submitted before a crop can be exported.*
- *Residue sampling system in place.*

- Availability of scientific information on basic biology, ecology and life cycles of insect pests on the crop was based on research undertaken by DSIR over a 15 year period prior to 1991 and able to be uplifted immediately when required by kiwifruit industry.
- Knowledge and experience with ‘soft’ sprays that allowed more selective control using *Bacillus thuringiensis* against leaf roller caterpillars and highly refined mineral oils against scale insects.
- Immediate, positive, bold and visionary decision by kiwifruit industry, based on technical knowledge as well as recognition of current and future customer needs, to adopt research findings (incomplete as they were) and encourage growers to switch from a traditional calendar spray programme to a *KiwiGreen* programme.
- Development of reliable monitoring techniques and establishment of meaningful threshold levels for specific pests.
- Development of comprehensive, understandable and complete manual written by technical personnel from both the industry and HortResearch, explaining all the processes and methodologies involved in monitoring for pest populations in the orchard, including insect life cycle charts, information on threshold population levels, and steps to be taken when threshold insect levels were exceeded.
- Implementation of a sustained technical transfer programme with experienced kiwifruit consultant who had the respect of growers (Mike Muller) and who provided a vital link between scientists, growers, and packhouses. Communication was fluid and politics did not prevent information flow. Technical backup for pest monitoring centres and growers is now provided by 0800 *KiwiGreen* Help line

- Kiwifruit industry grower pools reimbursed growers for the direct cost of monitoring for the first three years of the programme.
- Original growers taking up the technology were technically competent; they were innovators and risk takers who recognised the long-term market, environmental and personal health benefits.
- *KiwiGreen* evolved from a system focussed on zero residues to one that focussed on food safety with any residues being below 5% of the maximum residue levels (MRLs) set by any importing country.
- From 1997 Zespri International Ltd effectively marketed all Hayward kiwifruit under an 'eco-label' construct using new recyclable packaging, with electronic traceability identification on each tray, and fruit produced based on soft technology options giving low chemical residues.

All these features above combined in a unique and innovative way to allow the successful implementation of a industry life-saving strategy in record time achieving the desired commercial outcomes and in doing so set an international benchmark that has still not been attained in many competing countries.

#### 4. Benefits:

The kiwifruit industry retained the important Italian market, and continued market access to other major markets and customers was ensured.

New Zealand kiwifruit is recognised as being safe, healthy and nutritious and is eagerly sought after by supermarkets achieving a premium price over southern hemisphere competitor countries.

Because *KiwiGreen* was adopted by 100% of the industry so comprehensively and quickly, it became the industry standard, and pre-empted what European, then Nth American and now Asian supermarkets/customers demanded in the late 1990s in relation to compliance with food safety and quality standards required as a condition of purchase (e.g. EUREPGAP)

The *KiwiGreen* system set a new international standard for adoption and implementation of an environmentally friendly production system based on monitoring and subsequent application of sprays when needed.

Growers became better managers overall because of the need to closely and regularly inspect their orchards, thus becoming more aware of the patterns of insect, disease and plant growth development.

Research investment by DSIR, HortResearch and the New Zealand kiwifruit industry into pest management and monitoring systems were mutually applicable to both *KiwiGreen* and organic production systems.

Packhouses were used as industry implementation centres, expanding services offered by becoming Pest Monitoring Centres (PMC), thereby giving extended employment opportunities to larger numbers of quality control staff. This spawned a new industry of pest and disease monitoring that provided employment for increasingly well trained staff at local packhouses that set up laboratory facilities to undertake monitoring thus creating specialist technical centres.

A reduction in environmental hazards due to organophosphate sprays as a result of shift in pest control methods from spraying according to calendar date, to applying sprays only

when needed and using ‘softer’ alternative chemicals. It is estimated that adoption of the KiwiGreen programme has resulted in 100 tonnes of organophosphate chemical NOT being added to the environment every year.

The *KiwiGreen* system has provided a stepping-stone for growers wishing to convert from traditional to organic production.

## 5. Return on R&D investment

The total cost of research and development for developing the *KiwiGreen* programme from 1986 to 2003 was \$49.3 million; this includes the early underpinning research, and involves funding contributions by industry and government with figures adjusted to a 2004 dollar value and incorporating a 10% opportunity cost.

In developing a measure of the economic significance of the science and innovation work in the development and implementation of the *KiwiGreen Programme* for Zespri’s kiwifruit exports, the concept ‘counterfactuals’ has been adopted. This is where some assumptions are made as to what would have happened had the science or innovation initiative not been developed and implemented. The concept does not attempt to consider all options, but one most likely scenario is selected for analysis purposes.

### Counterfactuals<sup>1</sup>:

The key elements of the counterfactuals are:

- Assume that the traditional calendar spray based programmes would continue on 90% of orchards with continuing attendant risk of fruit rejection in export markets because of unacceptable chemical residues.
- Assume loss of Italian market of, and premium for, 3 million trays for 5 years or until a new *KiwiGreen* system was developed as a result of commercial imperatives.
- Assume loss of substantial markets in Europe and elsewhere because fruit exported had unacceptable MRLs. Fruit placed on other markets would have created a glut and with substantially lower prices being received (estimated to be 5-20% price reduction on 40% of global markets).
- Assume loss of market sales due to losses caused by the fungus *Botrytis cinerea*, estimated to be \$0.25 per tray from 1997 onwards.
- Assume continued environmental contamination and ongoing health risks to orchardists, workers and consumers due to persistent use of highly toxic organophosphate sprays applied regularly.

### Assessment results:

The Internal Rate of Return<sup>2</sup> (IRR) figures are directly dependent upon the assumptions indicated in the counterfactuals above. As there will be varying opinions on this level, we have provided a range of calculations:

World prices depressed by	5%	10%	20%
Internal Rate of Return (IRR)	31%	47%	79%

Net Present Value<sup>3</sup> (NPV) calculation = \$196,500,000

(Note: for definitions of Counterfactuals, IRR and NPV – see Appendix on last page.)

## 6. Quotes

- “KiwiGreen innovation is characterised by a very long period of research-driven knowledge accumulation, and then a rapid process of adaption and adoption”. (Harris, 1998).
- “The presence of key researchers, such as David Steven, who had a long corporate memory in research which had been undertaken in the area, was an extremely important factor in retaining the knowledge and preventing the repetition of research”. (Harris, 1998)
- “I was always most concerned about pest management, the rest was easy once KiwiGreen proved that pests could be managed without using hard sprays”. (Organic kiwifruit grower).
- “NZ's export fruit industries had led the drive to this type of production system, with the pipfruit sector's integrated fruit production (IFP) programme, sustainable winegrowing, and KiwiGreen kiwifruit recognised as world leaders in this area”. John Mangan, CEO, Freshco, an Auckland-based produce exporter.
- “A world-leading environmental management system maps, measures and monitors the entire kiwifruit production process from orchard to retail outlet. The KiwiGreen programme, an environmental pest management system, is used to minimise the use of control agents and to guarantee no harmful residues. It also helps protect New Zealand's natural environment”. New Zealand Trade and Enterprise Industry profile.

## 7. Information sources

Information supplied by:

### Private consultants:

Dr David Steven, IPM Research Ltd., Glenfield Auckland

### HortResearch personnel

Dr Cathy McKenna, HortResearch, Te Puke Research Centre

Dr Jim Walker; HortResearch, Hawkes Bay Research Centre, Havelock North.

### Zespri personnel, Mt Maunganui

Peter Berry: (also a former chair of NZKMB Research Committee)

Bob Martin: (also a former R&D Manager and member of NZKMB Research Committee)

David Jenks: (Zespri kiwifruit marketer with long-term experience).

## References

Campbell, H., J. Fairweather and D. Steven (1997). *Recent developments in organic food production in New Zealand*. Part 2: Kiwifruit in the Bay of Plenty. Studies in Rural Sustainability Research Report No. 2, Department of Anthropology, University of Otago, Dunedin, pp. 51.

Harris, S. (1998). *Evaluation of PGSF's Output area 4; Horticulture, Arable and other Food and Beverage Industries. Report No. 87*, Published by the Ministry of Research, Science and Technology, Wellington, NZ, pp. 155.

Steven, D. (1999). *Perceptions and reality in pest control on kiwifruit in New Zealand*. Acta Horticulturae 498:359-363.

## 8. Observations by Author:

The stand out features of this case study are:

- The very rapid response that the industry made to a major hazard of market compliance.
- The ability of the science community to quickly bring together many years of research into areas that scientists had predicted were going to be a problem in the use of 'hard' (strong) agrichemicals.
- It is another example of the dynamics trade where nothing stands still and it is a continual battle to maintain market access
- This industry requires innovation and research to maintain sustainable returns – 'you stand still and you lose the trade'.
- The ability of a well-integrated industry to adopt at short notice new technologies within an industry-wide system.
- The economic analysis proves the excellent returns that have come from the substantial work that science and innovation champions have brought to this industry.
- We think that these calculations above are very conservative estimates and that research and development is essential to maintain New Zealand's substantial international kiwifruit business in the long term.

## Appendix

The working definitions used in this assessment are as follows:

<sup>1</sup>**Counterfactual:** Counterfactuals are used to offset the value of what might have happened in the absence of the innovation or discovery. A highly probable single alternative is selected to calculate what the resource (e.g. land) might otherwise have produced.

<sup>2</sup>**Net Present Value (NPV):** Net Present Value represents the benefits, less the costs, converted into equivalent values today. In the case of R&D, we have summed the benefits of an identified R&D advance, taken away the costs and used a 7% discount rate to calculate the NPV.

<sup>3</sup>**Internal Rate of Return (IRR):** The Internal Rate of Return calculates the interest rate received from an investment over a specific period. By examining the costs, and when they occur, compared to the benefits (income) over time, the IRR calculation is the rate of interest at which the present value of future cash flows become exactly equal to the initial capital investment.

This case study is one of a 21-part case study series aimed at demonstrating the value of science and innovation in New Zealand's leading edge bio-science industries... and their significance to New Zealand.

Martech Consulting Group is a strategic consultancy based in New Zealand. The growingfutures case study series was in part based upon Martech's extensive work with sector representative groups, science providers and organisations that interact with science providers to achieve consensus on co-ordinated actions, improve governance, develop sector-based strategies and improve innovation processes.

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