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SMART THINKING IS SHIFTING NEW ZEALAND HORTICULTURE INTO VALUABLE NEW MARKET SPHERES
21 Case Studies that demonstrate the value of research investment in horticulture

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Background

- Horticultural science in many countries is in crisis.
- Increasing shortage of well trained young people to grow and manage innovation
- Decline of university horticultural departments.
- Funding decreasing for research in traditional applied sciences
- Political and public ignorance of the importance of horticulture and horticultural science

*The above is a global phenomenon that creates a global opportunity for New Zealand …

... and we are taking many of those opportunities.*
Export growth

New Zealand’s horticultural exports have grown for $115 million in 1980 to over $2.2 billion in 2004.
Background

- We have done amazing things
- We tend to take our accomplishments for granted
- We seldom get positive media coverage UNLESS the news is negative
- We do not tell our stories in a way that captures imagination and inspires
Objectives

The objective that drove the development of this ‘growingfutures’ case study series was to answer two questions:

1. *What is the value of a dollar spent on science and innovation in the horticulture sector?*

2. *What is the value of the horticulture sector to New Zealand?*
Case studies of amazing R&D stories

- We wanted to collect stories that would
  * educate
  * entertain
  * astonish
  and  * amaze a discerning intelligent audience

- Approached about 100 people for input

- Received 80 topics from 80 replies; reduced to 25 topics

- Interviewed key persons from research and business for critical steps, costs and benefits.

- Worked with NZIER where defensible economic analysis of inputs and outputs could be isolated.
Amazing people

Key findings

- All projects had champions involved: Growers, scientists, marketers and exporters
- They had vision and ongoing commitment
- Often they had challenged official advice and proceeded regardless
- Virtually all of the case studies had research origins going back to foundation work done 30 or so years ago. Today's achievements, including sustainable systems, would not exist without that foundation work.
- They were motivated and committed risk takers who saw large long-term benefits rather than small short term gains.
Amazing projects-cultivars

- NZ has an international reputation for introducing new fruit and cultivars to world trade:
  - kiwifruit (cultivars for Hayward, Hort 16A/Zespri Gold™)
  - apple cultivars Gala, Braeburn and Jazz™
  - calla lilies

- Developed and improved cultivars from abroad:
  - hops
  - blueberries
  - apricots
New Zealand hort exports to 110 countries

- Sixty-five percent of New Zealand’s product exports are from its plant-based industries.
- Exports of horticultural crops exceeded $1 million to 41 countries, up from 15 in 1994. Fruit industry is export driven and must innovate to remain competitive and survive.

NZ Horticulture
Facts & Figures
2004
Hort 16A or ZESPRI Gold™

- 1970s through 1980s germplasm from China
- 1987 the cross made
- 1991-92 Hort 16A selected following taste panels and some trial plantings made (top worked Hayward vines)
- 1996 commercial agreement and further plantings
- 2000 commercial launch in markets with immediate acceptance because of taste, flavour and novel colour
- Vine management and postharvest R&D needed
- Export value more than $150 million exceeds R&D costs
- IP protection internationally allows controlled plantings in northern hemisphere countries with royalty flows back to NZ
David Jenks (Zespri Gold), an example of a New Zealand marketing innovation champion.
KiwiGreen

- Vision to develop integrated pest management (IPM) for fruit led by scientist Howard Wearing long before grower acceptance
- Ecological and life cycle studies on vine pests done by DSIR
- Use of soft sprays (BT and mineral oils) to replace organo phosphates, led by scientist David Stevens during late 1980s
KiwiGreen

- Italian crisis in 1990-1991 (market barrier) threatened 3 million trays ex NZ
- 1992 produced 260,000 trays of *KiwiGreen* fruit from 25 trials on grower blocks
- *Kiwigreen* is an eco-friendly orchard management system
- 1992 Major commercial decision to proceed with *KiwiGreen* for entire industry
- 1997 all kiwifruit exported grown under *KiwiGreen* system. Such rapid adoption of a new crop management system for an entire industry, without government subsidy, has never been accomplished anywhere else in the world.
KiwiGreen - Key elements

- Vital decision and commitment of industry (Peter Bull, Catherine Richardson and key growers)
- Intimate life cycle knowledge of pests
- Monitoring system for pests introduced
- Use of BT and oils sprayed as required and not according to calendar
- Establishment of critical pest threshold levels
- Reduced Botrytis problem dramatically
- Intensive information/technology transfer programme fronted by trusted industry consultant with intensive HortResearch support
KiwiGreen outcomes

- Saved important Italian market thus maintaining prices elsewhere
- Met EurepGAP standards immediately when introduced in late 1990s giving market advantage
- 1998 economic analysis suggested IRR of >20%
- 2004 analysis indicates IRR 31-79% IRR over 25 years on about $50 million R&D costs
  * includes 10% opportunity costs
  * adjustment to 2003 dollars
- This is an AMAZING return on investment

IRR - Internal Rate of Return, an economic performance measure.
Fruit sorting machines

- Innovation, ingenuity and adaptability characterise the development of fruit sorting machines in NZ.

- Early apple graders sized mechanically and only according to fruit diameter.

- The wonderful Orbit Grader for kiwifruit was designed and built in 6 weeks by John Hancock - it tossed fruit into the air and caught them gently at the apogee of their trajectory. This design prevailed for 20 years until the early 1980s. In his own words:

  “Some new thinking was necessary to allow the new industry to market its product effectively, and a small group of growers approached a Te Puna engineer to design a special grader for their very awkward crop.

  Because of the unusual shape of the fruit, it was decided that the grader had to weigh the fruit, instead of gauging its diameter, as most fruitgraders did. Experiments were carried out to find a method which would work effectively, to present a well-graded, uniform fruit to the tray-packers.

  During these experiments it was found that the mathematical formula which the Romans used for their "Catapulta Ballistique", and which allowed the newly launched "Sputnik" satellite to be placed into a precise orbit around the Earth, would also allow a Chinese Gooseberry to be placed into a precise grading slot.

  The new machine was christened the "Orbit" grader.”
Fruit sorting machines

- 1984 Hamish Kennedy, an engineering Masters student, designed and built an electronic sorting machine for his father’s kiwifruit
- Aim was to increase speed, accuracy and costs of labour using modern electronic and/or optical technology
- Created Compac Sorting Equipment, a world leader today in fast, accurate electronic sorting.
Compac Sorting machines

- Kennedy was the driver with ability and vision
- Invested heavily in R&D and recruited best brains internationally
- Worked closely with customers providing on site servicing in major markets
- Electronic and/or optical segregation of
  - size including weight, diameter and density
  - colour
  - internal quality (Brix)
  - physical defects

[With the Compac system, the weight of each fruit is recorded 250 times and analysed to 0.1 grams - all in less than 1/10th of a second.]

- Machines sold in USA, Italy, France and Chile with sales projected to double in 5 years.
Fruit sorting machines

Fruit Grading machines have dramatically increased grading speeds and accuracy.

1930s: Graders using diverging rollers, etc.

1950s: Egg graders 0.5 tonnes per day

1964: The Orbit Grader, John Hancock, Te Puke (mechanical/projectile weight): 4 lanes = 14 tonnes per day

1980: Early electronic models: Treeways and MacDonalds: 35t/day (4.4t/hr)

1984: Hamish Kennedy starts work on integrated sensing devices and founds Compac Sorting Equipment Limited

1984: AWA start designing Lynx range of sorting machines

2000s: Compac install a 40 lane machine in California with an accurate grading speed of 108 tonnes per hour (400 pieces of fruit per second!)
Segregation technologies

- Weight
- Colour
- Brix
- Shape
- Defect sorting
Soft fruit sorting

- BBC Technologies developed fast sorting machines based on colour, weight and firmness of small soft fruits.

- Use high speed pressure sensing technology for small fruit including blueberries, strawberries, cranberries, cherries, cherry tomatoes, olives and nuts.

- A world leader with major sales in the USA

- Can sort 7 to 9 tonnes per hour

Compac Sort and BBC Technologies are two examples of the seven innovative sorting equipment companies in New Zealand that are reviewed in the case study, each of whom are achieving global success in many markets in a wide range of fruit and vegetable applications.
New Zealand Future Horticulture industries supply systems, or sell high-technology equipment to, or grow produce in many other countries that all add to our export revenues.
Innovative packaging

- Recognised by TIME magazine (29 Nov. 2004) as being one of the world’s most amazing inventions in 2004, *ripesense™* is the world’s first intelligent ripeness indicator label.

- *ripesense™* was developed by HortResearch in collaboration with fruit labelling company Jenkins Group and involved over seven years of R&D.

- Consumers can tell when fruit is ready to eat thus enhancing convenience and adding value.

- HortResearch scientists developed another pack for consumers to control fruit ripening on demand based on controlled ethylene release.
Example: Helping consumers to assess eating quality

Recognised by TIME magazine as being one of the world’s most amazing inventions in 2004, ripeSense™ is the world's first intelligent ripeness indicator label.

This development is but one of many innovations New Zealand organisations are pursuing to meet three trends.
Example: Helping retailers to maximise value

- Not knowing if, or when, the fruit has reached their preferred state of ripeness frustrates consumers and becomes a barrier to purchase.

- ripeSense™ eliminates this problem by using a sensor label that reacts to the aromas released by fruit as it ripens.

- Damage and shrinkage are reduced as ripeSense™ significantly reduces damage by consumers.

- The ripeSense™ pack is recyclable and provides improved hygiene security.

- Extra handling can lead to high levels of shrinkage in store.
Crispness, tanginess combined with sweetness for apples and kiwifruit.

NZ led the world in creating distinctive and sought-after New World
flavours and tastes in Sauvignon Blanc and Pinot Noir wines.

NZ tastes and fruit products seem to have characteristic flavours, tastes,
and textures.

NZ Fruits and Flavours
NZ Sauvignon Blanc: a highly distinctive product on the world stage

- Wines produced in New Zealand’s cool temperate climate have excited an international market demanding fruity, intense and crisp new wine flavors.

- The supply of these wines is led by Cloudy Bay and Montana brands with their distinctive and iconic New World Sauvignon Blancs.

- The tremendous growth in the New Zealand wine industry has seen export earnings rise from $3 million (fob) in 1985 to $302 million in 2004 in what is arguably one of horticulture's more demanding products.

- Vision, climate and soils combined with astute and innovative marketing changed an initially struggling sector of New Zealand’s fruit industry to be globally competitive.

- Sauvignon Blanc accounts for 44% New Zealand’s wine production in 2004, up from 7% in 1990.

- Projections are for a $1.5 billion NZ wine industry by 2010.

- quote from 'Wine Spectator', Nov 2003. “in just a few short years (New Zealand) has gone from nowhere to the world's utopia of Sauvignon Blanc.”
An Iconic New Zealand Brand

Arguably the best Sauvignon Blanc in the World?
Blueberries – a 20th Century fruit contributing to New Zealand’s expanding horticulture industry

- The foundation of today’s blueberry industry was laid in the 1970s when MAF imported blueberry cultivars from USA. The best performing USA cultivars were released to the new industry during the 1980s and the national crop area of 2 ha in 1975 quickly expanded to 238 ha in 1981. Earlier cultivar introductions had been made to evaluate the crop’s potential on the acid peat soils of the Waikato.

- In an global development New Zealand cultivars have been released to nurseries in Europe, Japan and USA under licence. Royalties earned have flowed back to HortResearch, which took over the breeding programme in 1992.

- Blueberries rank very high in antioxidant activity when compared to most other fresh fruit and vegetables and domestic demand is increasing.

- Blueberry exports commenced during the 1980s and reached $2 million in 1985. In 2004 exports of fresh and frozen blueberries are valued at $7.4 million.
Fresh Onions: a 5,000 year history – and New Zealand exports 200,000 tonnes

- Fresh onions are New Zealand’s highest value vegetable export at around $100 million (f.o.b.) and 200,000 tonnes since 1999/2000. New Zealand is the largest exporter of fresh onions to the European Community.

- To ship to Europe the product has to be of excellent quality. The New Zealand onion industry has progressively refined the qualities of onions in terms of yield, skin quality and appearance, robustness and greater consistency.

- The industry’s growth depends on an active R & D programme. Onion white rot disease is a global problem that is compounded by intensive production systems. Onion thrip is a pest that is very hard to detect, hard to control and resistant to approved chemicals and it may only become apparent on arrival in distant export markets.

- New Zealand’s Crop & Food Research and HortResearch are world leaders in postharvest and pest management research; working with industry they are improving cultivars, postharvest technologies and pest and disease management strategies.
New Zealand Kobocha - buttercup squash exports use many innovations

- New Zealand exports of squash pumpkin (kabocha in Japan) average over $60 million (f.o.b.) with over 95% shipped to Japan and South Korea. Science and innovation is helping to maintain present squash exports and to develop new markets.

- Aphids are a significant pest of New Zealand squash crops. They are vectors of viruses that can reduce marketable fruit weight by up to 85%.

- During the 1980s New Zealand scientists studied aphid ecology and built long-term data sets that are now used to predict aphid flight and infestation patterns.

- High level suction traps operated by Aphid Watch are now used to sample the aerial aphid population at an altitude where aphids are least affected by ground influences. These forecasts of aphid flights assist managers by providing an early warning system allowing growers to implement effective preventative control strategies.
Trends that impact New Zealand’s horticultural

- **Consumer Power**: predicting needs and desires is an inexact science, but smart companies will develop techniques important for commercial success.

- **Convenience rules**: snacks and meals have become interchangeable; can be eaten on the move and are quick for home cooking – with increasing concern that they should be healthier.

- **Increasing customisation of food**: designed to suit needs.

- **Health as a driver** of food consumption: health and wellness.

- **Environmental sustainability**

- **Food safety**: proof of claims is becoming a key requirement. Certification and tracking of food production is increasing.

- **Increasing Competition**: trade barriers are being lowered; one consequence may be the need to reduce costs to stay competitive.

- **BioDigital**: biological systems managed using real-time decision making.

- **Convergence of Sectors**: Convergence of food, health and biotechnology will result in new products e.g. plants and microbes may become ‘factories’ to produce biomaterials, plastics, fuels etc.
**Other Case Study Topics**

**Case # 6**
DNA used to identify pests on export apples - a world first in biosecurity

**Case # 7**
New Zealand’s award winning hops produce exceptional beers

**Case # 8**
New technology helps horticulturalists in sustainable management of land & water

**Case # 9**
Smart technologies used to control pests on outdoor vegetables

**Case # 11**
There is much more to New Zealand’s fresh supply chains than just timely delivery to markets

**Case # 14**
Calla lilies (Zantedeschia) – a novel export flower crop with a global impact

**Case # 15**
AspireNZ decision support system for asparagus has global demand

**Case # 18**
Health enhancing products from New Zealand plants

**Case # 19**
Convenience Foods and the revolution in produce marketing

**Case # 20**
Novel & Gourmet Foods
Economic Analysis

Case 1. ZESPRI™ GOLD
By 2009 expected to have reached an IRR of 10% and the NPV is calculated to then be $28.8 million.

Case 2. ZESPRI™ System (the KiwiGreen system).
The Internal Rate of Return^2 (IRR) figures are directly dependent upon the assumptions indicated in the counterfactuals (details in main report). As there will be varying opinions on this level, we have provided a range of calculations:

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<tr>
<th>World prices depressed by</th>
<th>5%</th>
<th>10%</th>
<th>20%</th>
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<tbody>
<tr>
<td>Internal Rate of Return (IRR)</td>
<td>31%</td>
<td>47%</td>
<td>79%</td>
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</table>
Economic Analysis

Case 3. New apples cultivars - Jazz apples

- *Jazz™* was first planted on New Zealand commercial orchards in 1996, on commercial orchards in Washington State, USA in 1999, and on commercial orchards in France in 2000. By 2003, some 450,000 trees had been planted on commercial orchards worldwide.

- At present *Jazz™* returns a significant premium over other varieties. This premium is expected to continue for the medium term.

- Assessment results:

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<th>as at 2004</th>
<th>as at 2009</th>
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<tbody>
<tr>
<td>Internal Rate of Return</td>
<td></td>
<td>13%</td>
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<tr>
<td>Net Present Value</td>
<td></td>
<td>$2.8 million</td>
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Case 6. Pests on export apples

Assessment results:

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<th>as at 2004</th>
<th>as at 2009</th>
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<tbody>
<tr>
<td>Internal Rate of Return</td>
<td>43%</td>
<td>44%</td>
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<tr>
<td>Net Present Value</td>
<td>$16.6 million</td>
<td>$22.3 million</td>
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The 2009 assessments are based on the assumptions that:

- Apple exports to USA will continue at present levels until 2009.
- Present prices for export apples will continue until 2009.
Economic Analysis

Case 7. Hops

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<th>as at 2009</th>
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<tr>
<td>Internal Rate of Return</td>
<td>8%</td>
<td>13%</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>$4.8 million</td>
<td>$16.5 million</td>
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The 2009 assessments are based on the assumptions that:

- Hop production continues to be 8000 tonnes/year.
- Domestic consumption of hops continues to be 15% of total production.
- The present swing towards growing aroma varieties continues at the rate of a 3% reduction in alpha acid varieties each year.
- Export prices continue at current levels.
Economic Analysis

Case 13: Blueberries

- The area of the blueberry crop is about 430 ha in 2004, having expanded from 300 ha in the early 1990s.
- Exports of fresh fruit have increased from $680,000 in 1983 to $2.1 million in 1990 and $7.5 million in 2003.
- The sale of NZ bred cultivars in Europe, USA and Japan returns a significant royalty payment to HortResearch as the breeder.
- It takes about 10 years to breed and select a new blueberry cultivar.

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<th>as at 2004</th>
<th>as at 2009</th>
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<tr>
<td>Internal Rate of Return</td>
<td>19%</td>
<td>21%</td>
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<tr>
<td>Net Present Value</td>
<td>$0.5 million</td>
<td>$2.7 million</td>
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- The 2009 assessments are based on the assumptions that:
  - Crop area will not increase between 2004 and 2009
  - Fresh export will increase at 4% per year with same profile of early, mid and late season sales.
  - HortResearch’s forward projections of royalty income will be met.
  - Processed exports and domestic sales will continue at present levels.
Economic Analysis

**Case 15: Asparagus** (development of the *AspireNZ* decision support system)

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<th>as at 2009</th>
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<tr>
<td>Internal Rate of Return</td>
<td>53%</td>
<td>61%</td>
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<tr>
<td>Net Present Value</td>
<td>$2.1 million</td>
<td>$5.4 million</td>
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The 2009 assessments are based on the assumptions that:

- Crop area declines from 1900 ha in 2004 to 1800 ha in 2009.
- Average yields will increase from 3 tonnes/ha in 2004 to 4 tonnes/ha in 2009. This result is expected as a result of industry rationalisation and Vegfed’s concerted drive to double yields by 2010.
- The profile of asparagus use and prices will not change after 2004.
- Overseas fees for *AspireUS* and others will double between 2004 and 2009, while the portion of New Zealand crop under *AspireNZ* management will increase from 33% to 50% over the same period.
Conclusions 1

New Zealand’s horticulture industry is export driven and must innovate to remain competitive and survive:

- NZ scientists have demonstrated international leadership in many fields while working closely with growers on applied problems
- Growers are risk takers and enthusiastically adopt new ideas and technologies
- Close and seamless linkages exist between all in the supply chain with local and global networks
- Strong biosecurity policies are essential to protect industry.
Conclusions 2

New Zealand’s horticulture industry is export driven and must innovate to remain competitive and survive:

- Numerous examples exist of important scientific innovations that have had profound benefits for NZ horticulture
- None of the products that make up our $2.2 billion horticultural industries exports are in the same form as 20 years ago when their exports were only $200 million
- New Zealand’s horticultural industries have continued to grow profitably because of key R&D discoveries and implementation by industry
- Knowledge of these amazing events are not known or appreciated by policy makers or by the general public and potential students ...
- Why?
New Zealand’s horticulture industry is export driven and must innovate to remain competitive and survive:

- Some R&D programmes have amazing returns on research dollar investment
- All our stories involve visionary people who made things happen
- We must develop an ongoing process to tell others outside our business of the potential and benefits of the our business
- New Zealand Horticulture industry and its science could be seen as the ‘Silicon Valley’ of the plant sciences underpinning future human health and wellbeing.
Conclusions 4

New Zealand’s horticulture industry is export driven and must innovate to remain competitive and survive:

- We now recognise the importance of taste and flavour
- We used to think of production and ignore the consumer
- We used to think total yield but now we think quality yield
- We used to think locally but now we think globally
- We now have a greater appreciation of the farm-to-plate supply chain
- We are perceived as low tech and traditional when much of the reality is high tech, innovative and progressive.
What is the business of New Zealand Horticulture?

- The growingfutures case studies challenge us to recognise that we are in the following businesses:
  * food
  * fashion
  * health and well being
  * indulgence

- New Zealand needs to continue to create new strategic alliances across the commercial and science disciplines and through the industry’s supply chain to ensure future success.
Continuing Challenge

- New Zealand must continue to be imaginative if we want to change the perspective of others.
- We must recognise and accept a paradigm shift in our thinking in order to progress.
- We must think outside the square.
- We must align ourselves with other partners to achieve synergy, strength and a basis for progressing.
- We must promote our success stories and our champions.
Acknowledgements

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- HortResearch
- Crop and Food Research
- Zespri International
- NZ Trade and Enterprise

*and all those who provided us with their amazing stories.*

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