2017 Kiwifruit Book

A Resource for New Zealand Secondary School Teachers and Growers new to the Kiwifruit Industry

NZKGI
NEW ZEALAND KIWIFRUIT GROWERS

Kiwifruit Quick Facts

#1

THERE ARE APPROXIMATELY
2,600
KIWIFRUIT GROWERS IN
NEW ZEALAND

#2

KIWIFRUIT REPRESENTS
34% OF NEW ZEALAND'S
TOTAL HORTICULTURAL EXPORT REVENUE

#3

THE WORLD'S TOTAL PRODUCTION OF KIWIFRUIT HAS INCREASED BY OVER
50% DURING THE LAST DECADE

#4

THERE IS INVESTMENT OF
$35 MILLION A YEAR
IN INNOVATION IN NEW ZEALAND'S KIWIFRUIT INDUSTRY WHICH HELPS IT
STAY COMPETITIVE ON THE GLOBAL STAGE

#5

ZESPRI SUNGOLD KIWIFRUIT CONTAINS
MORE THAN THREE TIMES
THE AMOUNT OF VITAMIN C
FOUND IN ORANGES

#6

NEW ZEALAND EXPORTS KIWIFRUIT TO
OVER 56 DIFFERENT COUNTRIES
WITH THE LARGEST MARKETS BEING
JAPAN, CHINA, SPAIN, TAIWAN, GERMANY AND SOUTH KOREA

#7

SINCE 2014, KIWIFRUIT SALES IN CHINA HAVE MORE THAN DOUBLED FROM
11.4 MILLION TRAYS TO 23.6 MILLION TRAYS IN 2016

#8

81% OF NEW ZEALAND
GROWN KIWIFRUIT
COMES FROM THE
BAY OF PLENTY

FOREWORD

Welcome to the third edition of the Kiwifruit Book. This book is intended as an open access, up-to-date resource for Secondary School teachers and new growers. It covers what was thought to be relevant in 2017, from the industry's structure and the marketing of kiwifruit, through to practical growing advice from real kiwifruit growers.

The development of this kiwifruit book started through a query made by Rick Jochem, an Ag/Hort teacher from Palmerston North Boys High School, asking if New Zealand Kiwifruit Growers Incorporated (NZKGI) would consider supporting the development of a kiwifruit workbook for use in secondary schools. Rick expressed concern at the limited availability of kiwifruit industry information available online. NZKGI agreed to support Rick and utilised funding received from a grower through the Acorn Foundation, together with a number of industry resources, to pull together relevant information for the first edition of the book.

The third edition of the Kiwifruit Book has taken the bones of the first and second and built on them to include the latest industry research and development. Additions to the 2017 Kiwifruit Book include:

- A 'quick facts' page detailing industry key points for quick reference;
- An overview on the different adverse events that may affect growers, with an in-depth look at the 2017 Edgecumbe floods and how they were managed and overcome;
- Information on kiwifruit varietal licenses and the recent Sungold license release;
- An investigation on one of biosecurity's most un-wanted pests; the Brown Marmorated Stink Bug;
- Information on the 2017 GIA Biosecurity Agreement;
- The importance of RSE Workers to New Zealand's horticultural workforce;
- An overview of the rise of the organic kiwifruit;
- A look at what regional councils are doing to solve New Zealand's fresh water issues; and
- Updated statistics and information from the 2016/17 financial year.

CONTRIBUTORS

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If you would like more information on featured topics in this book or can contribute to the next edition, please contact New Zealand Kiwifruit Growers Incorporated on 0800 232 505.

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TERMS AND DEFINITIONS

Bio-Stimulants	Include diverse formulations of compounds, substances and micro-organisms that are applied to plants or soils to improve crop vigour, yields, quality and tolerance of stresses.
Black seeds	The number of mature black seeds in a fruit. It is used as a measure of maturity.
Botrytis	A pathogenic fungus that can attack many different types of plants.
CA	Controlled Atmosphere storage slows down the opening process and sends the fruit into hibernation meaning fruit can be kept for longer.
Cupric Ion	Of or pertaining to copper, especially copper in its highest valence.
Dioecious	Kiwifruit is dioecious, having separate male and female plants.
Dry Matter	Calculated as the ratio of dry to fresh weight. Using the following equation: Dry matter (DM) = Dry Weight ÷ Fresh Weight. Here fresh weight is the total fruit weight, including water and the dry weight contents that have been removed after the water has been removed.
FOBS	Free on board (FOB) is a trade term requiring the seller to deliver goods on board a vessel designated by the buyer. The seller fulfils its obligations to deliver when the goods have passed over the ship's rail.
Gold3	This cultivar was commercialised by Zespri in 2010 and is otherwise known as Zespri SunGold.
Gold9	This cultivar was commercialised by Zespri in 2010 and is otherwise known as Zespri Charm. However G9 is no longer on the market due to faults with its physical appearance.
Green14	This cultivar was commercialised by Zespri in 2010 and is otherwise known as Sweet Green.
Hort16A	The variety otherwise known as Zespri Gold.
Hybrid Cooperative	Is an organisational structure where growers are accountable through holding a share of the business, share in its profits, and must equally share its burdens.
KISP	The Kiwifruit Industry Strategy Project is a sustainable and long-term plan developed by Kiwifruit Industry representatives to maximise the wealth of New Zealand kiwifruit growers.
Leaf Chlorosis	Chlorosis is a condition in which leaves produce insufficient chlorophyll. As chlorophyll is responsible for the green colour of leaves, chlorotic leaves are pale, yellow, or yellow-white.
MTS	Minimum Taste Standard is a Zespri initiative used to optimise the taste standard of crops so all Zespri® Kiwifruit are recognised and valued by customers as being consistent in taste.
Non-Terminating Shoots/ Terminating Shoots	Two types of shoots are produced. Terminating shoots are short, 3-6 leaved shoots, which frequently form flower buds the following year. Non-terminating shoots may grow 10-15 feet in a season, producing smaller leaves along long internodes, with the distal portion of the shoot often coiling on contact with other shoots or solid objects. Non-terminating shoots perform the function of tendrils, which are absent in kiwifruit.
Phloem	Phloem is one of the two types of transport tissue in vascular plants; Xylem being the other. Phloem is a transport tissue in vascular plants which conducts sugars and other metabolic products downwards from the leaves.
Phytotoxicity	Is a toxic effect by a compound on plant growth. Such damage may be caused by a wide variety of compounds, including trace metals, salinity, pesticides, phytotoxins or allelochemicals.
PLU	Price Look Up numbers are identification numbers affixed to produce in grocery stores and supermarkets to make check-out and inventory control easier, faster, and more accurate.
SPE	Single Point of Entry is the use of one exporter over multiple exporters for example Zespri holds the SPE for the NZ kiwifruit industry.
TE	Tray Equivalent.
TZG	Taste Zespri Grade mechanism for calculating the quality of taste in Zespri Kiwifruit.
Xylem	Xylem is one of the two types of transport tissue in vascular plants; phloem being the other. The basic function of xylem is to transport water from roots to shoot and leaves, but it also transports some nutrients.
Zespri	Zespri International Limited is the world's largest marketer of kiwifruit, selling kiwifruit in more than 50 countries and managing 30 percent of the global volume.
Zespri Crop Protection Standard	The Zespri Crop Protection Standard tells growers which Agrochemical Compounds may be applied to fruit which will be marketed by Zespri. These standards ensure fruit meets the legal requirements in each country where Zespri fruit is sold.

CHAPTER 1: INDUSTRY OVERVIEW

This chapter is separated into two parts as follows:

- The kiwifruit industry's history in brief (Section 1.1)
- The current structure of the kiwifruit industry (Section 1.2)

1.1 THE KIWIFRUIT INDUSTRY'S HISTORY IN BRIEF

This section briefly takes the reader through the history of the kiwifruit industry and aims to describe the major historical events that shaped the kiwifruit industry into what it is today. The section is divided as follows:

- The beginnings
- 1960s
- 1980s
- 1990s
- The early 2000s

The beginnings

Kiwifruit seeds were brought into New Zealand from China in 1904. At the time, kiwifruit was known by its Chinese name Yang Tao and English names Chinese Gooseberry and Monkey Peach. In 1927, New Zealander Hayward Wright bred a cultivar of kiwifruit known as 'Hayward'. By the 1960's, 'Hayward' became the standard cultivar of exported kiwifruit around the world and now makes up 90% of the world production of kiwifruit (Anon., 2010).

1960s

The kiwifruit industry in New Zealand is youthful in comparison to many other primary industries. Its real commercial beginnings sit in the 1960s. The first industry body the Kiwifruit Export Promotion Committee was formed in 1970. This led to the New Zealand Kiwifruit Authority (NZKA), which in its initial form, dates back to October 1977. Its structure was very different to what exists today. Its role was to license exporters, such as Turners and Growers, the New Zealand Fruitgrowers' Federation and Auckland Export and at its peak had up to seven exporters licensed. As well as licensing, the NZKA co-ordinated packaging and had authority over export grade standards and promotion, but it had no control over sales and marketing activities.

1980s

From the mid-1980s, the volume of kiwifruit started to increase significantly. In 1981 for example, 22,000 tonnes of kiwifruit were exported. By 1897, that had risen to 203,000 tonnes. Over the same period the return to growers per tray had dropped from $7.84 in 1981 to $3.00 in 1987 (pre-packing charges which were around $2.00 a tray). This resulted in 91 percent of growers making a loss from their kiwifruit operations. A dramatic rise in the New Zealand dollar (NZD) in 1987, followed by inflation reducing policies by the Reserve Bank of New Zealand (RBNZ) led to interest rates reaching their peak at 20.5% in June 1987 (RBNZ, 2012). Over-production along with the high NZD made the price of New Zealand kiwifruit expensive in overseas markets and therefore reduced demand. This combined with kiwifruit land values falling led to an equity crisis for many growers. This was the turning point that started the debate about the advantages of having one exporter (known today as Single Point of Entry) over multiple exporters.

In 1987, as a result of heated debate on the topic, the NZKA engaged a consultant's report. A referendum was then held in September 1988. The industry's set target was to get 80% grower support for the SPE. The fall in export prices and the undercutting between the seven kiwifruit exporters were key arguments in favour of the creation of the SPE. In the end, 84% of growers supported the creation of the Kiwifruit Marketing Board with statutory powers to buy all kiwifruit that was to be exported. The New Zealand Kiwifruit Marketing Board (NZKMB) came into being and its first season of operation was 1989/90. This ended the multi-exporter regime and replaced it with the single desk marketing structure that the kiwifruit industry has today. This foresight has allowed New Zealand kiwifruit growers to develop their industry into a global business with concerted investment in branding, marketing, quality, and research and development.

1990s

The 1992/93 season was a disaster for the New Zealand kiwifruit industry. New Zealand and international kiwifruit volumes continued to grow and problems came to a peak during this season as a result of various factors such as bad management and governance. The NZKMB got into serious difficulty. Growers were over-paid and massive debt was the result. The NZKMB with strong grower support reacted decisively, and the debt was paid off over the ensuing 18 months.

As a result of what had occurred, the industry put in place a three-stage review that incorporated major structural change.

1. New Zealand Kiwifruit Growers Incorporated (NZKGI) became operational in July 1994.
2. Marketing and branding was reviewed and the recommendation that resulted led to the creation of the Zespri brand, which was launched in the 1996/97 season, and the creation of Zespri as a separate marketing and sales organisation.
3. Corporatisation, collaborative marketing and the industry's operational structures were looked at and a report presented to NZKGI. A referendum was held and the structure of the industry altered (in 1996/97) to include: Zespri as a marketing company, an NZKGI Forum, and NZKMB (which remained in existence.) (New legislation was not required to make these changes.)

The positive results of the three-stage review included the formation of the Zespri business, the establishment of collaborative marketing, and a more efficient on-shore operational structure. The three-stage review also incorporated 12-month supply, new varieties and plant breeding. It was in 1997 that Zespri Gold was launched on a commercial basis. It was the first time there was an alternate successful variety to the Hayward. Furthermore, the three stage review formed the basis of today's kiwifruit industry, and the way in which it operates.

The late 1990s provided some challenges courtesy of the National Government which, at the time, did not favour producer boards – the NZKMB was one of these – and was keen for deregulation to occur. Negotiations with the National Government saw the kiwifruit industry win some battles and lose some. The fact the kiwifruit industry had recently created a new structure following its own review stood it in good stead. Corporatisation was a key talking point. A recommendation of the three-stage review was that the kiwifruit industry would become a corporatised business with a production-based share-holding concept. This was not approved by Government. A co-operative company was not an option; a standard corporate was. This remains the case today. What Government did concede, however, was that the industry's single desk status could remain. The ensuing Labour Government put to bed any discussion over deregulating the kiwifruit industry.

The early 2000s

April 1, 2000 saw the launch of the Zespri Group Ltd – Zespri was officially corporatised. All growers at that time become shareholders in the Zespri Group Ltd, with the number of shares relevant to tray production. This was but a moment in time when alignment existed between production and shareholding as growers who have since left the kiwifruit industry were able to retain their shares and there is no restriction on shareholding. The following year saw turmoil within the Apple and Pear Board, which was taken over and subsequently deregulated. The kiwifruit industry structure was different in that only growers could have shares.

In 2001 a change to kiwifruit legislation occurred. A voting cap was introduced to ensure growers retained control of the industry. The maximum number of votes a grower could have was based on production and hence a direct link between production and voting rights was established. No significant further review of the Kiwifruit Industry has been held until the Kiwifruit Industry Strategy Project (KISP) that was launched in October 2013. The Kiwifruit Industry Strategy Project (KISP) was established to jointly develop a strategy to maximise the industry's ability to achieve the New Zealand kiwifruit industry's long-term market, strategic and financial performance for the benefit of New Zealand kiwifruit growers in a changing global market with the wide support of key industry stakeholders.

A group of people were appointed by the Industry Advisory Council (IAC) as a cross-representative group of the three corners of the industry structure – growers, post-harvest and Zespri. The project began by establishing a broadly agreed set of principles that framed industry discussion and decision-making when agreeing to a long-term strategy for the New Zealand kiwifruit industry. These principles included:

KISP Framework

The New Zealand kiwifruit industry must act responsibly and ethically on all economic, sustainability, environmental, social and regulatory issues to the benefit of New Zealand kiwifruit growers and the wider New Zealand community.

Single Point of Entry (SPE)

The Single Point of Entry is retained and enhanced to maximise its performance for New Zealand kiwifruit growers.

Industry Governance

Given the increasingly competitive international market, Zespri governance must meet world-best practice standards so that it delivers on its Purpose.

Effective leadership and governance of all industry structures must be supported by effective New Zealand kiwifruit grower control, representation and consultation.

Zespri Ownership

New Zealand kiwifruit growers must own and control Zespri, and be the main beneficiaries of Zespri performance*.

*In considering submissions on Zespri ownership, the Group will consider all aspects of ownership, including alignment with production.

Marketing

Zespri's purpose is to be "best in class" international branded kiwifruit sales and marketing organisation in order to ensure a sustainable New Zealand kiwifruit industry that maximises New Zealand kiwifruit grower returns.

Zespri-branded kiwifruit is the best available kiwifruit around the world 12 months of the year for the overall benefit of New Zealand kiwifruit growers. **

The New Zealand kiwifruit industry must have a process to evaluate and implement genuine innovative commercial and marketing ideas, including collaborative marketing, that are aligned to Zespri's global marketing strategy and for the long-term benefit of New Zealand kiwifruit growers.

**The Group will consider the implications of the industry strategy to non-New Zealand supply businesses and consider how the risks and rewards from the activity are captured by Zespri and how the profits are used.

Supply Chain Effectiveness

The New Zealand kiwifruit industry must have an efficient, competitive and responsive onshore post-harvest sector that is aligned with the industry strategy, offering grower choice that is integrated into an efficient global supply chain. The New Zealand kiwifruit industry must have a world-class global supply chain from orchard to consumer.

Zespri's payment system for New Zealand-grown kiwifruit must reflect commercial signals based on in-market returns.

Innovation

To maximise the New Zealand kiwifruit industry's global competitive advantage the New Zealand kiwifruit industry must continue to develop and implement a world-class and sustainable R&D programme.

As an integral part of the SPE, the New Zealand kiwifruit industry must have the ability to develop, own, licence, control and maximise the value generated from the world's leading portfolio of kiwifruit Plant Variety Right varieties.

Funding

Zespri is funded and remunerated appropriately to ensure it can deliver the full scope of its responsibilities.

Working groups were established to consider each of the key principles and an output paper was established for each group. The industry was then consulted on the recommendations for these working groups in a document called Stage 2: Industry Vision Document. Meetings were held in all kiwifruit growing regions to discuss the proposals and industry members were invited to make submissions. In December 2014, following the consideration of submissions, a revised set of proposals was published for further consultation. A referendum of growers on the proposal was held in early 2015 to determine support for the KISP proposals.

The project has gained the mandate from growers to implement KISP's proposals in a referendum held in March 2015. New Zealand kiwifruit growers turned out in record numbers to vote, delivering a very solid mandate for the future ownership, control and structure of the industry through the Kiwifruit Industry Strategy Project process.

Two thirds of New Zealand growers voted during the Kiwifruit Industry Strategy Project referendum, and of these, 91% supported the ten propositions. The key results in the referendum were:

- 98% of growers supporting the industry's Single Point of Entry structure
- 92% of growers supporting the implementation of a cap on Zespri share-holding
- 91% of growers supporting a change to how Zespri is funded to maximise returns to New Zealand growers
- 94% of growers supporting changes to their industry representation to ensure they determine grower equity decisions about grower payments

Following the referendum, the KISP group asked the Ministry for Primary Industries to revise the Kiwifruit Regulations to allow implementation of the KISP recommendations. MPI issued a public consultation paper in early 2016 and revision of the Kiwifruit Regulations was announced in August 2016.

Kiwifruit Regulations

In July 2017, an amendment was made to the Kiwifruit Export Regulations which resulted from Growers requests in the 2015 KISP referendum. The revised Regulations address three main areas: Shareholder alignment, Zespri's core business and the governance and funding of the regulator Kiwifruit New Zealand (KNZ). The regulations enable Zespri to make changes to its constitution to allow for greater alignment between growers and shareholders. The regulations also expand the definition of core business will provide stability to Zespri as the industry grows, maximizing the wealth of New Zealand kiwifruit growers.

The regulations have made significant changes to the governance and funding of KNZ and while growers no longer have a majority on the KNZ Board, independent expertise is available. As supported by the KISP referendum, KNZ also have greater flexibility in funding their operations but also enhanced reporting requirements.

Zespri Funding

The KISP process provided direction on how Zespri should be funded for its involvement in the NZ fruit supply business. Industry discussions are scheduled to be completed in 2017 to provide a revised agreement for the setting of Zespri's margin for the NZ fruit supply business. This agreement is based on the principles agreed during the KISP process.

1.2 Current Industry Structure

This section focusses on the key organisations (1.2.1) in the kiwifruit industry as well as levy funded organisations (1.2.2) and the industry's Single Point of Entry (SPE) structure (1.2.3).

1.2.1 Key Organisations

The following key organisations are described in this section:

- Kiwifruit New Zealand (KNZ)
- Zespri International Limited
- New Zealand Kiwifruit Growers Incorporated (NZKGI)
- Kiwifruit Vine Health (KVH)
- Plant & Food Research (P&FR)
- Maori Forum
- Postharvest Operators
- Supply Entity Groups

Kiwifruit New Zealand

The majority of the New Zealand kiwifruit sector is focussed on the export of fresh fruit. The export of New Zealand kiwifruit is regulated through the Kiwifruit Export Regulations 1999. These regulations permit a single marketer to export and market the majority of New Zealand grown kiwifruit outside of Australasia. This position is called the 'Single Point of Entry' (SPE). The Kiwifruit Export Regulations are enacted by Kiwifruit New Zealand (KNZ). KNZ is the kiwifruit industry's regulator and gives Zespri the mandate to be the vehicle of the SPE. KNZ also have the mandate to allow other exporters to trade New Zealand grown kiwifruit outside of Australasia and do so on a case-by-case basis. This is dependent on the value those exporters can derive for growers over and above what is achieved by Zespri.

Zespri International Limited

Zespri is a limited liability company, owned by past and present New Zealand kiwifruit growers, which in addition to its role as the single desk marketer also provides logistics services and research and development management for the kiwifruit industry.

New Zealand Kiwifruit Growers Incorporated

New Zealand kiwifruit growers are represented by an organisation called New Zealand Kiwifruit Growers Incorporated (NZKGI). NZKGI is levy funded and its purpose is to protect the political and commercial interests of New Zealand Kiwifruit Growers. Key roles include but are not limited to: safeguarding the Single Point of Entry; grower well-being and welfare; consulting with growers on industry initiatives; reporting on Zespri performance; driving for greater supply chain efficiencies; driving for the best possible market outcomes; grower advocate with government and stakeholders. The bottom line is that New Zealand Kiwifruit Growers Incorporated aims to increase growers returns.

Kiwifruit Vine Health (KVH)

KVH is a grower-driven, pan-industry, levy funded organisation that was established in 2010 to lead the response to the Psa incursion and since 2012 has been responsible for managing wider biosecurity on behalf of the kiwifruit industry. A key research and development objective for KVH is to jointly lead (with Zespri), a world class research and development programme that continually seeks to identify ways to best manage Psa-V and other biosecurity risks to New Zealand's kiwifruit industry.

Plant & Food Research

Plant & Food Research is a science company that is a New Zealand government owned Crown Research institute. Approximately 100 of the 900 people employed by Plant & Food Research carry out 60% of the kiwifruit industry's research. Kiwifruit has a broad research programme which covers new cultivar development, supply chain and consumer value add. Plant & Food Research have a site in Te Puke that is home to the largest kiwifruit breeding population outside of China.

Maori Forum

The Māori Kiwifruit Growers Forum Incorporated has been created to advocate for the interests of Māori kiwifruit growers and is a partnership between Maori kiwifruit growers, Te Puni Kokiri and Zespri. It aims to improve information dissemination, and to ultimately assist and help improve net returns for Māori growers. The forum is governed by 11 elected members who represent the Māori communities involved in the kiwifruit industry. There is a close relationship between the Māori Kiwifruit Growers Forum and the NZKGI through the appointment of an NZKGI Forum representative.

Postharvest Operators

Growers do not supply their fruit directly to Zespri. Growers select a postharvest operator, who can be a co-operative or company, to manage their fruit from harvest. The postharvest operator is or is aligned with a Zespri Registered Supplier, who is paid by Zespri to supply the fruit to the port.

There are approximately 53 packing facilities and 85+ coolstores used in the kiwifruit industry and 18 Zespri Registered Suppliers.

The major postharvest operators of kiwifruit in New Zealand are:

- EastPack Limited
- Seeka Kiwifruit Industries Limited
- Apata Group Limited
- DMS Progrowers Limited
- Trevelyan's Pack and Cool Limited
- Hume Pack-N-Cool Limited
- Opotiki Packing and Coolstorage Limited (OPAC)
- Aongatete Coolstores Limited
- Auckland Pack and Cool (APAC), Mount Pack and Cool (MPAC)

Many operators also pack and cool avocados.

Supply Entities

There are different forms of a Supply Entity, but typically is that the Supply Entity is a Limited Liability Company (or Trust) that growers contract with to supply their fruit. The Supply Entity then negotiates with an aligned post-harvest facility for the provision of packing, cooling, inventory management, financial management and other services. The Supply Entity can be the party that signs a Supply Agreement with Zespri, though in some instances there is another virtual company in-between.

Also, typically, the grower (being the owner of the fruit at harvest) remains the principal through to the point of ownership transfer at FOBS to Zespri. This means that the Supply Entity (and Supplier if there is another intermediary) acts as an agent for the grower. It could be argued that, therefore, each grower, in effect, is the contracting party with Zespri. However, the significance is that there is a direct relationship from a grower, through their Supply Entity to Zespri via the Supply Agreement.

Examples of Supply Entity Groups include:

- Eastpack Entity Trust
- Seeka Grower Council
- Trevelyan's Growers Limited
- Apata Suppliers Entity Limited
- Aongatete Growers Trust

1.2.2 Levy Funded Organisations

NZKGI

The Kiwifruit Commodity Levy Order is the funding mechanism for NZKGI. Kiwifruit growers first voted to establish a kiwifruit commodity levy to fund the operation of NZKGI in 2011. The levy is currently set at 1c/tray ($0.0028/kg) and can only be increased by vote at a NZKGI AGM or Special General Meeting. In 2017, NZKGI were given a mandate by kiwifruit growers to work on their behalf for the next six-year kiwifruit levy cycle running through to 2023.

KVH

KVH is funded through two levies, a National Pest Management levy for the management of Psa which is set at 0.6c per tray and a levy for biosecurity readiness and response activities which is set at 1c per tray for all varieties. KVH's levy is renewed annually at their AGM.

1.2.3 Single Point of Entry

"98% of growers, in a referendum conducted in 2015, voted to keep the Single Point of Entry (65% of growers who produced 80% of the exported kiwifruit volume voted)".

The Single Point of Entry (SPE) structure is the use of one exporter over multiple exporters and Zespri holds the SPE for New Zealand's kiwifruit industry. This marketing structure held by Zespri is in place as it helps producers deliver scale in the market place. Quality, category management and customer relationships are the essence of the SPE structure in market. What it means is that Zespri can choose a few motivated distributors to serve each market, making kiwifruit a significant priority and an essential part of their business. If many distributors were utilised, kiwifruit would be a small part of their business and their livelihood and profit would not be so dependent on selling kiwifruit. This gives Zespri market power in the key markets and the ability to sell kiwifruit at premium prices. There are other advantages:

- Promotional spend in the market that creates market demand.
- The integrated supply chain which delivers efficiencies and speed to successfully launch new varieties.
- Viable returns to growers in difficult financial times.
- An iconic international brand that allows Zespri to differentiate its product; the Zespri brand is a globally recognised brand that symbolises quality, vitality and freshness.
- In market presence. Zespri has offshore offices to market and promote its product.
- Coordinated innovation.
- The largest new cultivar breeding programme in the world.
- Maintenance of quality that delivers Zespri a premium price over its competitors.
- Confidence for growers to invest in the industry.

Benefits of Scale

All of these advantages are achieved because the SPE structure allows the NZ kiwifruit industry to achieve scale. Scale is identified as the key factor for achieving growth in Horticulture NZ's *Growing a New Future* strategy. Horticulture NZ growth target is for horticulture to increase industry revenue to $10 billion by 2020. Horticulture NZ's strategy was developed following extensive industry consultation and research. It identified that the most successful horticulture businesses in this country are the ones that bring growers together, with collaborative sharing of knowledge, costs, marketing and research. But the key point in the strategy is to reach this $10 billion target you need scale. With scale comes the ability to invest in research, capturing intellectual property, to develop markets and to develop branding. Through the SPE structure the NZ kiwifruit industry achieves scale.

Benefits from Zespri's Structure

Zespri is what is called a "hybrid co-operative". Zespri is a corporate company that has shareholders and independent accountability. The corporate pays returns to growers less sales commission, marketing costs and supply chain costs. Shareholding is voluntary, although restricted to growers, and dividends paid have given good returns to shareholders since the company was formed. One of the biggest advantages however, is the disciplines the industry model imposes on Zespri, which are healthy for the stakeholders within kiwifruit industry. These obligations are set out in the Regulations.

Benefits from Investment

Zespri has been set up with the right to export under the Regulations with the purpose of focusing on the interests of kiwifruit growers. The company earns commission only from kiwifruit and looks after kiwifruit markets and growers as the reason for its existence. Zespri in turn, invests in research and development of new varieties, on orchard practices, and supply chain procedures to improve our competitiveness and ultimately grower returns. Large sums of money are spent each year on innovation, and kiwifruit's SPE structure provides a valuable mechanism to coordinate the sharing of this information within the industry.

Benefits from Branded Premium Product

Kiwifruit's SPE structure has allowed Zespri to grow its market share in our key markets and allowed Zespri to develop the Zespri brand. One result is that Zespri is the largest marketer of kiwifruit in the world. The most important result is that Zespri branded kiwifruit is no longer a commodity product. It is a premium product that earns returns that are higher than its competitors. This is the most important benefit of the SPE to the NZ grower.

Benefits from the Commercialisation of New Varieties

Kiwifruit's SPE allowed Zespri to commercialise different Gold kiwifruit cultivars in record time developing markets making top returns for growers. As other new varieties are developed kiwifruit's SPE structure and strong distribution channels will similarly allow for effective and timely commercialisation and market development.

Benefits from Consistent Quality

Another important marketing advantage that comes from kiwifruit's SPE structure is the delivery of consistent quality to customers. Only an integrated and cohesive industry can achieve this. Customers and consumers alike will pay a high price for quality and they will repurchase that premium product because they know they will get the same eating experience. There is no doubt that consistent quality underpins kiwifruit's SPE structure.

Benefits from Customer Service

The markets are becoming more sophisticated and customers are putting more pressure on the industry. Zespri deals with large offshore customers that want to deal with a company that has a strong brand and can deliver the quality and quantity retailers are looking for. Customers want a choice and retailers want to keep their shelves stocked 12 months of the year at the best prices. To face these challenges growers need clear communication from the markets so that the market needs can be met. New Zealand's SPE structure allows these market signals to flow back to growers in an accurate and timely manner.

Benefits from Sustainability

A challenge that New Zealand Kiwifruit Growers face in the international marketplace relates to sustainability of the industry; issues such as responsible employment practices, carbon footprint, food miles, surplus fruit, and strong grower support for environmentally sound practices are some of the important issues to customers. The New Zealand kiwifruit industry must stand as a unified and cohesive industry to face these challenges and maintain the high quality standards that earn the premiums in the market and avoid New Zealand kiwifruit from becoming a commodity product. Kiwifruit's SPE structure allows Zespri to effectively respond to these challenges.

Benefits from Competitive Return

Kiwifruit's SPE provides essential advantages in challenging years when grower returns are under extreme pressure. It is not hard to imagine what returns would be like if other competing marketers had all marketed the increased volume of fruit to the highest paying markets. The bottom line is that to retain the SPE structure Zespri need to deliver competitive returns to the grower to maintain their support for kiwifruit's SPE.

CHAPTER 2: OPERATING ENVIRONMENT

This chapter gives an overview of the environment the kiwifruit industry operates in covering the following topics:

- Competitive position globally (Section 2.1)
- Biosecurity (Section 2.2)
- Environmental sustainability (Section 2.3)

2.1 COMPETITIVE POSITION GLOBALLY

New Zealand has some of the best growing conditions in the world. Clean air, fertile soils, a cool ocean, generous climate, and fewer pests and diseases all contribute to the unique quality and taste of New Zealand grown kiwifruit.

Image 1: Birds eye view of kiwifruit and avocado orchards in the Bay of Plenty (Bevan Jelly, NZ Avocado).

There are approximately 2,600 kiwifruit growers in New Zealand and around 12,578 hectares of kiwifruit in production. Zespri markets the majority of New Zealand grown kiwifruit and is the most recognised fruit brand in the largest cities in China. Zespri Kiwifruit generated global sales revenue of $2.262 billion in the 2016/17 season and sold 137.7 million trays (3.55kg = 1 tray). 81% of New Zealand grown kiwifruit comes from the Bay of Plenty.

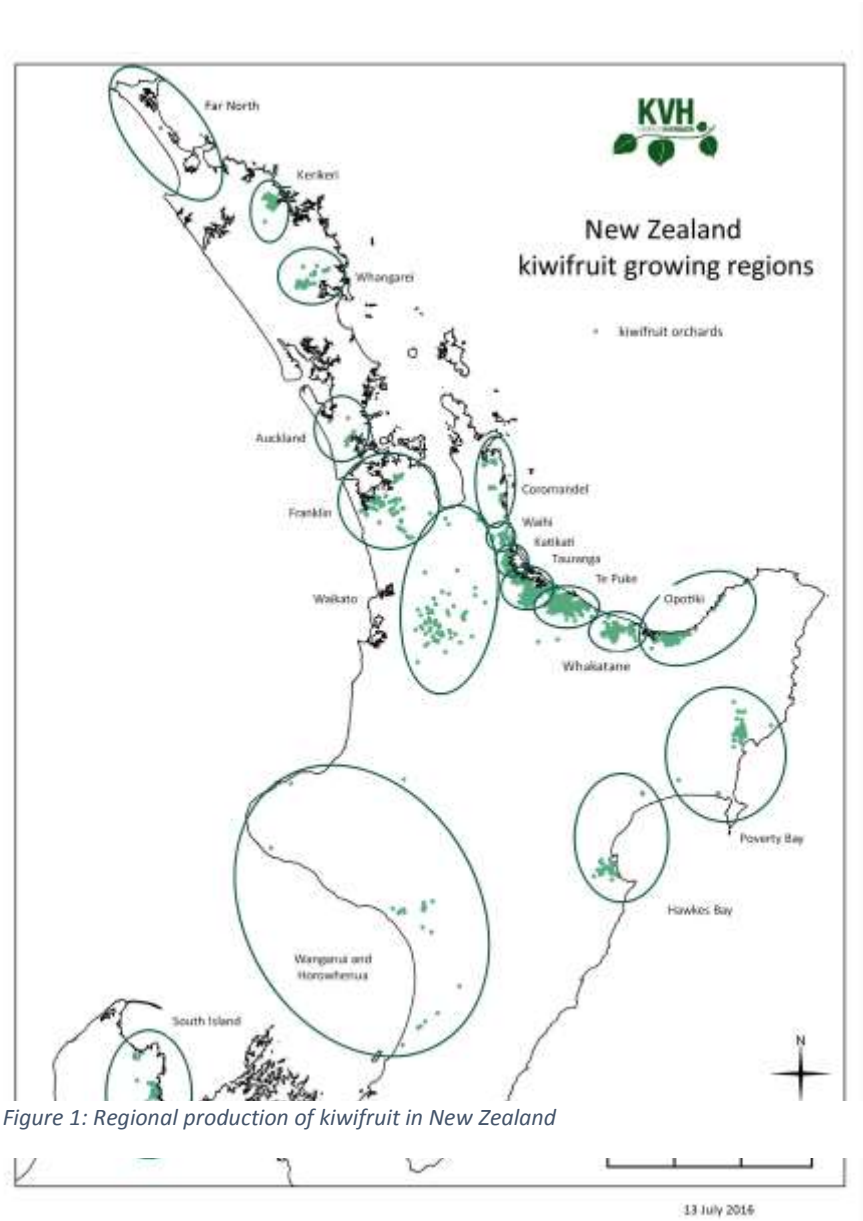


Figure 1: Regional production of kiwifruit in New Zealand

Regional production of kiwifruit by hectare in 2017	
Northland	355
Auckland	475
BOP	10,228
Waikato	531
Poverty Bay	254
Hawkes Bay	196
Lower North Island	73
South Island	466

Figure 2: Number of hectares of kiwifruit produced in each region.

The return made by New Zealand kiwifruit export revenue in the 2016 year is significant in comparison to other fruit and vegetables. Kiwifruit was $1.7 billion whilst total horticultural export revenue was $5 billion. Kiwifruit represents 34% of the total horticultural export revenue. Although New Zealand grown kiwifruit export returns are large in comparison to other horticultural products, kiwifruit is a small fruit category in a global context. While the world total production of kiwifruit has increased by over 50% during the last decade, the kiwifruit

remains a niche fruit, taking up an estimated 0.22% of the global fruit bowl, which is dominated by apples, oranges, and bananas.

Figure 3: Picture of fruit stand representing the competition New Zealand faces in the market place.

New Zealand kiwifruit growers compete against other kiwifruit growers from other countries and other fruits available in the market at the same time as New Zealand kiwifruit. New Zealand kiwifruit faces competition in all markets from a wide range of fresh fruit and consumer products. Direct kiwifruit competition occurs from other southern hemisphere producers of which Chile is the most significant. Chile produces 217,878 metric tonnes vs New Zealand 318,651 in 2016 (O'Rourke & 2016).

Many other producers attempt to capture market space using price while the New Zealand strategy is more about adding value through product taste, quality and consistency, branding, promotional support and reliable supply. This contributes to a higher cost of production. New Zealand has a higher cost of production than our major competitors in the southern hemisphere (Chile).

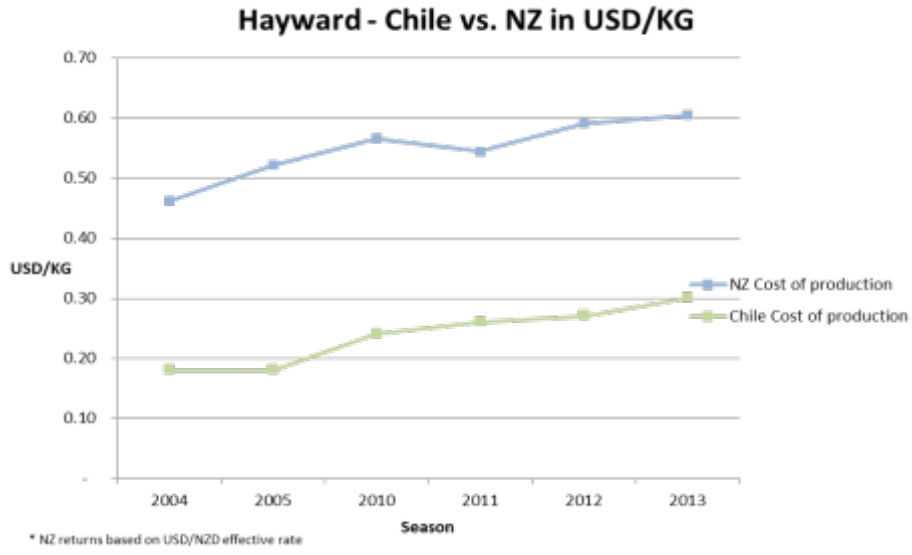


Figure 4: Cost of production: New Zealand verses Chile in USD per Kilogram.

New Zealand is able to compete through a differentiated market position based on a high-quality branded product. Through focus on quality, Zespri is gaining a market premium over competitors. From a global kiwifruit perspective New Zealand kiwifruit represents around on third of globally traded kiwifruit but captures almost two thirds of the value reflecting the premium position of New Zealand kiwifruit product.

Figure 5: New Zealand verses Chilean returns in USD per kilo; 2009-2013.

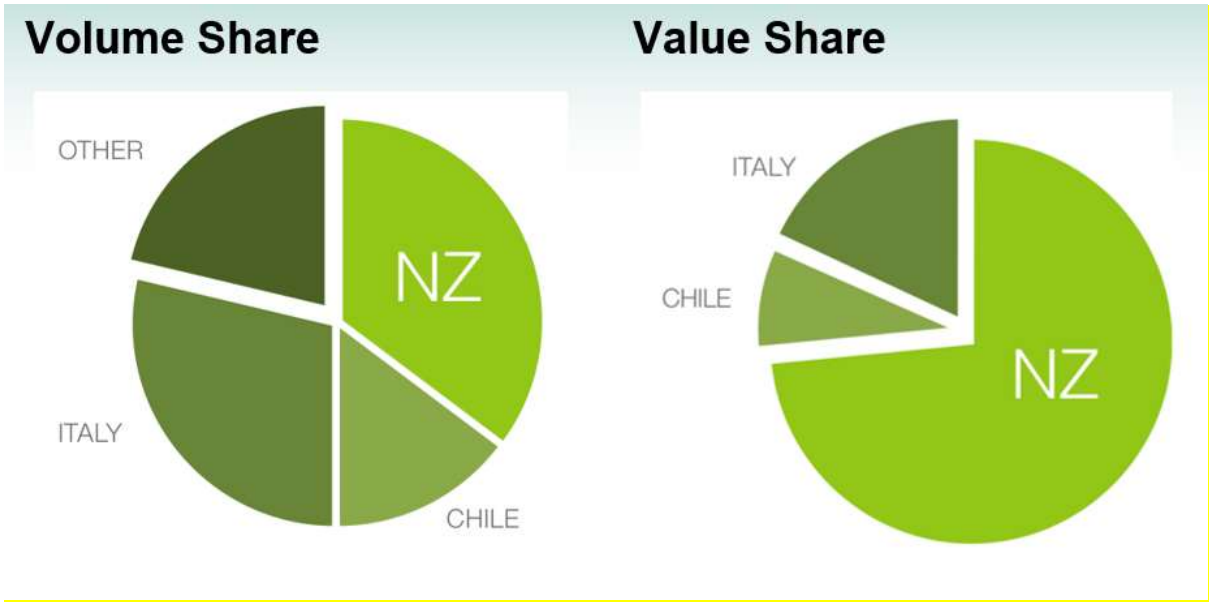


Figure 6: Comparison of volume and value share of the global kiwifruit export market.

2.2 BIOSECURITY

In this section, the following biosecurity topics are discussed:

- International Shipping Routes (Section 2.2.1)
- Brown Marmorated Stink Bug (Section 2.2.2)
- PSA-V (Section 2.2.3)
- Industry response to PSA-V (Section 2.2.4)
- Government Industry Agreement (GIA)(Section 2.2.5)

2.2.1 INTERNATIONAL SHIPPING ROUTES

Worldwide, there is an increasing amount of kiwifruit loaded directly into containers at cool stores, before the containers are trucked to the wharf and shipped to receiving countries. Border officials must ensure that unwanted pests are not being transported to new locations by being lodged in cavities in a container or in soil or debris. The image below shows in yellow the many and varied international shipping routes of vessels entering and exiting New Zealand's ports. Border officials at each port need to be highly vigilant to ensure unwanted organisms which are currently not present in New Zealand do not cross our borders.

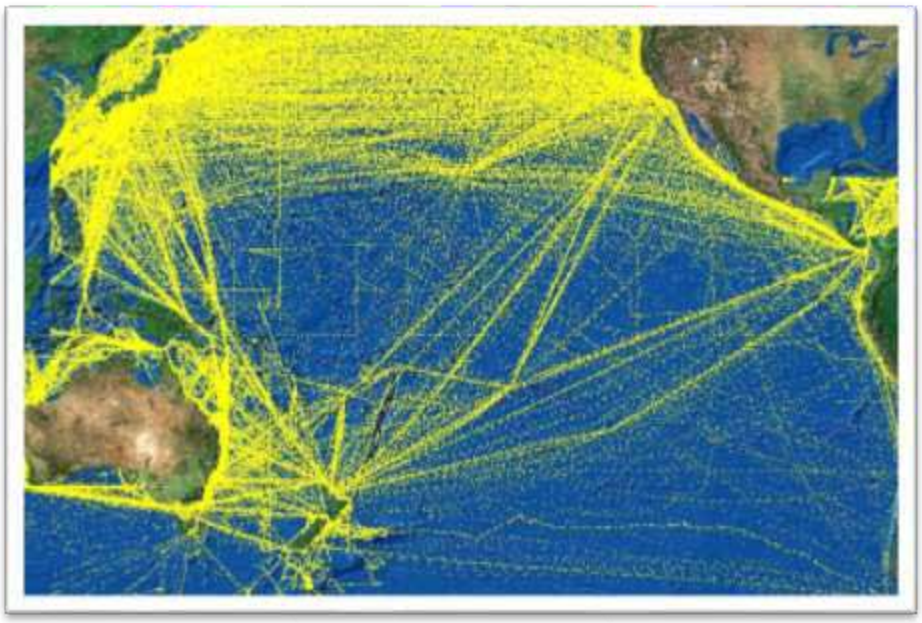


Image 2: Map showing world shipping movements in 2016

2.2.2 BROWN MARMORATED STINK BUG (HALYOMORPHA HALYS)

The Brown Marmorated Stink Bug (BMSB) is the kiwifruit industry's second-most 'unwanted' biosecurity threat after fruit flies; and the risk of it entering New Zealand is now considered extreme. BMSB can hitchhike on inanimate objects such as cars and shipping containers from Asia, USA and Europe. If it were to enter NZ it would have no problem establishing due to NZ's highly suitable climate and abundance of host material. Its entry and establishment would result in significant production impacts to many horticultural industries. Kiwifruit is a host species and BMSB feeding results in fruit drop and post-harvest rot. Anecdotal reports suggest fruit loss could be up to 30% on some kiwifruit orchards.

Identification

The BMSB has a shield-shaped body that is mottled brown with white banding on the antennae and alternating light/dark bands on the outer edge of the abdomen. Its body is 14 - 17mm long and emits a pungent odour when disturbed. BMSB are larger than other shield bugs found in NZ .

Figure 7: Adult BMSB with ruler to indicate large size (left), nymph and egg mass (right).

The white or pale green cylindrical shaped eggs are laid on the undersides of leaves in clusters of about 25. The eggs are only 1mm in diameter but become apparent when nymphs emerge as they stay with the egg mass for several days. Nymphs are brightly coloured with black and white banding on legs, dark reddish eyes and yellow-reddish underbelly with black stripes (Figure 7 & 10).

Signs and Symptoms

BMSB feed on a wide range of plants with seeds or fruit including ornamental plants and vegetables. They pierce the outer surface of the fruit and suck out juices while injecting saliva, this causes dimpling on the fruit's surface and rotting and corking of the flesh (Figure 8). Adults are mobile and readily move from plants with early ripening fruit to ones with later ripening fruit. They seek shelter in houses/protected areas in autumn/winter. Egg masses and nymphs may be seen on the undersides of leaves.

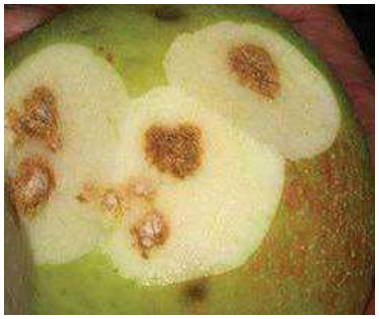


Figure 8: BMSB feeding damage on an apple

Distribution and Climate Range

BMSB is now present across three major continents (Figure 3). It is native to Asia and found in China, Japan and Korea. In 1996 it invaded USA where it rapidly spread and is now present in over 43 states. In 2007 it was detected in Switzerland and has now spread to nine countries in Europe and is increasing in numbers and spreading to rural areas including Italian kiwifruit orchards. South-eastern and south- western Australia and much of New Zealand have been identified as having a highly suitable climate for BMSB.

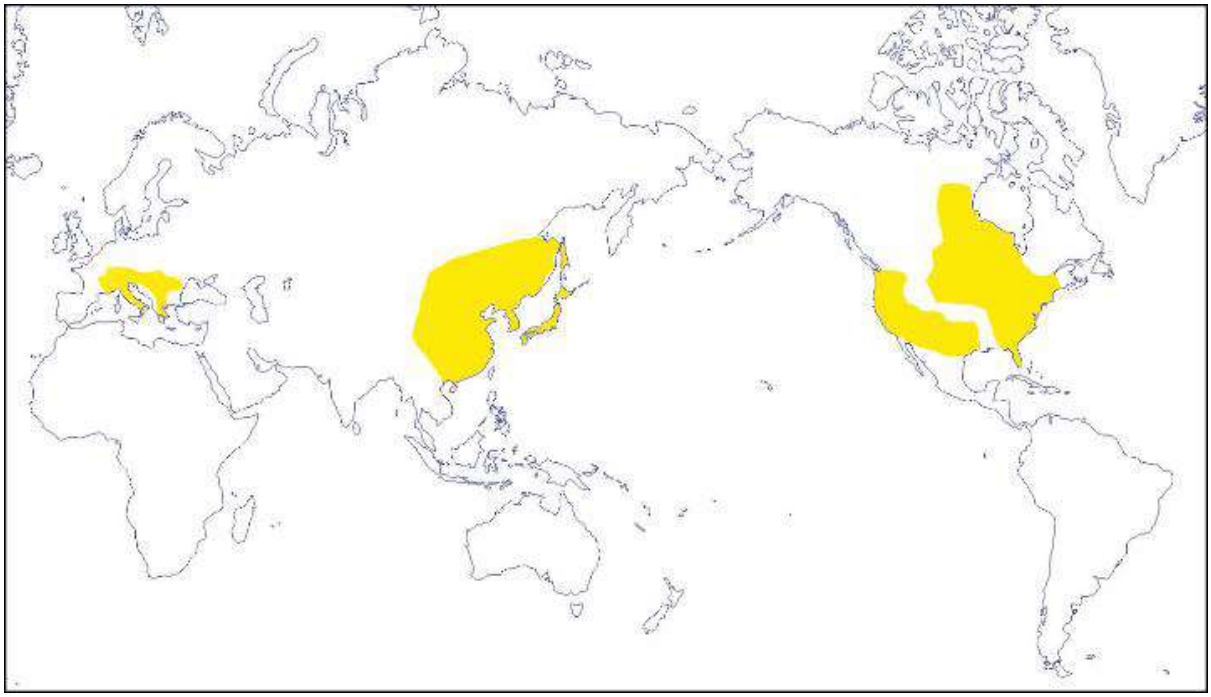


Figure 9: BMSB distribution shown in yellow

Control

Eradication of BMSB is extremely difficult and early detection is crucial for success. While traps are available for monitoring, these are not suitable for use in a surveillance network for early detection, like we have for fruit fly. Therefore, public reporting of suspect finds is critical. Offshore growers manage BMSB by using a range of pesticide or essential oil applications, physical barriers such as netting, traps (light & pheromone) and use of biological control agents. New Zealand is already undertaking pre-emptive risk assessment work to obtain pre-approval for the release of a biological control should we be faced with a breeding population in the future. More details on management practices are available at STOP BMSB, a large program of 50 researchers in the USA www.stopbmsb.org

Figure 10: Nymphal stages of BMSB. Photo W. Hershberger

HOW CAN I IDENTIFY BMSB?

There are currently other species of stink bugs found in New Zealand that could be confused with the Brown Marmorated Stink Bug (BMSB).

Key distinguishing features of the adult BMSB are:

- Its size (14–17mm);
- White banding on the antennae;
- Alternate black and white markings on the abdomen.

If you are unsure, catch it and call KVH. 0800 80 99 66

2.2.3 GIA (Government Industry Agreement)

The importance of being prepared for future biosecurity outbreaks is one of the biggest lessons the kiwifruit industry has learned from Psa-V. Although the industry responded well to the outbreak in late 2010, there is always the risk of another unwanted exotic pest or disease making its way to New Zealand's shores and affecting kiwifruit once again. The industry now has a better understanding of how to manage biosecurity risk, along with more tools to identify emerging risks. There is also a more engaged biosecurity relationship with government and increased capability to respond thanks to the formalising of the Government Industry Agreement (GIA) Deed and Operational Agreements for specific threats.

GIA commits the kiwifruit industry to work with government and other primary sector industries - to improve readiness for future biosecurity events, and jointly respond to future outbreaks. Determining what capability exists within the industry and how we can rapidly deploy this is also a key part of GIA commitments. By signing the agreements, KVH and MPI have committed to doing everything possible to stop another Psa-type event from occurring and working together to achieve the best possible outcomes should there be an incursion. What makes the GIA concept so important to KVH and the kiwifruit industry is that it enables industry and government to achieve better biosecurity outcomes through the work undertaken jointly. Because decision making, costs and responsibilities are shared, all partners can have the confidence that the best decisions are being made about managing biosecurity – there isn't just one group making the big calls.

The agreements set out the contractual arrangements of how industry and government will work together. They establish the operational details for readiness and response activities, include the roles and responsibilities of all the parties before, during and after a response, as well as detail on how joint activities will be cost shared. KVH has so far finalised two separate operational agreements. The first was a multi-sector agreement for the management of fruit fly in New Zealand, which KVH has signed representing the kiwifruit industry, joining MPI as the Government's representative, along with organisations representing the pipfruit, avocado, citrus and vegetable sectors.

2.2.4 Pseudomonas Syringae pv. Actinidiae, (Psa-V)

Psa-V is a bacterial disease that can kill kiwifruit vines. It carries no risks associated with human or animal health and does not affect plants other than kiwifruit vines. The greatest impact from Psa-V was felt in 2013/14 when grower payments were down 17 percent to $800.8 million due to a 55 percent reduction in volumes of Gold

kiwifruit. Growers are now looking forward and there is a general feeling within the industry while Psa-V is here to stay, it can be managed.

Psa-V is a virulent form of the disease and was discovered for the first time in New Zealand on a Te Puke kiwifruit orchard in November 2010. Since then, Psa-V has spread rapidly and now almost 80 percent of New Zealand kiwifruit orchards are affected to some degree by the disease. It has been an extremely challenging period in the industry's history, significantly impacting orchards and kiwifruit production.

Psa-V can spread rapidly through weather events, namely wind and rain, and the movement of plant material. It can also spread through unclean footwear, vehicles, machinery and orchard tools. Psa-V thrives in wet, humid conditions; and multiplies quickly in wet conditions. Therefore, spring and autumn are high-risk periods for Psa-V to spread. The disease slows down in warm, dry conditions like summer.

In an orchard Psa-V can exist as:

- An epiphyte, living on plant surfaces without causing high levels of infection; and/or
- As an endophyte, living within the vine, having entered through natural plant openings or man-made wounds—resulting in severe infection.

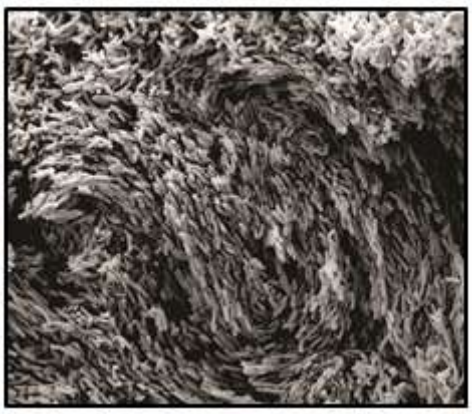


Image 3: (left) Psa-V magnified 6000 times (KVH). Image 4: (right) Psa-V is rod shaped with flagella (KVH/ Plant and Food research).

Image 5: (left) Leaf spotting symptom of Psa-V (KVH). Image 6: (right) Exudate (ooze) coming from a kiwifruit plant is another symptom of Psa-V (KVH).

2.2.5 Industry Response to PSA-V

Media Release

25 May 2016

Todd Muller

MP for Bay of Plenty

Muller welcomes stunning kiwifruit recovery and result

Todd Muller, Bay of Plenty MP says the Zespri result announced this morning is good for growers, good for Tauranga and good for NZ.

"Zespri and the kiwifruit industry need to be acknowledged. It was only a few short years ago the industry was under real pressure and they have turned it around superbly".

"The annual results announced today talk to leadership, discipline and collaboration from the orchard canopy to the supermarket shelves around the world".

"The results across all categories are powerful but the Green result is astonishing".

"That a fruit that has been around for 50 years, and to all intents and purposes at risk of commoditisation, has become through the Zespri system a premium global food brand is the stuff of Harvard Business Reviews".

"It is an industry that is still flat out with their 2016 harvest, but they do collectively deserve to reflect a moment on a job well done".

ENDS

Figure 11: Media release from Todd Muller, May 2016.

The outbreak of bacterial disease Psa-V in 2010 was a severe blow to the kiwifruit industry. Only seven short years ago the industry was seriously questioning its future as the disease rapidly spread and growers watched helplessly as entire orchards were removed. However, the focus of conversation about Psa-V among industry and government bodies nation-wide today is more about the industry's remarkable recovery from it, rather than its grim history.

The past six and a half years have shown that through a coordinated and collaborative approach, the industry has been able to come a long way down the Psa recovery pathway. The success of the industry's recovery has been a combination of many factors, but is underpinned by the replacement of the highly-susceptible Hort16A variety, with the more Psa-tolerant Gold3 variety. Through a combination of research and development, grower innovation and by banding together to share knowledge, an enormous amount of information has been discovered about the disease and how best to manage it.

Growers now have a number of tools and best-practice techniques available to them to help manage the disease and remain profitable in a Psa-V environment. This section will outline some of the initiatives and actions put in place by industry to bring the industry back from the brink of devastation and onwards to new levels of success.

The Establishment of Kiwifruit Vine Health (KVH)

See page 15 for an overview on KVH. For more information, go to www.kvh.org.nz.

Innovation - the development of Psa tolerant cultivars

Plant & Food Research is the sole research provider to the New Zealand Kiwifruit Research Consortium, jointly funded by the Ministry of Business, Innovation and Employment (MBIE) and Zespri. Together they are developing new cultivars of superior quality that command a market premium, with a focus on taste, novelty and convenience. Additionally, new cultivars are bred with tolerance to diseases, including Psa-V. The industry quickly established that Hort16A no longer had a commercial future in the New Zealand kiwifruit industry due to its high susceptibility to Psa-V. As a result, New Zealand growers have grafted across to new, more-tolerant varieties (mainly Gold3) and very little of Hort16A remains in New Zealand. However, all varieties, including Gold3, require proactive management by growers to allow them to successfully grow in a Psa environment. Here is a video outlining the new kiwifruit cultivars which are Psa-V tolerant:

http://www.plantandfood.co.nz/page/news/video-index/video/breeding-psa-resistant-kiwifruit/

Research and Development Programme

KVH, in conjunction with Zespri Innovation, leads a global research and development (R&D) programme into Psa-V. The programme was established in early 2011 and has enlisted the best scientific minds globally to provide solutions for Psa-V. The Innovation team partners with around 20 global researchers to provide the best available expertise to the New Zealand kiwifruit industry. An annual budget of $2 million is allocated to the Psa programme.

For more information about the R&D programme go to: www.kvh.org.nz/psa_RD

Product Testing Programme

The KVH/Zespri product testing programme was developed to identify, rigorously test and get permission from ACVM to use suitable products to help manage and control the spread of Psa-V. To date, more than 300 products have been tested for efficacy against Psa-V in the KVH/Zespri product testing programme. The KVH Recommended Product List is available for growers and includes products with proven Psa-V efficacy and ACVM registration.

For more information about the Product Testing Programme go to: www.kvh.org.nz/producttesting.

For more information about the KVH Recommended Product List go to: www.kvh.org.nz/spray_information.

National Psa-V Pest Management Plan (NPMP)

The NPMP was established in May 2013 to help reduce the spread and impacts of Psa-V. Under the NPMP there are now industry rules governing disease management (including a year round spray programme), monitoring, movement controls and the development of plans. These rules are outlined in a set of KVH Protocols available on the KVH website at: www.kvh.org.nz/protocols_movement_controls.

Kiwifruit Plant Certification Scheme (KPCS)

Long term growth and success of the kiwifruit industry requires biosecurity risks (including Psa-V) to be managed right across the supply chain – this includes kiwifruit nurseries. Over the last two years KVH has introduced the KPCS to reduce the risk of pests and diseases being spread through the movement of nursery plants. By joining the KPCS, kiwifruit nurseries demonstrate they are managing biosecurity risks, have been independently audited, visually inspected for target organisms and returned a non-detected result for a very comprehensive testing regime for Psa-V.

On 1 October 2016 the KPCS becomes mandatory, meaning only KPCS-certified nursery plants may be bought, sold or moved between properties. However, growers may still produce plants on their own property for use on that property; and produce up to 1000 plant for movement between their own properties within the same Psa region. For more information about the KPCS go to: www.kvh.org.nz/kpcs

Orchard Biosecurity

Border biosecurity starts at the orchard gate. Growers are now aware that any equipment, vehicle or person entering their orchard could potentially introduce and/or spread Psa-V, not to mention other pests or diseases. Growers should have robust hygiene practices in place to protect their orchard; and anyone entering orchards should be aware of these measures.

Grower Support and Wellbeing

A large focus during the worst of the Psa incursion was on providing support to people who needed it through community services and workshops available around the regions; and providing information to help people recognise stress and anxiety in their friends, families and colleagues and by providing key contacts for help if they needed it. As a result, growers and the industry have come through the Psa-V crisis with sturdy resilience and the industry's future pathway is looking more positive than ever. A significant support network remains in place and is available for growers dealing with anxiety and depression associated with industry and crisis events.

Kiwifruit grower, Ian Greaves, has recently addressed several primary industry functions about coping with stress during difficult times, drawing on kiwifruit growers' experience with Psa-V. Here, Ian talks to Federated Farmers following the downturn of the dairy industry: https://www.youtube.com/watch?v=KOSGzxgRgDM

2.3 Environmental Sustainability

In this section, the following environmental issues are discussed:

- Growers benefit from sustainability
- Role of soils
- Sustainable nutrient management
- Options
    - Agrichemical use
    - Copper case study
    - PGR Sprays
    - Bactericides
    - Organic kiwifruit
- Environmental impact measurements
    - Carbon footprinting & greenhouse gas emissions
    - Water footprinting

2.3.1 Growers Benefit from Sustainability

Image 7: Measuring the carbon in soil on an orchard (J Troughton).

For many organisations, improved brand and corporate image are considered the major benefit of addressing sustainability issues. The New Zealand kiwifruit industry has also found this to be the case. For example, in the mid- 2000s, global retailers were challenged by non-government organisations to reveal the environmental cost of sourcing products. At that time, kiwifruit was cited as an example of a product that was grown, stored and shipped long distances to be sold in Europe. By partnering with government, including the Ministry of Foreign Affairs and Trade and the Ministry for Primary Industries, Zespri co-funded research on determining the carbon and water footprints for kiwifruit grown in New Zealand and consumed in Europe.

Essentially, the findings highlighted that our environmental impacts were comparable to those of competitors, including kiwifruit grown within Europe. This information was then communicated to our retail customers, where it helped alleviate major concerns about our products. The example above highlighted to our industry that there was a need to better understand the environmental impact of kiwifruit so that we could respond more quickly to any questions related to this topic from the markets or local communities.

Image 8: Kiwifruit Being unloaded at Port of Tauranga (J Troughton).

To this end, Zespri developed a strategy to manage the environmental impact associated with fresh kiwifruit production and consumption. Firstly, the top five globally important environmental impact areas were identified. These areas were greenhouse gas emissions (carbon footprint), water, waste, non-renewable resources and biodiversity. Next we identified and assessed methods to measure the impact of kiwifruit production on each of these five impact areas. This was important as we wanted to use measurements relevant to kiwifruit. These measurements allowed us to identify any environmental risks or opportunities. Tools were then developed to mitigate any risk and exploit any opportunity found. Work has been on-going to transfer these tools to industry.

2.3.2 Sustainable Nutrient Management

Declining freshwater quality and availability has become a global concern. So much so that some of Zespri International's customers like Walmart and Marks & Spencer are sensitive to water-related issues and have requested information on how water is used in the kiwifruit supply chain. Although by world standards, New Zealand has clean and abundant freshwater, freshwater quality in some of New Zealand's rural and urban areas has degraded and is coming under increased pressure as land use intensifies. A major reason for this degradation is the loss of nutrients (e.g. from urine and fertilisers) from farms into waterways.

What is Sustainable Nutrient Management?

When the term 'sustainable nutrient management' is used, it is often in relation to maintaining or improving freshwater quality. The most prevalent problem is *eutrophication* which is the nutrient enrichment of freshwater bodies leading to the growth of unwanted aquatic plants like algae and rooted plants. High levels of nutrients can also be harmful to animals including humans. Agriculture is a significant contributor to this process, particularly in New Zealand, where this sector dominates the landscape.

Nitrogen (N) and Phosphorus (P) are presently the main nutrients of concern and must be carefully managed as the input of these into a water body can significantly affect its quality. Consequently, there is growing social and regulatory pressure to mitigate the impacts of these. Understanding the N and P cycles, and how these can move from land and into water bodies is key to managing these nutrients effectively.

Leaching- What is it and how does it occur?

Leaching refers to the loss of nutrients and other chemicals through the soil with water as it drains through. Climate, soil characteristics, irrigation, and fertiliser practices are the main factors that contribute to leaching from kiwifruit orchards. For example an orchard with a free draining soil where soluble Nitrogen is applied prior to a major drainage event (e.g. heavy downpour) will leach a significant amount of N.

Nitrogen (N) is the main nutrient risk for kiwifruit production on freshwater quality. Simply put, N applied to or already present in the soil is converted to nitrates (NO_3^-), which are readily leached with water as it drains down through the soil profile. Although N is usually available in the soil for plant uptake initially in the form of ammonium, which leaches much less, this is converted to nitrate through the microbial process of nitrification (see Figure 12).

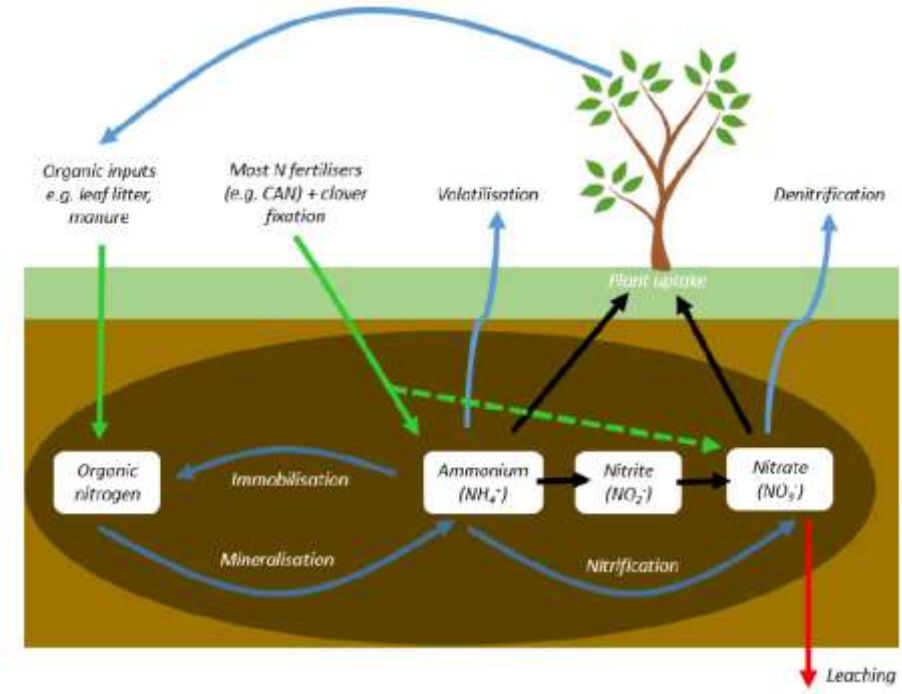


Figure 12: Soil nitrogen cycle for a plant-based system.

How much N is applied to kiwifruit orchards and how much is leached?

Typically kiwifruit orchardists apply 100-150kg N/ha/yr (Nitrogen/per hectare/per year). On conventional orchards, soluble fertilisers like calcium ammonium nitrate (CAN; 27% N) are commonly applied while on organic orchards, relatively insoluble inputs like composts are often used, at 5-10 tonnes/ha. The associated N losses

from kiwifruit orchards are modelled to be typically less than 20kg NO3-N/ha/yr on average (for orchards in the Bay of Plenty where most orchards are located). Such losses are low relative to those from other land uses. For example, losses from some Dairy farms in NZ have been reported to be as high as 80kg NO3-N/ha/yr. Only one study of note has measured N losses from kiwifruit orchards however the results were highly variable. Further direct measurement is being undertaken to clarify N losses from kiwifruit orchards.

As far as ecological and human health concerns are framed, it's the concentration of nitrate-nitrogen (mg N/L, or parts per million) in water that is important, not the loading (kg N/ha/yr). High concentrations of nitrate in drinking water can pose a health risk for certain people, particularly bottle-fed babies who drink formula made with the water. For this reason, the Ministry of Health has a Maximum Acceptable Level (MAV) of 11.3 mg/L (or parts per million) for nitrate-nitrogen. Measured and modelled values for kiwifruit on average have been found to be below this.

Why model and not measure nutrient losses?

Directly measuring nutrient losses from farms is not practical and is expensive. Therefore, models are often used to estimate losses although the values obtained are likely to be less accurate. In kiwifruit, two models called OVERSEER™ and SPASMO have been used as these have dedicated kiwifruit components. OVERSEER™ is the most widely used model in NZ agriculture and is being used to develop nutrient budgets i.e. reports showing the amounts of nutrients added and lost from farms. In some places it is mandatory for OVERSEER™ to be used in order to obtain consent to farm. For more information, visit http://overseer.org.nz

Phosphorus

Phosphorus is the other main nutrient of concern for freshwater quality. Like N, too much P in aquatic environments can lead to excessive plant growth, algal blooms and the depletion of oxygen dissolved in the water. But unlike N, the main pathway for P entering our waterways is via run-off, unless the soils are coarse pumice or sandy in which case leaching could occur. Generally, P losses from kiwifruit orchards are relatively flat and so run off is low. Also, features like shelter-belts impede run off.

Recommended practices for sustainable nutrient management in kiwifruit

In general terms, mitigation of nutrient losses involves applying the right fertiliser, in the right amounts at the right time, and in the right place. Some options for minimising nutrient losses in a kiwifruit orchard are presented below. Growers should consider how these might affect their economic and production objectives.

Plant vegetation around waterways

Plant buffer zones adjacent to waterways act as a last line of defence and will filter nutrients as well as reduce erosion and enhance biodiversity. These zones are commonly referred to as riparian zones.

Minimise bare ground

Plants present in orchards will take up N that would otherwise be leached. Furthermore, having clover present instead of bare ground is beneficial as it will add N to the orchard system because the clover assimilates N from the atmosphere (through the process of nitrogen fixation).

Don't apply when the leaching risk is high

Apply N as late as practical in the growing season, past the wetter winter months. Do not apply when the soil is waterlogged. Applying too late after the plant requires it will impact on production and this N will be prone to leaching if the plant is not taking it up.

Apply only when the plant needs it

First application of the season should be as close to bud break as practical. Applying well before in wetter months, does not advantage N uptake but increases the risk of leaching.

Don't apply too much

Previous research has indicated kiwifruit vines typically required in the vicinity of 150kg N/ha/yr. Fertiliser inputs should match this, and consider the process of mineralisation which can supply from an estimated 50 kg N/ha/yr towards the 150 requirement. Applying higher amounts of N may not necessarily increase production.

Split applications

Some of the N applied in a single application may not be taken up by the plant. Therefore apply around 2/3rd prior to budbreak and the rest in late spring/early summer, prior to fruitset.

Consider less soluble forms of N

Organic fertilisers for example are inherently less soluble and N leaching risk is less. However, they may not deliver sufficient available nutrients to meet fruit production goals. Less soluble forms of synthetic fertiliser are also available however like organic forms they may not supply sufficient nutrient when required and are usually more expensive.

Sustainable Management Practices: How does your region measure up?

For the regions where kiwifruit is mostly grown, freshwater quality is generally stable or improving although some individual measures in some regions have been deteriorating. To view freshwater quality trends for a specific region or catchment, visit the Land Air Water Aotearoa (LAWA) website http://www.lawa.org.nz

For further reading see:

Nitrogen and Phosphorus are the two nutrients of focus:
http://www.horizons.govt.nz/assets/horizons/Images/one-plan-tech-reports-public/nutrient%20loading%20technical%20report3%20-%20final%20draft_Jemmas%20edits.pdf

Best practice fertiliser use. Minimum nitrogen inputs, don't apply prior to lots of rain:
http://www.fertiliser.org.nz/Site/code_of_practice/best_management_practices_considerations/fertiliser_use/best_management_practices_for_nitrogen_use.aspx

2.3.3 Role of Soils

For many growers, the health and quality of their soils is an important consideration in their management activities. Globally, health and quality of soils is also seen as important by consumers, retail customers and society. Reasons for this include the role of soil in supporting food production, filtering of water, supporting ecosystem biodiversity and function in the carbon cycle. Increasingly, retailers are asking producers to provide information on the state of our orchard soils and how we manage them. For the purposes of our sustainability strategy, soil was important to each of the five environmental impact areas. For example, we found that the soil under kiwifruit cultivation captures and stores carbon from the atmosphere. Our soils can store 2.4 tonnes of carbon dioxide-equivalent per hectare, per year more than the greenhouse gas emissions from the energy normally used on the orchard. Depending on sampling depth and soil type, it is possible to store up to 42 percent of the total greenhouse gas emissions associated with producing kiwifruit. Measuring and quantifying the role

of soil carbon in relation to greenhouse gas emission associated with kiwifruit production is assisting industry in getting soil carbon recognised as a way of managing these emissions.

Storage of carbon in our soils as organic matter occurs as a result of how we grow and manage our orchards. Many Bay of Plenty orchards are located on allophanic soils that, due to their chemical properties, are good at stabilising any organic carbon deposited within the soil profile. Kiwifruit vines have a root system that can explore soils at depth, and typically can turnover about 40 percent of their root mass annually. For soil carbon accumulation, this root turnover has two main benefits. Firstly, it can deposit carbon from the roots not remobilised into the plant, and secondly, the channels created by roots that have died back can provide earthworms with deeper access into the soil profile. Pergola- trained kiwifruit vines also maintain a moist soil surface over summer, allowing surface organic matter to be broken down by soil microorganisms, and digested by earthworms or washed into root channels for deeper deposition. Once deposited, this organic matter can improve water storage capacity of soils; reducing the amount of irrigation required or in some cases the need for irrigation. Soil organic matter also plays an important role in reducing the leaching of nutrients, such as nitrogen, and subsequently improving the efficiency of their use, as well as supporting microorganisms that assist in remobilising nutrients from soils for plants. As some food cultivation systems can result in the degradation of soil organic matter and soil function, it is important to be able to demonstrate to our customers the long- term sustainability of our soil resources.

2.3.4 Options

Some growers have concerns that greater interest in sustainability from the marketplace will created compliance issues that may add cost and reduce the choices they have to manage their orchards. Zespri has been proactive in developing tools so that growers have a range of options to manage environmental impacts. Across industry, there are examples of growers applying different techniques to mitigate environmental risks as part of their orchard management activities. Examples include better optimisation of fertiliser application timing and rate to reduce leaching or runoff and improve efficiency. Also, growers are planting riparian zones and steep banks to reduce erosion and sediment flows. Across industry, significant gains in orchard productivity through the introduction of new cultivars and growing methods will also reduce the environmental impact per kilogram of fruit sold in market. Growers are also finding that efficiencies in water use, fertiliser application or energy usage can provide cost savings without significant losses in productivity. As New Zealand kiwifruit growers share their knowledge and experiences on techniques to reduce environmental impacts, the options available to all growers will continue to increase.

2.3.5 Agrichemical use

Agrichemical use in all horticultural systems is required to achieve desirable production outcomes. It is important to understand what and why and also to measure and record the use of agrichemicals. The kiwifruit industry follows best practice guidelines where fertiliser and chemicals are only applied when there are visible signs they are required. The “KiwiGreen” programme is an integrated pest management programme, where orchards are monitored and, depending on the level of a particular pest or disease, a spray may be applied to control that pest or disease. Weather is monitored to ensure that applications do not occur before a heavy downpour of rain when it could be washed off. This programme eliminates the use of unnecessary chemicals, and ensures that when an agrichemical is required, the environmentally safest product is chosen.

Here copper, a commonly used agrichemical in horticulture, is presented as a case study. The case study is split into three parts: a description of copper and what is used for; copper’s ecological impacts; and copper's impact on the health of kiwifruit plants.

2.3.6 Copper Case Study

Copper is registered for use on virtually all food/feed crops as a form of disease control. Copper sprays are used in many horticultural industries to protect foliage and fruit from a range of bacterial diseases. Successful disease control depends on both an even distribution, and good retention of the copper across all plant surfaces. Copper is most effective on those diseases that need water present to develop—such as Psa-V (see chapter 2.2 on biosecurity for more information on Psa-V).

Copper is a bactericide, and it can kill the bacteria on contact. The copper ions travel through the cell walls of the bacteria and disrupt the cellular enzyme activity. It is non-systemic i.e. it is not absorbed or circulated by a plant, it only kills bacteria on the plant surface. As copper is a protectant, it needs to be applied evenly to the plant surface before the disease develops. It is often applied in conjunction with adjuvants that have super-spreading capabilities, to allow better coverage with a lower total dose of copper.

Ecological Impacts

Small quantities of copper are necessary for the functioning of most forms of life, but to most aquatic organisms excess levels of copper are highly toxic. The main cause of copper toxicity to fish and aquatic invertebrates is through rapid binding of copper to the gill membranes, which causes damage and interferes with osmoregulatory processes. The amount of cupric ion in the environment, and its toxicity to aquatic animals through gill damage, is dependent on a number of water quality parameters including pH, alkalinity, and dissolved organic carbon.

Many terrestrial animals have the ability to cope with some amount of excess copper exposure by storing it in the liver and bone marrow. Laboratory toxicity studies have shown that exposure to high levels of copper in the diet can overwhelm the ability of birds and mammals to maintain the stability of their bodies internal environment in response to changes in external conditions. However, animals which are repeatedly exposed to levels of copper which do not cause permanent harm may undergo enzymatic adaptation which allows them to cope with greater levels of exposure. Available data from a honey bee acute toxicity study indicated that copper is practically nontoxic to honey bees.

To reduce ecological exposures, product use labels have been amended, by way of a reduction of application rates, defining application intervals, and determining seasonal maximum application rates. Monitoring weather conditions and minimising spray drift go some way to reducing the non-desirable impacts.

Plant Impacts

Copper (Cu) is considered as a micronutrient for plants. Enhanced industrial and mining activities have contributed to the increasing occurrence of Cu in ecosystems. Excess copper in the soil can induces stress and causes toxicity in plants. This leads to plant growth retardation and leaf chlorosis and/or burning. In kiwifruit vines copper toxicity often appears first in the leaves, similar to many other nutrient toxicities. Some key factors that play a role in toxicity problems are listed below.

- Using products that are not designed as agrichemicals.
- Excessive chemical rates.
- Tank mixing of multiple chemicals.
- Poor tank agitation.
- Slow drying conditions.
- High temperatures during application.
- An excessive use of spreader/super-spreaders at high water rates.

- An excessive build-up of chemicals on leaves.


Image 9: (left) Leaf speckling. Image 10: (right) Leaf burn at the leaf margin.


Image 11: (left) Bronzing of the upper leaf surface. Image 12: (right) Brown staining of leaf veins.

Growers must weigh up the risk of disease killing their vines, the risk of chemical use to the environment, and the risk of phytotoxicity resulting in small, light green leaves that cannot support the development of high yielding high quality fruit.

Zespri works closely with growers to ensure that copper, a critically necessary tool to manage Psa, is used effectively with minimum environmental impact. An upper limit is placed on the amount of copper that a grower can apply in one year and this is closely monitored by Zespri.

2.3.7 PGR Sprays

Plant Growth Regulators (PGR's) have traditionally been banned from all use as part of Zespri's programme due to fruit quality and "market perception" concerns. One of the most common PGR's forchlorfenuron (CPPU) is an effective tool to increase fruit size when applied to young fruitlets. Both Chile and Italy still allow the use of CPPU to assist with increasing fruit size. The consequence of using CPPU to increase fruit size is however lower dry matter and therefore poorer taste. It can also cause issues with the shape and appearance of fruit.

In 2013, as part of an extensive program trialling of hundreds of products, CPPU was found to help reduce Psa-V symptoms in kiwifruit. Exactly how it works to reduce symptoms is not fully understood, however a number of trials have consistently shown it is effective in reducing Psa-V leaf spotting. Based on the Psa-V research Zespri has allowed restricted applications of CPPU to orchards. CPPU must only be applied in early spring before any flowers are open and therefore there are no fruit present. At this time it has been shown to have no effect on

the fruit that develop later and so is not technically being used as a true PGR. To assist with enforcing the timing of CPPU use, every orchard supplying fruit to Zespri is subjected to a residue test. Any application of CPPU when fruit have formed will be detected and the fruit withdrawn from sale.

2.3.8 Bactericides

Following the outbreak of the kiwifruit bacterial infection Psa-V, a number of products were tested for their effectiveness in controlling the bacteria and some are now registered with ACVM to control Psa-V in kiwifruit. An effective compound found was the bactericide Streptomycin. Streptomycin has a history of being used to control fire blight in the apple industry and as such was already approved for use in Horticulture in New Zealand in the form of a horticultural spray called KeyStrepto. The kiwifruit industry undertakes a comprehensive resistance management programme for the allowed Psa-V control products, and bacterial resistance was identified for streptomycin in April 2015. In response to market and customer feedback and also as part of a strategy to deal with antimicrobial resistance, streptomycin was removed from the allowed list of Psa-V control products for the 2016-17 season.

A second bactericide Kasugamycin (which has been used overseas in horticulture) has also been found to be highly effective. The primary advantage of Kasugamycin is that it has no human health or animal application and therefore any potential consequence of resistance developing from its use is relatively minor. With food safety being the number one priority of Zespri, extensive resistance monitoring and residue testing programmes along with strict application procedures are in place to ensure that no trace of Streptomycin or Kasugamycin would ever be found in kiwifruit. The testing and procedures also ensured that no traces made their way via bees used for pollination into honey.

2.3.9 Organic Kiwifruit

Zespri Organic kiwifruit is grown to the strictest organic standards and is certified by Bio-Gro, New Zealand's organic protocol organisation. Consumers are becoming increasingly concerned about how their food is produced and the associated impacts of getting fruit to market. Some consumers look for options that are more environmentally friendly. Global demand for organic produce continues to grow strongly with growth rates ranging from 8 to 12 percent per annum based on the traditional markets of Europe and North America.

There are 537 hectares of organic kiwifruit grown in New Zealand as at July 2016. Organically grown kiwifruit generally has lower average yields than conventionally grown kiwifruit. Zespri aims to sell organic kiwifruit at a premium to non-organically grown kiwifruit. The majority of the fruit produced by organic growers is sent to Europe and North America. Organic demand is emerging in Asia and is aligned to the trend toward safe, healthy food – yet still, this market remains a small niche.

A study undertaken by The Agriculture Research Group on Sustainability (ARGOS) indicates that the environment of kiwifruit orchards is good regardless of whether they are organic or conventional, but that there are some differences between organic and conventional systems that could affect fruit production and quality.

2.4 Environmental Impact Measurements

Prior to the introduction of Psa-V, Zespri worked with a range of public and private research organisations to quantify the environmental impact for kiwifruit production. At that time, the carbon footprint for Hayward kiwifruit grown in New Zealand and consumed in Europe was 1.61kg CO2-eq/kg of fruit. About 44 percent of the greenhouse gas emissions were associated with shipping. The water footprint was calculated to be 458L H2O/kg of fruit for the same fruit grown. However, when we consider the water falling on an orchard during a year versus the amount required by the crop, we find that the environment gains by 150L H2O/ kg of fruit. The amount of non-renewable fossil fuel required for this fruit was 0.3L/ kg fruit. Similarly, the amount of waste kiwifruit produced in this situation was estimated to be 0.19kg waste kiwifruit per kg of kiwifruit consumed.

With regard to waste fruit, it is estimated that about 0.35kg waste fruit per kg of fruit consumed is typical for many export fruit crops.

For biodiversity, it has been estimated that approximately 6.6% of the land title associated with a kiwifruit orchard provides ecological refuge. In summary, growers have an increasing range of tools to assist in reducing reputational risks to the Zespri brand and the industry as a whole in relation to the environmental impact of New Zealand kiwifruit production and consumption. (Mowat, 2015).

2.4.1 Carbon Footprinting and Greenhouse Gas Emissions

"Carbon footprint is the overall amount of greenhouse gas emissions, consisting primarily of carbon dioxide, associated with an organisation, event or production. It is one of the most common measures of the effect of an individual, community, industry, or country on the environment. An increase in greenhouse gas emissions, and therefore in carbon footprint, is the primary event associated with climate change that has led to global warming"(Source:http://www.livestrong.com/article/183436-the-importance-of-reducing-a-carbon-footprint/) Some businesses are interested in carbon footprinting as it allows them to identify efficiencies and in doing so save money. Globally the aim is to reduce greenhouse gasses. Check the links below;

http://www.landcareresearch.co.nz/science/living/sustainable-business/carbon-footprinting/zespri

2.4.2 Water management in the Bay of Plenty

The National Policy Statement for Freshwater Management (NPS-FM)

Water is a vital resource to the kiwifruit industry and NZKGI takes an active role alongside Horticulture NZ in water matters affecting kiwifruit growers. Further, councils around the country are implementing what is referred to as the National Policy Statement for freshwater (NPS-FM) which sets out the objectives and policies for freshwater management under the Resource Management Act 1991. It directs regional councils, in consultation with their communities to set objectives for the state of fresh water bodies in their regions and to set limits to meet these objectives. Regional councils are required to fully implement the NPS-FM no later than 31 December 2025. The image below and set of objectives show how the Bay of Plenty region plans to implement the NPS-FM. The image shows water management areas in the Bay of Plenty, with areas such as Kaituna and Pongakawa which are home to the most intense kiwifruit growing in New Zealand. Water modelling and land use work is currently being carried out those areas.

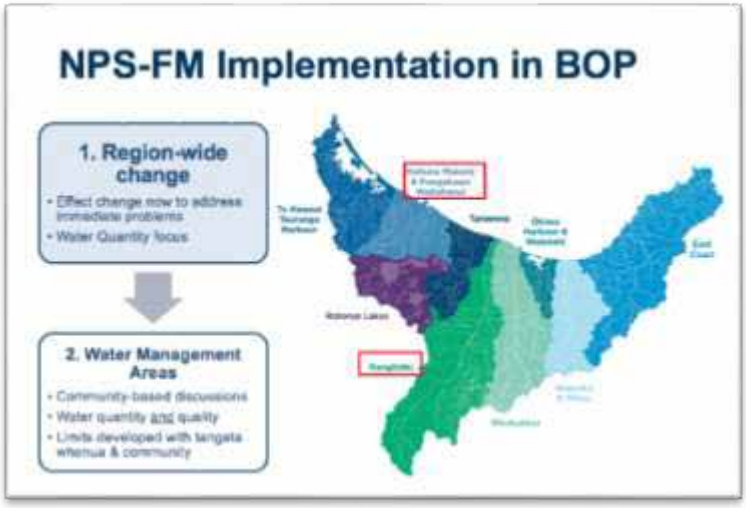


Figure 13: Bay of Plenty regional map and water management areas

Objectives for the Bay of Plenty NPS-FM

1. Safeguard fresh water's life-supporting capacity, ecosystem processes, and indigenous species
2. Safeguard the health of people who come into contact with the water through recreation
3. Maintain or improve the overall quality of fresh water within a region
4. Protect the significant values of wetlands and outstanding freshwater bodies
5. Set limits on resource use (e.g. how much water can be taken or how much of a contaminant can be discharged) to meet limits over time and ensure they continue to be met
6. Determine the appropriate set of methods to meet the objectives and limits
7. Take an integrated approach to managing land use, fresh water and coastal water
8. Involve iwi and hapū in decision-making and management of fresh water

2.4.3 Water Footprinting

The water footprint is an indicator of freshwater use that looks at both direct and indirect water use of a consumer or producer. The water footprint of an individual, community or business is defined as the total volume of freshwater used to produce the goods and services consumed by the individual or community or produced by the business. Water use is measured in terms of water volumes consumed (evaporated or incorporated into a product) and/or polluted per unit of time. A water footprint can be calculated for a particular product, for any well-defined group of consumers (for example, an individual, family, village, city, province, state or nation) or producers (for example, a public organization, private enterprise or economic sector). The water footprint is a geographically explicit indicator, showing not only volumes of water use and pollution, but also the locations (Source: http://www.waterfootprint.org).

This is becoming just as important as greenhouse gas emissions and could become even more important in the future as we don't have an infinite supply of water and the world is fast using it up. This is not so much of an issue in New Zealand yet but it is for our customers who are aware of this issue and sensitive to it.

http://www.landcareresearch.co.nz/science/living/sustainable-business/carbon-footprinting/water-footprinting

http://www.scoop.co.nz/stories/BU1107/S00014/zespri-quantifies-kiwifruit-water-footprint.htm

https://www.zespri.com/companyinformation/newsroom/kiwifruit-water

http://www.radionz.co.nz/news/national/78946/single-kiwifruit-needs-42-litres-of-water,-study-shows

CHAPTER 3: ZESPRI'S ROLE IN THE INDUSTRY

Zespri is acknowledged as a category leader in kiwifruit, managing 30 percent of globally traded volume. Zespri has built a strong reputation through:

- Focus on innovation to develop new varieties, productivity and sustainable growing techniques.
- Developing advanced supply chain systems to distribute premium quality kiwifruit.
- Researching the health benefits of kiwifruit with credible research partners.
- Establishing strong brand awareness and in-market service.

Zespri uses the SPE to underpin its entire operations as depicted in the following diagram. This leads to maintaining their leading global kiwifruit product portfolio. This is done through: brand and marketing, a focus on quality and in market distribution, an integrated supply system, category management and innovation. The aim is to build a sustainable competitive advantage as the industry expands over the coming decade.

Figure 14: Zespri's Long Term Strategy.

Zespri's long-term strategy is divided in this section under its six pillars as follows:

- Brand and Marketing (Section 3.1)
  - Health Marketing (Section 3.1.1)
  - Developing New Markets (Section 3.1.2)
- Quality (Section 3.2)
- In-market Distribution (Section 3.3)
- Integrated Supply System (Section 3.4)
- Category Management (Section 3.5)
- Leaders in Innovation (Section 3.6)
  - Variety Licenses (Section 3.6.1)

3.1 BRAND AND MARKETING

The Zespri brand is immensely valuable for New Zealand kiwifruit growers. It represents all the positive aspects of the Zespri System – great taste, consistent high quality, reliable supply, a healthy product – and presents to consumers all around the world the emotive qualities that enables a connection recognised, trusted and preferred. The Zespri brand holds a specific perception in customers' minds concerning the qualities and

attributes of our kiwifruit product – it is not only related to the tangible aspects, but also to the emotional perceptions.

In the 2016/17 financial year, Zespri invested over $150 million in marketing Zespri Kiwifruit, representing approximately 9 percent of sales revenues. Most of the funds are directed to Zespri's top ten markets – they account for 84 percent of the volume sales, 89 percent of the market contribution and 89 percent of the marketing funds. The marketing plan has very clear guidelines on how to maximise the results and the effectiveness of this investment. Zespri's global strategy has been based on years of consumer research, insight and experience, and focuses on the key criteria that effect a consumer's decision to buy and eat Zespri Kiwifruit. Taste and quality, health and convenience are the top three factors that will drive consumption of kiwifruit.

Zespri's marketing strategy aims to rapidly grow demand ahead of supply. It includes attracting new customers to the category, building penetration among fruit eaters and increasing consumption among occasional and trial users. The marketing plans developed in each country are consistent with the global strategy and highly tailored to the local market conditions –consumers' attitude to fruit, their familiarity with kiwifruit, the level of development and engagement with the Zespri brand, their local language, culture and customs. One of the main reasons Zespri has been able to establish itself as one of the world's leading fruit brands is its 'think global, act local' approach, which makes sure that all communication and activities are relevant for the local consumers.

Investment in the sales and marketing programmes builds the premium imagery of Zespri Kiwifruit and supports the high quality; taste and healthy positioning that consumers know and trust. It enables premium price points, distribution reach and shelf space extension. It brings our consumers closer to us, and as all our growers, suppliers, distributors and retailers would agree, consumers are the most important part of the chain. Marketing a high quality, delicious and nutritious kiwifruit that is safe to eat will ensure our consumers' continued satisfaction and repeat purchase of our wonderful kiwifruit, and turn them all into Zespri fans. (Ward, 2014).

2016 Marketing Campaign: Zespri Green Kiwifruits Are Sweeter Than You Think

Despite being a superfruit, Green Kiwifruits have chalked up a reputation for being sour over the years and this has proved to be one of the top purchase barriers globally. To debunk the age-old misconception, Zespri has launched an entertaining thematic campaign – Sweeter Than You Think – to encourage consumers to give this fuzzy fruit another try.

Kicking off with a series of videos depicting tough guys in a song-and-dance, belting out their stand to look beyond the exterior and discover the sweetness inside – very much like the Zespri Green Kiwifruit, which is sweeter than you think when enjoyed softer and ripe. A central website educates with bite-sized pieces of advice in the form of light-hearted videos and is supported with print, radio, social media and on-ground sampling of ready-to-eat Zespri Green Kiwifruit, all in a bid to drive this message forward.

"Sweeter Than You Think" spans across nine countries in Asia- Pacific including China, Korea, Singapore, Thailand, Vietnam, Indonesia, Malaysia, Taiwan and Hong Kong. Discover the secrets to greater-tasting Zespri Kiwifruits at *www.SweeterThanYouThink.com*

Other examples for Zespri promotion – have a look on YouTube to see some of the examples of how Zespri kiwifruit is promoted around the world.

Singapore: https://www.youtube.com/watch?v=ta0mxNComV4

China: https://www.youtube.com/watch?v=bzGv0tRO66A

France: https://www.youtube.com/watch?v=0iaEs7c-Ups

Malaysia: https://www.youtube.com/watch?v=znWCIwuaWPg

3.1.1 Health Marketing

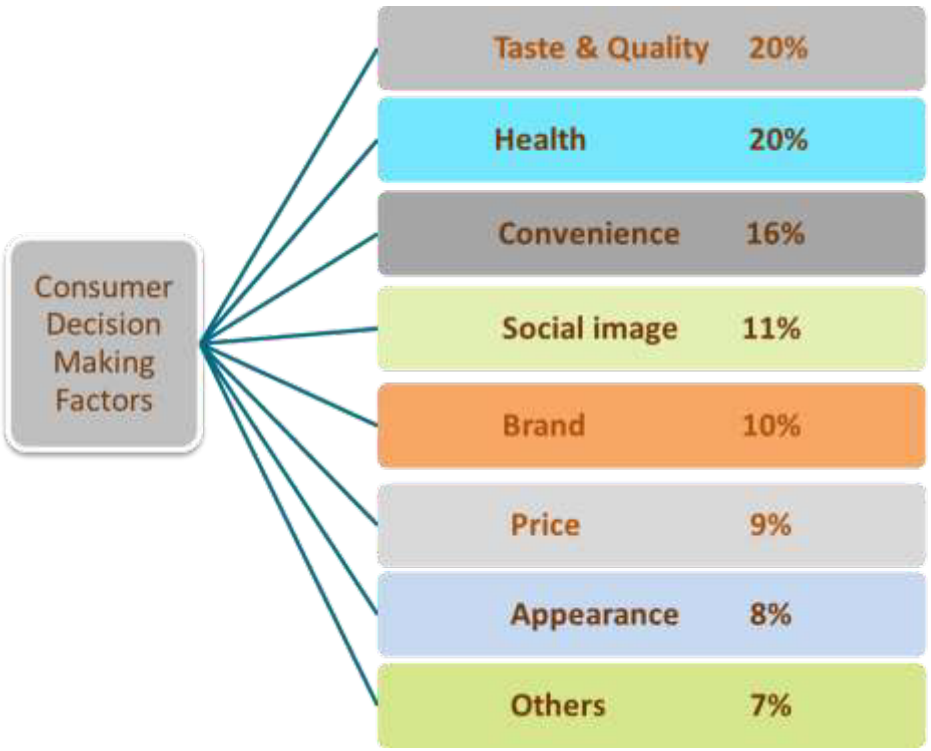


Figure 15: Project Healthy 2007 – Consumer survey understanding why consumers buy Zespri Kiwifruit.

Health marketing is a key part of Zespri's strategy. After taste and quality, health is one of the major reasons consumers buy Zespri Kiwifruit. Zespri has researched the health benefits of kiwifruit for many years and recently these findings were overlaid with what consumers identified with to determine health marketing strategy.

The diagram on page 45 summarises the health benefits of kiwifruit into three pillars. Each pillar represents an area where there is scientific evidence of a health benefit and also is an area that consumers identify with and report being a reason that they purchase kiwifruit.

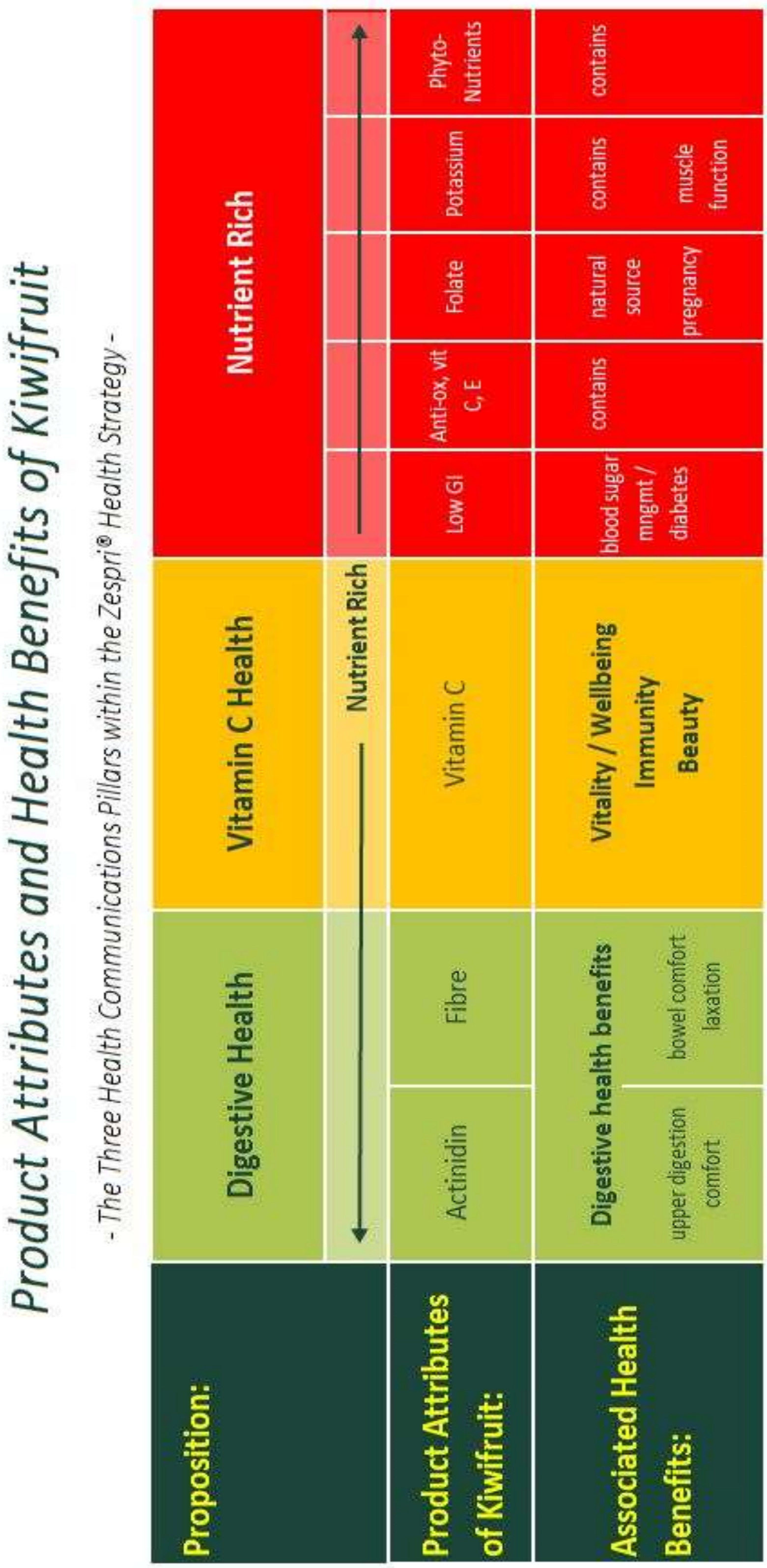


Figure 16: The three health communications pillars within the Zespri health strategy.

Marketing-Promoting the Nutritional Benefits of Kiwifruit

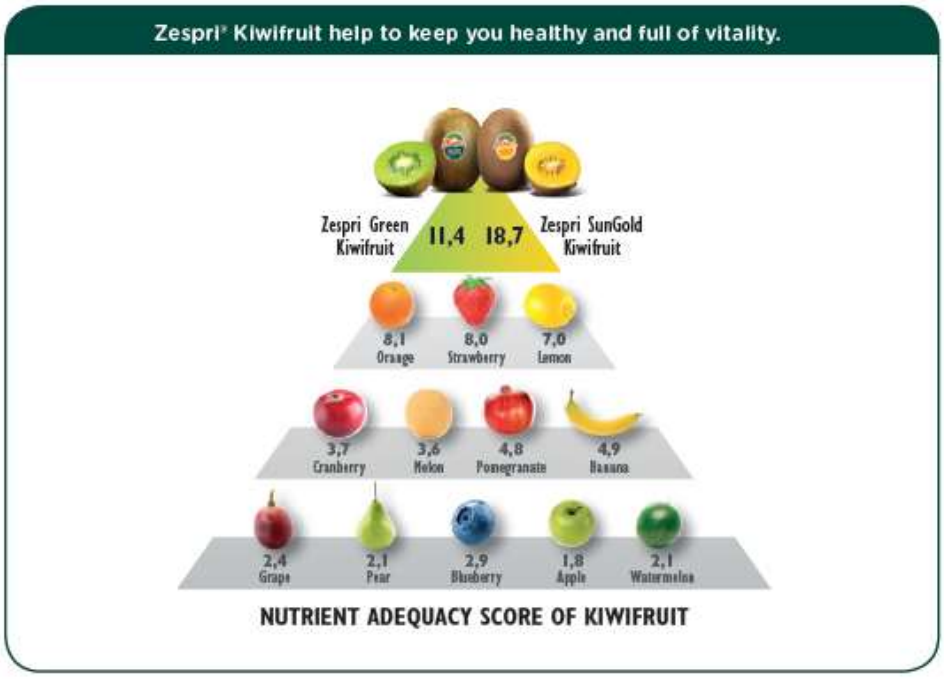


Figure 17: Nutrient adequacy score of kiwifruit.

Actinidin

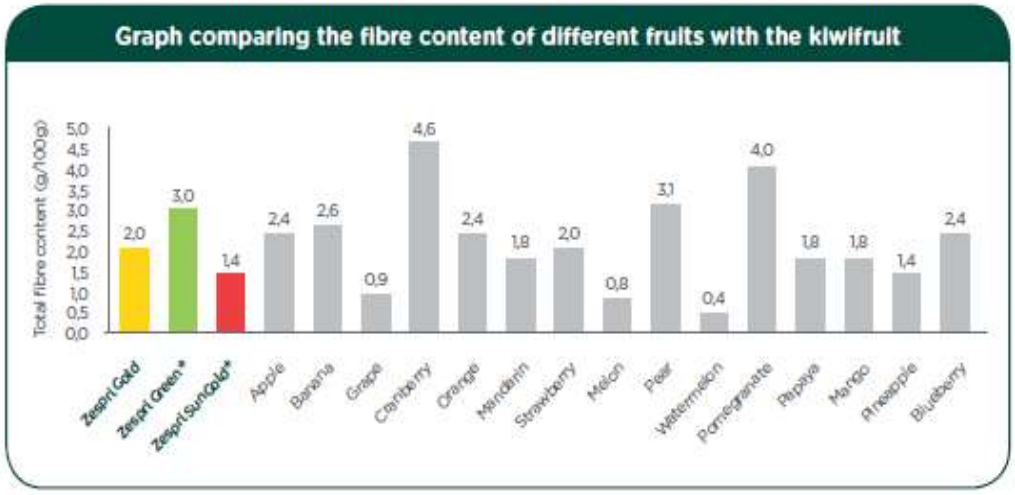
Kiwifruit contains actinidin, a highly-active proteolytic enzyme of the cysteine protease family, so called after the scientific name of the green kiwifruit vine, Actinidia Deliciosa. This enzyme has the ability to hydrolyse a wide range of food proteins more completely and faster than the digestive enzymes can do on their own. Recent in vitro and in vivo studies in rats and pigs have shown that eating green kiwifruit with a protein-rich meal improves the digestion of the proteins, particularly in the stomach. Actinidin can increase the absorption of proteins in the small intestine by improving the gastric digestion of proteins. It has been observed that the presence of actinidin causes a more rapid emptying of the stomach when digesting beef. This means that eating Kiwifruit with a protein-rich meal can offer benefits for people with a compromised digestive system and help reduce the sensation of heaviness and the gastric disturbances typical of protein-rich diets.

Dietary Fibre

Dietary fibre is made up of plant components that reach the intestine without being digested and undergo total or partial fermentation in the large bowel by gut bacteria. Dietary fibre has benefits for digestive health, the regulation of glucose in the blood, and blood cholesterol levels. It also promotes the growth of beneficial bacteria in the colon and helps to control weight. Good quantities of fibre are found in wholegrain cereals, pulses, fruits and vegetables. There are two types of fibre, and both of them are necessary for good health:

- Soluble fibre (pectins and gums): Helps to lower blood cholesterol levels, and can help to reduce constipation. Found in fruits, vegetables, oat bran, barley, flax, seeds, dried beans, lentils, peas and soya milk.
- Insoluble fibre (cellulose, hemicellulose and lignin): The main effect of this type of fibre is

to increase the bulk of the stools and to alleviate constipation and associated problems such as haemorrhoids. Found in the husks of wheat, maize and rice, the skins of fruits and vegetables, nuts, seeds, legumes and wholegrain cereals.

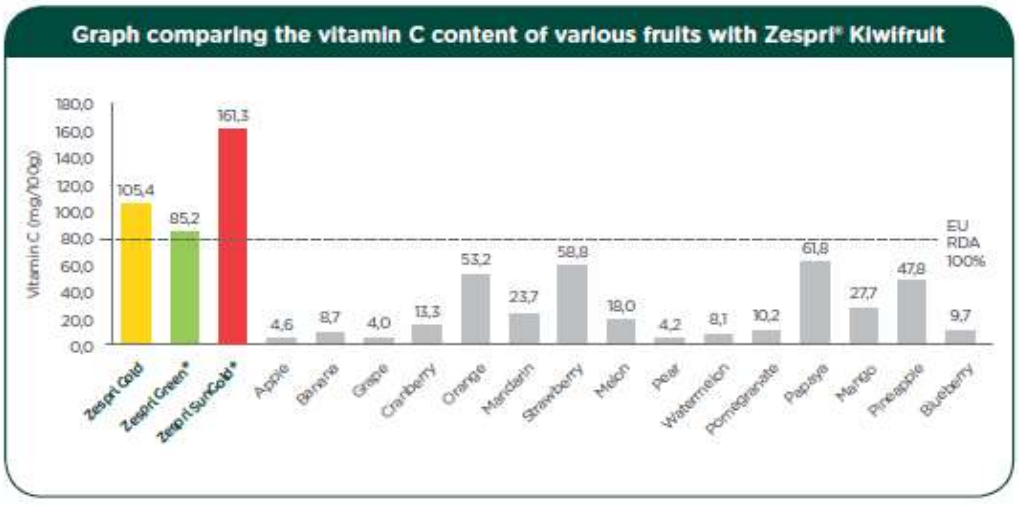


Source: USDA Nutrient Database 2012 (Release 25)
**New Zealand FOODfiles 2012 Version 01*

Figure 18: Fruit fibre content comparison graph.

Vitamin C

Vitamin C is an essential vitamin for human nutrition. It plays a significant role in maintaining good health by influencing various components of the immune system, promoting a general feeling of vitality. Vitamin C helps to activate a number of enzymes in your body that improve metabolic energy levels and different neurochemicals in the brain. This means taking more vitamin C could reduce the sensation of fatigue and increase physical and mental energy. The human body cannot synthesise vitamin C. This means that, in order to maintain good health and vitality, we must regularly eat foods that contain vitamin C. Various fruits and vegetables are rich in vitamin C, and kiwifruit is one of the best sources of vitamin C among fruit and vegetables.



Source: USDA Nutrient Database 2012 (Release 25)
**New Zealand FOODfiles 2012 Version 01*

Figure 19: Fruit vitamin C content comparison graph.

Low Glycaemic Index

The Glycaemic Index (GI) indicates the amount of glucose that is released during digestion from carbohydrates into the blood system.

- High GI **>70**
- Medium GI **55-70**
- Low GI **<55**

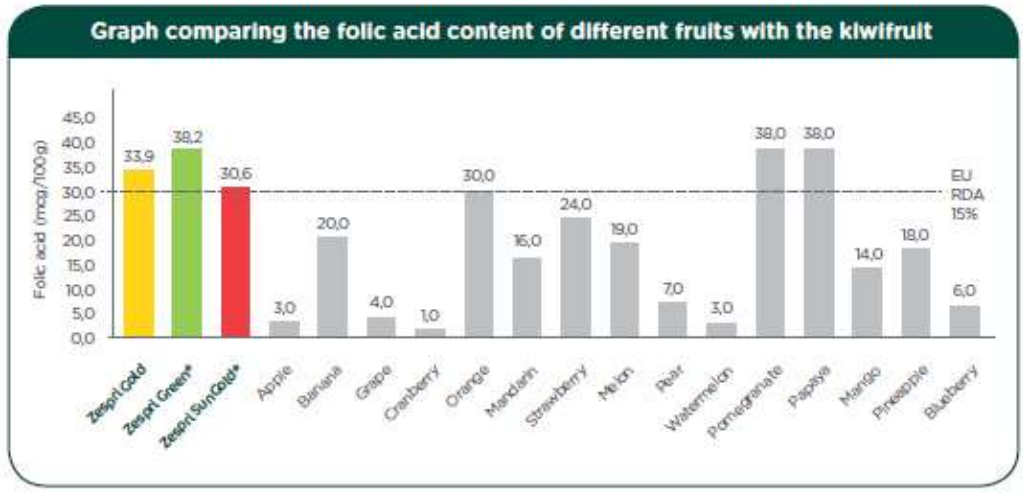
The Glycemic Index (GI) for the three varieties of Zespri Kiwifruit is:

- Zespri Green: **39**
- Zespri Gold: **49**
- Zespri SunGold: **38**

The carbohydrates available in ripe kiwifruit are a mixture of glucose, fructose and sucrose in a proportion of 2:2:1. Of these sugars, glucose has a GI of 100% (the benchmark), fructose 19% and sucrose 68%. There are other factors capable of reducing the speed of absorption of glucose, i.e. the GI. In the case of kiwifruit, it has been observed that the impact it produces on plasma glucose levels is less than its Glycaemic Index – in other words very low. For this reason, kiwifruit is a healthy option for people with a reduced tolerance to glucose, for example people with diabetes.

Folic Acid

Folic acid is an essential nutrient for cellular growth and development, and is vital for the formation of the erythrocytes which transport oxygen, iron and other minerals. Folic acid performs important functions in the healthy body, and sufficiently high levels are needed before and during pregnancy. It is also vital for infant growth. Some of its functions include; growth of tissue during pregnancy, normal formation of amino acids, normal formation of blood cells, normal formation of homocysteine and normal psychological function.



Source: USDA Nutrient Database 2012 (Release 25)
**New Zealand FOODfiles 2012 Version 01*

Figure 20: Fruit folic acid content comparison graph.

Potassium

Potassium is an important mineral for the development of many different body functions. In particular, it contributes to the normal function of the nervous system and is necessary for muscular contraction. Fresh foods such as fruits, green vegetables and cereals or wholemeal bread are generally high in potassium and low in sodium. Kiwifruit is a natural source of potassium.

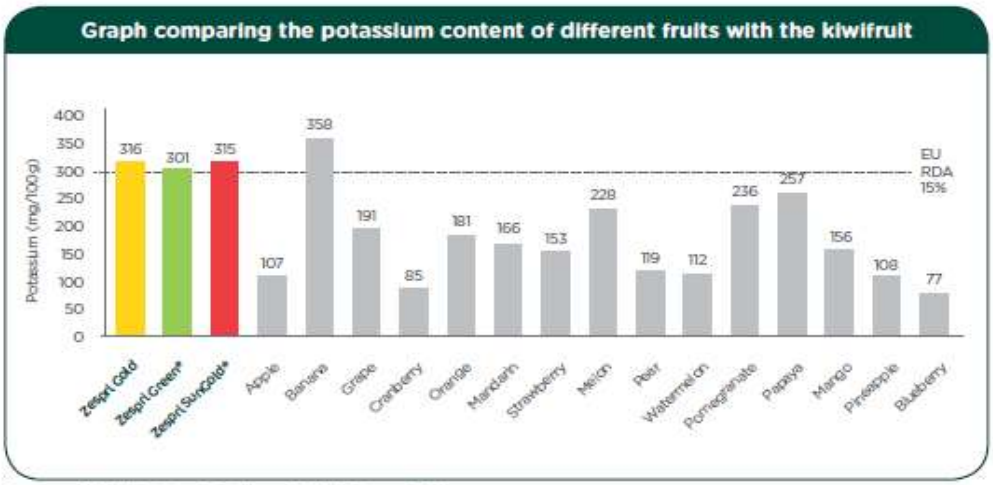


Figure 21: Fruit potassium content comparison graph.

Antioxidants

Antioxidants are found in certain foods and neutralise free radicals, helping to reduce the damage caused by oxidation. Despite the vitamin E levels are not that high in kiwifruit, Zespri Gold and SunGold contain a relatively high quantity of vitamin E compared to other fruit. Research has shown a significant increase in plasma antioxidant measures following the consumption of kiwifruit compared to the consumption of other fruit and foods. Kiwifruit contains a wide range of antioxidants, such as vitamin C and polyphenols. The polyphenols present in both Zespri Green and Zespri SunGold Kiwifruit also have an antioxidant effect.

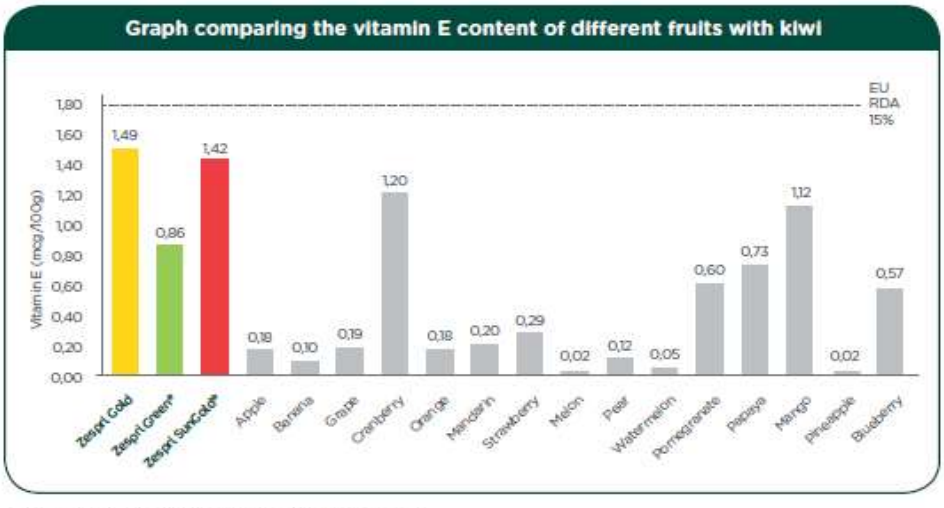


Figure 22: Fruit Vitamin E Content comparison graph.

3.1.2 Developing New Markets

In 2016/2017 Zespri sold 137.7 million trays of kiwifruit (3.55kilo/tray). The dip in production in the graph below during 2011-2013 shows how crop volumes were impacted by the bacterial disease Psa-V. Zespri's challenge is to develop demand ahead of supply to maximise returns to growers. As the graph shows below, Zespri aims to produce 207 million trays by 2025, which will see global sales revenues increasing to 4.5 billion.

Figure 23: Forecast volume growth by category, forecast supply volumes to 2026.

The production of kiwifruit grown in New Zealand is increasing. To maintain value, as production increases so must demand. In 2016, the majority of trays went to The European Union and Japan, followed by the China, Taiwan and the United States of America. (see Figure 24). Zespri's top ten historic markets by volume can be found figure 46 on page 100.

Market	2014		2015		2016	
	Volume	Value	Volume	Value	Volume	Value
European Union	162,832	305,343,361	186,990	350,796,556	200,317	433,219,812
Japan	72,035	238,474,945	85,864	274,510,659	103,839	390,229,542
China	40,909	123,005,867	57,899	199,602,558	93,646	371,369,466
Taiwan	25,979	69,368,492	31,530	100,788,576	39,570	154,124,390
United States of America	9,686	21,472,024	11,182	30,090,378	19,046	58,984,858
Korea, Republic of	17,329	44,300,422	18,880	51,376,244	21,816	56,316,782
Australia	16,444	33,392,197	18,006	41,098,074	17,549	41,736,216
Hong Kong	7,072	21,462,466	7,183	25,636,734	7,898	35,205,294
Malaysia	4,579	11,864,023	5,443	16,845,059	4,909	16,467,863
Singapore	3,541	9,944,022	3,932	12,536,357	3,588	14,630,687

Figure 24: Sales volume by market 2016.

3.2 Quality

Zespri is one of the top-five most recognised fruit brands in many of Zespri's leading markets and is seen to represent quality, great taste, sustainability and food safety. Zespri works with growers and partners to optimise quality, taste, and convenience to support premium positioning. Zespri focus on being able to supply optimal quality throughout the season and continue to lead the category of commitment to food safety and sustainability. A huge amount of effort, across the supply chain, goes into ensuring Zespri kiwifruit that gets to the consumer is of the highest quality. The size, quality, appearance, and taste of the fruit is driven by what the consumer wants and then what growers are realistically able to achieve through modifying their orchard management practices and research undertaken by industry. The following quality requirements are described in this section:

- Fruit size (Section 3.2.1)
- Taste/ (TZG) Taste Zespri Grade (Section 3.2.2)
- Internal colour (Section 3.2.3)
- Appearance (Section 3.2.4)
- Traceability (Section 3.2.5)
- Chemical residues (Section 3.2.6)
- Consistency of supply (Section 3.2.7)

3.2.1 Fruit Size

Fruit sizes range from size 18 to size 42. 'Size' of fruit is relative to weight range which translates into how many fruit fit into a 3.6kg tray e.g. size 18 means that 18 fruit can fit into a tray. This varies slightly by variety. Fruit that is smaller than size 42 is considered to be non-standard supply (NSS). This fruit is either sold on the local market, processed or used as animal feed and only limited volumes of size 46 are required and sold by Zespri. The following table shows the size of fruit the market prefers for each cultivar:

Preferred average size by cultivar:

Cultivar	Preferred average size
Green	33
Organic Green	34.5
Sweet Green (G14)	33.7
Gold3 and Organic Gold3	29.5

Figure 25: Market size preference for fruit by cultivar in 2017.

It is important that fruit size matches consumer demand. Different markets and different customers have a different size preference. Fruit is sized by weight. The size profile of each cultivar is quite different. Gold3 tends to grow quite large while Green14 is much smaller.

Zespri continues to stress that for Gold3, which is a naturally larger fruit, focus must be on taste over yield. In this variety larger fruit have higher dry matter which means it tastes better. Growers need to be aware that some fruit sizing tools, such as bio-stimulants, can increase fruit size but tend to lower dry matter and may in fact be counter-productive in improving taste. Market signals are received by growers by the income they receive for their fruit. Growers will modify their orchard management practices to maximise the amount of fruit they produce of the preferred size range which in turn increases their fruit payments.

Different markets and different customers have different size preferences. It is important that growers produce a range of sizes to meet this demand. Market demand for very large and very small fruit is limited.

3.2.2 Taste (Taste Zespri Grade TZG)

Taste is primarily driven by the amount of sugars and acids in the fruit. Both sugars and acids are detected by our tongues with sugars providing the 'sweetness' and acids giving the tangy, zesty taste associated with kiwifruit. Volatiles given off by the fruit contribute to the flavour and aroma when they are carried from the mouth onto the sensory receptor in the nose as we chew and swallow food. The volatiles are only present in minute amounts, at parts per million, but have a huge impact on the flavour of kiwifruit (Woodard, 2012).

Sugars + Acids = Taste

Taste + Aroma = Flavour

Zespri and New Zealand Kiwifruit growers capture more of the value in market than any other kiwifruit exporter. Achieving this important outcome for growers is achieved by making sure the market signals with respect to taste and quality are reflected in the payments made to growers. One of the measures of taste developed from market research undertaken by Zespri has been the measure of dry matter reflecting the amount of carbohydrates in the fruit. Dry matter (DM) is the dry weight of kiwifruit or the measurement of mass when kiwifruit is completely dried.

In an effort to enhance the overall quality of Zespri Kiwifruit, the Taste Zespri programme was launched in 2001. Taste Zespri Grade (TZG) was originally based on the premise that Japanese consumers preferred a sweeter tasting kiwifruit and were prepared to pay for it. Our objective is for the Zespri-branded portfolio to represent the best-tasting kiwifruit in each segment (Green, Gold, and Red etc.) and for this superior taste experience to be consistently delivered to the consumer. To achieve this objective, Zespri has integrated 'Taste' as a commercial target for improved product delivery. Through consumer research, acceptance and preference thresholds for all commercial cultivars have been established. A maturity criteria programme and payment mechanism have been developed to incentivise growers to grow fruit that is aligned to market requirements.

Minimum Taste Standard (MTS)

More recent research has continued to demonstrate that consumers prefer and are more likely to repurchase fruit above a minimum taste standard (MTS). Repeat purchasing leads to an increase in retail price simply because demand has increased over supply. The MTS is the minimum dry matter of the applicable maturity area for a variety. For Hayward, Hayward Organic and G3 cultivars the MTS requires 70% of the fruit to have a

dry matter result above the minimum. For G14 the MTS is a minimum average dry matter. The MTS of fruit provides a benchmark that growers need to exceed to get fruit into inventory and as the Taste payments growers receive are only made on fruit exceeding the MTS. This standard incentivises and rewards growers for producing the greater tasting fruit that the market requires.

Gold3's MTS has been adjusted in 2017, with an introduction of a taste-by-size model for Gold3. Zespri uses size grouping to reduce the risk of smaller sized poor tasting Gold3 reaching the market. Gold3 size has been found to have a large bearing on the taste so samples are taken at each size grouping. Size groupings are based on count size per packed tray with large size 30+, medium size 33 and size 36, and small size 39 and 42.

Cultivar	Dry Matter average required
Hayward	70% of fruit at or above 15.5%
Gold3	70% of fruit at or above 16.1%
Green14	16.8% or more
Hayward Organic	70% of fruit at or above 15.5 %

Figure 26: Minimum Taste Standard by Cultivar in 2017.

Fruit that does not meet the MTS is not accepted by Zespri for export. This fruit is either processed or used as animal feed. Once dry matter has been calculated it is allocated to the relevant count size and depending upon the distribution of the dry matter a calculation is made to arrive at a TZG figure. Fruit that does meet the MTS will be further segregated into taste bands. There are three taste bands (Y, T, M), Y representing the highest TZG and M representing the lowest TZG. This ensures that customers received pallets of fruit that are consistent in sweetness. It also allows Zespri to target fruit to specific markets to match their taste preferences. E.g. Japanese consumers tend to prefer sweeter fruit compared to European consumers.

Growers are incentivised financially to grow the right taste band fruit. The higher the TZG the grower achieves the greater proportion of the maximum taste payment (MTP) the grower will receive. The MTP is calculated by Zespri and is reflective of higher value that consumers place on a superior taste experience. In the 2013/14 season the MTP for Green was $2.42 per tray whilst the Gold category had a MTP of $9.60 per tray. The grower's TZG is multiplied by the MTP to calculate their taste payment.

As outlined in the orchard practices section of this book there are lots of practices growers can consider throughout the year to increase their dry matter. This includes:

- Increasing the temperature of the orchard (artificial shelter).
- Monitoring crop loads to ensure they are not excessive (thinning).
- Opening up any dark areas of the canopy or areas that may become dark (vine management).
- Summer trunk girdling.
- A close root prune on both sides of the vines. This has given, in both scientific and grower trials, a 1 percent increase in dry matter, on top of a trunk girdle effect.
- Monitoring leaf health.
- Harvesting later.

Delivering taste and consistency

At a high level, there are a number of key components that need to be understood and managed to optimise the delivery of taste and consistency, namely:

1. Cultivar

2. Growing environment, vine management and season

3. Maturity criteria and 'Ship-By' rules

4. Dry matter

5. Sugars, acids and volatiles (composition and change through temperature/time)

6. Physical appearance

7. Curing, storage and ripening regimes (temperature/time components)

8. Value chain and programmes like 'Ready to Retail/Ready to Eat'

9. Market and consumer preferences

10. Taste Zespri evolution and inventory segregation/management

The above list, while not exhaustive, demonstrates the number of variables impacting on the delivery of taste and consistency.

3.2.3 Internal colour

Internal colour must be fully developed and typical of the cultivar. Flesh colour is measured using a chronometer. The standard requires at least 87/90 fruit to meet the minimum colour standard. The 87th fruit is called the fractile.

Cultivar in a 90 fruit sample	
Gold3	Green fractile 112.9^{o} hue
Green14	A Gold fractile of 109^{o} hue

Figure 27: Fruit sample cultivar in 2017.

3.2.4 Appearance

Consumers buy with their eyes so appearance is very important. Zespri sets high standards that must be met for fruit to be sold. Fruit that is free from blemish, stain, physical damage, pitting or dehydration will stand out. Consumers keep coming back for more quality Zespri Kiwifruit because they have to meet such high standards. Standards are also set for fruit shape.

The following is an example of a Zespri standard:

Cosmetic blemishes such as marks or scars on the skin of the fruit may be caused by:

- Skin rub
- Healed physical damage
- Healed hail damage
- Healed insect damage/cosmetic pests
- Fungal damage
- Skin burn
- Chimera mark

There are allowances for some blemishes in the Zespri Grade Standards Manual as follows:

In all classes blemishes which merge with the colour of the skin are acceptable.

CLASS I - Acceptable blemishes are:

- Superficial
- Light in colour provided they do not affect the general appearance of the fruit.
- Total one square centimetre or less in area.

CLASS Family Kiwi™ - Acceptable blemishes are:

- Blemishes which contrast with the colour of the skin and total two cm squared or less in area are acceptable.

Unacceptable in all classes are:

- Black marks
- Significantly deep or raised blemishes.
- Cosmetic pests which are less than 1millimetre in diameter but total one centimetre squared or greater in area.

These are depicted on page 45 in a poster that Zespri Orchard Productivity Centre has developed for growers.

Figure 28: Growing superior dry matter in Zespri Kiwifruit (Zespri, OPC).

3.2.5 Traceability

Traceability is the requirement for Zespri to be able to track the journey of kiwifruit from an orchard to the consumer. This includes what sprays have been applied, where it was packed and when. Traceability is a key requirement for entry into all markets. It is achieved at both a consolidated level of a pallet and at the individual pack level and tracked through the supply chain by the use of a European Article Number (EAN) barcode. Each tray has an EAN barcode applied which, when scanned, links to a system where details of the fruits journey can be viewed. This allows Zespri to determine market suitability of any piece of fruit. This is used to prevent fruit being shipped to markets where it doesn't meet their access requirements e.g. a pest has been identified on an orchard so its fruit is banned from a certain country. Electronic capture also allows for rapid response, location and segregation should it be required at any point. This is particularly critical in issues of food safety where accurate tracking is vital to minimise the volume of fruit that may need to be recalled and disposed of. Customer foods safety programmes all require high levels of traceability and as such is a fundamental market requirement.

3.2.6 Chemical Residues

Agrichemicals are required to manage pest levels to very low levels so fruit meets market access requirements. However, food safety is critical to all customers and consumers and all countries have individual requirements which relate to agrichemical residues. The Zespri Crop Protection Standard (CPS) is actively managed to ensure only approved sprays are used and to minimise the presence of any residues. All lines of fruit are residue tested to ensure adherence to the crop protection standard and ensure that individual market access requirements are met.

3.2.7 Consistency of Supply

Customers require consistent supply of consistent product to be able to provide consumers with a reliable source of high quality and high taste kiwifruit 12 months of the year. Capturing and keeping shelf space full is key to the customer relationship and maximises the value to all parties while reducing the New Zealand grower's risk of competitor replacement. Market planning and shipping programmes all attempt to keep supply available for as long as possible. During the early part of the season when supply is limited markets are only started when there is sufficient fruit to allow for continued supply.

Having a product with a long, reliable storage life greatly assists being able to provide consumers with a good eating experience over a long selling season. Sales to customers may continue 6-7 months from harvest and final retail sales can extend for another month after that. For both New Zealand growers and for in-market customers having practically all the volume consolidated through one seller in Zespri provides a mechanism to give a high level of assurance of consistent supply.

3.3 In-Market Distribution

Zespri sell into more than 50 markets worldwide and work with distribution customers and partners, who buy fruit from Zespri and get the product into wholesale markets and onto the supermarket shelves. From the wharf, the fruit goes into dedicated coolstore distribution centres and on to thousands of wholesale and retail outlets. Zespri serve distribution and retail customers with the optimal balance of Green, Gold and Organic products.

Zespri is dedicated to its customers and is focused on consistently providing excellent product and excellent service. The Zespri System, the integrated production and distribution system used to deliver the world's best kiwifruit to consumers worldwide, is one of the foundation blocks of the Zespri Brand. It is the culmination of many years of scientific, technical and practical developments and an uncompromised commitment to continual improvement.

The Zespri System recognises that quality has many components, but they all rely on a combination of Best Practice, excellent product and documented assurance to provide customer confidence. It has been developed in recognition of customers' needs for a comprehensive assurance that fruit has been grown and handled safely with:

- A strong focus on good agricultural practice.
- Environmental and economic sustainability including the efficient use of natural resources.
- Integrated Pest Management.
- Orchard to retail traceability.
- A socially responsible approach to workers and the communities it supports, practices that maximise fruit quality, taste and storage potential of the fruit.
- Leading edge Good Manufacturing Practice throughout the postharvest and distribution sectors of the industry.
- An understanding of current and future market and customer needs.
- World class Quality Management systems.
- Certified food safety and Good Agricultural Practice (GAP) systems.
- Quality specification and measurement throughout the supply chain.

- Comprehensive feedback systems to ensure that customer feedback drives continual improvement. (Zespri, 2014c).

https://www.youtube.com/watch?v=UtIwp6DsfXg- 1 min length

https://www.youtube.com/watch?v=Tmfb0VgjN1U-3 min length

https://www.youtube.com/watch?v=hKOj_Wikq_A -10 min length

Visit www.freshfacts.co.nz for the latest industry statistics and find out how kiwifruit compares with other horticultural exports such as pipfruit. Also have a look at the 2016/17 Zespri Annual Report and Review available on their website www.zespri.com.

3.4 Integrated Supply System

The development of Zespri's supply chain and service offering is a key focus. Supply chain efficiency is expected to unlock significant value for the industry in future years; many opportunities exist in the supply chain design space with the application of new supply chain management processes and technologies for improving product quality attributes.

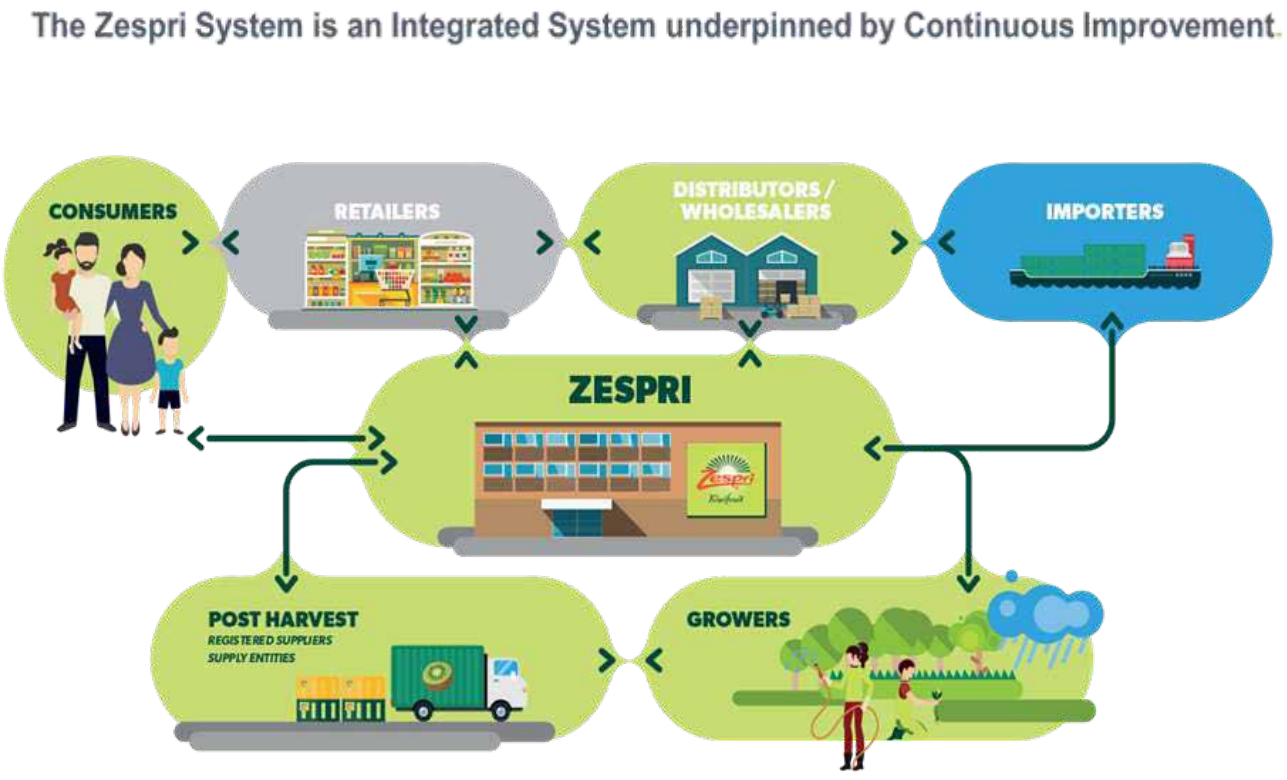


Figure 29: The Zespri System.

Zespri Global Supply business is a source of Zespri's competitive advantage and a key part of Zespri's "category management" work stream. Non-New Zealand supply is poised for strong growth in the five year planning horizon, driven predominately by Gold3 recovery in Italy, and ability to procure Zespri Green from Italy to meet rising global demand. Read more here:
http://www.zespri.com/companyinformation/newsroom/increaseitaliansungold

The strategic focus of ZGS is to consolidate non-NZ supply as a fundamental pillar of Zespri's competitive strength, underpinning its position as a leader in the global fruit industry. Zespri's aim is to unlock value in the business by leveraging the brand, intellectual property and supply chain expertise.

Zespri currently sources non NZ supply from Italy, France, Japan, and South Korea and is assessing the capability to supply a premium quality kiwifruit grown in China, and developing supply partnerships to underpin a sustainable long-term business.

12 Month Supply

12 month supply refers to the procurement and marketing of Northern Hemisphere or early Southern Hemisphere kiwifruit (when New Zealand fruit is not available in market) to complement the sale of New Zealand kiwifruit. 12 month supply is an important part of Zespri's business strategy and a key source of Zespri's competitive advantage. Specifically it strengthens Zespri's New Zealand kiwifruit business by continually building the brand and strengthening global relationships.

The benefits of Zespri offering 12 month supply in a market are:

1. To partner with our distributors in kiwifruit 12 months of the year and demonstrate consistent quality and standards, irrespective of origin, to support their strategic objectives and add value to their businesses.

2. To maintain shelf space 12 months of the year – ideally to be the kiwifruit category manager, by offering confirmed volumes and quality for the full year, as opposed to seasonal competitors from other countries who cannot provide such reliability. This allows more flexibility for volumes of New Zealand kiwifruit to be placed in the best position to maximise returns.

3. To maintain brand presence 12 months of the year such that when New Zealand kiwifruit comes into markets, it is not fighting for shelf space with earlier seasonal produce or seeking to displace other produce that is available 12 months of the year.

4. To grow branded products over 12 months rather than just in the New Zealand supply window. This is critical from a category growth perspective, i.e., apples, tomatoes, and bananas are all available 12 months of the year.

5. In growing regions, having a local presence enables Zespri to better manage the pressures placed on distributors and retailers to support local product, by supporting the domestic kiwifruit community, which in most cases are not competitive to Zespri's New Zealand supply windows; further this enables Zespri to maintain the quality standards for the category as a whole in that market.

In addition there are other benefits to the New Zealand grower as well outside of the market benefits, such as:

1. Growing in both the Southern and Northern Hemisphere locations allows the New Zealand industry to learn and innovate at twice the pace. This benefit was very evident during the height of Psa where time was against the industry and the learning's needed to be adopted as quickly as possible.

2. ZGS is a "stand alone" business unit that is allocated a portion of overhead costs from other business units, thus allowing for better utilisation of corporate overhead spend.

3. By having activity across 12 months of the year creates a platform to retain core staff; seasonal roles can create staff turnover and an associated loss of experience within the organisation.

As other kiwifruit brands begin to build momentum and aim for 12 month supply, Zespri needs to maintain a continuous supply strategy and build brand awareness or risk losing future market share to emerging brands. With the plethora of new cultivars grown globally by competitors, it is imperative Zespri retains a strong presence in the market place 12 months of the year to position NZ kiwifruit strongly and retain strong customer and distribution relationships. Zespri 12 month supply enhances consumer loyalty and strengthens the position of key distribution partners, when increasingly competitive alternatives are emerging. Therefore, as Zespri Northern Hemisphere supply volumes grow the benefit to New Zealand growers is also increasing.

3.6 Leaders in Innovation

Zespri's innovation investment aims to create value across the supply chain from breeding to consumer. To do this Zespri invests across five innovation platforms:

- New cultivar development (breeding and advanced selections)
- Sustainable production systems (on-orchard productivity, crop protection and biosecurity)
- Sustainable delivery of fruit (food safety and market access, fruit physiology, taste and quality, engineered supply chain)
- Value addition and creation (health and nutrition, convenience, consumer understanding)
- Research investment in Psa-V management tools and techniques continues, integrated across the on-orchard productivity and crop protection portfolios.

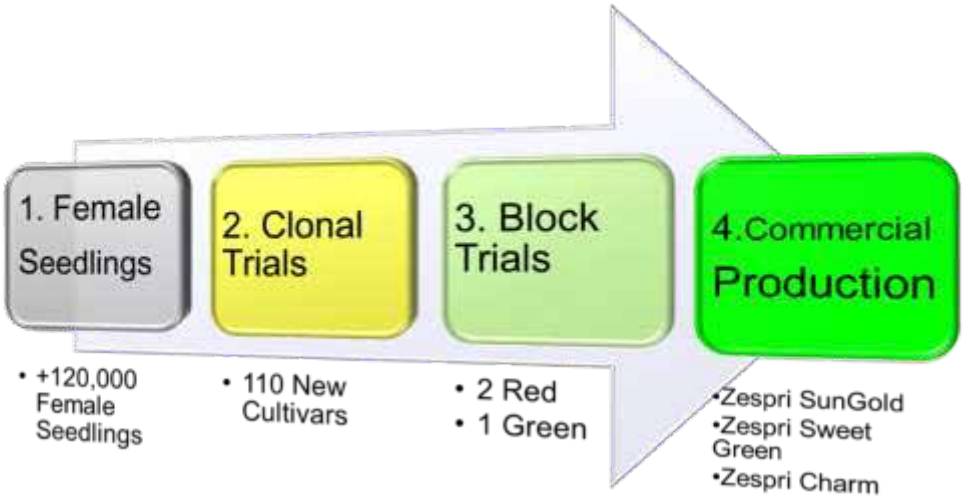
New Cultivar Development

Kiwifruit come from the Genus *Actinidia* and the New Zealand commercialised cultivars from both the *Deliciosa* and *Chinensis* species. All *Actinidia* species are perennial climbing plants (vines) and almost all species are deciduous (some are only partially so) (Ferguson, 1990). There is greater genetic diversity in kiwifruit than there is for apples. New Zealand researchers have been collecting kiwifruit genetic material over several decades and now have the largest selection of kiwifruit genetic material outside of China. New Zealand has a kiwifruit vine library planted in Te Puke, New Zealand that is used to breed different cultivars based on research into what future consumers will demand.

Figure 30: An example of different types of kiwifruit cultivars planted in Te Puke.

Figure 31: Zespri and Plant & Food Research 'Breeding Pipeline'.

In 1997, the first Gold kiwifruit cultivar was launched and it was a very successful alternative variety to Hayward. Zespri Gold was bred by Plant & Food Research and commercialised and marketed by Zespri in 2000. Zespri Gold was the first gold fleshed kiwifruit available in the market in the world. In economic terms Zespri had 'first mover



advantage' which led to price premiums in the market that have been extremely profitable. Since Zespri Gold was commercialised, it has led to an economic benefit to New Zealand of over $4 billion. Prior to the bacterial disease Psa incursion Zespri Gold also generated more than $525 million in annual global revenue (Anon., 2010).

Figure 32: Zespri Gold.

Zespri has an operating agreement with NZ's Crown Research Institute (CRI) for Plant & Food Research. Plant & Food Research is responsible for the parental development of kiwifruit cultivars, and supplying the tools associated to speed up the Breeding Pipeline. In the breeding pipeline currently there are over 120,000 female seedlings, 110 new cultivars, two red and one green cultivar in block trials and three cultivars in commercial production.

For a new cultivar to progress through the new cultivar pipeline it needs to exceed product attribute thresholds. The product attributes include taste, nutritional composition, fruit size, shape and skin type, pest and disease resistance, harvest timing and storage keeping ability.

Zespri is responsible for new cultivar development including commercialisation of new cultivars. In June 2010, three more cultivars were commercialised, known as Gold3, Gold9, and Green14. Gold3 and Gold9 were developed to extend the Zespri Gold market window. Green14 has green flesh with higher sugar content than 'Hayward' and was bred to establish a new market segment.

Figure 33: Picture displaying Zespri's current commercial cultivars. From left to right: Organic Green, Organic SunGold Green, SunGold, and Sweet Green.

The key commercial cultivars for New Zealand are Hayward (Green), Gold3 (SunGold), Green14 (Sweet Green), and Organic (both Green and SunGold). Also still produced but in declining numbers due to Psa, is Hort 16A. Check out this link for more information www.zespri.com/varieties . The combination of a single marketing desk and commercialised cultivars has led to the kiwifruit industry becoming a billion-dollar fresh kiwifruit exporter. Further extensive plant breading continues to be undertaken.

The De-commercialisation of G9

In 2010, Charm (G9) joined the Gold variety mix as a high taste fruit with expected long storage characteristics. The variety was relatively easy to grow and had high yields. In early production it became clear there were issues with the fruit shrivelling which was deterring buyers from purchasing the fruit because they believed the fruit was deteriorating. This shrivel issue did not disappear as the vines got more mature so a decision was made to de-commercialise the variety. Growers were able to transfer across to the other Gold variety Sungold (G3) which had shown strong resilience to Psa V.

3.7 Variety Licenses

Since the commercialisation of Gold3, Gold9 and Green14 in June 2010, a total of 5,500 hectares of licensed varieties have been allocated to New Zealand kiwifruit growers. Approximately 60% (1,500 growers) of New Zealand growers grow at least one or more of Zespri's licensed varieties on a kiwifruit property that they own, totalling 1,800 orchards that grow a licensed variety. All growers that grow a Zespri licensed variety are bound by a Zespri Kiwifruit Variety License which gives growers the right to acquire plant material for growing a variety within the licensed area. Below is a sample license agreement between Zespri and the Grower.

Parties

1. ZESPRI GROUP LIMITED ("ZGL")

2. ("Grower")

BACKGROUND:

A. ZGL owns the kiwifruit variety named in Appendix A, together with all associated proprietary and plant variety rights to such variety.

B. ZGL has agreed to grant the Grower limited rights to grow this Plant Material within the Licensed Area and to sell the Fruit resulting from it strictly in accordance with this Agreement.

AGREEMENT:

ZGL grants to the Grower, and the Grower accepts, a licence to grow Plant Material within the Licensed Area and to sell the Fruit resulting from it strictly in accordance with the terms and conditions set out in this Agreement.

EXECUTION:

Signed for and on behalf of ZESPRI GROUP LIMITED by

Signature of Authorised Signatory

Name

Position

Date

Signed for and on behalf of the GROWER by

Signature of Authorised Signatory

Name

Position

Date

SAMPLE

Figure 34: Sample License Agreement between Zespri and the Grower

Zespri Variety Licenses – SunGold License Release

Significant investment is made by Zespri into a breeding programme that focusses on increasing returns to growers through the development of profitable new cultivars. Showing early signs of tolerance to PSA, there has been two license release rounds for the SunGold Variety. 400 hectares of SunGold licence was released in March 2016 and a further 400 hectares in 2017. If global demand continues, 400 more hectares of SunGold licence will also be released in 2018 and 2019.

CHAPTER 4: ORCHARD DEVELOPMENT

There are around 13,500 hectares of kiwifruit vines that have been established in New Zealand over the last 100 years. The development of kiwifruit orchards has significantly advanced over this time period, particularly in the last 10 years. This chapter identifies important aspects of orchard development including:

- Support Structures (Section 4.1)
- Shelter (Section 4.2)
- Irrigation (Section 4.3)
- Frost Protection (Section 4.4)
- Rootstocks and Grafting (Section 4.5)
- Stringing (Section 4.6)

4.1 SUPPORT STRUCTURES

Kiwifruit vines need to be trained onto a support structure for commercial cultivation. The most commonly used support structure is the pergola system. Historically vines have been grown on a T-Bar system which was cheaper to construct and easier to maintain. However, greater yields are achieved on pergola structures and most orchards are now grown using the pergola system.

Image 13: A young kiwifruit vine growing on pergola system (Shane Max, Zespri OPC).

Image 14: (left) Grafted kiwifruit stumps with pergola structures and wires in place ready for training (Shane Max, Zespri OPC). Image 15: (right) Kiwifruit growing on a pergola system.

Image 16: (left) T-Bar grown kiwifruit vines. Image 17: (right) T- Bar to Pergola conversion kiwifruit vines (Shane Max, Zespri OPC).

4.2 SHELTER

It is important to have shelter established before kiwifruit vines are planted. Good shelter raises orchard yields through improved growth, better pollination and export quality fruit. Crops produced in well-sheltered blocks can also have significantly less rejects due to wind-rub, especially skin sensitive Gold varieties. In reducing damage to kiwifruit vines, the likelihood of Psa-V infection is also reduced. Apart from reducing wind damage, good shelter reduces wind speeds and can increase orchard temperatures. Reducing wind speeds reduce evapotranspiration, decreasing how much water the vines require in windier seasons. Cold temperatures during flowering/fruit set can reduce bee activity, restrict the growth of pollen tubes, and prolong flowering and slow fruitlet growth, all impacting final fruit size.

Types of Shelter

Natural shelter (e.g. tree shelterbelts) is used extensively in New Zealand. Natural shelter is cheap to establish, but it takes time to establish. Kiwifruit vines need the most protection when the vines are developing and if natural shelter is being grown at the same time as young kiwifruit vines it does not provide adequate protection. Natural shelter comes with regular maintenance costs, including trimming mulching and spraying for pests. It also takes up productive land area.

Artificial windbreaks can be used to increase shelter while not limiting light and still maximising productive land area. Artificial shelter is more expensive to install than natural shelter, but gives an immediate solution, rather than waiting for natural shelter to establish. There are also fewer ongoing maintenance costs.

Overhead shelters hang above kiwifruit vines. Overhead shelters have an expensive outlay cost but the financial rewards can be significant. The benefits include:

- reducing the impact of a hail event to nothing provided the cloth is in good condition;
- a significant reduction in wind speed;
- elimination of wind turbulence;
- reducing leaf wetness and vine damage minimising the spread of Psa and risk of Psa infection;
- and improved pest control.

Growers have reported improved pest control with the elimination of susceptible shelter species that can harbour pests such as Leafroller, Scale and Passion Vine Hopper. There are also reports of improved cicada control in using overhead shelter as emerging adults do not like the enclosed canopy and immediately fly to one end and attempt to exit (Stokes, 2014). There is ongoing research on the use of overhead shelter and its impact on bees.

Image 18: Trees planted for natural shelter (Shane Max, Zespri OPC). Image 19: (right) Internal shelter helps to keep temperatures up reduce wind and improve the growth of developing vines (Shane Max, Zespri OPC).

Image 20: The erection of hail netting over an orchard. In this instance the structure also has enclosed sides.

Image 21: (left) Perimeter artificial shelter (Shane Max) Image 22 : (right) Internal artificial wind breaks have removed the need for natural shelter and so increasing the productive area (Shane Max, Zespri OPC).

4.3 IRRIGATION

Young developing vines require constant watering to help develop healthy leaf growth and root systems. Irrigation requirements are variable throughout New Zealand. Soil type is a significant factor in determining how much and how often a block of kiwifruit is watered. Soils with a high proportion of pumice will drain quicker

than soils with a high proportion of clay and will be watered more frequently. Kiwifruit vines that run short of water especially during phases of rapid growth will wilt and the leaves will quickly go brown (Sale, 1990). Kiwifruit vines suffering from drought will produce smaller fruit and excessive drought can reduce the follow seasons yield.

Excessive irrigation, particularly in clay soils, can also be detrimental to the productivity of kiwifruit vines. If the roots of the kiwifruit vine remain under water for too long then they effectively drown. This is termed 'wet feet'. Excessive wet feet can reduce fruit quality and yield due to the reduced root system.

Irrigation can also be used as tool to increase fruit size prior to harvest. This is managed with caution by growers because although water increases the fruit size it also reduces the fruits dry matter. Growers are paid using both of these measures. Irrigation can also be used for frost protection.

Image 23: Sprinkler used for irrigation (Shane Max, Zespri OPC).

4.4 Frost Protection

Nearly all the horticulturally significant frosts in New Zealand are of the radiation type. Radiation frosts occur on nights with clear skies and little or no wind. As heat is radiated away from the surface of vegetation (or other objects) the surface cools and draws heat from the plant material and the surrounding air. If suitable conditions persist, the temperature of the plant material falls to a point where irreversible damage occurs to the plant tissue.

Image 24: (left) Severely frost damaged kiwifruit leaves (Shane Max) Image 25: (right) Ice on kiwifruit (Shane Max).

Frost damaged fruit are not edible or saleable and frost damage to vines can negatively impact productivity of kiwifruit vines the following season.

4.4.1 Methods of Frost Protection

A wide range of methods are presently used to protect horticultural crops against frost damage, and can be loosely grouped into three main classes; directly heating the vines, mixing the air to disturb the temperature inversion and the use of a radiation barrier.

Heating

Actively heating the area may employ specially designed burners known as 'frost pots'. Frost pots are fuelled by oil, natural gas, LPG or by special solid fuel blocks or candles made from wax, compressed wood waste or other similar materials.

Sprinkler-based frost protection systems are most common and use the heat released when water changes state from a liquid to a solid. Spraying water at an appropriate rate onto a crop under frost conditions causes a layer of ice to slowly develop over the vines. Provided the surface of this ice layer is kept wet, the temperature of the enclosed plant tissue will not drop below about minus half a degree, even though the surrounding air may be at a much lower temperature.

Image 26: (left) "Frost pot" Burner used to heat orchard area. Image 27: (right) Sprinklers used for frost protection (Shane Max, Zespri OPC).

Mixing

A wind machine is essentially a large fan (with a horizontal axis) which rotates around the top of a 10 or so metre tower, located in the centre of the area to be protected. The 'jet' of air produced by the fan entrains the warm air from above the orchard and mixes it into the colder air closer to the ground.

Flying a heavily laden helicopter at relatively slow speed across the orchard area can also effectively mix the air and provide frost protection, but has the advantage over wind machines of being able to concentrate on selected areas if required, and to fly at greater elevations to provide added mixing capability.

Image 28: (left) Windmill Used for frost protection (Shane Max) Image 29: (right) Helicopters used for frost protection.

Radiation barriers

The principle of a radiation barrier is to reduce the heat radiated from the vines and soil surface, and hence increase the vine temperatures. This is achieved by intercepting the outgoing radiation by means of frost cloth, fog or some other radiation barrier (Riding, 2004).

Image 30: Overhead shelter (Shane Max).

4.5 Rootstocks and Grafting

Grafting is the joining of two plants to create desirable characterises expressed in one plant. Female kiwifruit vines are generally not one type of kiwifruit cultivar. A female kiwifruit cultivar is grafted on top of another type of female kiwifruit cultivar. The plant on the top is called a scion and the plant on the bottom is called a rootstock. The scion is chosen for the fruit it produces (e.g. Gold, Gold3, Gold9, Green14, Green). The rootstock is chosen for desirable characteristics such as tolerance to their roots being wet for long periods (known as 'wet feet').

The rootstock can also impart its characteristics on to the scion, such as reduced vigour. Reduced vigour aids in reduced pruning costs but it also takes longer for vines to establish.

There are a number of rootstocks used and the most common is 'Bruno'. Bruno has been used for many years due to its strong vigour and Psa tolerance. Less common rootstocks include: Hayward; Kaimai; Hort16A; and Bounty. Hayward is less vigorous and can produce fruit that is more variable than Bruno when it is used as a rootstock. Both Kaimai and Hort16A are highly susceptible to Psa. Bounty, a more recently bred rootstock, has Psa tolerance and appears to tolerate dry conditions as well as wet feet. The choice of rootstock can also impact on the timing of the vines development throughout the season (phenology). Gold3 budbreak and flowering can happen a week earlier when grafted onto Bounty compared to Bruno. This has financial implications for those growers whose fruit is early enough to make the first shipment of fruit to market. Bounty is less vigorous than Bruno and requires higher planting densities to speed up full-canopy establishment.

There has been extensive re-grafting in the kiwifruit industry post Psa to remove the most susceptible cultivars and replace them with the most tolerant ones. There are a number places on the vine that can be grafted, they include: notch grafting (side graft); stump grafting; and sucker/rootstock grafting. When the grower has decided where to graft, the type of graft is chosen. These include: kerf (chainsaw) grafting; cleft grafting; and whip and tongue grafting.

Mid-winter is the best time to begin grafting and should be completed by late winter. The grafting success rate declines once sap flow starts (sap flow can also be termed bleeding where there is exudation from cuts. Bleeding is less likely when plants are dormant). The timing of sap flow depends upon a number of factors including weather conditions, soil moisture and the chosen rootstock. Sap flow normally lasts six to eight weeks.

Summer grafting is possible but sap flow must be carefully managed. Summer grafting is generally not as successful as winter grafting and is usually only used when abnormal conditions exist. For example, there may be high rate of grafting failure in winter, or there may be high levels of Psa infection. The earlier summer grafting is undertaken (November) the better the subsequent growth.

Post grafting care and graft hygiene are of the upmost importance when it comes to insuring graft success. New shoot growth is vulnerable to damage from birds, leafrollers, bronze beetle, slugs and snails. It is important to keep the base of stump free of weeds and use slug pellets around the base and on top of the stump. When using insecticides, wet-able powder sprays are least likely to damage new shoots and emulsifiable concentrate formulations are the most likely to cause damage.

The links below show some of the grafting methods outlined above.

www.youtube.com/watch?v=4lkpc7pv41g

www.youtube.com/watch?v=QV4AICjPUlE

4.6 Stringing

Many orchardists, during the conversion or establishment stages of orchard development, employ a management practice called stringing. This is when new leaders and canes are grown up strings. This causes lots of rapid vegetative growth that fills the canopy area and allows growers to move into production sooner. After the development stage stringing is not often used as it reduces the ability of protective sprays (e.g. copper) to penetrate the canopy.

Image 31: (left) Kiwifruit vines growing up strings. Image 32: (right) Kiwifruit block step up for growing up strings (Shane Max, Zespri OPC).

Image 33: Pergola kiwifruit block set up for growing up strings (Shane Max).

CHAPTER 5: ON ORCHARD MANAGEMENT PRACTICES

This chapter is diverse, covering a range of orchard management practices. Firstly, the New Zealand kiwifruit growth cycle is explained and basic orchard management practices are identified. Lastly, an overview of management issues is provided, such as labour and the adverse events that may occur on an orchard.

- New Zealand Kiwifruit Growth Cycle (Section 5.1)
- Vine management – Pruning (Section 5.2)
    - Winter pruning (Section 5.2.1)
    - Summer pruning (Section 5.2.2)
    - Zero leaf pruning and tip squeezing (Section 5.2.3)
- Budbreak (Section 5.3)
- Pollination (Section 5.4)
- Thinning (Section 5.5)
- Girdling (Section 5.6)
- Root pruning (Section 5.7)
- Labour (Section 5.8)
    - RSE Workers (Section 5.8.1)
    - Health and Safety at Work Act 2015 (Section 5.8.2)
- Adverse Events (Section 5.9)
    - Hail (Section 5.9.1)
    - Floods (Section 5.9.2)
    - Pest and Disease Control (Section 5.9.3)

5.1 NEW ZEALAND KIWIFRUIT GROWTH CYCLE

The growing season for kiwifruit is long: up to 240 days. The New Zealand season begins with vine pruning in winter (June), which immediately follows the previous year's harvest. During the winter months (June to August) the vines lay dormant, allowing growers the opportunity to remove last season's fruiting canes and to select and tie down new canes which form the foundations for new growth.

Springtime (September to November) sees the kiwifruit vines begin to grow again. New shoots appear on the canes along with the first flower buds. When the flowers blossom, bees get to work pollinating the flowers. Pollinated female flowers transform into fruit.

As summer starts (December to February), kiwifruit vines undergo tremendous growth and growers frequently prune the vines to direct growth and manage the canopy (the canes can sometimes reach up to 5 - 6 metres in length during the growing process). The fruit grow quickly and crop volume can be estimated. Growers selectively thin kiwifruit to optimise fruit size and taste (generally the less there are, the larger and tastier they grow).

As the weather cools in the New Zealand autumn (March to May) harvest time approaches. The kiwifruit are tested for ripeness and when they pass a certain criteria for quality and grade, the kiwifruit are carefully picked by a huge team of workers many who come from overseas to assist. Once the kiwifruit have been picked, they are transported to the packhouse to be packed and stored ready for shipping and export. As the winter approaches, the leaves drop from the vines, signalling the end of another growing year. The vines move towards a dormant state and await the coming of spring (Zespri, 2014a).

Kiwifruit vines require sunshine, water, rich free-draining soil, winter chilling with an ideal soil pH between 5 and 6.8. To be productive, commercial crops requires significant management. Vine training, pruning, pollination, shelter from the wind and pest and disease control among other things all have a significant impact on the profitability and productivity of the crop. These management practices impact the size and the dry matter of fruit and the market acceptance of the fruit.

Season	Winter			Spring			Summer				Autumn	
	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY
	Dormant		Bud break			Flowering	Fruit set		Fruit growth		Leaf fall	
	Winter prune		Bud break sprays	Bud and flower thinning + pollination		Male prune	Canopy management + thinning + girdling				Harvest	

Figure 35: The New Zealand kiwifruit growing cycle showing the vine growth stage and orchard management practices on a seasonal basis.

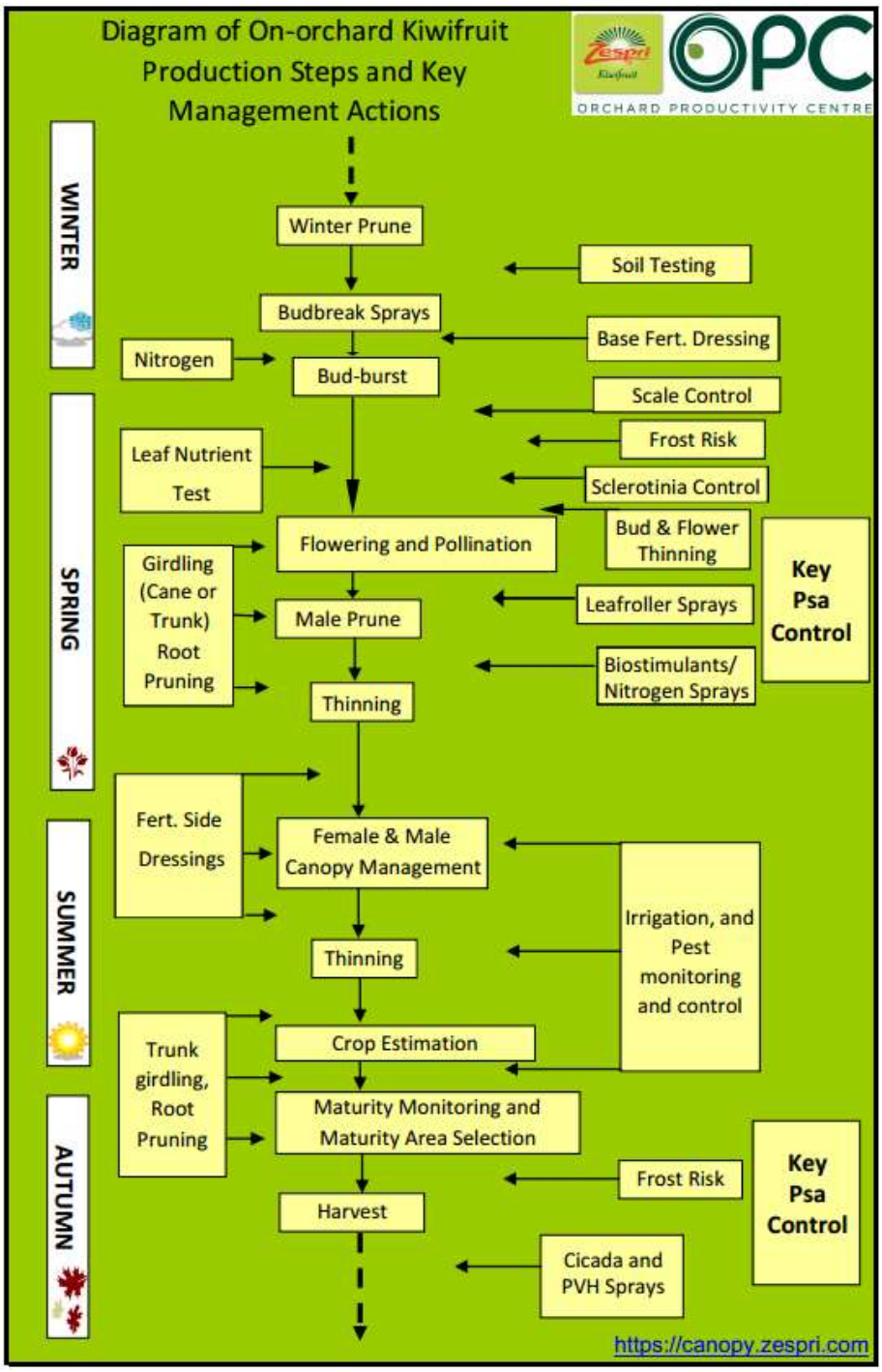
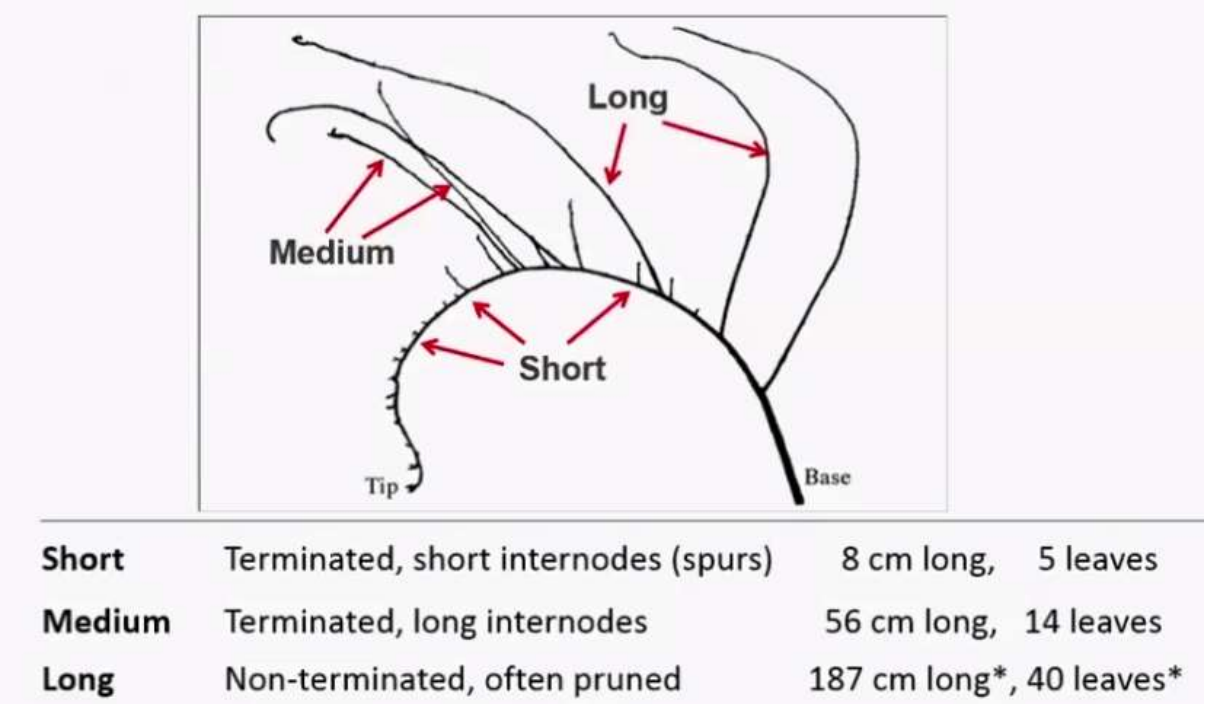


Figure 36: On- orchard kiwifruit production steps and key management actions.

5.2 Vine Management – Pruning

Pruning is one of the most important aspects of vine management and plays a major role in getting a consistent, quality yield each season. Successful management depends on good open pruning to prevent the vines becoming dense and tangled (image 30 and 31). Open pruning allows space for bees during the flowering period, penetration of sprays , air movement around the vines, and penetration of light throughout the vines to minimise the conditions which favour fungal disease such as Botrytis.

Open vines also provide adequate light needed to ripen the fruit and mature the fruiting canes for the following season. It is only under conditions of reasonable light penetration that new fruitful shoots will originate from the desired points on or close to the main leader (Sale, 1990). Good light levels and vital for dry matter and sugar level production in the fruit, it aids fruit size and enhances the storage life of the fruit. Figure 30 below shows an example of the different types of fruit wood that growers need to manage.



Short	Terminated, short internodes (spurs)	8 cm long, 5 leaves
Medium	Terminated, long internodes	56 cm long, 14 leaves
Long	Non-terminated, often pruned	187 cm long*, 40 leaves*

Figure 37: Shoot types.

5.2.1 Winter Pruning

Winter pruning can constrain orchard performance if it is not carried out correctly. Winter pruning is done after harvest when vines enter dormancy. The aim is to set up bays with optimal high quality winter bud numbers on canes that are evenly spaced throughout the canopy.

Canes are tied down immediately after pruning. Even spacing has a great influence on the performance of the canopy the following summer. Consistent canopy density will reduce variation in fruit attributes (e.g. size, dry matter). The aim is to fill the canopy so there is an even cane spacing and no gaps. Even cane and spur spacing results in a consistent summer canopy that produces optimum fruit size and dry matter (climate and summer vine management allowing) and is easy to manage and achieve good spray coverage.

Image 34: An even spread of high quality winter buds (Shane Max, Zespri OPC).

5.2 2 Summer Pruning

Summer pruning involves removing excess vegetation from the vine during the growing season to: ensure good light levels on the fruiting canopy; ensure quality fruiting wood is produced for next year's canopy; and to allow good spray coverage. The removal of excess growth also helps to prevent tangles and aids the development of next year's canopy which should in turn help to reduce work load and costs of winter pruning.

Why are light levels important? Good light levels will keep all the leaves in the canopy functioning which will: enhance dry matter and sugar levels in the fruit; improve taste; maximise fruit size; and enhance the storage life of the fruit. An open canopy will also improve airflow and spray penetration, reducing the risk of pests and disease.

Image 35: (left) Grass growing beneath an well- maintained open light canopy (Shane Max, Zespri OPC) Image 36 :(right) Poorly maintained with low light levels have led to shading and leaf drop (Shane Max, Zespri OPC).

The key to summer pruning is timing. Timing depends on a number of factors, including but not limited to: vine age; orchard environment; climate; canopy vigour; fertiliser use; the layout and structure of the orchard; and the size of the block. These factors will vary between and within orchards.

Key considerations for achieving good results from pruning are:

- To tip non-terminating shoots in the fruiting canopy to approximately four to six leaves past the last flower. The best time to do this is just as the earliest shoots begin to tangle.
- Vigorous excess canes will compete with fruit growth and increase shading.
- Terminated shoots do not need to be cut or shortened as these will not continue to grow or cause shading and are potentially the best cane to leave for next year's fruiting wood.
- Late growth (after flowering) should be removed as canes grown before flowering as often the most fruitful.
- Shaded cane or spurs need to be removed, as wood that is exposed to sunlight will always produce more flowers and better quality fruit.

- Canes growing back over the leader need to be removed as they are not optimal for vine structure and growth.


Image 37: (left) Regrowths and tangles in gold kiwifruit (Shane Max, Zespri OPC). Image 38 :(right) A non-terminated cane is shown on the left and a terminated cane on the right (Shane Max, Zespri OPC).

5.2.3 Zero- Leaf Pruning and Tip Squeezing

Both zero-leaf pruning and tip squeezing are management practices that are used to help maintain optimal light levels.

What is Zero-Leaf Pruning?

Is to prune selected fruiting shoots just above the last (distal) fruit on a lateral so that there are no axillary buds from which secondary re-growth can develop. It helps manage excessive vine vigour and maintain good light levels within the fruiting canopy. If this technique is done correctly the vines aren't too vigorous and virtually no re-growth will occur from the zero-leaf pruned shoot. This technique is primarily done to save on pruning costs. However, increases the risk of Psa infection due to creating a soft tissue wound. Studies have shown that it doesn't have a negative impact on fruit quality but it is also unlikely to improve productivity or fruit quality (Patterson, 2013).

What is Tip Squeezing?

Tip squeezing involves damaging the growing tip of actively growing shoots that would otherwise not self-terminate in spring and early summer. Tip squeezing prevents the shoot extending past a manageable length. Unlike straight pruning or removal of the tips which can stimulate secondary growth from lateral buds, tip squeezing leaves the shoot tip damaged but not broken, maintaining suppression of secondary growth while disabling the extension of the shoot (Max, 2012). If undertaken, tip squeezing is conducted several times (approximately five times dependent on canopy vigour) throughout spring and summer and minimises the need to summer prune.

5.3 Budbreak

Kiwifruit are dioecious. This means that the pistillate and staminate occur on separate plants (male and female reproductive organs are on different plants). This makes pollination and the mix of male and female plants vitally important to achieving economic success. Successful pollination requires a sufficient number of male and female flowers which in turn requires a sufficient number of buds to have broken into blossom.

For buds to break into blossoms requires a certain amount of cold weather. Unlike our European counterparts New Zealand's major kiwifruit growing region, the Bay of Plenty, struggles to get enough cold weather to cause a sufficient amount of buds to break without special attention given by the grower. Low budbreak results in low flower numbers and low flower numbers result in low yields.

Growers have a variety of mechanisms to get sufficient yields of high quality fruit, these include:

- Selection of high quality replacement cane in spring and removal of poor quality growth.
- Bud thinning – defect buds are removed before they develop into flowers to conserve plant carbohydrates.
- Fruit thinning – defect fruit are removed as soon as possible to ensure allocation of carbohydrates to high quality fruit.
- Girdling – Reduces competition for carbohydrates and ensures fruit attain maximum size and dry matter.
- Pruning – Removing unwanted vegetative growth early.
- Budbreak sprays.
- Constant use of best practice management throughout the season.

5.4 POLLINATION

Image 39: (left) Male kiwifruit flowers. Image 40: (right) Female kiwifruit flowers.

Pollination is an important aspect of commercial kiwifruit production. Financial returns are dependent on the number of fruit and their size, both of which are dependent on achieving adequate pollination. For example, the Zespri forecast return from August 2014 predicted that the value of increasing fruit weight by 1gram could equate to the following financial returns:

- Green $850-$900 per hectare
- Gold3 $800 -$900 per hectare
- Green14 $900-$1000 per hectare

However, achieving full pollination of kiwifruit flowers is difficult because:

- Pollen has to be moved large distances as male and female flowers are borne on separate vines.
- Fruit size and the value of the crop is in part determined by the number of seeds the fruit contain which is dependent on the level of pollination.
- Female flowers need to receive thousands of pollen grains for full pollination (1000 black seeds), unlike flowers of other fruit crops that only require a few pollen grains.
    - Green needs 1300 pollen grains to achieve full pollination.
    - Gold3 needs 6000 pollen grains to achieve full pollination.
    - Green14 needs 6000 pollen grains to achieve full pollination.
- Kiwifruit vines have relatively few flowers and require high levels of fruit set (>80%) compared to pip and stone fruit crops that need only a low percent fruit set.
- The flowers are not highly attractive to insect pollinators since they do not produce nectar.
- The vines flower late in the spring and consequently can have strong competition for insect visitors from other plants flowering at the same time.

- Kiwifruit vines were introduced into New Zealand from China so they are without the insect pollinators with which they co-evolved.
- The crop needs high shelter belts to protect the vines from wind damage which reduces pollination by wind.
- In New Zealand vines are grown close to the ground instead of up forest trees, (their natural habit) further reducing the level of wind pollination (Goodwin, 2000).

For these reasons the pollination of kiwifruit needs to be managed to a much greater extent than most other crops. This has resulted in the development of a pollination system for kiwifruit that is more sophisticated than that is used for almost any other crop in the world. The costs associated with pollination are also greater than for almost all other crops in New Zealand. Flowering and pollination occurs in spring but the timing varies by region, altitude and variety. The majority of kiwifruit orchards are pollinated by bees. To prevent bees from searching to find nectar, bee keepers and/or growers who are managing the bees, feed the bees a mixture of sugar and water at dawn and dusk. Bees feed on the sugar and water mix as a substitute for nectar and can spend more time searching for kiwifruit pollen which increases bee movements and visits between male and female kiwifruit flowers.

Growers also supplement beehives by applying additional pollen to kiwifruit vines through means other than bees. This activity is called 'artificial pollination'. Growers can elect to have the flowers on their male vines picked and processed to be used for artificial pollination. There are also growers whose business is to grow male kiwifruit vines for their flowers for use in the artificial pollination of female vines. It is important to acknowledge that all cultivars of male kiwifruit vines are not always compatible with all cultivars of female kiwifruit vines. Known male kiwifruit vine cultivars used in New Zealand include: Chieftan; Matua; King; M56; M33; M91; Toumuri; Russell; Baker; Bruce; Sparkler and Meteor.

There are a number of key things that growers consider when deciding to use artificial pollination. Stigma receptivity, bee activity, the use of overhead shelter, the rate of pollen to apply per hectare and the costs involved both pollen and labour. A major consideration is whether the extra cost of artificially applying pollen will attribute to financial returns.

There are a large number of pollination devices that growers can use to apply pollen and are categorised into three broad groups:

- Contact application – similar to hand pollination
- Wet application – spraying pollen onto the flowers
- Dry application – blowing the pollen on

5.4.1 Pollination under hail netting

Zespri has been working with Plant & Food Research from early 2015, to better understand why hail netting is having detrimental effect on standard honey bee hives and to look for ways to overcome this issue. Research to date has shown that overhead nets impede the bees' ability to locate the suns position and also suggests that a typical honey bee hive may not be the most suitable for pollinating under hail netting.

Zespri and Plant & Food Research are running research and extension activities to establish methods for pollinating covered Gold3 kiwifruit which do not impact honey bee health. The three-year project will starts in spring 2016 and aims to better understand how hail nets impede bee behaviour, foraging and health, and develop beehive management guidelines for enclosed environments. Alternative approaches for pollinating covered Gold3 in the absence of honey bees will also be established, building on existing knowledge to develop new methods/ technology.

Zespri had a stand at the National Apiculture conference in June to launch the concept of a new 'Hailnet Hive Standard'. Feedback from beekeepers was positive so Zespri is testing the concept of using smaller hives (five frame nucs) which are fed pollen supplements at a rate of 20 hives/ha in a trial in 2016.

Image 41: Hail netting.

http://sciencelearn.org.nz/Science-Stories/Seeds-Stems-and-Spores/Pollinating-kiwifruit

http://sciencelearn.org.nz/Contexts/Pollination/Sci-Media/Video/Artificial-pollination

http://www.pollenplus.co.nz/pollination-benefits.html

5.5 Thinning

Thinning is undertaken multiple times throughout the growing season to get the optimal amount of exportable yield. Too many fruit on the vine can reduce the overall quality of the fruit by reducing average fruit size and taste. Thinning can start as soon as buds develop where defect buds are removed before they develop into flowers. Removal of defect buds aids pollination as bee visits are not wasted on flowers that will not become exportable fruit. It is best practice to set the desired number of buds in winter pruning, it minimises flower/fruit thinning costs and doesn't compromise fruit dry matter.

During thinning, growers target a number of areas. They include:

- The removal of low value fruit (misshapen, damaged, undersize).
- Adjust fruit load per shoot to obtain minimum leaf: shoot ratios (2-3 leaves per fruit)
    - Spurs 1-2 fruit (approx. 5 leaves)
    - Medium terminated shoots 2-6 fruit (7-21 leaves)
    - Long terminated shoots 4-6 fruit (14-40+ leaves)
- Removal of lateral fruit as the king fruit is always larger and has higher dry matter than the lateral fruit (Figure 38).
- Remove more fruit from heavily shaded parts of the vine as these fruit tend to be of lower dry matter.

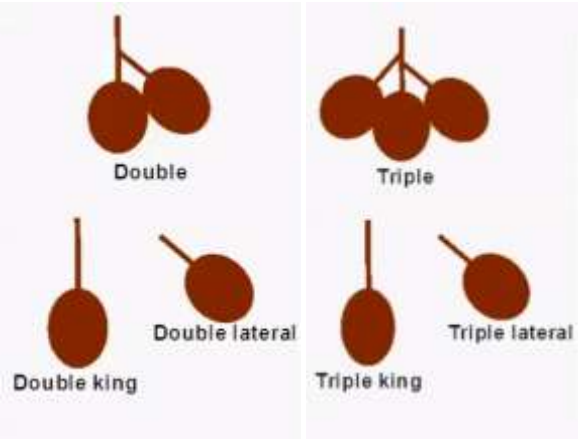


Figure 38: Which fruit is king fruit and which is lateral?

The figure above is a visual illustration of the fruit thinned off. When there are two fruit growing together the fruit which is growing on the side (lateral) is removed as it will never be as big as the king fruit (the fruit in the centre). The lateral fruit will reduce the size and the dry matter accumulation of the king fruit. The same is true if all three fruit are together in a triple, the two fruit either side of the king fruit are removed.

5.6 GIRDLING

Trunk girdling of kiwifruit is used to increase dry matter, increase fruit weight, and increase the number of flowers the following season. The process works by isolating roots, in the period when the girdle is open, so that they cannot compete with the fruit for the carbohydrates produced by the leaves.

Kiwifruit growers often apply a girdle during both spring and summer of the same season. The summer girdle allows the fruit to attain a higher dry matter and return bloom and in spring a greater fruit size. Recent research has also indicated that pre-flowering girdling may be a useful tool in preventing bud rot (a bacterial disease causing the flowers to die) and subsequent crop losses in Hayward (Green).

Trunk girdles are easy to apply, with the use of a tool or a girdling chain. The tool is a double bladed knife which cuts and removes a thin slice of bark from the circumference of a stem and the chain is a blunt chainsaw chain with a handle at each end that is pulled back and forth to remove the wood.

Technique is important, if the girdle is too shallow and has not gone through the phloem the root system will still be able to compete with the fruit. If the girdle is too vigorous and cuts through the xylem it will disable the supply of water and nutrients to the canopy. The girdles will also be slower to heal and vines will be at greater risk of disease infection.

The key is to remove all of the phloem down to the xylem around the entire stem. It can be easy to spot a girdle that has not removed all of the phloem connections – when phloem tissue is cut it turns very quickly from white to brown as the cells oxidise. If there is a fresh girdle where a part of the truck is girdled too shallow the phloem tissue would be brown and the rest of the girdle would stay white indicating that it had correctly reached the xylem. The xylem goes brown much more slowly.

Using a tool it can take two to three days to girdle a hectare of mature vines, although this depends on how thick and rough the bark is. The chain is a lot faster but it comes with higher risk of xylem damage and Psa expression. It is recommended that the chain is not used on young vines and cultivars that are more sensitive to Psa.

The cost can range from approximately $100 to $300/ha but the benefits in increased fruit weight, dry matter, and return bloom can be very significant. Increase in gross orchard income of $2000/ha, $11000/ha are easily achievable for Hayward and Gold3 orchards respectively, this is clearly dependent on fruit prices and level of response. This potential additional gross income comes about from increase in fruit size (more fruit in higher paying larger counts) increased yield (more trays as larger fruit mean fewer fruit are required to fill a tray) and

an increase in fruit dry matter. At 2014/2015 prices, a one percent lift in dry matter is worth $400 and $1600 per 1000 trays for Green and Gold varieties respectively. Growers may also receive additional payments for being early in the season. It most situations, it would likely that the cost to apply a truck girdle would more than be covered by the potential financial gains. (OPC, 2014).

Image 42: (left) Severe girdle- cut through both the phloem and xylem. Pen shows where girdle should have finished. (Shane Max, Zespri OPC). Image 43 (right) Correct girdle (Shane Max, Zespri OPC).

Image 44: (left) Three healed girdles (Shane Max). Image: 45 (right) Chain used for girdling (Shane Max, Zespri OPC).

Image 46: Girdling knife.

5.7 Root Pruning

Root pruning should not be confused with soil ripping, which is used to improve soil structure and drainage on heavier soils. Root pruning is used to increase fruit dry matter, this is achieved by cutting off roots and reducing the size of the root system, which in turn reduces the carbohydrate demands of the root system making more available for fruit growth and dry mater accumulation. (Pentreath, 2013)

Image 47: Root pruning is done with a large blade attached to the back of a tractor that drives slowly down the rows and cuts down into the soil.

Image 48: Ripper attached to the back of a tractor, used to help improve soil drainage (Shane Max).

5.8 LABOUR

The following topics are described in this section:

- Recognised Seasonal Employer (RSE Workers)
- Health and Safety at Work Act (2015)

5.8.1 RSE WORKERS

Although New Zealanders are the kiwifruit industry's first priority when it comes to picking and packing kiwifruit, the low unemployment rate makes it difficult to fill all of the available positions. Other sources of seasonal labour include backpackers and students, however there are shortages at critical times, particularly around weekends and nightshifts. To address labour shortages, the Recognised Seasonal Employer (RSE) scheme was established in April 2007. The policy allows the horticulture and viticulture industries to recruit workers from overseas for seasonal work when there are not enough New Zealand workers. Each year the kiwifruit industry employs approximately 2000 RSE workers. Read more here:

https://www.stuff.co.nz/business/farming/agribusiness/94490362/rse-scheme-turns-10-the-crucial-role-seasonal-workers-play-in-new-zealands-growing-wine-industry

5.8.2 Health & Safety at Work Act (2015)

The Health and Safety at Work Act 2015 (HSWA) is New Zealand's workplace health and safety law. It came into effect on 4 April 2016. HSWA repeals the Health and Safety in Employment Act 1992. HSWA shifts the focus from monitoring and recording health and safety incidents to proactively identifying and managing risks so everyone is safe and healthy. Persons conducting a business or undertaking (PCBUs) have duties to ensure, so far as is reasonably practicable, that the workplace is without risks to the health and safety of any person.

5.9 Adverse Events

Adverse events are defined as abnormal, harmful, or undesirable effects on an organism that causes anatomical or functional damage, irreversible physical changes, or increases the susceptibility to other biological, chemical, or environmental stresses. There are a number of adverse events that could impact on growers' wellbeing, such as weather, financial struggle, family circumstances or natural disasters.

5.9.1 Hail

Hail damaged fruit are not edible or saleable and hail damage to vines can negatively impact productivity of kiwifruit vines the following season. If 60% of the fruit is damaged by hail, growers strip all of the fruit off the vines and leave it on the canopy floor. If less than 60% of fruit is damaged by hail, growers strip the damaged fruit off the vines and aim to harvest the remainder.

Collectively, kiwifruit growers are insured for hail damage. The kiwifruit industry's structure enables growers' loss from hail to be partly insured from a commercial insurer and partly from the pooled grower return. Kiwifruit growers agree to the level of insurance that growers pay and will be compensated prior to season start. Currently compensation is enough to cover the costs of production. The cost of insurance is funded by all growers; however, the cost is less for growers who have overhead shelters as their risk of hail damage is reduced. For more information on preventative measures, see the section on shelter (Section 4.2).

For more information on hail insurance, see: http://nzkgi.org.nz/nzkgi-factsheet-pool-hail-insurance-cover/

5.9.2 Floods

The 2017 Edgecumbe floods

On April 6, 2017 Cyclone Debbie hit New Zealand in full force. The rural Bay of Plenty town Edgecumbe was hit the hardest due to the Rangitaiki River breaching and flooding the town. Below is an article from the industry publication *The Kiwiflier* which details how many growers were affected, and how the industry comes together to support its growers in times of need.

Image 49: A flooded kiwifruit orchard in Edgecumbe, April 2017.

Growers Harvest in Wet and Windy Weather

Mike Murphy, NZKGI

While many growers did get their feet wet in the recent flooding in Edgecumbe and its surrounding areas, it is unlikely that the flooding and wind is unlikely to have a significant impact on the overall season.

There are around 80 grower entities based in the Edgecumbe/Whakatane region, which represents 3% of New Zealand's total exportable volume of kiwifruit. Of this, only a small handful of growers Te Teko and Edgecumbe experienced significant damage from the flooding. The small number of orchards which have had their fruit touched by flood waters will not be harvested due to food safety reasons.

The weather event from ex-Cyclone Cook which followed on from ex-Cyclone Debbie was better than forecast and no further significant damage has been reported.

Supporting kiwifruit growers has been a top priority for stakeholders across the whole industry during the recent flooding.

Grower assistance has been focused around three core areas. This involved identifying severely affected orchards and providing information and support where necessary. Assistance in the provision of pumps for getting water off orchards and thirdly, communicating the availability of pastoral care those experiencing stress.

On Tuesday, 11 April, Zespri CEO Lain Jager, NZKGI Chairperson Doug Brown and NZKGI representative Matthew Moore met at Ian Kinvig's orchard in Edgecumbe to discuss issues surrounding the flooding with Ministers Nathan Guy and Anne Tolly.

Moments before the meeting, the Government classified the flooding from ex-Cyclone Debbie as a medium-scale adverse event. This classification made extra recovery assistance measures available including recovery coordination, increased support through Enhanced Task Force Green teams and Bay of Plenty Rural Support Trust, as well as tax flexibility. It also allowed for Rural Assistance Payments which can be made available to help with rural families' essential living costs in extreme events. Minister Guy had also classified the Tasman Tempest storm in March which damaged the Franklin Ward, Hauraki District and Thames-Coromandel District as a medium-scale adverse event.

However, Cyclones in harvest time make grower lives tricky not just on – but also off the orchards. Throughout ex-Cyclone Debbie and ex-Cyclone Cook, growers had to deal issues including cordoned roads and damage to infrastructure such as the Pekatahi Bridge project on State Highway 2 and road closures such as State Highway 2 near Waimana Gorge and at Edgecumbe.

The primary industry is always susceptible to adverse events. Kiwifruit growers are used to dealing with flooding and the industry has retained its knowledge of previous floods such as from Cyclone Bola and in 2005. The utilisation of this knowledge is an advantage to responding quickly to adverse events and working to retain vine health on flooded orchards.

Special note must be made of Matthew Moore and Paul Edkins of NZKGI as well as Kiritapu Allan of Māori Kiwifruit Grower Incorporated who supported growers voluntarily in the Whakatane/Edgecumbe/TeTeko areas since the first rainfall.

Figure 38: Article featured in the Kiwiflier, April 2017

5.9.3 Pest and Disease Control

Zespri has strong tailored integrated strategies around disease and pest management. The market demands that food products are safe and are produced in a way that minimises any adverse impact on human health and the environment. This is achieved by minimising the use of broad spectrum insecticides and by emphasising the use of non-chemical techniques, such as biological controls, to limit pest and disease from causing economic losses. When spraying is required, safer and more selective spray materials are promoted.

It is also important to follow strict protocol when using sprays. The image below is an example of 'what not to do' when spraying kiwifruit vines. In the image, notice that the sprayer has misaligned nozzles and there is a sign masking the airflow of the fan.

Image 50: Incorrect spraying of dormant kiwifruit vines- (Shane Max, Zespri OPC).

For further reading on pest and diseases, see the biosecurity chapter 2.2.

CHAPTER 6: HARVEST AND POSTHARVEST PRACTICES

The harvest and postharvest practices chapter is brief and will be expanded on if there becomes a need. Ultimately the following diagram outlines the key process and management actions that take place in preparation for and after harvest.

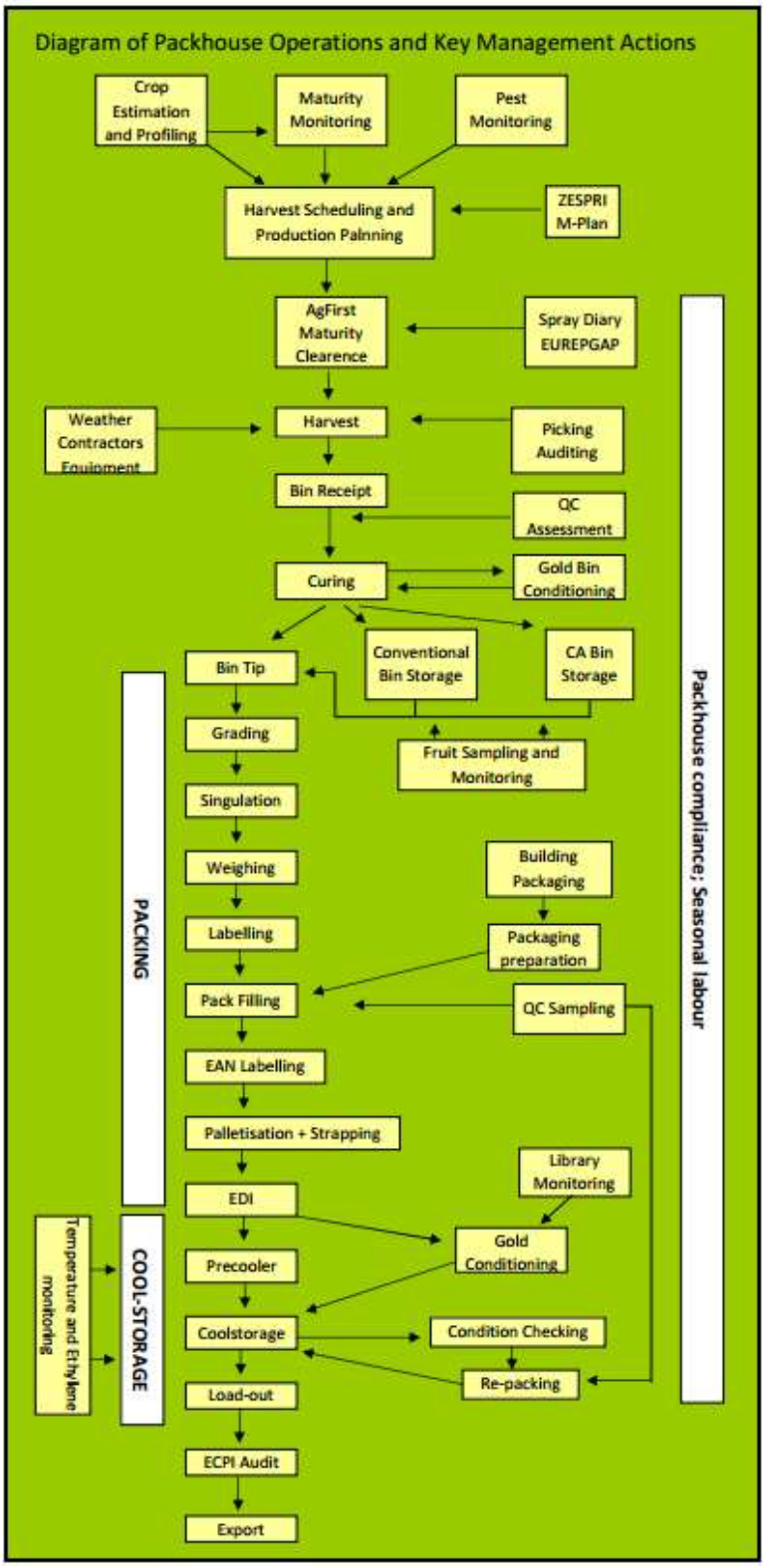


Figure 39: Flow chart outlines all the process and controls that fruit goes through before it is exported.

This chapter will now attempt to go into each of the actions outlined in the flow chart on page 79. This chapter will be split into three broad sections including:

- Harvest (Section 6.1)
    - Timing (Section 6.1.1)
    - Kiwistart premium (Section 6.1.2)
    - Time payments (Section 6.1.3)
- Postharvest (Section 6.2)
    - Packing (Section 6.2.1)
    - Packaging (Section 6.2.2)
    - Labelling (Section 6.2.3)
    - Coolstorage (Section 6.2.4)
    - Shipping (Section 6.2.5)

6.1 Harvest

Before fruit is harvested, it must be mature enough to ripen when it is off the kiwifruit vine. The fruit needs to have black seeds, meet the MTS, be the right colour, and reach a Soluble Solid Concentration (SSC) or brix (sugar content of an aqueous solution) of more than 6.2% for Hayward and 8% for Gold. When it is time to harvest, an independent company called Eurofins will test the kiwifruits maturity and if it meets the standard will give clearance to pick.

SSC or brix is measured by a refractometer which uses light refraction to measure different sugar concentrations. Degrees of brix are the units of measure a refractometer uses. SSC and brix are effectively interchangeable terms. Generally, the greater the maturity at harvest the greater the taste and storage potential of the fruit. Brix can also be used when the fruit is eating ripe as a measure of how 'sweet' the fruit is. Fruit is increasingly being tested by retailers at the point of sale as an assessment of fruit quality. The higher the dry matter of fruit at harvest the higher the brix will be when sold at eating firmness at point of sale.

Generally kiwifruit harvest begins in March. 'Main pack' for Hayward is in May which is when the majority of fruit is harvested. Gold varieties 'Main pack' is generally a little earlier. Harvest is generally over by the middle of June. There are two types of additional payments growers receive based on when their fruit is shipped. These are called the Kiwistart premium and time payments. This section will describe the harvest timings for two different cultivars, the timing of harvest between regions, and the Kiwistart premium and time payments.

6.1.1 Timing

The Hayward (Green) harvest starts in late March and peaks in May and is usually complete by early June. There are some regional variations with Poverty Bay and coastal Bay of Plenty having the earliest harvest most years. Harvest in the more elevated regions in the Bay of Plenty follow in May and June. Nelson has a relatively short harvest window due to their naturally later maturity and early onset of winter cold. This means harvest is usually limited to the first three weeks of May. Gold kiwifruit harvest starts with in mid to late March and is normally complete by early May. Poverty Bay, Hawkes Bay and coastal Bay of Plenty harvest ahead of other regions.

6.1.2 Kiwistart Premium

The fruit picked at the start of the season is termed 'Kiwistart'. This fruit has reached a level of maturity where it will ripen off the vine and be acceptable to consumers but has not reached its optimum size or taste on the vine. Zespri incentivise growers to pick early by compensating them for lost fruit size and taste payments plus a 15% premium. Zespri want fruit to hit the markets shelves before competitor fruit from Chile. Further, Zespri want to sell as much fruit as possible before main pack in May. A more balanced supply over time reduces storage costs and fruit loss.

6.1.3 Time Payments

Kiwistart compensates growers for their fruit being sold early; time payments compensate growers for their fruit being sold late. Time payments cover the additional costs of storing and supplying kiwifruit overtime. As kiwifruit is stored longer, it requires additional coolstorage and because the fruit is deteriorating overtime, condition checking, repacking, fruit loss, and taste compensation levels all increase. There are a variety of variables that lead to kiwifruit being able to be stored for months. Maximising storage potential requires optimisation of inventory management practice, fruit maturity and high quality fruit handling.

Kiwistart and time premiums extend the New Zealand kiwifruit selling season. Markets require consistent supply so that New Zealand kiwifruit is available to their customers for as long as possible.

Image 51: Picking fruit into picking bags during harvest and emptying into bins for transport to the packhouse.

6.2 Postharvest

A packhouse operator receives fruit from the kiwifruit orchard in bins and packs the fruit into trays before putting them into storage in preparation for shipping. Packing and cool storage are not regulated by statute and there is active competition between postharvest operators that helps to minimise growers postharvest costs. There are approximately 53 packing facilities and 85+ coolstores used in the kiwifruit industry. These facilities are located in Northland, Auckland, Bay of Plenty, Opotiki, Gisborne, and Nelson. The smallest facilities pack from 50,000 trays (3.55kg/ tray) per season whilst the largest pack up to 12 million trays per season.

Image 52: (left) Kiwifruit passing over grading tables in the packhouse. Image 53: (right) Kiwifruit on the sizer where they are weighted and sent to the packing lane where that size is being packed.

6.2.1 Packing

Packing is the key control point where the fruit is segregated into market acceptable product. Fruit is graded for defects, sized, labelled and placed into packs suitable for the market. Product traceability moves from the orchard bin down to the individual pack level. It is at this point that maturity, dry matter, Global Good Agricultural Practice (GAP) requirements and market restrictions and regulations are all consolidated and identified electronically at the pack and pallet level.

6.2.2 Packaging

Packaging is a key market messaging tool with branding and graphics carefully controlled. In some cases customers require specific packaging requirements for example addition of their own branding. In-market packing is also used to meet customer requirements where fruit transferred from loose filled bulk packs and packed into smaller retail packs or bags.

Image 54: Zespri Kiwifruit exported to South Korea in loose modular bulk pack and re-packaged in smaller retail packs (Mark Gardiner, Nov 2014).

All packaging must protect the fruit through the whole supply chain and be able to be disposed of at the end of its use in market. There are a variety of pack types that Zespri's customers can order.

6.2.3 Labelling

Markets have wide ranging pack and label requirements. Individual fruit labelling of the Zespri brand is a requirement in all markets in preparation for retail sale. All fruit labels either contain a Price Look-Up (PLU) code for that cultivar and size of kiwifruit or a bar code for use at the point of sale. Some markets have additional market specific labelling requirements at the individual pack level. For example South Korea, Brazil, Indonesia, India, Malaysia, Thailand and Egypt, all require country specific language showing the local contact details of the importer. These labels must exactly meet the importing countries statutory requirements to allow entry.

Another example of specific packaging requirements is when Zespri Organic Kiwifruit is exported to Japan. Zespri Organic Kiwifruit is packed into a standard Green Modular Bulk (MB) pack and an organic coupon label is applied to the end panel of the pack. If the product is fumigated, the top layer of the label is removed and it changes the descriptor to Green Kiwifruit – whereas previously it said Organic Green. We are also required to have the Japanese Agricultural Standard (JAS) organic certification logo on any organic packs exported to Japan.

Figure 40: (left) Zespri Green Organic Green Kiwifruit label which is then removed if required (i.e. fumigation) to reveal the standard |Green Kiwifruit label (right).

6.2.4 COOLSTORAGE

Coolstores utilising refrigerated air are used to reduce to the temperature of kiwifruit so that it stores for longer. Controlled atmosphere (CA) storage is also used where oxygen, carbon dioxide, and nitrogen concentrations as well as temperature and humidity are regulated to enable kiwifruit to store longer.

6.3 SHIPPING

Zespri uses different modes of shipping to deliver fruit overseas. Zespri uses a mixture of charted refrigerated vessels and container shipping.

Charted vessels – are whole ships that are charted specifically for Zespri. Typically 3000-6000 pallets are loaded on charter vessels. The charter vessels are booked to pick up from the Port of Tauranga, and deliver to Zespri specified destination ports such as Tokyo, Zeebrugge (Belgium), Incheon (South Korea) and Tarragona (Spain). Container shipping is a bit like booking a seat on a bus. Container ships have a set route with multiple stops which extends the shipping time, but allows cost-effective movement of smaller fruit volumes to smaller markets. Zespri books container space on container ships going to many destinations including Taipei, USA Australia, South East Asia, Middle East, South America and South Africa.

Image 55: Vessel leaving Tauranga Port

6.3.1 'Diary of a graduate kiwifruit technician'- Written by Ben Luke, Zespri

With a last-minute position needing to be filled, I was given the call up to spend two weeks at sea monitoring 1.2 million trays of kiwifruit bound for Japan. With three days' notice I fervently prepared for the journey. I underwent intensive training with the Zespri team and spent the night before boarding watching 'Captain Phillips' to prepare for the worst and to potentially pick up some handy tips if any pirates boarded. Fresh faced, nervous yet excited, I was ready to board the Atlantic Erica on 3 June.

Image 56: Ben Luke standing next to the Atlantic Erica

I soon got into the swing of things on board with the Filipino crew, with a typical day beginning by avoiding mysterious goo covered meats or fish for breakfast, and instead chowing down my trusty cereal and milk. After breakfast, I would hike up three flights of steep stairs to the bridge to see the Chief Officer. He would organise one of the crew to accompany me down into the cargo holds and let me know if the conditions were safe enough to collect the fruit for assessment. The monitoring process included collecting a total of 320 pieces of fruit, both green and gold, from eight different libraries which gave me access to four different pallets from four different grower lines. Before being loaded onto the ship, each library was chosen to ensure it was representative of the hold it was in. It's designed like this so if the temperature in the hold is adjusted based on the monitoring results, the rest of the fruit in the hold should ripen in the same way. The fruit collecting process took me around 50 minutes, which to the crew was probably very slow. It was as if they learnt how to climb ladders before learning how to walk.

I methodically checked the temperature, firmness and brix of the fruit collected which took around seven hours. The crew popped in every now and again to check everything was ok and once I finished testing all the fruit, I filled in my daily log, checked the data, save the file onto a USB stick and took it to the Captain to send back to Zespri New Zealand. The Zespri team in NZ then analysed the results and sent back instructions about any temperature changes to be made in the hold to ensure the fruit doesn't over ripen or ripen too slowly.

The highlight of my trip included enjoying a day with the crew on the Captain's birthday. Everyone indulged in a few brews, various meats and took a dip in a self-made pool at the back of the ship. The crew could not have been friendlier to me. Constantly offering me beers, inviting me to watch movies and treating me as if I were one of their own made me feel very welcomed. No communication or sight of land for two weeks was an interesting experience but amazing at the same time. Seeing a log floating in the vast empty ocean half way through the trip even made me excited. I'm not itching to get back on a ship but it was definitely an experience I will never forget. I certainly have a new-found respect for the team of technicians that come back year after year to spend weeks on end at sea, all to get our fruit to the other side of the world in optimal condition.

Image 57: The crew on board Atlantic Erica celebrating the Captains's birthday

CHAPTER 7: ORCHARD ACCOUNTS

Monitoring of Kiwifruit Orchard Profitability

The monitoring of profitability is an important review of the financial performance of an orchard. There are numerous orcharding activities that give rise to both income and costs on an orchard and growers give much time and thought into delivering the successful production of their crops. Monitoring and review of the financial performance of an orchard should be viewed as the financial result of that time. It is this result that demonstrates financial success and the meeting of grower expectation or not.

In this section, there are four key areas that will be covered:

- Seasonal Timing of Orchard Income and Costs (Section 7.1)
- The Concept of Orchard Gate Return (Section 7.2)
- Orchard Financial Reporting (Section 7.3)
- Collection of Financial Data (Section 7.4)

7.1 SEASONAL TIMING OF ORCHARD INCOME AND COSTS

The orcharding cash cycle of setting up an orchard in preparation for harvest and receiving the final income for that same harvest is spread over twenty-four months. The kiwifruit orcharding year begins with winter pruning around July and continues through to harvest. Harvest is typically conducted during the months of April and May. Throughout this growing period numerous orcharding costs are incurred as the new crop is setup and tendered (such as pruning, pollination, fertiliser etc.). Following harvest and the successful submit of fruit into Zespri inventory; Net Income is returned to the grower. Final Net Income is not received by the grower until June of the year following harvest.

7.2. THE CONCEPT OF ORCHARD GATE RETURN

Net Income received by a grower is referred to as *Orchard Gate Return* or OGR. In simple terms, Zespri receive money (gross income) from export customers. This is then distributed through to Registered Suppliers, and onto growers. The reason Orchard Gate Return is referred to as a Net Income is because the gross income received by Zespri is offset by various costs and incentives including postharvest costs such as packaging and logistics.

These costs and incentives are outlined in the contractual arrangement a grower has with their post-harvest partner and in the Supply Agreement signed by Registered Suppliers and Zespri. The preferred format for growers aimed at illustrating Orchard Gate Return for a full year is below. It is noteworthy to mention that Orchard Gate Return is not the complete measurement of orchard performance as it does not take into consideration orcharding costs such as pruning, pollination, fertiliser etc. Therefore, Orchard Gate Return is not the final formulation of orchard profitability.

Orchard Gate Return

	2016 Harvest ($ are for example only)
Income From Zespri	
Zespri Fruit Return	63,500
Plus Taste Income	3,000
Plus Early Start Income	14,400
Plus Loyalty Income	3,000
Total Income from Zespri	83,900
Cost of Post-Harvest	
Time Incentive Income	18,480
Less Fruit Loss Costs	(3,480)
Less Time Costs	(6,300)
Plus/Less Intercheck	(360)
Net Time Incentive	8,340
Less Packing & Harvest Costs	(21,900)
Less Coolstore Costs	(8,900)
Less Logistics Costs	(1,560)
Less Other	(500)
Total Cost of Post-Harvest	24,520
Total Net Income (Orchard Gate Return)	$59,380

Figure 41: Table showing Orchard Gate Return for a full year

7.3 Orchard Financial Reporting

The preparation of a financial report of the performance of an orchard is a tool a grower will use to measure the profitability of an orchard. It also forms part of the analysis in which to measure the financial viability of that orchard along with a grower's financial expectation and objective. Figure 35 provides an example of a simple orchard net profit and cash-flow report. The format works through:

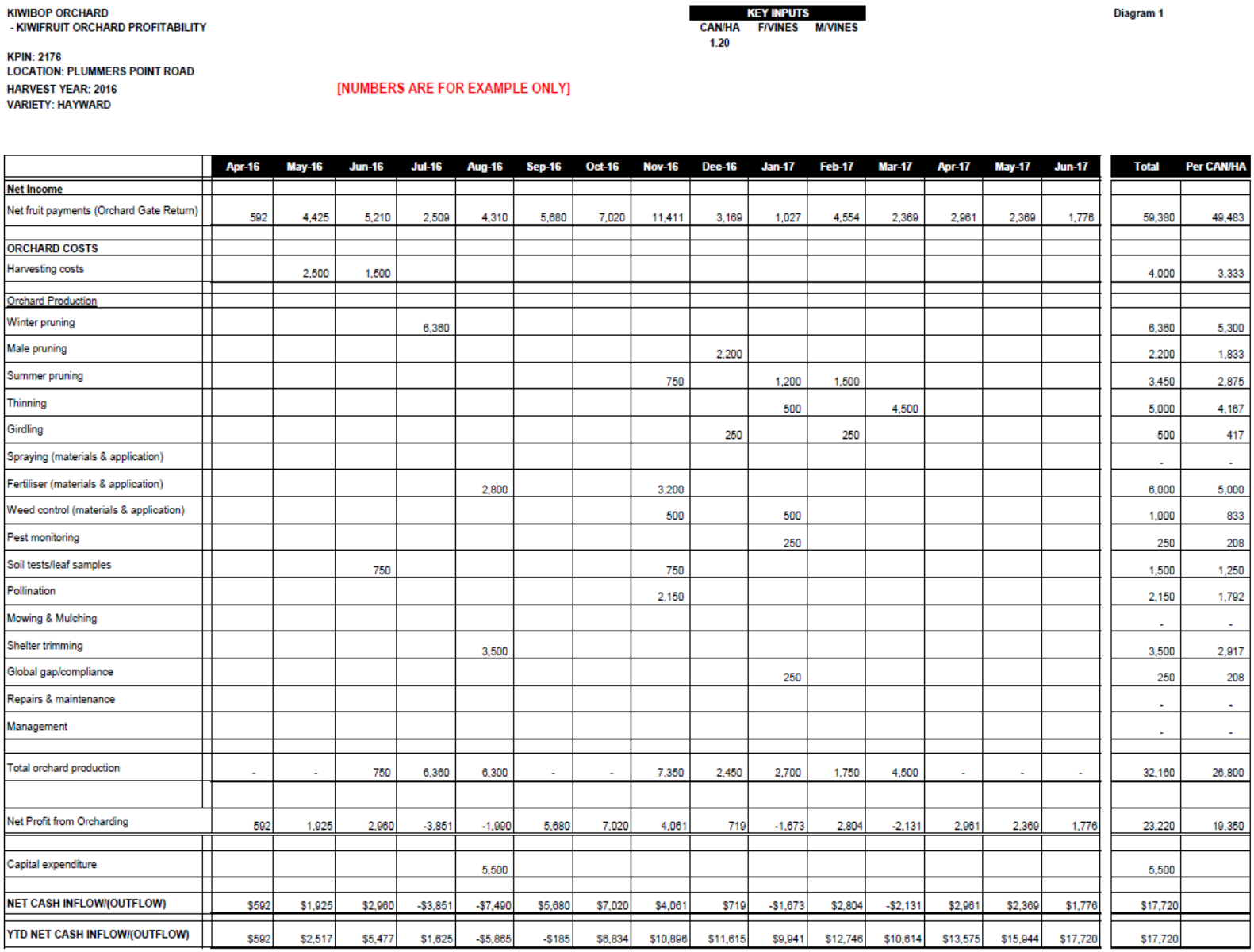
- Net Income (OGR)
- Less Orcharding costs
- Net Profit from Orcharding
- Less Capital expenditure
- Net Cash Inflow/Outflow

Net Profit from Orcharding shows the profitability of all income derived from each harvest less all direct costs that are incurred in delivering that same harvest. Net Cash Inflow/Outflow provides useful analysis of the net cash proceeds received from the orchard by considering capital expenditure such as setting up a new overhead artificial canopy. Typically, such a report would be reviewed on a monthly basis and annually.

The table on page 95 includes columns for each month that Net Income (OGR) is received. The final column is a conversion of the income or cost into a Per Canopy Hectare basis. This Per Canopy Hectare calculation is the most common and important metric used by a grower to benchmark the financial performance of their orchard against industry averages and prior historical information. As the orcharding year progresses a grower will find it necessary to understand the costs they incur on a 'per hectare basis'. Often piecemeal rates charged by suppliers and contractors are also based on a 'per hectare basis', such as winter pruning and girdling.

7.4 Collection of Financial Data

Collating this data into a user-friendly format such as in figure 42, must be simple and readily available. There are a variety of means available to a grower to prepare such a report and often it is prepared with support from the growers Chartered Accountant. Financial reporting has come a long way in recent years and apart from simple spreadsheets, there are a number of web based financial software tools available to growers to draw financial information from such as Xero.



KIWIBOP ORCHARD
- KIWIFRUIT ORCHARD PROFITABILITY

KPIN: 2176
LOCATION: PLUMMERS POINT ROAD
HARVEST YEAR: 2016
VARIETY: HAYWARD

[NUMBERS ARE FOR EXAMPLE ONLY]

KEY INPUTS		
CAN/HA	F/VINES	M/VINES
1.20		

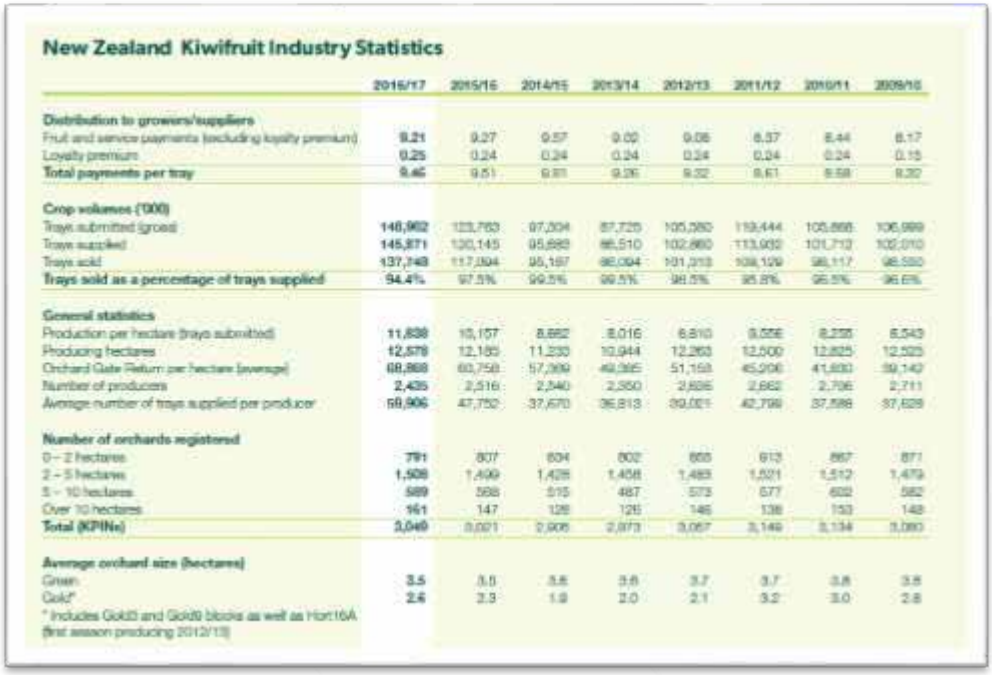
Diagram 1

	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Total	Per CAN/HA
Net Income																	
Net fruit payments (Orchard Gate Return)	592	4,425	5,210	2,509	4,310	5,680	7,020	11,411	3,169	1,027	4,554	2,369	2,961	2,369	1,776	59,380	49,483
ORCHARD COSTS																	
Harvesting costs		2,500	1,500													4,000	3,333
Orchard Production																	
Winter pruning				6,360												6,360	5,300
Male pruning									2,200							2,200	1,833
Summer pruning								750		1,200	1,500					3,450	2,875
Thinning										500		4,500				5,000	4,167
Girdling									250		250					500	417
Spraying (materials & application)																-	-
Fertiliser (materials & application)					2,800			3,200								6,000	5,000
Weed control (materials & application)								500		500						1,000	833
Pest monitoring										250						250	208
Soil tests/leaf samples			750					750								1,500	1,250
Pollination								2,150								2,150	1,792
Mowing & Mulching																-	-
Shelter trimming					3,500											3,500	2,917
Global gap/compliance										250						250	208
Repairs & maintenance																-	-
Management																-	-
Total orchard production	-	-	750	6,360	6,300	-	-	7,350	2,450	2,700	1,750	4,500	-	-	-	32,160	26,800
Net Profit from Orcharding	592	1,925	2,960	-3,851	-1,990	5,680	7,020	4,061	719	-1,673	2,804	-2,131	2,961	2,369	1,776	23,220	19,350
Capital expenditure					5,500											5,500	
NET CASH INFLOW/(OUTFLOW)	$592	$1,925	$2,960	-$3,851	-$7,490	$5,680	$7,020	$4,061	$719	-$1,673	$2,804	-$2,131	$2,961	$2,369	$1,776	$17,720	
YTD NET CASH INFLOW/(OUTFLOW)	$592	$2,517	$5,477	$1,625	-$5,865	-$185	$6,834	$10,896	$11,615	$9,941	$12,746	$10,614	$13,575	$15,944	$17,720	$17,720	

Figure 42: An example of an orchardist's budget showing expenses, incomes and profitability.

APPENDIX

Industry Statistics – Performance and Production by Cultivar, Region and Markets



New Zealand Kiwifruit Industry Statistics

	2016/17	2015/16	2014/15	2013/14	2012/13	2011/12	2010/11	2009/10
Distribution to growers/suppliers								
Fruit and service payments (excluding loyalty premium)	9.21	9.27	9.57	9.02	9.06	8.37	8.44	8.17
Loyalty premium	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.15
Total payments per tray	9.46	9.51	9.81	9.26	9.32	8.61	8.68	8.32
Crop volumes (000)								
Trays submitted (gross)	140,902	123,763	97,004	87,725	105,260	119,444	105,866	106,989
Trays supplied	145,871	120,145	95,688	86,510	102,860	113,903	101,712	102,010
Trays sold	137,748	117,094	95,167	86,084	101,313	109,129	98,117	98,550
Trays sold as a percentage of trays supplied	94.4%	97.5%	99.5%	99.5%	98.5%	95.8%	96.5%	96.6%
General statistics								
Production per hectare (trays submitted)	11,838	10,157	8,662	8,016	9,810	9,556	8,255	8,543
Producing hectares	12,578	12,185	11,200	10,944	12,263	12,500	12,825	12,525
Orchard Gate Return per hectare (average)	68,868	60,758	57,369	49,365	51,158	45,906	41,830	39,140
Number of producers	2,435	2,516	2,340	2,350	2,626	2,662	2,706	2,711
Average number of trays supplied per producer	59,906	47,752	37,670	36,813	39,061	42,799	37,588	37,629
Number of orchards registered								
0 – 2 hectares	791	807	804	802	866	913	867	871
2 – 5 hectares	1,508	1,499	1,428	1,458	1,483	1,521	1,512	1,479
5 – 10 hectares	589	568	515	487	573	577	602	582
Over 10 hectares	161	147	128	126	146	138	153	148
Total (KPINs)	3,049	3,021	2,905	2,873	3,067	3,149	3,134	3,080
Average orchard size (hectares)								
Green	3.5	3.5	3.6	3.6	3.7	3.7	3.8	3.8
Gold*	2.6	2.3	1.9	2.0	2.1	3.2	3.0	2.8

* Includes Gold3 and Gold9 blocks as well as Hort16A (first season producing 2012/13)

Figure 43: General industry statistics, production by size over eight previous seasons.

	2016/17	2015/16	Variance
Zespri global kiwifruit sales	$2.262 billion	$1.907 billion	+19%
Export earnings (New Zealand grown)	$1.603 billion	$1.327 billion	+21%
New Zealand-grown fruit and service payments	$1,380.0 million	$1,143.1 million	+21%
New Zealand-grown Orchard Gate Return (OGR) per hectare	$68,868 (average)	$60,758 (average)	+13%
- Green	$53,555	$56,673	+13%
- Organic Green	$54,427	$52,917	+3%
- Gold	$98,838	$71,080	+39%
- Green14	$45,853	$42,995	+7%
Zespri global volume (trays sold)	154.3 million	131.6 million	+17%
New Zealand-grown	137.7 million	117.1 million	+18%
Non-New Zealand-grown	16.6 million	14.5 million	+14%

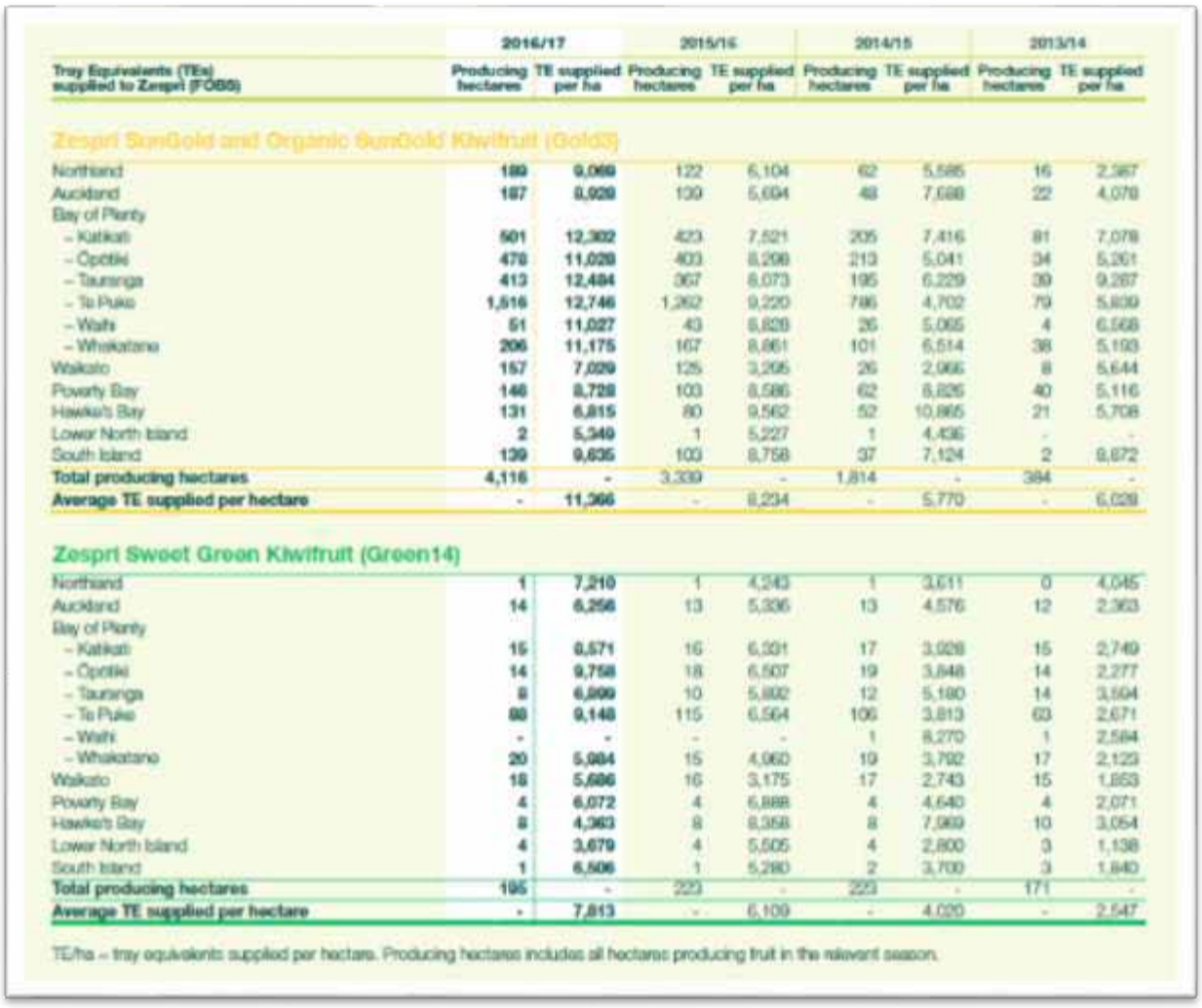
Figure 44: Key figures from Zespri's Annual Results 2016-17.

REGIONAL PRODUCTION ANALYSIS - New Zealand-grown Kiwifruit

Trays supplied to ZESPRI (FOBS).

Regional Production Analysis – New Zealand-Grown Kiwifruit

Tray Equivalents (TEs) supplied to Zespri (FOBS)	2016/17 Producing hectares	2016/17 TE supplied per ha	2015/16 Producing hectares	2015/16 TE supplied per ha	2014/15 Producing hectares	2014/15 TE supplied per ha	2013/14 Producing hectares	2013/14 TE supplied per ha
Zespri Green Kiwifruit								
Northland	**113**	**9,569**	116	7,896	124	7,652	153	7,704
Auckland	**272**	**9,502**	273	8,099	304	8,605	348	8,291
Bay of Plenty								
– Katikati	**966**	**11,972**	973	9,748	1,015	9,224	1,129	8,479
– Opotiki	**464**	**11,758**	469	10,756	477	9,691	539	7,736
– Tauranga	**1,116**	**12,533**	1,090	10,135	1,109	9,295	1,206	8,802
– Te Puke	**3,508**	**13,088**	3,524	12,204	3,586	9,486	3,754	8,575
– Waihi	**100**	**8,701**	105	7,804	115	6,957	134	5,096
– Whakatane	**439**	**9,889**	436	8,248	466	4,840	516	4,449
Waikato	**204**	**9,664**	206	8,867	209	7,462	227	7,315
Poverty Bay	**54**	**5,828**	55	6,605	59	5,558	79	4,883
Hawke's Bay	**45**	**7,290**	47	8,255	51	7,554	65	6,710
Lower North Island	**65**	**7,096**	69	6,186	70	7,750	72	5,852
South Island	**258**	**7,246**	250	6,156	309	5,591	388	6,255
Total producing hectares	**7,804**	-	7,814	-	7,892	-	8,612	-
Average TE supplied per hectare	-	**11,933**	-	10,590	-	8,612	-	8,049
Zespri Organic Green Kiwifruit								
Northland	-	-	-	-	3	2,473	3	3,687
Auckland	**1**	**5,856**	1	3,983	1	4,378	1	5,878
Bay of Plenty								
– Katikati	**31**	**9,208**	30	8,037	31	7,274	28	5,836
– Opotiki	**22**	**8,616**	22	7,404	22	7,407	22	4,851
– Tauranga	**210**	**8,652**	231	8,054	261	5,954	224	5,892
– Te Puke	**38**	**10,408**	57	8,841	77	6,953	80	6,703
– Waihi	**20**	**4,219**	20	4,806	20	4,099	15	3,765
– Whakatane	**4**	**5,525**	3	5,171	3	1,834	3	4,134
Waikato	**151**	**6,536**	153	6,148	156	5,428	147	5,819
Poverty Bay	**2**	**4,637**	2	5,284	3	5,817	7	3,006
Hawke's Bay	-	-	-	-	-	-	1	2,196
Lower North Island	**2**	**6,524**	2	6,365	2	6,533	2	5,803
South Island	**21**	**4,516**	16	2,873	19	3,593	19	4,501
Total producing hectares	**502**	-	537	-	597	-	552	-
Average TE supplied per hectare	-	**7,841**	-	7,254	-	5,908	-	5,724
Zespri Gold and Organic Gold Kiwifruit (Hort16A)								
Northland	**52**	**12,721**	172	12,133	213	14,522	224	8,848
Auckland	**1**	**5,822**	15	12,999	38	11,327	83	9,025
Bay of Plenty								
– Katikati	-	-	1	10,818	10	8,975	144	6,778
– Opotiki	-	-	-	-	12	3,730	166	3,704
– Tauranga	-	-	1	4,712	5	4,249	100	6,101
– Waihi	-	-	1	13,777	3	6,706	11	12,996
– Whakatane	-	-	-	-	-	-	4	2,227
Waikato	**1**	**9,564**	15	8,902	31	7,931	66	5,856
Poverty Bay	**48**	**9,248**	69	8,365	105	6,251	125	8,170
Hawke's Bay	**12**	**11,464**	55	11,567	57	13,722	76	11,426
South Island	**47**	**9,349**	64	10,796	71	9,853	55	9,209
Total producing hectares	**161**	-	394	-	555	-	1,056	-
Average TE supplied per hectare	-	**10,561**	-	11,077	-	11,586	-	7,459



Tray Equivalents (TEs) supplied to Zespri (FOBS)	2016/17 Producing hectares	2016/17 TE supplied per ha	2015/16 Producing hectares	2015/16 TE supplied per ha	2014/15 Producing hectares	2014/15 TE supplied per ha	2013/14 Producing hectares	2013/14 TE supplied per ha
Zespri SunGold and Organic SunGold Kiwifruit (Gold3)								
Northland	189	9,069	122	6,104	62	5,585	16	2,367
Auckland	187	8,929	130	5,694	48	7,688	22	4,078
Bay of Plenty								
– Katikati	501	12,302	423	7,521	205	7,416	81	7,078
– Ōpōtiki	470	11,029	403	8,298	213	5,041	34	5,261
– Tauranga	413	12,484	367	8,073	195	6,229	39	9,267
– Te Puke	1,516	12,746	1,262	9,220	786	4,702	79	5,839
– Waihi	51	11,027	43	8,828	26	5,065	4	6,668
– Whakatane	206	11,175	167	8,861	101	6,514	38	5,193
Waikato	157	7,029	125	3,295	26	2,066	8	5,644
Poverty Bay	146	8,728	103	8,586	62	6,825	40	5,116
Hawke's Bay	131	6,815	80	9,562	52	10,865	21	5,708
Lower North Island	2	5,349	1	5,227	1	4,436	-	-
South Island	139	9,635	103	8,758	37	7,124	2	9,672
Total producing hectares	4,116	-	3,339	-	1,814	-	384	-
Average TE supplied per hectare	-	11,366	-	8,234	-	5,770	-	6,029
Zespri Sweet Green Kiwifruit (Green14)								
Northland	1	7,210	1	4,243	1	3,611	0	4,045
Auckland	14	6,256	13	5,336	13	4,576	12	2,363
Bay of Plenty								
– Katikati	15	8,571	16	6,331	17	3,029	15	2,749
– Ōpōtiki	14	9,758	18	6,507	19	3,648	14	2,277
– Tauranga	9	6,999	10	5,892	12	5,180	14	3,594
– Te Puke	88	9,148	115	6,564	106	3,813	63	2,671
– Waihi	-	-	-	-	1	8,270	1	2,584
– Whakatane	20	5,984	15	4,960	19	3,792	17	2,123
Waikato	18	5,686	16	3,175	17	2,743	15	1,653
Poverty Bay	4	6,072	4	6,888	4	4,640	4	2,071
Hawke's Bay	8	4,363	8	8,358	8	7,969	10	3,054
Lower North Island	4	3,679	4	5,505	4	2,800	3	1,138
South Island	1	6,506	1	5,280	2	3,700	3	1,840
Total producing hectares	195	-	223	-	223	-	171	-
Average TE supplied per hectare	-	7,813	-	6,109	-	4,020	-	2,547

TE/ha – tray equivalents supplied per hectare. Producing hectares includes all hectares producing fruit in the relevant season.

Figure 45: Production area and trays supplied of kiwifruit varieties by region over the past four seasons.

Zespri Top 10 Historic Market Volumes

Country Name	Variety	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Japan	Gold/SunGold	5,575,087	5,884,671	5,605,824	6,365,430	6,750,803	6,967,134	7,265,402	7,841,708	7,042,648	5,139,332
	Hayward	9,343,680	8,201,044	8,110,489	8,991,853	8,425,611	8,681,949	9,493,245	9,150,974	9,220,179	10,322,641
Japan Total		14,918,766	14,085,715	13,716,314	15,357,283	15,176,414	15,649,083	16,758,647	16,992,682	16,262,827	15,461,973
China	Gold/SunGold	66,207	208,749	740,653	1,144,237	1,706,070	2,332,490	2,549,126	4,024,973	3,944,375	1,593,767
	Hayward	968,907	1,526,266	1,831,905	2,357,329	2,981,350	3,934,987	4,608,402	4,788,987	5,772,523	6,293,389
China Total		1,035,114	1,735,015	2,572,558	3,501,565	4,687,420	6,267,477	7,157,528	8,813,960	9,716,899	7,887,156
Spain	Gold/SunGold	870,464	742,421	844,575	1,024,615	1,185,123	1,364,537	1,035,238	1,166,642	597,297	128,953
	Hayward	9,646,261	10,240,942	10,164,282	11,465,317	11,323,455	10,321,119	9,953,440	11,104,282	10,858,045	10,230,473
Spain Total		10,516,725	10,983,362	11,008,857	12,489,932	12,508,577	11,685,656	10,988,678	12,270,925	11,455,343	10,359,425
Germany	Gold/SunGold	1,265,920	1,302,217	1,479,480	1,543,471	1,729,340	1,524,536	1,457,374	1,990,786	1,323,678	253,637
	Hayward	8,584,034	8,866,234	7,462,686	7,821,180	7,580,504	7,529,405	7,162,900	7,183,871	6,023,835	4,549,613
Germany Total		9,849,954	10,168,451	8,942,166	9,364,651	9,309,844	9,053,941	8,620,274	9,174,657	7,347,512	4,803,249
Taiwan	Gold/SunGold	1,220,506	1,291,524	1,343,136	1,691,828	2,138,285	2,008,683	2,016,022	2,965,592	3,024,233	452,617
	Hayward	1,900,964	3,023,380	2,688,026	3,040,193	3,176,556	3,782,169	3,811,295	4,383,909	5,062,790	5,320,182
Taiwan Total		3,121,470	4,314,904	4,031,162	4,732,021	5,314,840	5,790,852	5,827,318	7,349,501	8,087,023	5,772,800
Netherlands	Gold/SunGold	911,612	857,756	1,205,017	1,394,265	1,718,874	1,454,596	1,555,688	1,701,536	1,232,045	385,242
	Hayward	3,515,669	3,973,421	4,299,426	4,853,774	5,589,664	4,986,300	4,746,041	4,892,679	5,186,271	4,853,211
Netherlands Total		4,427,281	4,831,177	5,504,443	6,248,039	7,308,538	6,440,897	6,301,728	6,594,215	6,418,316	5,238,453
Italy	Gold/SunGold	206,109	109,064	183,056	257,848	290,349	418,749	506,605	537,639	241,336	157,438
	Hayward	3,540,169	4,075,301	3,539,502	3,593,680	4,308,906	3,746,593	3,967,663	4,212,242	3,957,013	4,628,394
Italy Total		3,746,279	4,184,365	3,722,559	3,851,528	4,599,255	4,165,342	4,474,268	4,749,881	4,198,349	4,785,831
France	Gold/SunGold	239,277	138,632	152,218	151,572	195,660	168,469	132,548	211,386	195,857	59,564
	Hayward	4,316,602	4,606,656	3,945,755	4,220,475	4,847,065	4,194,158	4,077,140	4,362,447	5,157,492	4,968,955
France Total		4,555,879	4,745,288	4,097,973	4,372,047	5,042,725	4,362,626	4,209,688	4,573,833	5,353,350	5,028,519
South Korea	Gold/SunGold	1,613,480	1,667,731	2,156,854	2,503,371	2,898,013	2,359,646	2,471,844	3,261,222	2,425,969	753,555
	Hayward	3,538,789	3,433,457	2,994,885	3,941,201	3,789,613	3,123,912	3,114,863	3,412,824	2,970,514	2,524,140
South Korea Total		5,152,268	5,101,188	5,151,739	6,444,572	6,687,626	5,483,558	5,586,707	6,674,046	5,396,482	3,277,694
Belgium	Gold/SunGold	421,918	438,462	422,389	569,272	639,414	578,097	533,869	635,464	533,931	206,776
	Hayward	2,237,268	2,170,822	1,990,421	2,127,389	2,380,070	2,190,922	2,182,952	2,352,286	2,320,508	2,325,509
Belgium Total		2,659,186	2,609,284	2,412,810	2,696,661	3,019,485	2,769,019	2,716,821	2,987,750	2,854,439	2,532,286

Figure 46: Zespri top 10 historic markets by volume sold (trays) for both green and gold varieties.

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FOREWORD

Welcome to the third edition of the Kiwifruit Book. This book is intended as an open access, up-to-date resource for Secondary School teachers and new growers. It covers what was thought to be relevant in 2017, from the industry's structure and the marketing of kiwifruit, through to practical growing advice from real kiwifruit growers.

The development of this kiwifruit book started through a query made by Rick Jochem, an Ag/Hort teacher from Palmerston North Boys High School, asking if New Zealand Kiwifruit Growers Incorporated (NZKGI) would consider supporting the development of a kiwifruit workbook for use in secondary schools. Rick expressed concern at the limited availability of kiwifruit industry information available online. NZKGI agreed to support Rick and utilised funding received from a grower through the Acorn Foundation, together with a number of industry resources, to pull together relevant information for the first edition of the book.

The third edition of the Kiwifruit Book has taken the bones of the first and second and built on them to include the latest industry research and development. Additions to the 2017 Kiwifruit Book include:

- A 'quick facts' page detailing industry key points for quick reference;
- An overview on the different adverse events that may affect growers, with an in-depth look at the 2017 Edgecumbe floods and how they were managed and overcome;
- Information on kiwifruit varietal licenses and the recent Sungold license release;
- An investigation on one of biosecurity's most un-wanted pests; the Brown Marmorated Stink Bug;
- Information on the 2017 GIA Biosecurity Agreement;
- The importance of RSE Workers to New Zealand's horticultural workforce;
- An overview of the rise of the organic kiwifruit;
- A look at what regional councils are doing to solve New Zealand's fresh water issues; and
- Updated statistics and information from the 2016/17 financial year.