16. New Zealand Kobocha – worth millions in Japan and elsewhere; our Squash Pumpkin exports use many innovations

Two researchers at Crop & Food Research summed up this case study when they observed "*it is truly amazing that we can produce thousands of tonnes of squash pumpkin in New Zealand and sell it fresh in Japan just a few weeks later. And remember that when it is harvested it is yet to reach perfect condition - just like a tomato is usually picked before it is fully ripe".*

New Zealand exports close to $70 million (f.o.b.) of squash pumpkin with a volume of about 90,000 tonnes. Prior to the mid 1980s squash exports were small but they increased rapidly from 1992 to Japan. In 2000, the industry group then known as the NZ Squash Council, adopted the Japanese name for the vegetable and became the NZ Kobocha Council (NZKC), and set about repositioning NZ kobocha in Japan as an exciting and versatile food option. Ross Johnson, the General Manager of the NZKC defined the objective as *"to establish a consumer focussed business based on market pull, not production push'.*

Growers made the commitment to fund a promotion budget of $600,000 in the Japanese market. Innovative aspects of the campaign were (i) point-of-sale material promoting the vegetable for use in an entrée, mains and dessert, (ii) a web site that receives over 3,500 hits per day, and (iii) a hugely successful step to employ New Zealand students living in Japan for instore promotion as 'Kobocha Kids'. Johnson says *"the students are fluent in Japanese and their enthusiasm is infectious".*

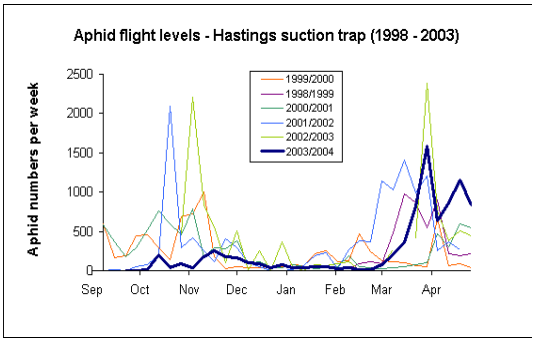
Science and innovation is important to maintaining squash exports. New markets are being developed to reduce the dependence upon Japan, currently the destination for over 90% of current exports. South Korea, an important developing market had been destroying or re-shipping some shipments of New Zealand buttercup squash (kabocha) because of a fungus associated with the squash that was believed to threaten their rice crop. Commissioned by NZKC, Dr Eric McKenzie mycologist (fungal scientist) with Landcare Research, uncovered a complicated case of mistaken identity that proved the fungus in question was quite harmless. It is expected that this work will save the squash industry over $1 million per annum.

Aphids are a significant pest of New Zealand squash crops being vectors of viruses that can reduce marketable fruit weight by up to 85% and cause presentation blemishes that may reduce marketable value by up to 82%.

Control of aphids can be managed in three ways: (i) *cultural control* (e.g. by destroying alternate hosts such as weeds), (ii) *biological control* (by using predators such as ladybirds and fungal pathogens that attack aphids) and (iii) *chemical control*. Most chemical treatment is by synthetic pesticides that are expensive, are not approved for organic production and may require two to four applications per season.

In the 1980s New Zealand scientists started studying aphids in wheat crops and have been able to build a long-term data set to help predict flight and infestation patterns. The optimum period for an application is when aphids are migrating into a crop. To identify this period historical data and regular crop monitoring are used to help make the correct spray decision.

More recently high level suction traps operated by *Aphid Watch* (supported by six funding organisations) are being used to take samples of the aerial aphid population at an altitude where the aphids are least affected by ground influences. This information is also provided as a service to growers of cereal, potato and lettuce crops.



1. Introduction

Thought to have originated in South America, pumpkins have been enjoyed for centuries. The Maori ate gourds baked in the hangi before Europeans came.

World production in 2003 of pumpkins, squash and gourds was estimated to be nearly 19 million tonnes, with China, India, Ukraine, USA and Egypt being the main producers.

Sometimes squash are referred to as winter squash or summer squash.

- Winter squash keep for a long time and have thicker skins. Buttercup squash has a dark rich green hard skin with speckles and stripes and a round flat shape with a fine textured orange-dark yellow flesh with a slightly sweet flavour.
- Summer squash have thin skins and include marrow, courgette (or zucchini) and scallopini.

Winter Squash is a major New Zealand export with about 90,000 tonnes of this fresh vegetable exported each year between January and May.

Like most vegetables, variations in growing conditions such as temperature, soil type and fertiliser used can result in significant variations in taste and texture. A buttercup squash grown in Pukekohe may taste significantly different from the same variety grown in Marlborough.

Nutritional Value
Pumpkins and squash are an excellent source of beta-carotene which the body converts to vitamin A. The highest levels are found in pumpkins with bright orange flesh. They are also a source of vitamin C, A, folate, fibre and potassium.

2. New Zealand Production

Total New Zealand production was estimated at approximately 123,000 tonnes in 2002/03 with an exported tonnage of almost 92,700 tonnes to two markets:

- Japan - 87,700 tonnes - an increase of 14% over the previous year.
- Korea - 5,000 tonnes - an increase of 67% over the previous year.

Export value in 2003 was approximately $76.5 million (f.o.b.)

In the 10 years from 1992 to 2002, planted area increased by 48% to 6,560 hectares. For additional information, refer to section # 8 for *Industry Statistics*.

3. Science and innovation features

Market Development

Over the past few years, considerable effort has been put into improving the quality of the product as it arrives on the market. This has led to a marked improvement for the image of New Zealand product. A market development plan has also been put in place for the Japanese market to increase the value of the product and maintain NZ buttercup/kabocha as the preferred source of supply during the export window of January to May. In Japan, buttercup squash are known as kabocha.

Innovative as the marketing effort is, science has also been playing an important role in our squash exports.

- A key development of the squash industry was storage and transport. During the 1980s scientists at DSIR (Sam Harris and Dave Beever) worked on door-off containers for transport through the tropics to Japan and fungal rot reduction to minimise losses during storage respectively.
- The industry uses 'curing' prior to transport. This is a period of exposure to ambient conditions for a few days to allow the skin to harden, and small surface wounds that arise from rough handling during harvesting to heal so that fungal infection through these wounds is minimised.
- A plant pathologist with DSIR, (Brian Hawthorne) carried out initial research on fungal diseases on squash and identified the main ones that caused the problems during export and in the market
- Squash are subject to chilling injury (when they can become physiologically damaged in the flesh) if exposed to temperatures of less than 12^{o}C. Work continues of finding economical ways to avoid such damage.

Food Safety Initiative

Food safety is of key importance for consumers and importing countries have regulatory authorities to deal with this issue.

In the late 1980s the New Zealand Squash Council was the first time when a New Zealand horticulture industry sector created a major programme to implement a food safety project. The primary driver was the need to reduce risk for all participants from the grower to the consumer. The squash industry now has a Squash Integrated Pest Management (IPM) programme.

The key outcome has been a significant enhancement in confidence and competitive edge for New Zealand product in its international markets. The project has also resulted in additional retailers in export markets being keen to handle the New Zealand product in the future.

Trade Barrier Investigation

South Korea had been destroying or re-shipping New Zealand buttercup squash (kabocha), because of a fungus associated with the squash that was believed to threaten their rice crop. Potatoes from the USA and Australia were also destroyed when the same fungus was detected. The fungus was believed to be *Verticillium tenerum*, which was classed as a pathogen by the Korean National Plant Quarantine Service.

The New Zealand Kabocha Council commissioned Landcare Research to review the naming, biology and distribution of this fungus, in the hope of convincing South Korean authorities it was not a quarantine pest. Landcare Research mycologist (fungal scientist) Dr Eric McKenzie found the fungus in question is quite harmless: *"While some Verticillium fungi are serious plant parasites, others in the group merely help to rot dead material. These fungi are not pathogenic, and do not damage rice."*

The Council's manager, Ross Johnson, says *"It enabled the Ministry of Agriculture and Forestry to prove to the South Koreans that the concerns were based on the wrong 'pest'. It brings to an end a problem that has persisted for several years".*

The buttercup squash industry expects to boost export earnings by $1 million a year, thanks to this science review work done by Landcare Research.

Aphids on squash crops

Aphids are an important pest of New Zealand squash crops as they can affect the yield of crops by withdrawing nutrients from the plants, stunting their growth and reducing the number and size of fruit.

New Zealand has ten species of aphids, but three species commonly found living on squash can transmit squash viruses.

Aphids typically spend the winter on weeds and other hosts and in the spring they multiply rapidly. Eventually their hosts become too crowded, then winged aphids are produced which fly off and colonise new host plants. This major spring flight of aphids peaks in October /November but the size and timing of the peak varies each season, as does the late summer/autumn flight of migrants.

Aphids are vectors of squash viruses and therefore infestations can have a major effect on yield. Virus infection can reduce marketable fruit weight by up to 85% and presentation defects can reduce fruit value by up to 82%.

Feeding on plant sap, aphid colonies compete with developing squash fruit and growing tips of runners for resources. Seedlings may be held back by a severe aphid infestation, and late in the growth of the crop aphid infestations in association with infections by the powdery mildew fungus or drought stress, may cause early collapse of the foliage.

Control of aphids can be managed in three ways:

(a) *Cultural control techniques*: these techniques aim to reduce aphid populations by, for example, destroying alternate hosts such as weeds.

(b) *Biological control agents:* a range of predators, specialised parasitoids and fungal pathogens that attack aphids; examples include ladybirds and lacewings.

(c) *Chemical control techniques:* insecticides are also used to reduce aphid populations and thus the transmission of squash viruses. The optimum period for an application is when aphids are migrating into a crop. To identify this period, a system to monitor aphid flights is required as well as a process to notify growers to help them make the correct spray decision.

Forecasting mosaic virus outbreaks

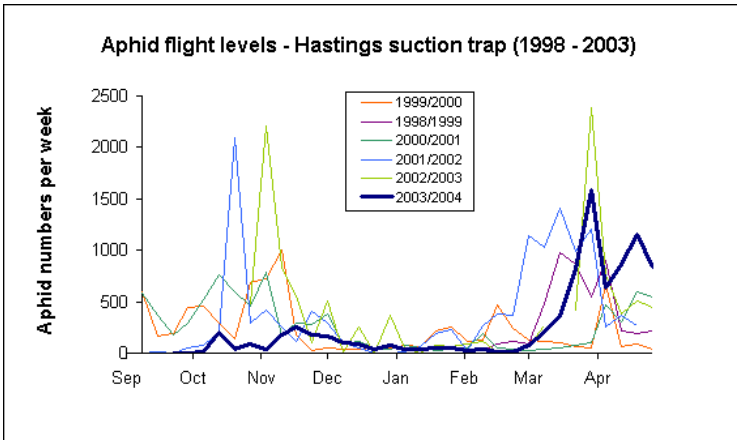
Systems for monitoring viruses that infect crops are based on monitoring aphid vectors. There are many in-crop traps, including water-pan traps, wind-vane traps or sticky traps, that are used to sample the aphid populations flying in a crop. These traps however are greatly influenced by the local surroundings, such as crop and farm management practices.

Research commenced in about 1980 by DSIR had the objective to develop a long-term data set on aphid flights and infestation patterns in wheat. Later in the 1990s, Crop & Food Research carried out further research that has became the foundation of the professionally conducted crop monitoring programmes now available. Crop monitoring visits are typically conducted 6 to 8 times during a growing season monitoring for cutworm, springtails, aphids, powdery mildew and symptoms of virus. Such information could be used as a management tool for farmers to predict aphid flights, potential infestation periods and implement control strategies.

A more recent development is a project known as Aphid Watch that provides aphid flight records, virus forecasts and other aphid information to New Zealand farmers and growers

Computer modeling work was funded by the Foundation for Research Science and Technology (FRST), Technology New Zealand and the ongoing work is supported by:
- MAF Sustainable Farming Fund
- Crop & Food Research
- AGMARDT
- VegFed
- Foundation for Arable Research

High level suction traps sample the aerial aphid population at an altitude where the aphids are least affected by ground influences. This information is then used to predict the aphid infestation in a crop and the subsequent infection of the crop by viruses. Once the relationship is determined, this data, along with historical data on virus incidence, is used to predict the level of virus infection based on flights of aphid vectors. The information helps growers determine the need for an insecticide application.



In addition to information for squash growers, Aphid Watch also provides information for potatoes, cereals and lettuce.

4. Benefits

Buttercup squash is New Zealand's second largest fresh vegetable export at approx. $70 million (f.o.b.) and 90,000 tonnes. Most of the squash grown in New Zealand is exported.

5. R&D investment

In the year 2000/2001 squash industry and growers investment in research funding was $1.3 million funded via a Vegetable Commodity Levy.

The ultimate aim of the R&D programme is to improve product quality. Research priority areas include:

- Internal quality, texture and flesh colour
- Image of freshness/external quality, product colour
- Product safety/integrity, chemical residues
- Taste, harvest maturity and crop management
- Imagery, product attributes
- Yield/profit, crop management

Immediate research priorities are:
- Industry soil testing/GPS mapping project.
- Varroa bee mite research – for the purpose of bee pollination research.

6. Strengths

The New Zealand Kabocha Council, formerly called the NZ Buttercup Squash Council, is an industry body working for the buttercup industry. It administers the Quality Management programme, R&D programme and market development programme at the generic level. The council and its activities are funded by levies on all export product.

The industry is well organised. Being a recognised product group under the Horticulture Export Authority Act has enabled the development of minimum quality standards for export product and to license exporters who wish to sell the crop. All growers, packhouses and exporters must register with the New Zealand Kabocha Council each year. This allows the council to keep growers informed throughout the season.

The key strengths of the industry are:

- Consistently good tasting, good quality product grown in a "clean green" environment.
- Industry quality assurance/food safety programmes.
- Generic in-market promotion and market development.

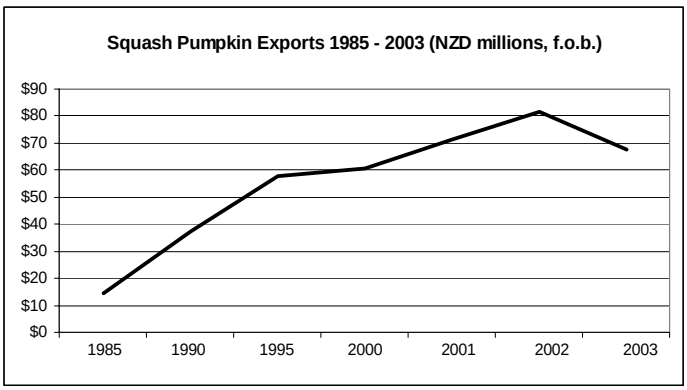
7. Outlook

- Increased interest in green-yellow vegetables and their health benefits is leading to a renewed interest in squash.
- The production, packing and exporting challenge is to enhance quality, consistency of product and service to the buyers, whilst at the same time maintaining profitability.
- The New Zealand Kabocha industry is keen to support further development of the Japan-side product traceability regime, to ensure the ongoing safety of New Zealand Kabocha in the market.
- To increase overall value of the crop by diversifying the usability of product, such as investigating alternative markets and processing options.
- To increase market penetration into Japan. Distribution had been centred around the Kansai region to date and the supply chain in Japan has the potential to be extended.
- To make improvements in the determination of maturity and storage capabilities of the product, through the R & D programme.
- A continual challenge for the Squash Industry is to develop and maintain the multidisciplinary approach needed to bring all steps together in the entire supply chain: growers → harvesting (timing) → packing and storage → transport and distribution to market → importer, wholesaler/retailer → consumer (acceptability and repurchase).
- Japanese market demand is for kabocha that has orange coloured flesh and a mild flavour. To meet this and the needs of other markets, scientists at Crop & Food Research say that much knowledge has come from post-harvest research work. This knowledge is likely to be of increasing value to the squash industry.
- The development of additional export markets for alternative off-season supply will be important.

8. Statistics

World production in 2003 was about 19 million tonnes, with the top producing countries being China (5.5 million tonnes); India (3.5 M tonnes); Ukraine (900 k tonnes); USA (700 k tonnes); and Egypt (700 k tonnes). In global terms New Zealand export levels are infinitesimal – but a reason why quality product to niche areas are a sustainable opportunity for New Zealand producers and exporters.

New Zealand Fresh export levels 92,700 tonnes $ 67.5 million (f.o.b.)



Fresh domestic market: estimated at 30,000 tonnes $ 9.8m

Number of Growers 181

Number of Packhouses 19

Number of Exporters Approx. 20

Planted Area 6,560 ha

Grown in most New Zealand provinces, but dominant areas are:

- Hawkes Bay 2,795 ha 43%
- Gisborne 2,427 ha 37%
- Manawatu/ Wanganui 685 ha 10%

9. Information sources – includes persons contacted and other references.

- Sam White & Winna Harvey, Richard Falloon & Ros Lister (virologist), Crop & Food Research (interviews)
- *New Zealand Horticultural Facts & Figures 2003,* HortResearch
- Landcare Research www.LandcareResearch.co.nz
- Aphid Watch www.aphidwatch.com
- Ross Johnson, General Manager, NZ Kobocha Council.
- 2003 Annual Report, New Zealand Kabocha Council
- NZ Vegetable & Potato Growers Federation (Inc) www.vegfed.co.nz
- *Spearhead*, 2004, (quarterly publication of the NZ Asparagus Council)
- Fruitfed Supplies crop monitoring service – www.fruitfed.co.nz

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

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

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