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

Calla lilies have become New Zealand's second most important export flower crop. This success has been built on the exciting range of coloured callas that have been produced for New Zealand gardens by a persistent lineage of New Zealand hybridisers at work since the 1930s.

During the 1980s several horticulturalists recognised that the unique pool of germplasm that was available in New Zealand could form the basis of a novel flower export industry. This development was helped because commercial growers and marketers were able to view Callas on the local scene and make judgements about their export potential. Subsequently, a series of industry and science innovations have underpinned the development.



This case study illustrates how industry and science came together to develop a new export crop. Often industry defined the problem or opportunity for science to tackle.

- Over 50 years of hybridising by New Zealand horticulturalists produced an invaluable genetic resource by 1980 and upon which the fledgling calla industry could be based.
- During the late 1970s and into the 1980s there was strong support at the political and research funding levels for the development of new horticultural enterprises with bright export potentials. The time was opportune for the development of the calla industry and the resources were available to support the sunrise industry.
- The industry needed to have large numbers of plants of cut flower varieties as soon as possible to reach a viable critical mass.
- Science developed the propagation technology that enabled thousands of plants to be produced from a single elite plant in a short time - with all plants identical to the original. This development was based on the new tissue culture propagation methods of the 1970s. Today commercial laboratories routinely use the technology to propagate plants for release to growers. These developments enable the industry to capitalise on the best of many hybrid varieties that come available from the breeders.
- The concurrent requirement was for management systems that produced quality flowers and tubers according to schedule and in a commercial setting. Innovative growers interacted with science to construct the complex technology mix that goes into managing the crop for both flower and tuber production. This revolves around understanding (i) the environmental conditions under which the plant is to be grown, (ii) the production and storage of tubers with enhanced flowering potential, (iii) the use of gibberellins to induce extra flowering, (iv) the development of effective disease control strategies and practices and (v) the timing of flowering to best match market demand.

In 2003 New Zealand's exports of calla flowers and tubers exceeded \$10 million (fob).

The status of the New Zealand calla industry owes much to the enthusiasm and drive of export marketers and commercial growers who exploited the excellent germplasm base created by the initial hybridisers. The subsequent propagation and management innovations by both industry and science have been a critical element in enabling the industry to build a commercial base with greater stability. Failure to have made these innovations would probably have meant a lost opportunity of developing a calla industry because the early growers could have been overwhelmed by a series of production problems. The global demand for calla tubers from New Zealand underlines both the potential that other countries see in this crop, and the regard that they hold for the work of New Zealand plant breeders.

1. Background

South Africa is the natural homeland of *Zantedeschia* (Calla lily). These lilies are also found elsewhere on the African continent in Angola, Kenya, Malawi, Zambia, Zimbabwe and Nigeria. *Zantedeschia* species grow naturally in warm temperate climate zones, but can be successfully grown in cool temperate climates. The coloured summer varieties like a warm temperate climate and the white winter flowering *Z. aethiopica* is often found growing in wetland areas.

Seeds of *Zantedeschia* were brought to New Zealand in the early 20th Century. The seed included the five original summer flowering species from which the colour hybrids have been developed. Some of the early hybridisation was completed by Luther Burbank, California but several New Zealand hybridisers entered the scene in the 1930s and their work has been carried forward to the present day. The early names included Tony Brljevič and his son Trevor, Richmond Harrison and Jim Mathews. The Calla lilies from their collections formed the basis of the industry that developed during the 1980s.

Callas are grown in a wide range of soils and climates in New Zealand from Northland, Auckland, Bay of Plenty and south to Canterbury. Calla growers may produce both tubers and flowers, which allows them to spread their risks somewhat compared to other flower crops, but there is a trend towards specialising in one or other. At present the flowering season is being extended by delayed field plantings and growing early and late season crops under cover. Greenhouse calla flower production is based on achieving premium prices for early and late season markets in Japan, North America and Europe. Prices have levelled out in these markets due to production from more temperate countries such as Kenya and Chile. However, there is still demand for smaller volumes of high quality stems from New Zealand and demand remains good for field grown flowers over the November to April period.

New Zealand calla breeding programmes are continuing to release new varieties for both pot and cut flower production. These varieties are protected in other countries by plant variety rights (PVR) and/or plant patents, but this process costs the breeders several thousand dollars per application. PVRs have only been obtained on the recently bred cultivars. New Zealand breeders are able to collect royalties for those varieties which are protected by a PVR. Overseas agents may be given rights to propagate plants using tissue culture. Royalties can provide a significant income stream for New Zealand businesses.

The demand for tubers remains steady. World-wide production will increase, but if the trends over the past few years continue, this is more likely to occur outside of New Zealand; a reflection of the limited investment in the New Zealand industry.

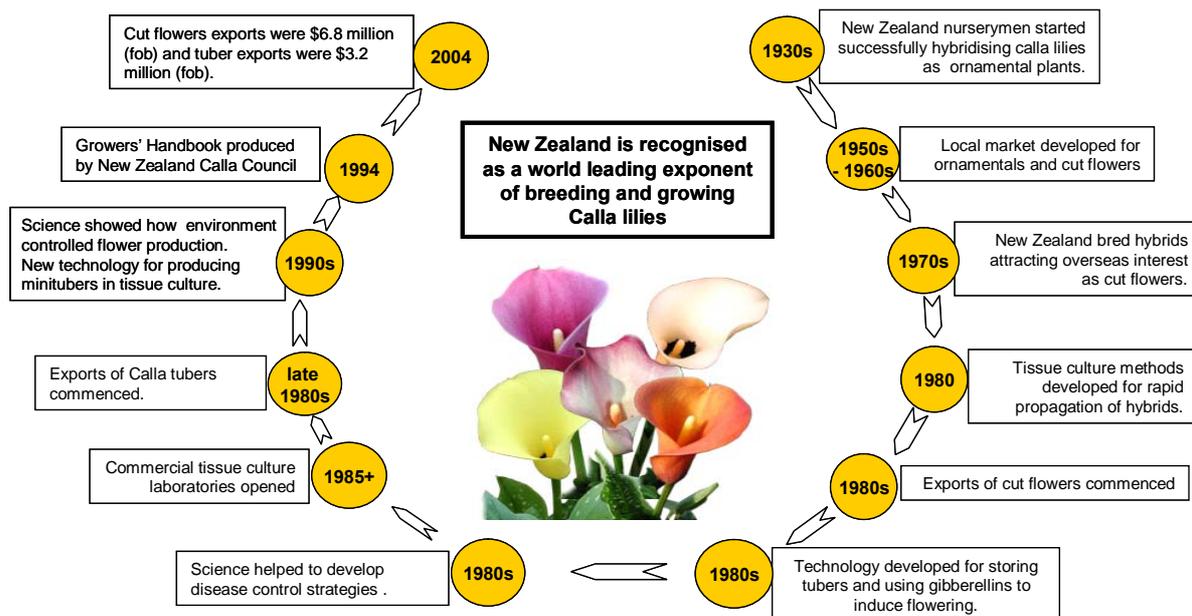
Growers are phasing in plant stocks of the new higher-yielding varieties, to update their market offerings. Each season most tuber growers are allocating a percentage of their production to new varieties to reflect market demand. This response is readily catered for by the use of tissue culture propagation. However, care is taken to ensure that new varieties will perform well in the commercial production setting.

The average prices of outdoor (mid-season) grown flowers are not much affected by new varieties at present because outdoor production remains relatively static and plantings of new varieties are limited. Expansion of outdoor calla production should avoid the late December-late January period when export prices are generally low.

Callas have become an important up-market flower crop on the global scene. Several Dutch companies are putting a large investment into Callas, and for some it is the #3 ranked flower crop. This development explains why there is a demand for NZ tubers.

Some of the globalisation of Calla lily production has been initiated from New Zealand. Commercial companies have expanded their operations offshore by growing flowers and bulbs in Kenya, Taiwan, India and Swaziland, for lucrative northern hemisphere markets. Developments in countries such as Chile are also being considered.

2. Timeline



3. Science and innovation features:

- The Calla industry has been developed in New Zealand as an export sector which is based around both cut flowers and tubers and built initially on an industry designed to serve the local market. Most export growers also produce products for the local market.
- A key aspect of the development was the breeding and selection of new cultivars by New Zealand horticulturalists over 50+ years prior to 1980. Following the development of fresh flower markets the objectives have been to improve the range of flower colours, the shape of the spathe, increase flower numbers and extend the life of the blooms on the plant and as cut flowers.
- The development of the tissue culture technology in 1980 by DSIR enabled the micropropagation of elite varieties with a rapid expansion of plant numbers. This development was initiated by science and has been a key to the expansion of the industry. This technology provides a rapid method of clonal propagation which is superior to the slow increase in tuber stocks through natural vegetative propagation. Typically variability exists when plants are propagated from seed. However, hybridising has enabled selected Calla varieties to be reproduced from hybrid seed with little variability.
- Science has led to an understanding of the viruses that infect Callas. This enabled the development of high health (absolute minimum virus infection)

production facilities and the use of virus-free mother plants from which to propagate.

- Throughout the 1980s and 1990s science provided further understanding of the storage technology for tubers and the environmental conditions necessary for optimum flower production. This work continues. There is still a shortfall of information regarding the growth and development of Calla plants, especially with respect to tuber growth.
- Science has provided a basis for developing practical measures for controlling tuber and soft rots; also flower spathe fungal spotting. The problems of soft (bacterial) rots are not completely solved. The Dutch are now breeding for resistance to these rots.

4. Benefits

New Zealand has established an international profile with respect to the breeding and development of Calla lilies. This profile is based on the quality of the Calla varieties bred in New Zealand during the past 70 years and is yet another contributor to our high standing within the international horticultural community.

Calla lilies are difficult plants to grow and without the support of science many growers would have abandoned the crop.

The advent of PVRs has enabled the New Zealand breeders to capture some economic benefit from their new Calla varieties.

Science and innovation has contributed to the establishment of the Calla export sector during the 1990s. This sector now has total export earnings of around \$10 million (fob) and is the second largest cut flower export crop.

5. Return on R&D investment

The return on investment was not assessed because there is a significant difficulty in obtaining a single causal relationship between the various innovations and the sale of Calla flowers and tubers in the domestic and export markets. Too many other factors have an impact on the commercial returns for the export flowers and tubers. Equally, the science input has been provided by many organisations during the past 25 years, in order for the industry to access the required skill base and this makes the R&D investment very difficult to estimate.

However, there are specific examples of R&D investment that can show a large potential or actual return:

1. Bacterial soft rot studies have led to important cultural controls and have reduced the risk of devastating tuber and crop losses.
2. The development of gibberellin treatment of tubers has increased flowering yield by up to 100% in many situations.

Key information on Calla lilies:

Calla lilies became a significant export flower crop in 1990, and have grown steadily to reach \$6.8 million (fob) in 2003/04 when about 6.3 million stems were exported. The exports are primarily to Japan (57%) and USA (25%). Volumes are expected to increase for 2004/05, predominantly from those crops under greenhouse production. There are some 15 export companies servicing these world markets.

Calla tuber exports rose to 63 tonnes in 2003/04, which is approaching the high of 68 tonnes exported in 1995/96. Stock from New Zealand breeding programmes is popular

and export sales reached \$3.2 million (fob) in 2003/04. Interest from South America, Africa and Asia is increasing.

6. Quotes:

"The greatest milestone in recent years is in the laboratorytissue culture (technique), which can multiply one selected (Calla) plant to thousands in a short time with all the plants being identical to the original. In New Zealand this technique was developed and perfected at the DSIR, Plant Physiology Division."

Joy Amos, 1984.

"HortResearch virologists lead the world in Zantedeschia virus detection after many years of tricky research and interpretation. From the BLOOMZ perspective as a leading Zantedeschia exporter it's great to have confidence in people that really know what they're about."

Andy Warren, CEO, BLOOMZ. HortResearch Research Report 2000/01.

"We are now accepting orders for our next shipping season: January through June 2005. Please keep in mind, however, that the New Zealand varieties are routinely sold out well before the beginning of the season."

The New Zealand varieties are most popular with cut-flower growers due to their tall, strong stems, large blooms and characteristic flower shape. If you are interested in the New Zealand calla lilies, please let us know as soon as possible."

Pacific Callas, California, USA. www.pacificcallas.comT

"Whether New Zealand could become a "floriculture technology centre" for the Asia-Pacific region remains questionable. This is mainly due to the lack of cohesion and infrastructure that currently exists within the industry. Certainly, New Zealand has the expertise in breeding and growing crops such as calla and sandersonia."

MAF Horticulture Monitoring Report, 2004.

7. Related activities:

Several commercial laboratories were established during the 1980s for the tissue culture propagation of Calla lilies. This activity continues today with the focus on propagating new Calla varieties as these are released for commercial production. There is some export of live plants.

Crop & Food Research continues to supply services to the industry such as determining the colour in blooms for breeders, assessing the likely tissue culture success for a particular cultivar. There is a large variation among cultivars with respect to the ease with which they can be propagated through tissue culture.

From some viewpoints Callas are a missed opportunity. The Dutch have recognised the potential for Callas. New Zealand's small Calla businesses do not have the investment resources and associated vision of the large Dutch companies. During the 1990s the number of Calla flower stems passing through the largest Dutch flower auction increased 10 fold to approx 30 million stems.

The Calla growers have established a research fund which enables them to examine other cultural issues which face the industry. These R&D funds alongwith other industry activities such as technology transfer and market development in Japan and Europe, are overseen by the NZ Calla Council.

8. Information sources:

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

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

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