THE NEW ZEALAND CALLA

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The calla lily (*Zantedeschia*) is not new to floriculture. Members of the genus have been cultivated in greenhouses or outdoors in Mediterranean climates for many years. The New Zealand hybrid calla with its diversity in colour and form is the focal point of a current revival in popularity amongst florists.

Papers on the topic of callas appear in recent volumes of the IPPS Proceedings. One of the most significant was a paper presented by Cohen in 1981 (2) detailing his work on micropropagation of callas. This work opened the doorway for commercialisation of a crop that was previously slow to clonally propagate in large numbers.

In 1983 Hatch (4) outlined procedures involved with breeding and selecting hybrid callas. This was followed in 1986 by a paper I authored entitled "A system for the evaluation of *Zantedeschia* (calla lily)" (7). In 1988 I joined with Plummer to co-author a paper entitled, "Preliminary evaluation of dwarf white calla lily as a potted plant" (10).

This paper will describe the evolution of the calla into a commercial crop for New Zealand and it will discuss the problems and opportunities encountered.

THE GENUS

The term calla lily misrepresents the true classification. The genus *Zantedeschia* correctly belongs to the family Araceae. It is more closely related to the caladium and does not have the same habit and cultural requirements as found in true lilies. There are six known species in the genus *Zantedeschia* (5):

Z. jucunda	deciduous, yellow (not used horticulturally)
Z. aethiopica	evergreen, white flowers
Z. rehmannii	deciduous, small pink flowers
Z. albomaculata	deciduous, cream flowers
Z. elliottiana	deciduous, yellow-gold flowers
Z. angustiloba [syn. *Z. pentlandii*]	deciduous, yellow/gold

Over 50 years of crossing and selecting the last four species has produced the present range of cultivars available in New Zealand. *Z. rehmannii* has enabled breeders to produce a smaller growing species, with lanceolate leaves more suitable for pot plant

production. *Z. elliottiana* has given greater size to spathe, leaves, and flower stems for cut flower production.

The deciduous types form an underground tuber which is dormant over winter. Growth and flowering is not greatly affected by daylength; however, plants must undergo a rest period (6 to 8 weeks) before growth will resume. The growing cycle ranges from 16 to 24 weeks and the rest period can be induced by cold or dry periods. Form and habit vary among the named hybrids. Leaf shape is lanceolate, hastate, or sagittate (lance, spear or arrow). Leaves can be heavily spotted with white markings through to plain green. Plants are either monopodial or sympodial in branching habit depending on the cultivar. Established plants range in natural height from 30 to 150 cm tall.

The "flower" is composed of a central spadix which bears the true male and female flowers, a coloured spathe and a scape (flower stem). The top of the flower spathe is round or pointed in shape and the front can be open or semi-open. Flower quantity is dependent on cultivar, tuber size, storage treatments, and growth regulator applications. One to three flowers can be expected from a 4 to 5 cm diameter tuber. The flowers are green at macrobud stage and gain full colour upon opening. After pollination flowers often deepen in colour, begin to re-green, and then close. Re-greening occurs from four days to 21 days after opening depending on the cultivar (7).

PROPAGATION

The true species are propagated by seed. Many of the small flowered pink, yellow and cream cultivars available to growers are produced by seed with the majority of seed-grown tubers originating from a California nursery. Breeders in New Zealand are currently working in the direction of making more cultivars available true-to-type from seed, however the range is still very limited.

The early hybridizers in New Zealand used natural division of tuber offsets as a means of propagation from the early 1900s to the 1980s. Bulking up of plant material in this way is slow and conducive to carry over of bacterial and viral diseases. While natural division is an acceptable method for cut flower growers to increase stock, it is not a realistic approach for commercial tuber production.

The technique for micropropagation developed at the Division of Scientific and Industrial Research (DSIR), Palmerston North, was a milestone for the commercial development of callas. Initiation in culture is simple and multiplication rates are high (2). The tissue culture of callas has enabled propagators to rapidly bulk up a wide

range of selected clones which would not come true from seed. Callas are one of the ariods which suffer from the aphid vectored virus. Provided material is indexed as clean when initiated, tissue culture is the only means of ensuring clean propagules (11).

TUBER PRODUCTION FROM TISSUE CULTURE

Once plantlets are removed from the flask they require two growing cycles before they reach a natural flowering size of 4 to 5 cm in diameter (8). With each growth cycle, consisting of 4 to 5 months growing and a 6 to 8 week rest, natural flowering-sized tubers can be achieved in just over 15 months if greenhouses are used for out-of-season forcing. Tuber production can be cycled for year-round production, particularly when shipped from one hemisphere to another.

FLOWER FORCING

Forcing for cut flower production can occur at any time of year provided soil temperatures can be maintained at 13° C minimum. To obtain high quality flowers with strong stems and vibrant colours, light levels must be high, but temperatures in excess of 25 °C must be avoided. New Zealand growers use open field production techniques for flowering the crop over summer under natural flowering conditions. Tubers are planted early and late in the season under protected environmental structures to extend the harvesting period to cover 6 months.

Flowering productivity is greatly enhanced by the use of gibberellic acid GA_3 (3). Yield increases range from 200 to 400%. Treatments at 25 to 500 ppm have been reported as being successful (9). The use of GA_3 treatments are also important for pot plant production, not only to increase flower number but also to ensure that 100% of the tubers flower. This is particularly important when smaller planting material is used.

Potted plant production of callas has met with only limited success. The hybrid coloured callas do make attractive flowering plants when treated with GA_3 to increase flowering, and with Bonzi® (paclobutrazol) as a soil drench to reduce plant height (6). Post harvest keeping qualities are not good with the coloured callas when they are kept under low light. The dwarf white calla has adequate keeping qualities under low light conditions making it a suitable choice for production as an indoor potted plant (10). The hybrid coloured callas make excellent patio pot plants as they require high light to produce flowers true to colour.

BREEDING OF NEW ZEALAND HYBRIDS

Calla lilies have probably been grown at Kew and other European botanic gardens since the discovery of South Africa's flora. At the turn of the century, Luther Burbank, a noted early plant breeder in California, was making many crosses within *Zantedeschia* using some or all of the deciduous species mentioned above. His work yielded several horticultural cultivars (1).

There is no record of when the first zantedeschias were introduced into New Zealand. A 1912 Yates Bulb Catalogue does list three species and cultivar selections bearing names used by Burbank. One can only surmise that early introductions were brought in directly from Africa or from horticultural collections in California and Europe. There appears to have been an abundance of amateur breeders making crosses in the early 1900's. However, most of the cultivars available in New Zealand appear to be the result of three hybridisers, each working independently. Brljevich of Maungaturoto, began breeding in 1932, Matthews of Waikanae, started collecting and breeding in 1946, as well as Harrison who was active in the 1960s.

Today's commercial hybrids have been selected from gene pools created by the above mentioned plant breeders. Hybridising is continuing amongst some calla growers with the intention of improving characteristics important for commercial production. Their objectives include improvement of: stem strength, plant habit, flower forms, colour purity and diversity, productivity, and disease tolerance.

New Zealand has inherited a world leadership role in the development of new calla cultivars and their commercialisation. To maintain this world leadership will be a challenge for the New Zealand floriculture industry.

As quantities of calla tubers began to build up in the mid-80s a two-pronged export industry in callas began to emerge. Calla tubers for export to pot plant forcers and calla cut flowers for shipment to overseas flower markets were both achieving near equal returns. Exports of both products have remained near equal from 1986-90; however exports of tubers have suffered from difficulties. As a result, two of the three major tuber exporting companies have withdrawn from the calla ındustry. The majority of tuber exports from New Zealand now originate from cut flower growers selling surplus stock.

TUBER EXPORT DIFFICULTIES

Too much disease in exported tubers has been a common complaint. Bacterial soft rots (*Erwinia*) are often the cause of losses when forcing callas in artificial environments, i.e. soilless potting

mix and warm humid greenhouses. The pathogen is always present in calla crops to a certain degree and over the years calla growers have learned to manage the disease with better cultural practices. These include: good aeration in the medium around the tuber, avoiding excessive overhead irrigation, and starting with plant material that is not more than two growing cycles from tissue culture as opposed to field divisions.

Virus can also be another disease problem in callas. The main virus which infects callas is Dasheen Mosiac Virus (DMV). It is spread by aphids and is systemic in the plant once infection occurs. New Zealand propagators are now beginning to have mother stock virus indexed prior to initiation into culture. Again, for health reasons tubers for flower forcing should be two cycles from tissue culture.

Marketing difficulties have also slowed the growth of tubers for export to the Northern Hemisphere.

Tuber growers have, in the past, been guilty of producing tubers only when it suited natural growing conditions. Grades and standards have not been rigourously set and adhered to, resulting in customers often receiving undersized material. The price structure has been based on cost of production and producer/broker profit margins, resulting in a low return product for potplant producers facing market set pricing for the end product.

Product performance of tubers destined for pot culture do not always meet up to customer expectations. Uniformity of forcing time is complicated by lack of information on individual cultivars and pre-planting storage history. Coloured calla flowers fade under low light conditions after 5 to 10 days, reducing the shelf-life dramatically as an indoor pot plant. Lack of knowledge of growth regulator requirements has also lead to poor flowering and leggy plants.

CALLA INDUSTRY OPPORTUNITIES:

1. *Production of calla tubers for export from virus indexed tissue cultured material under protected environments.* This will greatly minimize disease occurrence and provide tubers ready for forcing at the time of greatest demand for pot forcers (winter and spring).

2. *Promotion of pot callas as an outdoor patio plant.* Callas will perform for 6 to 8 weeks in flower true-to-type if kept outdoors under full light or partial shade. The foliage will continue after flowering for a further 6 to 8 weeks.

3. *Propagation of small tubers (2 cm diameter) for growing on in the Northern Hemisphere or tropical areas.* This will allow for year round supply of calla tubers ready for forcing.

4. *Expansion of cutflower production.* A recent study by the New Zealand Trade Development Board showed that both demand and production levels will continue to increase (11). The cut flower section of the calla industry has a good reputation for quality and consistent grading standards. The product is available at a time of year when demand is high, October to April. Producers are now gaining adequate experience to control harvesting dates through staggered planting and losses from diseases are under control. Calla flowers are exported to Japan, Europe, North America, and Hong Kong. They command a high price and are used by "up market" florists in these countries. The potential for market development and further expansion of the cut calla industry is promising.

5. *World leadership in callas.* New Zealand is currently the leader in coloured calla production and marketing. This leadership position, however, has largely been acquired by chance. To continue to lead, the industry is starting to develop and implement a strategic plan. This plan will incorporate efficiency in: production technology, new product development leadership, a market development programme, strong industry organisation and co-operation, and accurate information systems on industry performance.

CONCLUSIONS

In conclusion, the calla industry in New Zealand has gone through the growing pains of developing a new crop for international floricultural consumption. The future growth in export of ornamental horticultural crops from New Zealand is likely to occur from new crops. Most will have a similar development pattern as was experienced with callas. The lessons learned from the calla industry will greatly assist development of future new crops for the world to enjoy.

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