# Horticultural Use of the Genetic Variation of New Zealand and Australian Teatrees

**Warwick Harris**
Manaaki Whenua - Landcare Research, P.O. Box 69, Lincoln

## HISTORY

The name teatree comes from the use of these plants for making a herbal tea by Captain Cook in his voyages to New Zealand beginning in 1769. This use was part of Cook's strategy to overcome scurvy, one of the curses of long distance sea travel in those days. The botanist on Cook's first voyage, Daniel Solander, identified two species of teatree which he ascribed to the genus *Philadelphus*. Seeds of these were taken back to England and by 1778 four kinds of New Zealand *Philadelphus* were being offered for sale by an English nurseryman (Brooker et al., 1988). These plants fetched a price of 7s 6d (75¢) each, which, on the basis of the inflation that has occurred since that time, must have been an astronomical price! One of these was named *P. aromaticus*, and the essential oils that give this aromatic character have been recently developed as new products in New Zealand and are reputed to have significant pharmacological properties.

On Cook's next voyage in 1773, the accompanying botanists, father and son—John Rheinhold and George Forster, recognised that the New Zealand teatrees were something quite different from the mockorange genus *Philadelphus* and established the genus *Leptospermum*. *Leptospermum* means narrow seeded, and the Forsters named the first species of the genus *scoparium*, meaning "broom like". This is the plant that is commonly known today as manuka. It was not until 1832 that a second species that had been recognised by Solander was described as *L. ericoides*, *ericoides* meaning "heath-like", by the French taxonomist A. Richard. This was from a specimen collected during the voyages of exploration by Duperrey and D'Urville in either 1824 or 1827. This is the plant that is commonly known today as kanuka. People continue to have difficulty separating manuka and kanuka but the differences between them are quite obvious once they are pointed out.

A third species of *Leptospermum* indigenous to New Zealand was described in 1899 by Thomas Kirk, one of New Zealand's most notable resident botanists of last century. This species, named *Leptospermum sinclairii*, is endemic to an area around Mt. Hobson on Great Barrier Island. Volume I of the Flora of New Zealand (Allan, 1961) recognised these three species of New Zealand teatrees. This reference also recognised the variety *incanum* of *L. scoparium* based on pink-flowered plants from northern North Auckland, and also the varieties *lineare* and *microflorum* of *L. ericoides*.

## VARIATION AND ORNAMENTAL CULTIVARS

New Zealand botanists soon realised that both manuka and kanuka were very variable species. Leonard Cockayne (1919) remarked that manuka presented a diversity of forms that were seemingly impossible to classify. Even though our knowledge of manuka has advanced considerably since Cockayne's time, what he said about the difficulty of their classification remains largely true. New Zealand

nurserymen and gardeners soon came to regard this variability as an asset to be exploited. However, whereas English horticulturists were enthused by the novelty and simple beauty of the white, single-flowered forms brought back from Cook's voyages, these soon became commonplace to those who settled in New Zealand.

Instead, rare variants discovered amongst the widespread wild stands of manuka were brought into cultivation and provided the parents of most of the 100 or more named cultivars of *L. scoparium* that have been released since the beginning of this century (Harris, 1993a, 1994). Amongst the most notable of the manuka cultivars directly derived from wild plants were *L.* 'Nichollsii' from a crimson-flowered plant discovered near Kaiapoi in 1898, *L.* 'Leonard Wilson' a white double-flowered plant described by Cockayne (1918) from a plant collected at Port Levy, and *L.* 'Keatleyi', a plant with large pink flowers discovered near Parengarenga Harbour in the far north in 1917 (Stevens, 1944).

The next major step forward in the use of manuka as an ornamental plant began in 1939 in a crossing and selection programme by W.E. Lammerts (1945) in California. Lammerts produced a series of cultivars from the F2 progeny of the cross between *L.* 'Nichollsii' and a double-flowered cultivar *L.* 'Rose Double' of uncertain origin. Since Lammerts time other important series of selections have come from the E.F. Jenkin & Sons Nursery near Melbourne Australia, the "Nanum" series named after New Zealand birds released by Duncan and Davies, New Plymouth, New Zealand, in the 1950s, and the recent "Wiri" selections made by Jack Hobbs, Curator of the Auckland Regional Botanic Gardens.

## THE AUSTRALIAN CONNECTION

Allan's (1961) opinion was that the three *Leptospermum* species indigenous in New Zealand were also endemic. He considered that in total there were about 35 species of *Leptospermum* and most of these were Australian. This view of *Leptospermum* was radically changed in the early 1980s when Joy Thompson, working on a revision of the genus, placed kanuka in the genus *Kunzea* as *K. ericoides* and included *K. sinclairii* with this species. She also stated that both *L. scoparium* and *K. ericoides* occurred naturally in both Australia and New Zealand (Thompson, 1983). In her published revision of *Leptospermum* (Thompson, 1989) she describes 79 species, and several of these were recently discovered plants. Amongst these was *L. spectabile*, a species with a very local distribution along the Colo River close to Sydney. We introduced and evaluated this plant at Lincoln and made a selection named *L. spectabile* 'Christmas Star' (Harris and Percy, 1988). Although in many respects it is a more spectacular plant than the manuka cultivars it has not become widely grown because it is difficult to propagate, has low frost resistance, and has a habit not convenient for container growing. However, I have a specimen at home that looks and grows well on the sheltered northern side of the house.

By the time Joy Thompson's findings became known I had assembled and raised 50 populations of manuka and 20 of kanuka from seed collected from sites throughout New Zealand. By bringing these populations to the one site and growing them in a common environment, genetic differences between these populations were revealed. Amongst the observations made on these plants were height and width growth, leaf and flower characters, flowering, disease and pest resistance, and frost tolerance. Very significant genetically based differences between these populations were revealed in this way, and within populations some very distinctive

plants of horticultural interest were found. As an example, variation of shrub form of both manuka and kanuka between and within populations is illustrated in Fig. 1. From this variation the distinctive compact dwarf *Kunzea ericoides* 'Karo Greenfingers' has been described and selected (Harris, 1994). 'Karo' is being included in the names of all the ornamental cultivars selected by Landcare Research. It is an acronym of "known and recorded origin" and highlights the importance of accurate recording of the origin and characteristics of cultivars before they are commercially propagated.

Joy Thompson's findings encouraged me to introduce seed of populations of both *L.* scoparium and *K. ericoides* from Australia. Also, several of the Australian species she described were introduced. As well as *L. spectabile* 'Christmas Star', a cultivar *L. variabile* 'Karo Crimson Pearl' has been developed (Harris, 1993a) and selections of several other Australian species are being tested by New Zealand plant propagators. While many cultivars of *L. scoparium* had been selected, relatively few cultivars of Australian *Leptospermum* species have been described. Australian's neglect of their *Leptospermum* species can be explained by the wealth of spectacular and colourful plants in their flora. Without the rare occurrence of red pigments and double-flowered characters in manuka it would not have attracted the use as an ornamental it has received. It was quickly observed that the Australian species had characters that would enhance the features of the ornamental *L. scoparium* if crosses could be made, but little information was available to indicate whether hybridisation was possible.

## CHANCE AND DELIBERATE HYBRIDS

Two hybrids came into the research programme by chance, both spectacular in different ways and by different routes. Twenty-four plants were grown for each of the 70 populations of New Zealand manuka and kanuka so that the differences between plants within the populations could be studied as well as the differences between populations. Amongst the *K. sinclairii* population from Mt. Hobson, Great Barrier Island was one plant that stood out as being quite different from the rest. Consequently this plant received careful study and this showed it to be an intergeneric hybrid between *L. scoparium* and *K. sinclairii* (Harris et al., 1992).

This plant is a sterile F1 hybrid and the probability is that had the seed it grew from fallen on the ground in the wild it would not have grown into a plant. Following correct plant nomenclatural procedures this plant has been named ×*Kunzspermum hirakimata* the specific name being the Maori name for Mt. Hobson. Being a unique plant, and combining several of the good features of the parent species, this plant also deserved description as a cultivar—hence ×*Kunzspermum hirakimata* 'Karo Hobson Choice' (Harris, 1993b). Since the discovery of the intergeneric hybrid, several deliberate crosses between *L. scoparium* ornamental cultivars and *K. ericoides* and *K. sinclairii* have been tried with the aim of introducing red pigmentation into the flowers of kanuka. These have not been successful.

When the *L. spectabile* plants raised from seed obtained from Australia flowered and set seed, seed from a selection of these plants which showed strong red flower coloration was in turn sown. Amongst the seedlings from this sowing was one with leaves distinctive from those of *L. spectabile* and this was marked for closer attention. When this plant first flowered in 1991 it had large and distinctively coloured flowers, markedly different from the variation of flowers amongst the

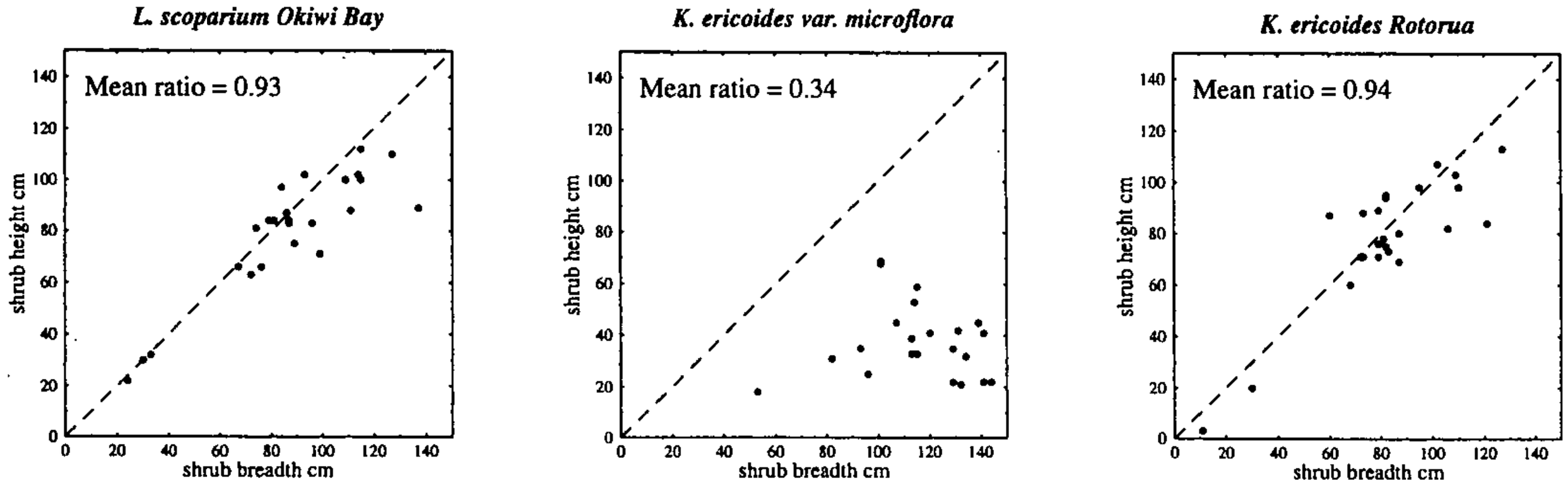


**Figure 1.** Variation between and within teatree populations of shrub dimensions. Means of the shrub height-to-breadth ratio are shown for each population. Prostrate shrubs are below the diagonal line and erect shrubs above the line (From Harris, 1994).

parent *L. spectabile*. Returning to the specific *L. spectabile* plant from which the seed had been collected, it was found that it was adjacent to a block of *Leptospermum* cultivars, mostly manuka cultivars but also a plant of *L. rotundifolium* 'Jervis Bay'.

The natural distribution of *L. rotundifolium* is in an area south of Sydney on the tableland escarpment of central eastern New South Wales to the coast near Jervis Bay. It has large flowers that vary in colour from white and cream to a purple that is not found in any other *Leptospermum* species. This plant, a spontaneous hybrid between the *Leptospermum* species with the most spectacular flowers, has been described and named as *Leptospermum* ×*violipurpureum* 'Karo Spectrobay'.

Although this hybrid has large and distinctly beautiful flowers, it has inherited the difficulties of propagation that characterise the parents. Similar to the specimen of *L. spectabile* 'Christmas Star', a specimen of *L.* 'Karo Spectrobay' looks and is growing well on the sunny side of a trellis in my home garden.

While these spontaneous hybrids were being discovered at Lincoln, research at Levin to improve the floricultural characteristics of *Leptospermum* had generated hybrids of *L. scoparium* with *L. rotundifolium* and *L. macrocarpum*. Also, my colleague Murray Dawson who made the very interesting discovery of tetraploidy and triploidy amongst *L. scoparium* cultivars (Dawson, 1990), obtained a successful cross between *L. scoparium* 'Pink Lady' and *L. spectabile* 'Christmas Star' in the late 1980s and has selected progeny from this cross for use as ornamental cultivars.

Since 1990 I have attempted crosses between a selection of *L. scoparium* cultivars and most of the Australian species grown in the collection at Lincoln and several other interspecific crosses. For the purpose of gaining fundamental knowledge about *Leptospermum* this has been done to define the reproductive barriers between the species of the genus. To do the possible 6162 interspecific crosses between the 79 species defined by Thompson (1989) is an impossible task even if all of the species could be grown at Lincoln. Using red-flowered cultivars of manuka is useful, as presence of red coloration in a hybrid usually indicates a successful cross, as all but a few species of *Leptospermum* have white flowers. These hybrids also have possibilities as ornamentals because of the combination of flower colour with the superior foliage characteristics, shrub conformation, and disease and pest resistance that several species have compared to *L. scoparium*. Amongst the more interesting hybrids are *L. variabile* × *L. spectabile*, *L. scoparium* × *L. rupestre* and *L. scoparium* × *L. polygalifolium*.

## A SMELL OF SUCCESS

A scented flower is often an attribute of a successful ornamental plant. Aromatic leaves also add interest to a plant, and it would seem that this was one of the features of the teatrees that attracted horticulturists when they were first introduced to England as *Philadelphus aromaticus*. It is not certain whether this name was applied to manuka or kanuka as the crushed leaves of both species are very and distinctly aromatic. Aroma can be used to distinguish the species as kanuka has a harsher eucalyptus-like aroma whereas manuka leaves have a more pleasant, some say a more juniper-like aroma. More detailed sniffing of plants within the species also shows aroma differences between populations and between plants within populations. Recent research by the Crop & Food Institute has shown that there are a complex array of essential oils that contribute to the distinctive aromas of the teatrees (Douglas et al.,1994).

One of the successful developments of my research on the teatrees in the last two years has been the opportunity to work with the Plant Extracts Research Unit of the Crop & Food Institute. The Unit has used the provenance and species collection to prospect for different essential oil components in New Zealand teatrees and closely related Australian species. An example of the variation of a component, α-pinene, in New Zealand*L. scoparium* and provenances from New South Wales, Victoria, and Tasmania, shows that this is higher in all the Australian provenances compared to the New Zealand provenances (Fig. 2). The two New Zealand populations (1, 4) with high α-pinene both come from the North Auckland Peninsula. Populations 2, 3, and 5 from similar latitude, but from sites in Great Barrier Island and the Coromandel Peninsula have similar levels of α-pinene as the other New Zealand populations. This is very useful information for understanding the relationships between *L. scoparium* in New Zealand and related taxa in Australia. The variation may relate to the ecological situations of the taxa, one suggestion being that content of α-pinene may relate to fire-ecology.

## TEATREES TO EUROPE

Although the novelty that greeted teatrees when they were first introduced to Europe soon faded, they still hold their attraction in a market for ornamental plants that is vast compared to that of Australia and New Zealand. The colder climate of Great Britain and Ireland severely limits the use of New Zealand plants, and for all

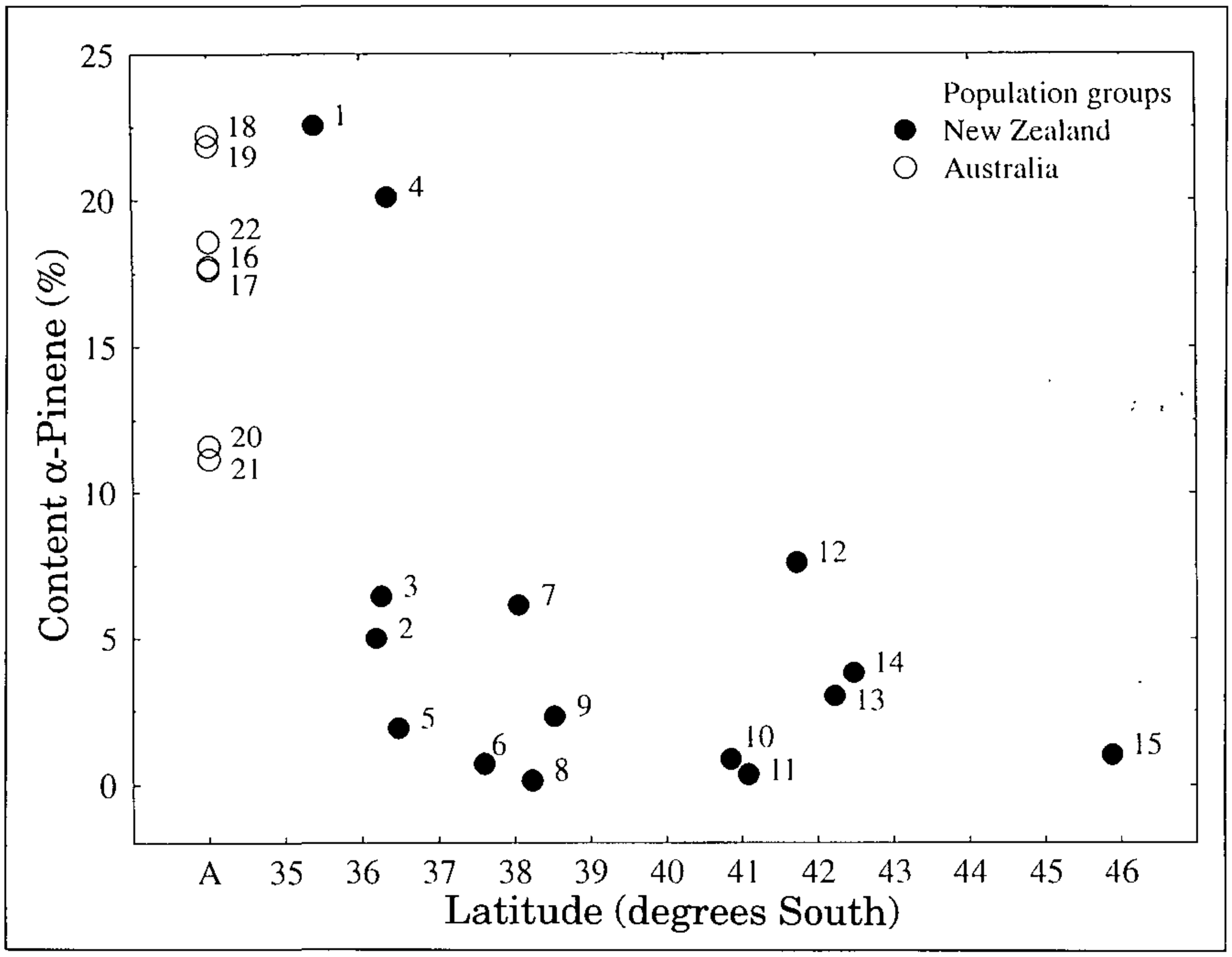


**Figure 2.** Variation in the percent content of α-pinene in 22 provenances of New Zealand *Leptospermum* and closely related Australian (A) taxa. The New Zealand provenances are plotted against their latitude of origin.

but a few species, their growth outdoors is limited to the southern and western regions of those islands. Even there occasional episodes of very cold air from continental Europe can cause severe damage. Cabbage trees (*Cordyline australis*), named the Torquay palm in S.W. England, and often shown on postcards to give a false impression of warm and palmy holiday getaways in Cornwall and Devon, have in very cold winters been killed to ground level.

In looking to Europe as a destination for New Zealand plants it is important to recognise that the southern most part of England is 3° of latitude closer to the polar regions than Stewart Island. The first introductions of New Zealand plants to Europe were more frequently from coastal and northern regions of New Zealand. This may have given New Zealand plants a poorer reputation for cold hardiness than if the plants introduced had come from southern and inland highland regions of the country. The main route of introduction from New Zealand to Europe via the United Kingdom, most likely filtered out many species and provenances that would be climatically suited to the Mediterranean latitudes that are the antipodes of New Zealand.

It was with these possibilities in mind that Luc Decourtye, international leader in the selection of fruit trees and ornamental shrubs from INRA France, came to New Zealand in 1986. His aim was to collect New Zealand tree and shrub species from higher altitude regions of the South Island, to prospect for more cold-hardy provenances better able to survive and show attractive ornamental growth in

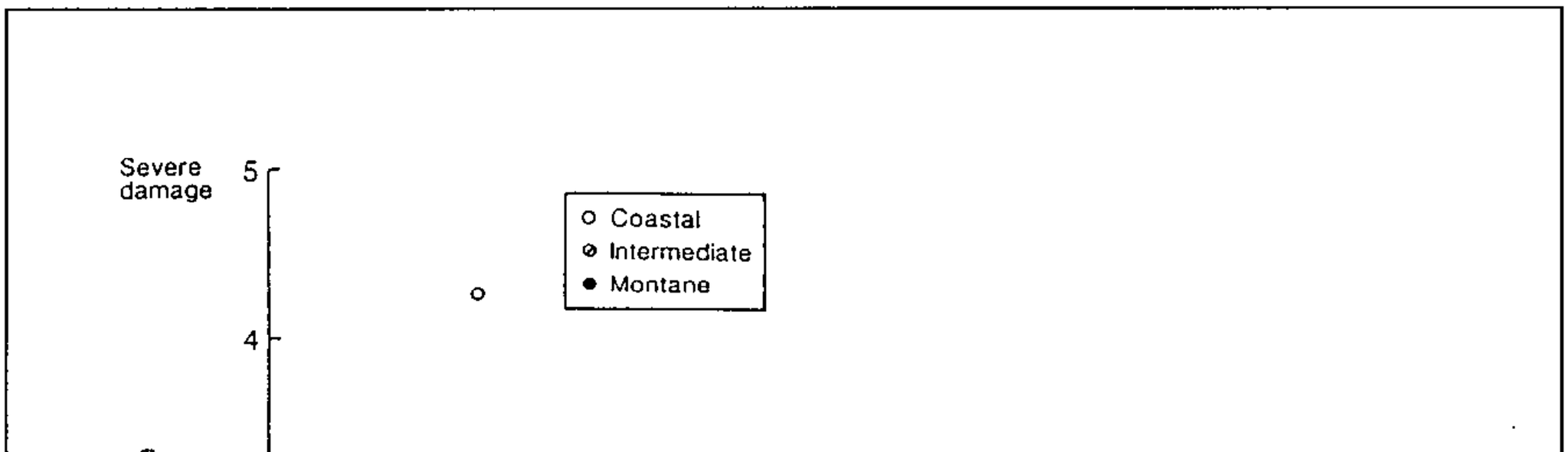


**Figure 3.** Relationship between cold damage score and latitude of origin of New Zealand populations of *Leptospermum scoparium* after the 1988-89 winter at Angers, France (from Harris and Decourtye, 1991).

France (Decourtye et al., 1991). It was through this contact that several of the provenances of teatree that I had gathered at Lincoln were also tested at Angers in the Loire Valley, Landerneau near the Brittany Coast and Fréjus on the Mediterranean coast of France. We found that the extent of cold damage to *L. scoparium* provenances during an average Angers' winter in 1988-89 was related to their latitude and altitude of origin in New Zealand (Fig. 3, Harris and Decourtye, 1991). The cold tolerance of the provenances was even more markedly defined after the severe 1990-91 winter when grass minimum temperatures fell to -12.5C (Decourtye and Harris, 1992). We also observed the cold tolerance of 75 other New Zealand plant species, and for some their provenances and cultivars, over 4 years at Angers (Harris & Decourtye, 1995).

This assessment of the variability of cold tolerance provides information that will give more confidence about the prediction of suitable areas of cultivation of New Zealand plants in the southern and south western regions of Europe. The opportunity is available for selection to improve the cold hardiness of New Zealand ornamentals. A difficult issue to resolve is that of controlling and gaining a return from the investment in such selection if it were to succeed in expanding the market opportunities for New Zealand plants in Europe.

## CONCLUSION

My experience with teatrees has emphasised that natural genetic variation of plants provides a rich resource for the development of new plant materials for plant propagators. In recent times plant science has become bedazzled with the possibilities of applications of DNA-related technologies. It is important DNA applications do not blind us to the opportunities of revealing, classifying, conserving, and molding natural plant genetic variation to our needs.

**Acknowledgements.** I wish to make acknowledgment to Malcolm Douglas, Nigel Perry, and John van Klink, New Zealand Institute for Crop & Food Research Ltd. for sharing their information on essential oils, and to Luc Decourtye, Diane Percy, Murray Dawson, Peter Heenan, and the late Andrew Purdie for the contributions they have made to the research reported in this paper. Funds for the research reported were provided by the New Zealand Foundation for Research Science and Technology under contract C09319.

## LITERATURE CITED

**Allan, H.H.** 1961. Flora of New Zealand, Vol. I. Government Printer, Wellington.

**Brooker, S.G., R.C. Cambie,** and **R.C. Cooper.** 1988. *Economic native plants of New Zealand.* Botany Division, DSIR, Christchurch.

**Cockayne, L.** 1919. New Zealand plants and their story (2nd edition). Government Printer, Wellington.

**Cockayne, L.** 1918. Notes on New Zealand floristic botany, including descriptions of new species. Trans. Proc. N.Z. Inst. 50:161-191.

**Dawson, M.I.** 1990. *Leptospermum scoparium* (manuka)— Chromosome variation of cultivars. Hortic. N.Z. 1:15-19.

**Decourtye, L.** and **W. Harris.** 1992. Selection for cold resistance in Leptospermum scoparium (J.R. et G. Forst.). Acta Horticulturae 320:39-48.

**Decourtye, L., W. Harris,** and **A. Cadic.** 1991. Collecte et évaluation d'arbuste ornamentaux spontanés en Nouvelle-Zélande et au Nepal. Conference Academie Agriculture du France. January 1991:1-18.

**Douglas, M., J. McGimpsey,** and **N. Perry.** 1994. Essential oils in New Zealand. Hort. N.Z. 5(2):22-25.

**Harris, W.** 1993a. Observations on the history and opportunities for ornamental use of *Leptospermum* and a new cultivar—*Leptospermum* variabile 'Karo Crimson Pearl'. Hort. N.Z. 4(2):6-9.

**Harris, W.** 1993b. ×*Kunzspermum hirakimata* 'Karo Hobson Choice—A new intergeneric hybrid teatree cultivar. Hort. N.Z. 4(2):10-12.

**Harris, W.** 1994. Horticultural use of low-growing forms of manuka and kanuka and a new cultivar—*Kunzea ericoides* 'Karo Greenfingers'. Hort. N.Z. 5(1):2-6.

**Harris, W.** and **L. Decourtye.** 1991. Winter climatic comparisons between France and New Zealand: effects of frost damage on populations of *Leptospermum scoparium* J.R. et G. Forst grown at three locations in France. Agronomie 11:847-861.

**Harris, W.** and **L. Decourtye.** 1995. Observations on cold damage to New Zealand plants grown at Angers, France. Hort. N.Z. 6(1):9-19.

**Harris, W.** and **D. Percy.** 1988: New *Leptospermum* a Christmas star. N.Z. Gard. 44(12):50-51.

**Harris, W., N.G. Porter,** and **M.I. Dawson.** 1992. Observations on biosystematic relationships of *Kunzea sinclairii* and an intergeneric hybrid *Kunzea sinclairii* × *Leptospermum scoparium*. N.Z. J. Bot. 30:213-230.

**Lammerts, W.E.** 1945. New double flowering Leptospermum hybrids. J. Calif. Hort. Soc. 6(3):250-257.

**Stevens, W.R.** 1944. *Leptospermum* 'Keatleyi'. Romance of its discovery. N.Z. Gard. 1(1):532-533, 540.

**Thompson, J**. 1983. Redefinitions and nomenclatural changes within the *Leptospermum* suballiance of Myrtaceae. Telopea 2:370-383.

**Thompson, J.** 1989. A revision of the genus *Leptospermum*. Telopea 3: 301-448.

# Blue Mountain Azaleas

**Denis Hughes**
Blue Mountain Nurseries, 99 Bushy Hill St., Tapanui, West Otago

Blue Mountain Nurseries was established by my father Stanley Hughes in 1932. His interests were strongly associated with the growing of plants beginning with quick crops, such as vegetables and bedding plants. With his primary interests being ornamental plants, it was not long before perennials, bulbs, cut flowers, and floristry became an appreciable part of his business. The war years saw vegetables returning to the forefront of his endeavours and elite plants were always kept to produce seeds for the following crops or for dividing and naming.

Examples of these were:

- Winter and spring harvesting cauliflowers.
- *Psylliostachys suworowii*—red form. This form does not seem to be available now.
- *Helichrysum bracteatum*—pastel pink forms. This has become common in seed lists.
- *Polyanthus* "Pacific Strain"—a selected seed strain with a wide mixed colour blend.