ANNUAL JOURNAL No. 10 1982

ROYAL NEW ZEALAND INSTITUTE OF HORTICULTURE

ISSN 0110-5760

ROYAL NEW ZEALAND INSTITUTE OF HORTICULTURE (INC.)

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COVER PICTURE

Haastia recurva Hook.f. An endemic sub-shrub growing in the Mt. Hutt region of Canterbury.

Photo by courtesy of Dr. D. Given, New Zealand representative on the I.U.C.N. Threatened Plants Committee.

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The policy of the R.N.Z.I.H. annual journal since its inception in 1973 has been to publish articles of interest from all sectors of horticulture with particular emphasis on research and education. This has most definitely been achieved and today the journal is highly regarded by both amateur and professional horticulturists. This success has been to a large extent due to the hard work and enthusiasm of Dr Michael Thomas. As editor from 1974 to 1981 Dr Thomas not only managed to gather a large number of interesting articles for each edition but contributed many of his own. As the new editor I would like to thank Dr Thomas for his tremendous contribution to the annual journal and to the Institute in general.

Mike Oates

Editor

The Banks Lecture, 1982
The Selection and Establishment of Ornamental Plants

by

J.W. Goodwin A.H.R.I.H., V.M.H., N.D.H.

In 1801 Sir Joseph Banks wrote "I know of no trade that conceals so many valuable branches of knowledge as that of a gardener and few subjects where the public will be more benefitted by the disclosures which such a society will immediately occasion."

He was referring to the formation of "The Royal Horticultural Society".

Ornamental plants may be defined as those not grown specifically for food, timber or other commercial purpose. With the present high prices for plants, the high percentage of loss during establishment, errors in siting and the increase in labour and cartage costs, it is more than ever necessary to know the requirements of plants for their successful establishment.

The typical Kiwi enthusiast is a veritable green fingers. Like our pioneers who were never slow to introduce new plants from many lands, amateur gardeners today still retain this attribute.

Little is known of the earliest cultivation of ornamental plants except from stone carvings of the Sumarians and the Temple Gardens of Karnak from 1500 B.C. In 600 B.C. the Hanging Gardens of Babylon became one of the "Seven Wonders of the World". About 350 B.C. Theophrastus wrote his "Enquiry into Plants" followed by the Herbal of Dioscorides and the Roman Scrolls describing strange plants and fruits during the first century A.D. In China and Japan the art of horticulture was highly developed by their ancient civilisations specialising in *Camellia*, *Paeony*, *Chrysanthemum* and even Bonzai culture.

In 1543 the first European Botanic Garden was established at Padua, in Italy, to be followed by many others. Kew was established in 1759 and its first Curator Aiton later founded "Hortus Kewensis". Another milestone was the foundation, by Curtis, of "The Botanical Magazine" in 1787. Sir Joseph Hooker, well known in New Zealand botany was sent by Kew to collect in India in 1847-1851. His Himalayan Journals make compulsive reading with detailed observations on people, plants, geology and climatic recordings. He collected magnificent rhododendrons, magnolias and conifers from higher altitudes. Veitch's Nurseries were established in 1808 and during the following century introduced more ornamental species to the British Isles than anyone before or since. Their collectors covered the whole world with a special visit by Peter Veitch to New Zealand in 1877 to collect *Ranunculus lyallii*, *Hebes*, *Notospartium* and *Celmisias*. He also collected Rhododendrons from Borneo.

The Royal Horticultural Society and other benefactors sent Fortune, Henry, Forestry, Wilson, Farrer and Kingdon-Ward to Asia and they in turn wrote fascinating stories of their travels and the plants they collected. The famous Arnold Arboretum was established in 1872 but was preceded by our first New Zealand Botanic Garden at Christchurch in 1863.

At the time of Theophrastus a mere 500 plants were recorded. Linnaeus was already, in the 1750's faced with 85,000 flowering plants plus 9,000 ferns. By contrast today, there is an estimated 250,000 flowering species and countless hybrids.

New Zealand has a combination of climatic factors making it one of the most favourable for plant growth in temperate regions. Surrounded by ocean there is a generous supply of moisture. Lying between the high pressure belt of the tropics and the pressuure

trough of the southern ocean we are subject to frequent weather changes. The effect of the high mountains intercepting the prevailing wind gives extremes in rainfall and often excessive winds. Higher elevations bring colder conditions with snow and frost at times. Sheltered coastal areas are comparatively mild with their diversity of microclimates around inlets and estuaries.

All of the above habitats offer favourable homes for an exceptional range of plants in New Zealand.

It is wise to study both climate and soil if one is to successfully introduce new and interesting subjects.

RAINFALL: It is not so much the total as the distribution and heaviness of falls that is important for plant growth. Monthly averages give a fair indication and the maximum and minimum monthly falls will indicate extremes. If the average number of wet days per month is set out, with the other figures in a chart, there is also an indication of the heaviness and effectiveness of individual falls.

TEMPERATURE: This may be the limiting factor for outdoor cultivation, but within an area there is considerable variation created by shelter, aspect or air drainage. Again the average mean alongside the maximum and minimum temperatures recorded for each month will prove invaluable in plant selection. With frost, the freezing of plant cells will cause death in some species, whilst only the softer tissue may be damaged in others. A mild climate is no guarantee that a subject will flower or fruit, even when growing vigorously. For example, *Grevillea robusta* and *Jacaranda* require the heat of Napier to flower. At the other extreme the winter freeze is a protection to many species and also enforces dormancy, but in milder conditions they are difficult to grow successfully.

WIND: Wind minimises the benefit from rainfall, intensifies dry conditions, loss by transpiration and damage by breakage or windburn. A comparative wind chart will show from where and in what month forces may be expected and also the percentage of calm conditions.

SUNSHINE: Sunshine is a factor in the fuller development of leaf, flower and fruit, particularly for plants from sunny lands. The sun warms both soil and air and the monthly averages will show that our winters are shorter and less severe than in England. Our summer temperatures are more comparable with theirs.

RELATIVE HUMIDITY: Humidity can be a major factor for the establishment of some plants. It is simply not possible to grow rain forest subjects in a dry district. However, the latter would be most suitable for Xerophytic species. Some modification is possible within a garden to improve humidity conditions, but other than by shelter, gully or waterside situations, it is not practicable on a large scale to significantly change humidity. The relative humidity recorded at 9 a.m., along with the extremes per month gives an indication, but these must be considered in relation to other local conditions.

SHELTER: In a country where wind is a dominant factor, except in some inland areas, shelter becomes very important for protection of plants against physical damage. Salt laden or drying winds, in extreme exposures, prevent the growth of any but the hardiest subjects. In a small garden, shelter from adjoining properties is rarely sufficient to prevent ground draughts or 'back lash'. Walls and timbered fences, while providing shelter require less room and provide a home for shrubs or climbers. Shelter is essential and well worth the loss of space when evaluating final results. In exposed areas the hardiest subjects may be, by their very nature, root competitive, but the second planting line could well provide the real ornamental attraction. Quick growing subjects are desirable, but brittle species can only lead to devastation during severe gales. Where there is a remnant native bush margin to farm land, fencing to exclude stock will stimulate the undergrowth and existing canopy. One should also make use of natural features such as gullies or escarpments which may protect tender plants or autumn foliage against a prevailing wind. There are a number of subjects with a columnear habit which are most economical of space, root run and maintenance. There are also shelter species which respond to trimming, increasing density and reducing

width. In these categories there are attractive plants which will enhance the landscape whilst providing shelter or screen. For example, some *Salix*, *Populus*, *Casuarina*, *Phebalium*, *Cupresso-cyparis*, *Pomaderris*, *Banksia*, *Dodonea* and Pohutukawas.

SOIL CONDITIONS: Soils vary considerably within a park or garden, from the crest of a ridge to the bottom of a gully. They may be modified by retaining walls, drainage or special treatment. The general type of soil in any one area may be ascertained from the "Descriptive Soil Atlas of New Zealand" and more detailed information from "The Soil Pattern of New Zealand".

The nature of soil varies considerably and some may be quite restricting towards plant selection. The majority of plants require a well drained root run. There are those that must be able to reach down to moisture, some that require a tight root run and others that respond to organic matter. The key is to ensure good drainage whilst at the same time retaining nutrients and the water holding capacity. The need for drainage will depend on the nature of the local soil and the particular site. High water tables may restrict a choice severely. Soil pans can cause seasonal problems and hinder root penetration of tall trees in particular. Shattering of such pans can be well worth the extra costs involved in site preparation. Variations in soil acidity or alkalinity may restrict the range of suitable plant subjects. The majority of soils may be a little on the acid side, which is favourable to a wide range of ornamental species. After soil tests for pH and nutrients, corrections may be made during cultural operations or else the selection of plants can be varied to suit the existing conditions. Container grown plants may be planted at any time, provided they receive that extra attention necessary to ensure establishment without check. Plants grown in a soilless media can receive a "rude shock" when introduced to some soils and may require careful 'acclimatisation'.

Plant material grown in nursery rows or at home should be well grown, yet firm of growth and well wrenched prior to transplanting. With transport costs high and most nursery lines small, there is some justification for growing on ones own specimens near the planting site. But this should only be attempted if done properly.

In selecting plant material it is necessary to weigh the merit and any demerit factors along with personal choice as well as the soil and climatic conditions.

ON THE MERIT SIDE - We must always remember:

1. The contribution made by living plants to the existence of life on earth.
2. The modifying influences on temperatures, rainfall and humidity.
3. The minimising of noise, glare, plus the provision of shelter or screen.
4. The educational values are often underestimated. Plants and plantings stimulate discussion which often extends into the arts as well as the biological sciences.
5. Therapeutic values of plants extend from the activity of gardening to the restfulness it offers to all ages, the troubled and the convalescent. Scented foliage is appreciated by all, but especially the handicapped.
6. Floral display and arrangement use the diversity of form and colour of flowers, foliage, fruit and coloured bark.
7. Landscape effects which enhance ones own garden may extend into the countryside. Examples of plants with distinctive character include *Cordyline*, *Pseudopanax*, *Cycas*, *Musa* and *Aciphylla*.
8. Plants provide food and shelter for wild life, both native and exotic. For example, nectar, fruit, foliage and even *Ascelpice* for the Monarch Butterfly.
9. Conservation of rare or threatened species has frequently been assured by growing in private or public gardens. *Franklinia alatamaha* and our own *Clianthus* are examples.
10. Most plants provide ground cover and help check erosion, whilst some such as legumes are soil improvers and others act as nurse plants.

ON THE DISCREDIT SIDE there are plants which:

1. May cause problems and others of a nuisance nature which include accumulation of leaves.
2. Litter from fallen fruit, twigs or branches from wind damage.
3. Danger to person or property from falling trees and branches.

Fig. 1 Large leaf rhododendrons are amenable to varying conditions but the real effect of foliage and freedom of flowering may only be seen in higher rainfall and humidity regions. This photo taken in Hollards garden near the base of Mt Egmont. Bernie Hollard gifted his property with a substantial endowment to the Queen Elizabeth II Trust.

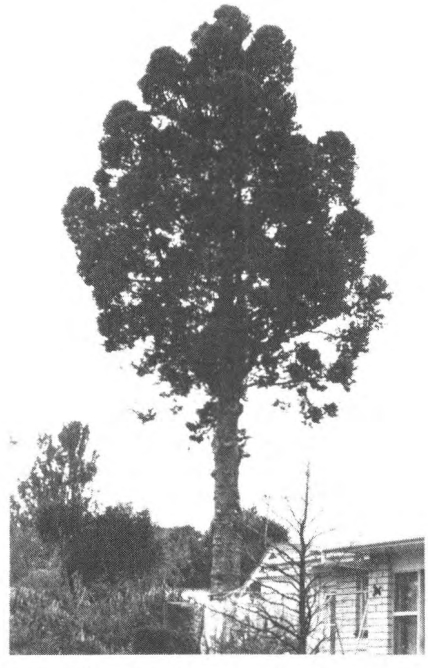

Fig. 2 *Agathis australis* the New Zealand kauri is a sky line subject suitable for milder climatic conditions where growth is quite surprising. It also withstands coastal winds. The tree shown here is changing from columnar to arborescent character. Many other native plants are unique in form and flower and suitable for a wide range of habitats.

4. Danger from evergreen trees shading frost pockets or blocking visibility on roads.
5. Roots of most trees are penetrative for moisture and some block drains or lift foundations. Other plants compete for nutrients to the detriment of weaker but more desirable neighbours.
6. Shade is a great advantage at times and in many places but may overshadow or cause dampness in buildings.
7. Pollen may stain fresh paintwork or aggravate hayfever.
8. Weedy species may be beautiful but create problems if untended or planted in the wrong place.
9. Climbers both introduced and native may suppress large trees. For example, *Tropaeolum speciosum*, *Ipomoea*, *Clematis vitalba* and *Muehlenbeckia*.
10. Shrubby ornamental species can also be difficult and costly to eradicate, e.g. *Berberis darwinii*.

Although complaints due to ornamental plants can arise, most are far outweighed by the real contribution they make especially to community life. With forethought there are ample alternative plants to choose from in selection for landscape and shelter effects.

PLANT SELECTION

Aspect is very important when selecting the right subject for a position. There are just as many plants suitable to the shady side as there are suited to the sunny side. An eastern face may protect plants or flowers against the heat of the day or the drying westerly wind.

In the first examination of an area much should be learned from the growth of existing plant material, on land with similar orientation and with similar growing conditions. Planning may commence from the main viewing point, but this also should be considered from all lines of approach and potential vistas. Deciduous trees under-planted with bluebells, daffodils or crocus or other similar combinations, allow the sun's rays to penetrate to the ground floor. This permits a free flow of air during the winter. Such an area may be grazed by sheep and could even be used for supplementary car parking. Generally, however, greater variety may be introduced in a border or series of 'drifts', mixing deciduous and evergreen subjects to provide a ground cover with a minimum of maintenance. This does not mean that a mass planting should not be planned very carefully. It is better to 'jog one's memory' and compile a list of subjects which could be suitable to provide 'high lines', and another list for evergreen and deciduous complementary subjects.

Smaller trees or large shrubs may be preferred to a few large trees, which may over shade or dominate the available space. The Japanese maples, cherries, smaller magnolias and dogwoods come readily to mind, with smaller growing conifers for all season colour among the evergreens. These could include manuka, *Corokia*, *Grevillea*, *Camellia* and *Rhododendron* for variety. It is a good plan to use one or more of a limited number of feature plants to create character or form in each border and use complementary subjects to provide a succession of seasonal colour. Along with soil and climatic factors, combined with personal choice, one must consider the shade or root robbing propensities of shelter or other trees. In weighing the pros and cons always remember that a common plant well grown, will surpass a special plant poorly grown.

Herbaceous borders do permit an annual overhaul and a chance to 'ring the changes'. But the tendency today is towards mixed borders, where evergreen perennials and shrubs are well spaced to provide shelter and support for deciduous perennials, or some of the delightful bulbs ranging from lilies to Autumn crocuses. It is also possible to arrange a planting of annuals to "cover" for the bulbs in their dormant season. Annuals or biennials also have a place in changing the scene in prominent beds set in lawn or court-yard. "Exotic" is a word often used by gardeners for something unusual which may require extra skill to flower effectively. In this respect there are often neglected areas in the shelter of a residence with the choice of aspect and opportunity to vary growing conditions. Why not try something new or difficult here? Some may prefer a collection of smaller subjects with a few small climbers. Others may prefer a dominant feature like *Wisteria* across the front of a home, with a succession of smaller plants at the base.

ROCK GARDENS vary considerably in their effectiveness and much depends on the placing of rocks and the nature of the growing medium. The full story is a long one, but in a small rock garden many species may be grown that would otherwise be lost from competition, soil movement or other factors. Even small rocks will protect plants and the cool root run underneath, is often the difference between success and failure. A surface mulch of metal chips protects against the effects of wind and rain, drains moisture away from the sensitive crowns, keeps the soil cool and moist and is even a deterrent to cats. The essential soil factors are drainage, balanced with waterholding capacity. These may be modified by the addition of peat, sand or grit, in varying proportions, supplemented with light dressings of the appropriate fertiliser during the growing season. If lime is required for certain plants, they should be arranged effectively in a grouping of their own. Firstly a site should be selected where there is little danger that lime may move from a higher level to damage plants preferring acid soils. Secondly, it is easier to place limestone or maintain alkaline soil conditions in one area where the requirements of the plants grouped together are similar.

These same factors also apply when larger borders are requied for special plants or purposes. For example, summer mulches will prove beneficial for moisture retention and also facilitate weed control. Variations from the rock garden include the trough or the raised bed, whilst sunken or bog gardens may be contrived naturally at the edge of water or on seepage in a gully. Bog or scree gardens may also be laid down on a rock bed or polythene sheet, shaped to give a slight movement of underground water. At the same time to give the specific conditions for each plant the media may range from peat through to pure gravel. Although peat is normally considered expensive, there are some areas actually where it may even be a local problem. Here, the building of peat walls or raised beds may be warranted to improve drainage, and thus provide homes for many plants at various levels from the crest of the wall to the base.

Numerous modifications may be introduced in a garden or glass house to create a suitable environment for rare and beautiful, but sometimes difficult 'gems'. No one country could ever hope to grow the whole range of ornamental plants, but much may be achieved in perpetuating rare or endangered species if we can understand their specific requirements.

Insectivorous plants have considerable appeal and such subjects as Venus' Fly Trap or *Drosera* may be grown in well lighted places with moist air rising around them as on a bog. The Wardian Case was developed in 1836 to assist with the introduction of plants to England and carried by sea from the Far East. Today this, and variations sometimes referred to as "Terrarium" may house many interesting and useful plants. Our own native filmy ferns may be grown effectively with a little less light and some top cover to maintain a higher humidity than is required for most insectivorous plants. Cycads are one of the ancient plants used as ornamentals and their ancestors have been found in the New Zealand fossilised flora. *Cycas revoluta* has been grown for many years and though slow growing its distinctive foliage and habit make other Cycad genera worthy of consideration. Grown in pots and later in tubs, they should have a better chance to reach maturity.

Open park or farmland is admirably suited to the growing of larger specimens or groups of shade trees. Selection for inland areas less affected by winds, is easier than for coastal regions where the actual site determines the amount of exposure. Some of the common trees such as oak, beech, birch, chestnut and lime are long-lived and sturdy in habit - there are many distinctive foliage forms. The horse chestnut is a magnificent flowering tree comparable in display to Magnolias of the Campbellii group. But the flowers of the latter may be frosted in some situations. Alders are most suited to damp positions as is the swamp cypress and also members of the versatile willow family. Evergreen oaks, particularly *Quercus ilex*, will stand salt wind almost as well as the pohutukawa, Norfolk Island pine and golden Macrocarpa. In a really well sheltered area *Michaelia doltsopa* develops into a magnificent flowering tree allied to the handsome *Magnolia grandiflora* varieties. For sheltered or inland areas there are many more suitable trees, including rimu, kahikatea, firs or redwoods. Australian trees and shrubs are very much at home in New Zealand gardens and offer subjects such as *Banksia integrifolia*,

Fig. 3 *Magnolia soulangeana* represents a dependable free flowing genus suited to most climatic conditions and generally long lived. Other species, especially *Magnolia campbellii* can suffer frost damage to their flowers so care is necessary to choose the right site.

some *Casuarina*, *Agonis*, *Acacia* and others for coastal planting. There are many attractive and easily grown smaller Australian subjects for most positions in the garden or landscape. There are a number of Arboretums in New Zealand and it is hoped that many more representatives of plant genera will become available to the tree enthusiast. For instance there are Chinese counterparts of many well known genera including *Liquidambar*, *Acer*, *Liriodendron* and conifers. There are also endemic Chinese trees such as *Xanthoceras*, *Meliosma*, *Reevsia*, all so rare in cultivation. New Zealand native trees are equal if not superior to many introduced species, yet they are comparatively unknown. Tawapu, Tawari and the smaller conifers such as *Dacrydium biforme*, *D. kirkii* and *D. intermedium*.

The country landscape has come in for criticism, but there is really little wrong except that resulting from thoughtlessness and neglect. When one attempts to convert rainforest or tussock country into highly productive farmland then there inevitably must be change. In the drier areas we have a grassland climate suited to many deciduous trees and shrubs and conifers, both evergreen and deciduous. The rainforest areas are ideally suited for moisture loving specimens such as rhododendrons and conifers and plants originally from high rainfall areas. The undulating countryside and the plains with their hilly background and the well kept farmland are a delight in themselves. By contrast the real eyesores are the poorly farmed land or neglected and abandoned buildings. Some railway land is untidy and there are unkempt corners on some highways. From the regional or national planning angle there appears to be insufficient control over the siting or screening of industrial structures. Generally roadside trees flash past like power poles or a bush drive on a highway becomes a tunnel. Only on a winding road or on the limited speed sections approaching towns, would roadside plantings be of greatest visual impact. It is usually close to towns that there are neglected buildings or industrial projects without any planting screens. In the open country, plantings on roadside waste areas, lookouts or laybys, considerably enhance the landscape and perhaps camouflage an eyesore. There are many attractive farm homesteads which are a credit to New Zealand, as well as to their owners. Some farms, however, have not only neglected buildings but also a poor range of trees (e.g. a Privet and a Macrocarpa) which suggests disinterest and inadequate advice from the nurseryman. In general there is a lack of unity between the garden boundary of the farm home and the surrounding countryside. With some encouragement and advice farmers could be persuaded to plant specimens or groups of trees to create this unity. In some areas the distant scene or skyline may be rather bare or monotonous. This may also be corrected by comparatively small plantings of trees. Generally speaking steep, broken slopes and awkward corners could be planted out in groups of trees varying in size. They could, on maturity, be harvested as special purpose timbers - hopefully the different blocks will be removed in rotation. Along gullies and on hill crests farmers have in the past planted pines, Macrocarpa and Lawson cypress as stock shelter, creating quite distinctive landscape effects. Eucalyptus species have also been used with considerable success, but there have been some losses from insect pests. In the more sheltered areas deciduous trees from the Northern Hemisphere provide a distinctive change. Whatever the plantings selected, secure fencing and animal pest control measures will be well worth while.

Where pasture land gives way to horticultural crops there arises a completely new landscape. There is a distinct possibility that a complex of buildings and even chicken houses will mar the countryside. Hopefully there should be plantings of attractive subjects to screen unsightly objects from public view.

Where country road margins are wide and reasonably graded there has been a significant improvement in their appearance where farmers have grazed the 'long mile' or mown such strips for hay or silage. It is to be hoped that this practice will be encouraged along with regular maintenance by trimming of hedge or shelter screens. Where afforestation has taken over poor land and helped to restore some of the former character to the landscape, there

Fig. 4 Site of proposed Methanol Plant at Tikorangi.
There is little wrong with this country's landscape except where property has been neglected or there has been indiscriminate use of weed killers. Stream margins, shelter belts, hedgerows, and gully plants, both native and exotic, enhance the typical New Zealand landscape.

must be periods inevitably, when areas in rotation will be devastated. However, quick re-establishment is desirable and within a few years the scars are hidden for another growing cycle (maybe only for 30 years). As in many forests it is the untended corners, with perhaps the necessary fire breaks, which critics find unsightly. Hopefully margins will be planted with useful or ornamental subjects with considerable fire resistance. Some native birds will thrive in Pine forest, and there is little doubt that margins planted with native trees will provide homes for other native birds.

Remnant native bush areas set aside as scenic or recreation reserves and similar areas cared for by private land owners themselves, can be classified into three categories. Firstly in areas adjoining national parks or scientific reserves only the local species should be used for replanting. Secure fencing and a continuous programme of noxious animal control should be the No. 1 priority. This should also apply to all reserves.

Secondly, in native plant areas where all the major trees have been removed there is normally a wide range of shrubby species remaining. Here there is a real opportunity to build up a comprehensive collection of trees and shrubs from all parts of New Zealand selected for the local climatic factors. If conditions are suitable, then rain forest species would respond. But if too dry there is a large number of small trees and shrubby species from which to choose, e.g. *Senecio*, *Olearia*, *Pittosporum* and native brooms. There are few such collections of this type in New Zealand, e.g. Hukutaia Reserve, Opotiki.

Thirdly, where the native plants are severely depleted, there should be little argument against the introduction of exotics suited to the local conditions. Also included could be endangered species from New Zealand, our off shore islands, or even from other lands. Furthermore, there is no finer background than this modified native forest as a setting for a horticultural reserve or for a homestead. Proposals such as numbers 2 and 3 above will stimulate public interest and support.

It is a mistake to spray or bulldoze large areas of scrub-land which in most cases will provide protection from sun or drying wind. Manuka, Wineberry and other natives are natural means for protecting young plants. Release from excess shade will speed seedling growth according to both the species and the climate. Even gorse, broom and lupin are all soil improvers. It is questionable whether a noxious weed classification is necessary in some circumstances. These, or a planting of quick growing tree lucerne may be used as a nurse crop and to check weed invasion or erosion. Boundaries and open spaces may be planted with distinctive specimens to improve the composition and appearance of marginal or skyline growth. For example, Kahikatea, Kauri, Totara, Cabbage tree.

As in Banks time, people today are still collecting plants and searching for knowledge. Whilst the enthusiastic Kiwi has considerable success it is desirable to cut down losses during establishment and minimise wastage through poor planting. Selection should be based on a sound knowledge of a plant's requirements and the soil and climatic conditions in which it is intended to be grown. Successful establishment is based on the selection of high quality plants appropriate for the position, together with careful planting and their subsequent maintenance. There is a need for reselection of some clonal stocks and a study of some propagation methods and an increase in horticultural advisory services to the public. Continued care is necessary in all fields of conservation and every effort should be made to encourage all New Zealanders and industry itself to be conscious of our unique plant and landscape heritage.

After his return from New Zealand following his voyage with Cook, Sir Joseph Banks became one of the most influential men in England for the remainder of his life.

If he were here tonight I believe he would applaud the advances made in New Zealand farming and afforestation. No doubt he would be critical of the wastage of some of our resources. But I believe he would praise the research achievements of our institutions involved in the study of plants. I am sure he would also commend our fine National and Forest Parks, together with Otari Plant Museum and our Botanic Gardens, Public Parks and several fine private gardens. Finally, like David

Bellamy he would be excited by the very recent opening of the Auckland Regional Botanic Garden and acknowledge the many achievements of this Royal New Zealand Institute of Horticulture.

Acknowledgement: Photographs courtesy of Taranaki Newspapers Ltd.

Persimmons in Japan and Prospects for N.Z.

by

P.G. Glucina

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Japanese or Oriental persimmons (*Diospyros kaki*) or simply Kaki, have been extensively grown for centuries in Japan, where they are regarded as a national fruit. The fruit features in a number of ceremonies and customs and is held in very high regard, particularly by older Japanese. The first persimmons of the season usually sell for very high prices, as the appearance of the fruit is associated with the coming of autumn.

Persimmon trees are revered for their beauty and are the most common fruit trees in home-gardens throughout Japan, which attests to their very wide adaptability. In spite of this, the commercial production of persimmons has declined. The main reasons are:

(1) In the past hundreds of different cultivars were planted, many of which were of inferior quality, and these inferior types have now been eliminated.

(2) The use of Shibu, a highly astringent milky fluid rich in tannin (prepared from unripe persimmons), to toughen paper, wood, and fishnets has been superseded. (Astringent cultivars are also used in clarifying sake, and in medicine to reduce high blood pressure.)

(3) Cakes have largely replaced dried persimmons as a confectionery item.

CULTIVARS

Although more than a thousand persimmon cultivars have been recorded in Japan, fewer than 15 are of commercial importance. About 60 percent of total commercial plantings consist of non-astringent types. Two non-astringent cultivars, *Fuyu* and *Jiro*, alone occupy about 50 percent of the plantings, and accounted for 55 percent of the total production in 1978. The main reason for this is that the Japanese like firm-textured persimmons which can be peeled and eaten crisp like an apple. However, some consumers, particularly in northern Japan, appear to prefer the taste of astringent persimmons which have been treated to remove the astringency (but the fruits are still firm), as the flesh is a finer texture than naturally non-astringent types.

The most highly regarded persimmons cultivar in Japan is *Fuyu*. However, some consumers prefer the melting texture of treated *Hiratanenashi* fruits. The only other cultivars of commercial value are *Izu* and *Nishimura Wase* (on account of their earliness), *Maekawa Jiro*, *Ichikikei Jiro* and *Matsumoto Wase Fuyu*. *Jiro* appears to be losing favour.

A range of different cultivars has recently been imported for trial in New Zealand (see Glucina 1980) and it was of considerable interest to find out how some of these are currently rated in Japan.

(A) Pollination-constant, non-astringent cultivars.

These are cultivars which undergo no change in flesh colour as a result of pollination. In order of maturity:

Izu - very early maturing (one month before *Fuyu*), but the skin appears to mark readily in some areas. Trees are susceptible to anthracnose (caused by *Gleosporium kaki*) and have weak vigour.

Ichikikei Jiro - ripens at a similar time to *Maekawa Jiro* but tree vigour is weaker.

Maekawa Jiro - good fruit size, appears to be replacing *Jiro* and is about two weeks

* *Reprinted by kind permission of "The Orchardist of N.Z." (December 1981 issue).*

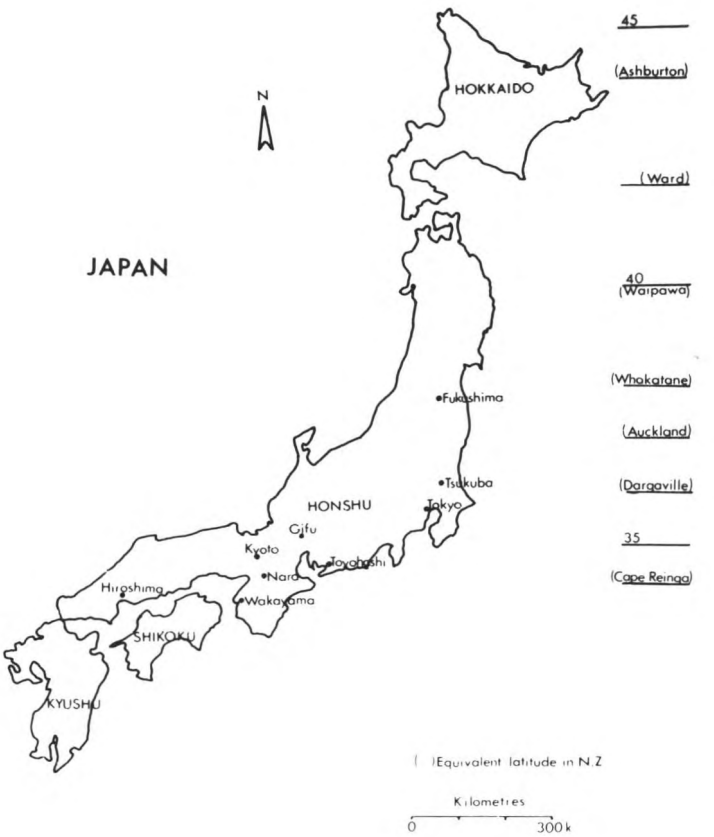

Fig. 1 Areas in Japan (.) visited by the party studying production methods for persimmons.

earlier. Higher parthenocarpic ability than *Jiro*, but oversized fruit sometimes crack at the apex.

Matsumoto Wase Fuyu - two weeks earlier than *Fuyu* but in cool regions it ripens at about the same time. Fruits are identical to *Fuyu* but are said to have a shorter shelf-life, and are susceptible to a defect which results in a space ("dehiscence" - see below) directly beneath the calyx, particularly in large-size fruits. More widely adaptable than *Fuyu* and worth growing where there are problems with *Fuyu*, such as traces of astringency in the flesh.

Jiro (*Ziro*) - losing favour in Japan; being replaced by *Maekawa Jiro*. Fruit has a very open stylar channel and therefore often cracks on top. Consumers do not like its furrowed or segmented appearance. Has higher parthenocarpic ability than *Fuyu* (i.e. requires less pollination).

Fuyu - ripens in Japan from November onwards; good appearance and storage qualities. Very reliable cropper, but the fruit is susceptible to dehiscence and has low parthenocarpic ability. The standard cultivar against which all others are compared.

Midai - selected in 1940; not a commercial cultivar owing to poor appearance and early flesh softening, particularly at the apex. Susceptible to anthracnose. Ripens with *Fuyu*, which is preferred.

Suruga - high quality, late-maturing cultivar (two weeks later than *Fuyu*) but adapted only to very mild climates. Consumers do not like the characteristic 'wrinkles' on the back of the fruit.

Many of the very early-maturing pollination-constant, non-astringent cultivars such as *Izu*, *Ichikikei Jiro*, and *Maekawa Jiro* have weak tree vigour, which would be an advantage for close planting.

(B) Pollination-variant, non-astringent cultivars.

The flesh is light-coloured when seedless and dark reddish-brown when seeded. The soluble tannins in the flesh which are responsible for astringency disappear after pollination and seed formation. However, if pollination is poor and only one or two seeds are formed, parts of the flesh remain astringent.

Akagaki - sometimes used as a pollinator. Fruits are fairly small (165 g average) but larger than fruit of the pollinator *Zenjimaru*. Texture is inferior to *Nishimura Wase*. Ripens very early.

Nishimura Wase - chance seedling discovered in 1953. Plantings are increasing as it ripens very early, from mid-September onwards, or 10 days before *Izu*. Fruit is medium to large and of reasonable quality. When pollination is poor, parts of the fruit remain astringent at maturity. These astringent fruits tend to be later maturing and are flatter in shape than multi-seeded non-astringent *Nishimura Wase*. Fruit with either a flat or a depressed apex (usually imperfectly pollinated) are thinned off just after fruit set.

Aizumishirazu - this is a pollination-variant, non-astringent type but it is usually grown in colder areas without pollination and is therefore treated as an astringent persimmon (the astringency is artificially removed). Ripens at the beginning of November, about 10 days after *Hiratanenashi*.

Shogatsu - ripens late, from the middle of November onwards; has good storage qualities. Used as a pollinator.

(C) Pollination-constant, astringent cultivars.

There are hundreds of different astringent persimmon cultivars in Japan but only a few produce fruit which is commercially useful.

Hiratanenashi - means flat, seedless in Japanese. Very old cultivar from northern Japan, and the most important astringent cultivar grown. It has very high parthenocarpic ability and does not need to be pollinated to get regular heavy crops. Fruit size is smaller than *Fuyu*. *Hiratanenashi* comes into leaf fairly early in spring, about 7-10 days before *Fuyu*.

Recently a number of early ripening budsports of *Hiratanenashi* have been selected.

Tonewase - first registered in 1979. Ripens at about the same time as *Izu*, possibly a few days before *Sugitawase*. Has a fairly short harvesting season. Trees have shorter internodes and are more upright than *Sugitawase*.

Sugitawase - discovered in 1970 in Niigata Prefecture, Sado Island. Fruit are

slightly larger than *Hiratanenashi* but are otherwise identical, ripens about 10 days earlier. Tree is rather weak in vigour and tends to have a spreading habit. The fruit of *Sugitawase* have a larger calyx and a higher cheek than *Tonewase*, and there may be problems in packing this cultivar.

Compact *Hiratanenashi* - fruit ripens at the same time and resembles *Hiratanenashi* but the trees are considerably smaller than the parent. Suitable plant density is about 300 trees per ha (Japanese recommend 180 *Hiratanenashi* trees per ha).

A few other astringent cultivars are grown but the fruit is only suitable for local consumption.

CLIMATE AFFECTS ASTRINGENCY

Different cultivars appear to be adapted to different regions in Japan and each district or Prefecture has a preference for particular cultivars. Some of these preferences are largely predetermined by climate, as non-astringent types require very warm conditions to mature properly. In cooler regions, non-astringent cultivars such as *Fuyu* can be grown but the fruits do not mature properly and have low sugar content and poor colour. Some astringency may also occur at maturity.

Early-maturing non-astringent cultivars such as *Izu* and *Matsumoto Wase Fuyu* are more suitable than *Fuyu* in regions with a cooler autumn climate. However, in very cool areas (e.g. Fukushima) up to 50 percent of the fruits of even early-maturing, non-astringent cultivars contain astringency at maturity. Under these conditions it is better to grow astringent cultivars. In Japan, areas where mandarins can be successfully grown usually experience climatic conditions suitable for pollination-constant, non-astringent persimmons.

POLLINATION

Trees of the most important Japanese cultivars bear only pistillate (female) flowers. Some cultivars (e.g. *Hiratanenashi, Aizumishirazu*) have a strong tendency to set fruit parthenocarpically and produce good yields regardless of pollination. Others such as *Fuyu* have low parthenocarpic ability and the flowers must be well pollinated in order to set a commercial crop. A number of cultivars (e.g. *Jiro, Maekawa Jiro*) are intermediate in their requirements for pollination.

A few cultivars bear both pistillate and staminate (male) flowers and are used as pollinators.

Zenjimaru - the most widely used pollinator. Bears many staminate flowers which produce an abundance of pollen. However, the first is small and has low commercial value.

Akagaki - also widely used; fruits are larger and of a higher quality than *Zenjimaru*. Flowers slightly earlier than *Zenjimaru*.

Omlyawase - new cultivar and may be useful as a pollinator.

A few other cultivars are sometimes used as pollinators, mainly because they have good fruit quality. However, most produce staminate flowers in varying proportions from year to year and cannot be relied upon as the sole pollinator.

Nishimura Wase - fruit has better texture and shelf life than *Akagaki*.

Shogatsu - flowers at about the same time as the main cultivars. Ripens late.

In most Prefectures visited two or three different pollinators were included in plantings to ensure that good overlap of flowering occurs. A combination of *Akagaki* and *Zenjimaru* would probably be suitable to pollinate all of the major cultivars grown in Japan.

Most commercial persimmon orchards have 30-40 pollinator trees per hectare, or only one pollinator tree to about every 10-15 plants of cropping cultivars. The large number of seedling trees (*Yamagaki*) that occur wild alongside roadways and in home-gardens ensures that natural pollination is usually adequate. However, in new areas where persimmon culture is attempted (such as in New Zealand) it would be preferable to have one tree of a specific pollinator (e.g. *Akagaki, Zenjimaru*, or *Omlyawase*) interplanted with every 8-10 plants of cropping cultivars.

In the past, artificial or hand pollination of persimmon flowers was a regular orchard practice in Japan. However, natural pollination is now favoured, except with a few special cultivars such as *Fuyu* and *Nishimura Wase*. *Fuyu* has low parthenocarpic ability and the fruit drop readily unless

they contain many seeds. Seeded *Fuyu* fruits are also said to be larger than seedless or poorly pollinated fruits, and command much higher prices. It is important to get good pollination with *Nishimura Wase* to ensure that the fruits are completely free of astringency (see above).

ROOTSTOCKS

Seed from a range of different cultivars is used to produce rootstocks for persimmons in Japan, but these cultivars are all *Diospyros kaki*. Often seed of *Yamagaki* (mountain or wild *D. kaki*) is used, mainly because it is readily available. *Mamegaki* (*D. lotus*; Mame means pea or small) is not widely used except in very cold regions, such as northern Japan. Although there does not appear to be much experience in Japan with trees of non-astringent cultivars grafted on to Mamegaki, most researchers I spoke to thought that there were compatability problems with this combination.

ORCHARD MANAGEMENT

Soils: Persimmons appear to require a deep, fairly fertile soil, well supplied with moisture. The trees are rarely grown on slopes as steep as those commonly used for citrus orchards, but are generally planted on more gentle slopes of higher fertility or on the flats. A few regions visited were establishing persimmon orchards on land that would normally be used for rice growing. Such areas are very suitable provided the soil is free draining. A soil pH of 6.5 (minimum 5.5) is said to be ideal for persimmons.

Spacing: Planting distances vary with the cultivar and with soil conditions. Persimmon trees are often double planted in Japan. One commercial orchard at Gifu (see Fig. 1) had *Nishimura Wase* trees spaced 6m x 3m apart (i.e. 556 trees per ha). These were thinned out to 6m x 6m in the 5th-7th year from planting. Another orchard of *Nishimura Wase* had trees initially 2.5m x 2.5m apart (i.e. 816 trees per ha). Five years from planting the trees were thinned out to 5m x 2.5m spacing. 'Temporary' trees were not wasted; after producing a crop in the fourth year they were lifted and transported to a site about 1 km away, and used to start a new orchard!

Yields: Mature *Fuyu* trees often yield about 20 tonnes per ha, under commercial conditions. Mature *Hiratanenashi* trees have been known to yield up to 40 tonnes per ha (average fruit size 180 g). In spite of these figures persimmons tend to be low yielding relative to some fruit crops (e.g. apples, Asian pears). The average yield of persimmons in Japan varies from 13 to 16 tonnes per ha. In comparison, in 1978 the average yield of Asian pears in Japan was 29.0 tonnes per ha (484,100 tonnes from 16,700 ha) and of apples 18.6 tonnes per ha (844,000 tonnes from 45,500 ha).

Persimmon trees are long-lived and I saw several orchards with very healthy trees that were 50-60 years of age.

Pruning: The habit and vigour of growth of cultivars vary considerably (see earlier). Young trees are pruned to either a vase or modified centre-leader system. Older trees usually have a few main leaders and are pruned as open-centre trees. Mature trees are often pruned fairly severely. Lateral growths carrying vigorous, well-developed buds are normally left to grow next season's fruiting spurs, and adventitious shoots which arise from the main branches are removed. Some growers prune the trees so that the fruit is all borne close to the main branches on very short lateral (spur) growths: others develop both first and second year lateral growths and work to a renewal pruning system.

Biennial bearing: is a major problem with persimmons in some Prefectures. Disbudding and flower thinning are used in the on-year to overcome this problem. Fruit thinning just after natural drop (i.e. in June) may also help to reduce the trend.

Nutrition: The amount of fertiliser that mature persimmon trees receive appears to vary between Prefectures. However, in most areas artificial fertiliser is applied at three times during the year. The first application is normally in June, just after flowering. The second application is in October or November, immediately after harvesting. The last application occurs in December or January, when the trees are dormant. The following rates were recommended at the Gifu Agricultural Experiment Station for mature trees.

	Dec-Mar		Jun-Aug		Oct		Total
N	140kg	(54%)*	60 kg	(23%)	60 kg	(23 %)	260 kg
P	190	(90%)	20	(10%)	0		210
K	120	(50%)	60	(25%)	50	(25%)	240

* % of total element applied annually.

Fresh drop: Very heavy fruit drop sometimes occurs with persimmons. Some cultivars are more susceptible to it than others. The main causes are:

(1) excessive nitrogen. Fruit dropping appears to be closely related to the nutrient status of the tree.

(2) insufficient sunlight. This could be quite important in New Zealand where the trees are planted close to orchard shelter belts.

(3) lack of pollination. This varies with cultivar and depends upon parthenocarpic ability. Cultivars such as *Fuyu*, which have very low parthenocarpic ability and contain many seeds per pollinated fruit, are markedly affected by pollination, whereas in cultivars like *Hiratanenashi* and *Aizumishirazu* which show high parthenocarpic fruit set, the influence of pollination on fruit dropping is not significant.

(4) excessive shoot growth. Competition for nutrients is very strong between shoot and fruit, especially in young or vigorously growing trees.

Fruit drop can be overcome by carefully regulating fertiliser applications, judicious pruning to allow good sunlight penetration, careful attention to pollination, and, when necessary, cincturing.

Cincturing to increase cropping: Cincturing or girdling is used mainly on young trees when vigour is excessive. A strip of bark, about 5 mm wide, is removed right around the stem of the tree and down to the wood. Cincturing is carried out from the end of May until July (*Fuyu* trees are at full flower in Central Japan about May 25 - June 4).

Dehiscence: Dehiscence refers to the space or cavity that sometimes occurs directly beneath the calyx of the fruit. It appears to occur more commonly on some cultivars (e.g. *Fuyu*, *Matsumoto Wase Fuyu*) than others and usually results in early fruit maturity, and leads to a down-grading of the fruit. The main causes are excessive nitrogen, unusually high autumn temperatures, and light crops (i.e. resulting in oversized fruit). These factors appear to cause excessive growth of the fruit just prior to maturity, when the calyx is fully formed and has ceased growing. The problem can be partially overcome by not over-thinning trees (i.e. regulating fruit size) and by avoiding excessive quantities of quick-acting nitrogenous fertiliser.

When thinning cultivars that are known to be susceptible to dehiscence, fruit with large calyxes are usually thinned off.

Fruit marking: Fruit marking, which results in parts of the skin turning black, is a major problem of persimmons in Japan. Marking has increased in the last 20 years or so and the exact causes are unknown. The primary problem appears to be light superficial skin cracking. A number of different factors are thought to be involved, such as high orchard humidity (i.e. more than 90 percent R.H. for 100 hours), phytotoxicity (particularly from excessive use of Bordeaux or copper oxychloride to control black spot), high nitrogen levels, air pollution, and postharvest problems associated with artificial removal of astringency and with C.A. storage (see later). These factors are thought merely to aggravate the problem, rather than to cause it. Some skin cracking may possibly be occurring as a result of thrip damage at flowering.

Some cultivars mark more readily than others. For example, *Izu* is very susceptible whereas *Fuyu* and *Matsumoto Wase Fuyu* are intermediate. *Suruga* has few problems with skin marking. To reduce the incidence of skin blackening it is important that trees be kept very open by pruning, mainly to lower the humidity around fruit. The number and amount of sprays applied in September and October must also be reduced. High levels of nitrogen (and potassium) are thought to reduce drastically the amount of calcium in leaves and fruits. Excessive nitrogen is supplied in animal manure, which is commonly spread around fruit trees in Japan.

Harvesting: Fruits are harvested when they have attained a deep yellow to reddish colour but are still firm. Where intended for storage or for treatment to remove astringency, fruit is harvested well before it is fully ripe. The optimum harvesting period is rather limited and must be carefully judged.

I was told that fully ripened *Fuyu* fruits should contain more than 15 percent sugar. At Wakayama, *Hiratanenashi* was picked at a fairly immature stage for treatment with CO_2 and alcohol to remove astringency, but the fruit was said to contain about 18 percent sugar (minimum 16

percent). Even at Fukushima (northern Japan), where *Hiratanenashi* is harvested very early to avoid autumn frost damage, fruits contained 15 percent sugar.

The fruits are clipped from the tree leaving the calyx and a very short piece of the stem intact. Often the fruit is clipped twice - once to remove it from the tree and a second time to shorten the stem piece.

Minimum fruit size: 200 grams is the minimum fruit size for sale at large markets such as Osaka and Tokyo. However, *Hiratanenashi* fruits are frequently 160-180g.

Grower returns: Growers at Toyohashi (Aichi Prefecture) were receiving the equivalent of about 50 cents a fruit for good quality persimmons. At the Tokyo wholesale market, I saw early *Fuyu* from the nearby Yamanashi Prefecture sell in mid October for 4,000 yen (about $20) per 7.5 kg box (32 fruit per box). The highest price was 10,000 yen ($48) per box, or $2 a fruit.

Table 1 shows the quantity and wholesale price of locally grown persimmons at the Tokyo central market. (This information was supplied by members of the Tokyo Fruit Retailers Association.) Early maturing fruit usually sells for very high prices (up to $9.60/kg), as the quantities available are fairly low. However, the same is not generally true for the price of fruit that is sold late in the season, from cold storage. Table 1 also shows that no persimmons are available on the market from February to July (persimmons ripen in New Zealand from April to May).

REMOVAL OF ASTRINGENCY

Some Japanese prefer the flavour and texture of astringent cultivars (e.g. *Hiratanenashi*) to those of the naturally non-astringent type (e.g. *Fuyu*, *Jiro*). Furthermore, because the Japanese prefer to eat fairly firm-fleshed Kaki it is necessary to remove the astringency, and several methods are used commercially.

1. CO_2 treatment. Treatment with CO_2 is generally the preferred method of removing astringency, mainly because it produces good results in a short time. However, the conditions required are fairly exacting. Physiological disorders (such as skin blackening) occur if the temperature is too high (more than 30°C) or if the fruit is treated for too long in high CO_2. If temperature and CO_2 are too low (i.e. less than 20°C and 60 percent CO_2) some astringency will remain in the fruit. The fruit will also soften early if O_2 levels are too low (1 percent).

Although the CO_2 method is commonly used the treatment varies between districts. At Aichi, astringent *Nishimura Wase* fruits are picked and then treated in tents with 98-100 percent CO_2 for 24 hours at 30°C. After 10 hours at ambient conditions the fruit is packed and marketed.

At Wakayama, CO_2 treatment of *Hiratanenashi* is well developed. Fruit is treated with 90-96 percent CO_2/3 percent O_2 for 12 hours at 22°C in specially constructed sealed C.T.S.D. (constant temperature short duration) chambers. Each chamber holds 15 tonnes of fruit and I saw three such chambers in use at a packhouse visited at Wakayama. Treated fruit are sent to Osaka and Tokyo (i.e. short distances from Wakayama).

2. Alcohol treatment (off the tree). This treatment usually results in early fruit softening and is not as efficient as using CO_2. However, it is still used as many consumers prefer the taste of alcohol-treated persimmons! Fruit for treatment is usually picked well before it is completely mature, otherwise it is liable to become excessively soft by the time treatment is completed. At Wakayama, *Hiratanenashi* is harvested at a very firm stage, graded, and packed into cardboard boxes. A machine delivers a spray of 180 ml of 35 percent ethanol on to the top of the packed box (containing 15 kg of fruit) and a cardboard liner is then placed over the last layer of fruit. The box is sealed, inverted, and transported to markets on Hokkaido (4-day journey). Because this treatment takes 3-4 days to remove astringency completely, alcohol-treated persimmons are normally consigned to cities that are some distance removed from the growing region.

3. Alcohol treatment (on the tree). At Nara and Wakayama, *Hiratanenashi* fruit are treated with alcohol while still on the tree. Individual fruits are enclosed in polyethylene bags containing approximately 1 ml of 40 percent ethanol (see Fig. 2). The bag is left in place for about three days. Bags are then removed and tied on to adjacent branches to indicate fruit that have been

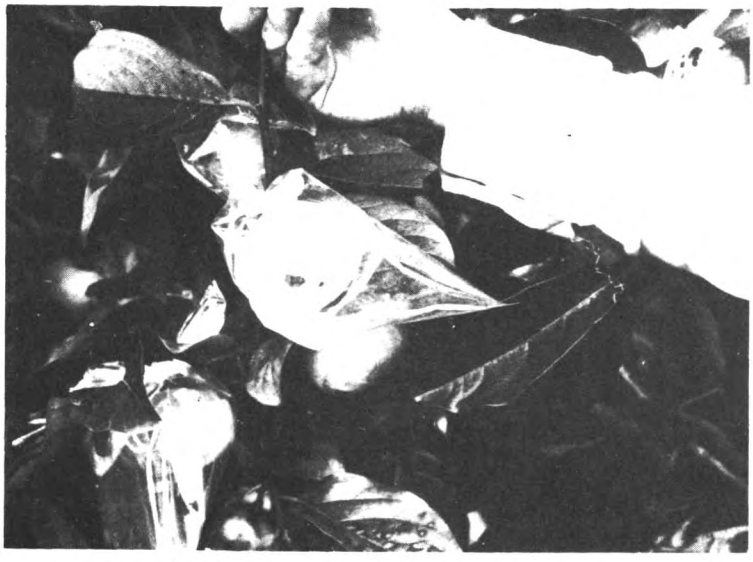

Fig. 2 Removal of astringency with alcohol (on the tree). Individual *Hiratanenashi* fruits are enclosed for three days in polyethylene bags containing small amounts of alcohol.

treated. Treated fruit are left on the tree until mature.

Hiratanenashi that are treated on the tree develop brown (instead of clear or pale orange) flesh. I was told that consumers in Tokyo actually prefer treated fruits with brown flesh and that these command higher prices. (Note: Flesh colour does not change when *Hiratanenashi* is treated with alcohol or CO_2 after picking.) A major advantage of this treatment is that it does not cause early flesh softening and fruit have longer shelf-life than those treated with alcohol after picking (see below). However, returns need to be high in order to cover the extra labour costs of bagging individual fruits.

4. Combination alcohol/CO_2 treatment. At Fukushima, astringent persimmons are picked and pretreated with alcohol before receiving the CO_2 treatment (70 percent CO_2 for 60 hrs at ambient temperature). The main reason for using a combination method appeared to be the unusual growing conditions at Fukushima. Both *Hiratanenashi* and *Aizumishirazu* must be picked very early to avoid damage from autumn frosts.

I discussed the problems associated with removing astringency from persimmons with a number of research workers. The point was made that although techniques for treating astringency are now much more refined than in the past, there are still problems with both the CO_2 and alcohol methods. Physiological disorders such as skin browning sometimes occur after treatment and this appears to depend upon the season. Furthermore, the main astringent cultivar grown in Japan, *Hiratanenashi*, is fairly difficult to treat. A number of other astringent cultivars are more easily treated but the fruit quality of these is not commercially acceptable. It should also be noted that the sealed chambers that are used for the CO_2 treatment are all located in the regions where astringent fruit is grown, rather than at the market centres. While astringent fruits could be pretreated in New Zealand this would reduce the shelf-life of the fruit and would rule out the possibility of sea transport. For these reasons it was recommended that New Zealand concentrate on growing pollination-constant, non-astringent persimmon cultivars, *Fuyu* in particular.

STORAGE

It is generally recognised that naturally

non-astringent persimmons (i.e. pollination-constant, non-astringent types) have a longer shelf-life than astringent persimmons which have been treated to remove astringency. However, as with many fruits, early-maturing, non-astringent cultivars such as *Izu* have a shorter shelf-life (5-7 days) than later maturing cultivars such as *Fuyu* (20-30 days). The shelf-life of astringent persimmons is greatly reduced if the astringency is artificially removed. Furthermore, the shelf-life of treated astringent fruits is dependent upon the method used to remove the astringency. *Hiratanenashi* fruits which are treated on the tree with alcohol have a shelf-life of 15 days or more. Fruit that is treated with CO_2 has 7-10 days shelf-life. Treatment with alcohol (off the tree) causes early softening and the fruit has only a 5-6 day shelf life.

MODIFIED-ATMOSPHERE STORAGE OF FUYU

Fuyu is commercially stored in Japan for up to five months at 0°C. Fruits are individually sealed in polyethylene bags of 0.06 mm thickness. It was claimed that under these conditions a modified atmosphere is created in which CO_2 is 5-10 percent, O_2 is 5-10 percent and relative humidity almost 100 percent. Individual wrapping also reduces the spread of disease within boxes and helps to keep down to low levels the ethylene given off by damaged fruit. Persimmons appear to be very sensitive to ethylene. The thickness of the polyethylene is critical. If the bag is too thin, O_2 levels become too high and this leads to early fruit softening. On the other hand, bags of 0.08 mm thickness result in an accumulation of CO_2 (10-20 percent or higher), which causes physiological damage (e.g. skin blackening).

Because the Japanese prefer to consume very firm-textured fruit it is vitally important that persimmons do not soften in storage.

CONCLUSIONS

I returned from Japan with three main impressions:

1. Good market opportunities exist for persimmons.

There appear to be good prospects for persimmons in Japan in the off-season period and it should be possible to produce high-quality persimmons in New Zealand for this market. The market requirement, however, is for nearly perfect, large (200 g and larger), blemish-free fruit, that can be consumed crisp. While there may be a limited market for astringent types (such as *Hiratanenashi*), there are many problems inherent in the treatment and marketing of astringent fruits (see earlier). Our best prospects lie in the export of pollination-constant, non-astringent cultivars, *Fuyu* in particular.

We should be aware, however, that there are some uncertainties.

(a) Many Japanese consumers, particularly the older generation, are very conscious of the normal season of harvesting and consumption of fruits, and fresh persimmons are usually regarded as an indicator of autumn. Furthermore, there is a strong association of certain fruits (Asian pears, persimmons, and chestnuts) with the national identity, and for this reason out-of-season persimmons may not necessarily fetch higher prices than those locally produced and marketed in-season. However, during recent years a few fruits (e.g. strawberries) have become available both in-season and out-of-season, so consumption patterns are changing.

(b) Although persimmons are regarded as a national fruit and feature in a number of

TABLE 1: Quantity and price of persimmons at the Tokyo wholesale central market for 1978.

		Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Persimmons	tonnes	29,296	58	-	-	-	-	-	-	0.4	555	7,986	15,360	5,338
	yen/kg*	193	318							1,981	491	243	161	176
Hiratanenashi	tonnes	4,505	-	-	-	-	-	-	-	-	-	3,112	1,392	0.3
	yen/kg	206	-	-	-	-	-	-	-	-	-	207	204	578
Fuyu	tonnes	18,910	14	-	-	-	-	-	-	0.05	55	2,195	11,832	4,813
	yen/kg	176	447	-	-	-	-	-	-	1,031	602	254	159	178
Jiro	tonnes	2,707	-	-	-	-	-	-	-	0.08	1.8	1,329	1,327	50
	yen/kg	200	-	-	-	-	-	-	-	250	267	259	144	111

* NZ$1.00 = 207 yen

ceremonies and customs, consumption trends indicate that this fruit may be declining somewhat in popularity, particularly among the younger generation.

In spite of these problems it is quite likely that this fruit can be developed in New Zealand. We need to find out which areas of the country are suitable for growing completely non-astringent persimmons. The industry will also need to introduce quality standards for export persimmons, to ensure that markets in Japan are not ruined by over-zealous exporters. In this regard I would strongly recommend that both growers and exporters consider imposing a total embargo on persimmon exports to Japan until those of the right type and quality become available. There is no sense in testing the market with inferior quality, home-garden fruit.

2. Packaging and presentation of horticultural commodities must be perfect. Japan represents a potentially large market which is a very attractive one for us. However, it is vitally important to realise that very high standards of both quality and packaging are required. I saw very few instances of poorly presented fruits (or vegetables) during my visit. The standards that must be met in Japan are very demanding but excellent prices can be achieved at the very limited, top end of the market.

3. There are a number of serious pests and diseases in Japan that are not yet established in New Zealand. It is important to ensure that none of these is inadvertently introduced, and we should be very careful with all plant material that is imported from Asia.

ACKNOWLEDGEMENTS

I would like to thank all the different organisations that financially supported our trip, and also Mr Cyril MacLeod, former General Manager of the N.Z. Fruitgrowers Federation Ltd, who coordinated the contributions from industry.

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Monocots and Geophytes

by

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The word monocot, is a shortened form of monocotyledon, and in the plural usually refers to monocotyledonous plants. However the term geophyte is less familiar to horticulturists and succinctly covers all those plants called in the nursery trade "bulbs" and described by gardeners as bulbs, corms, tubers, tuberous roots and subterranean rhizomes. Geophyte was coined by the Danish botanist Raunkaier (5) in his classification of vegetative life forms. It is applied to those plants which, during the most unfavourable growing period, perennate below the soil surface. This may not in fact be winter cold but is frequently summer heat and dryness, hence the fact that both daffodils and autumn crocuses are leafless in late summer.

The Monocot Habit

Monocots have so many distinctive features it is surprising that they have not been considered more fully as a group. There is Ann Arber's classic book (1) and Metcalfe's studies of their anatomy (4), but consideration of their growth habits has been partially neglected or at least not brought together in an available form.

Classical botanists have selected the features given below as being typical of monocots (3); Single cotyledon, stems with scattered vascular bundles, leaves usually paralleled veined with margins almost always entire and flower parts basically in threes.

With due reference I consider these aspects describe only certain attributes; under the heading monocotyledones. Hutchinson (2) classifies monocots into three classes:

Calyciferae (Calyx bearers) with a distinct usually green calyx and corolla (Butomaceae to Bromeliaceae)

Corrolliferae, in which the calyx and corolla are usually similar (Liliaceae to Orchidaceae)

Glumiflorae in which the perianth is much reduced (Juncaceae to Poaceae).

Considering the significance of these plants to man, for "all flesh is grass", it is surprising how little has been published on this group of plants as a whole. Botanists or even agronomists, let alone horticulturists have been unable to see the grass for the trees or appreciate the common features of durum wheat and date palms.

Comparison of Monocots and Dicots

One of the basic differences between monocots and dicots is the position and number of meristems. In many monocots, especially geophytes there is a massive basal axis; even in trees like *Cordyline indivisa* there is only one major meristematic apex, as compared with the thousands of meristems on a pine tree. In fact it is this major apex which creates the typical appearance of the palm trees. One can therefore understand why in colder climates, *Cordyline* is substituted for palms.

There are also other regions of active growth called intercalary meristems, the region at the base of each internode; anyone who has chewed a fresh green grass stalk, will be aware of the sweet succulent meristem when the stem has been pulled out of the embracing nodes. These meristems are

Fig. 1 A group of monocots, *Agapanthus*, *Yucca* and *Strelitzias* in flower.

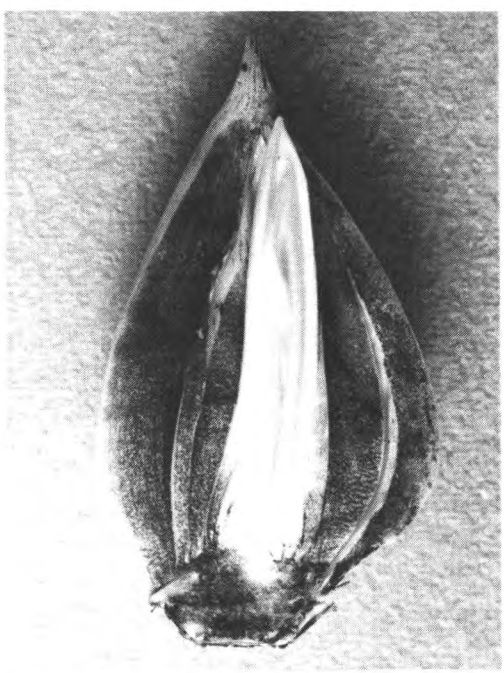

Fig. 2 Section through *Iris xiphium* bulb, showing vegetative growth from basal axis and (on left) a root emerging from the same region.

Fig. 3 *Dracaena* showing sheathing leaf bases.

TABLE 1

Monocots	Dicots
Roots	
Initially a primary root then all secondary adventitious roots:	Primary root to taproot
Contractile roots produced by geophytes:	Contractile roots rare
Continuous production of roots from central axis:	Root production distally
Sclerification of pericycle	Sclerification of vessels
Stems	
Massive basal meristematic region (basal axis):	Diffuse apical meristems
Growth in many cases by intercalary meristems):	Secondary enlargement of stems
Stem roots in some species	Stem roots rare
Leaf bases sheathing	Leaf bases attached to stems, leaves petiolate
Reproduction	
Inflorescence produced from centre of foliage, actually lateral to new bud:	Flower subtended from apical aerial growths
In herbs, flowers fully developed within or close to basal axis	Flowers initiated on aerial shoots
Growth usually sympodial	Growth both monopodial and sympodial
Survival	
Production of storage organs or offsets even when flowering or fruit produced	Usually fruit or seed dispersal; a few produce storage or reproducing roots
Few annuals, mostly non-woody perennials.	Many annuals and woody perennials.

particularly important in bulbs such as tulips as the emerging shoot and the flower stem is thrust up from below, rather than growing apically as in potatoes. There are in fact many differences between mono- and dicots; some of these features are compared in Table 1.

I must admit that there are anomalies, as in all living groups, for Procrustes operated on only one species of organism.

GEOPHYTES AND REPRODUCTION

1. Vegetative

My main interest though, is in geophytes and the geophytic habit; this is one of the most successful methods of plant survival that has been evolved. One has only to reflect upon the persistance of bluebells in deciduous woodland, of the persistance of iridaceous corms under grazing pressure in South Africa and the persistance of weeds such as *Oxalis latifolia*, couch grass and Johnson's grass.

Vegetative reproduction has not superceded sexual reproduction, but provides a secondary method of survival. All bulb growers are aware of the problems of volunteer plants surviving in subsequent seasons. I have known potatoes to persist after six years of

Fig. 4 Lily plant during growth with basal contractile roots and stem roots; the latter are frequently more prolific than the former.

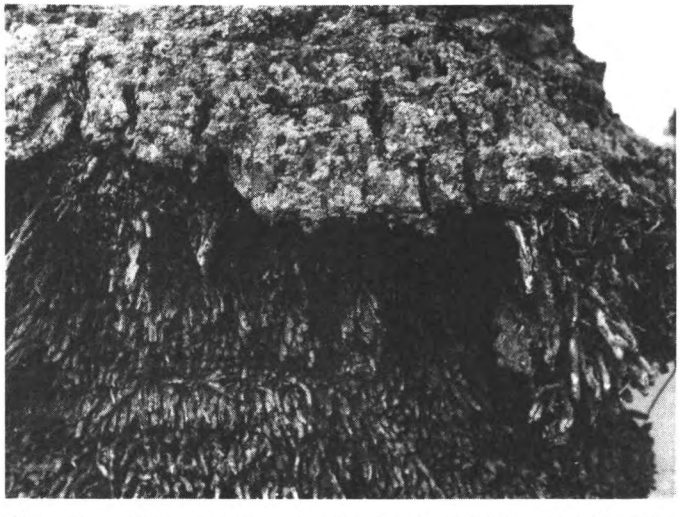

Fig. 5 Stem roots at the base of the trunk of a *Phoenix* palm.

cultivation with other crops.

Many other members of the monocots reproduce vegetatively; typical examples are bananas and bromeliads; while plants like *Philodendron* and *Astelia* have the ability to re-establish themselves from vegetative growths when these are detached from the parent plant. This ability is usually lacking in the dicotyledonous tree on which the plant is epiphytic.

2. Generative

Despite the reduced significance of reproduction from seed, it is surprising how rapidly and easily seed of some geophytes germinate. Seed of iridaceous plants such as *Freesia*, *Gladiolus* and *Watsonia* germinate immediately when provided with suitable conditions. In fact the large fleshy seeds of *Nerine* and *Crinum* will germinate without additional water or imbibition if the temperature is suitable.

Lilium species have developed various survival mechanisms in the seed; delayed hypogeal germination in *L. auratum* where seed ripens late in the season and must survive a cold winter, in contrast in *L. formosanum* from a warmer area, self sown seed will germinate, flower and set fertile seed all in one growing season. Lilies in fact have several vegetative survival mechanisms; stem bulblets in most species; stem bulbils more dormant in others; the ability to produce bulblets on detached scales, a condition which may occur in nature where a bulb is dug up or partially damaged.

Iridaceae

When iridaceous plants are considered, it is interesting to note the similarity between some South African corm bearing species as *Sparaxis* and bulbous iris, especially *Iris xiphium*.

Despite the difference in storage organs, both develop above ground foliage before flower initiation; and particularly with spring flowering species, a cool period is required to initiate flowers. As with corms, the iris bulbs are replaced annually (unlike *Narcissus*), and in these species the flowering axis is a spike, albeit with only two flowers in some cultivars of iris as *I.* 'Wedgewood' though *I.* 'Golden Harvest' often produces three flowers. Both types protect the emerging shoot with basal scale leaves and leaves are borne on the scape.

Amaryllidaceae

Another aspect invites comment, namely the position of the storage organ in the soil, particularly the anomalous behaviour of South African Amaryllidaceae such as *Amaryllis belladonna* and *Nerine*. Despite the production of contractile roots the bulbs of these plants gradually become exposed until they are above the soil surface, one should really call them epigeophytes. As mentioned earlier, their seeds germinate very easily so one can assume the bulbs are sensitive to air rather than soil temperature changes, especially the decrease in late summer, accompanied by autumn rains, so that the seed will be distributed and be placed in suitable conditions for germination.

The bulbs, as with many amaryllids apparently are toxic or unpalatable to browsing stock. In contrast corms are palatable so with iridaceous plants from the same geographical area we find that the contractile roots pull the newly subtended corms down to the same level as the parent corm.

Being a horticulturist and not an agrostologist, I have not discussed grasses and their growth habit. Sufficient to say that it is a very effective means of survival; from an ontogenetic viewpoint one could probably parallel them to the composites, with whom they so frequently share the same habitat.

It is difficult to decide whether monocots developed the geophytic habit or developed from geophytes. Did *Paris* arise from *Phoenix* or *Dracaena* from *Dracunculus*? Monocot geophytes are a fascinating study, providing valuable cut flowers and raising the spirits of poets from Solomon to Wordsworth.

I realise this is a somewhat superficial discussion and there are many other aspects such as chemotaxonomy and embryogenosis which might be considered, but I trust these observations will encourage others to philosophize on plants in general in addition to studying specific individuals; we need to think in the round as well as centering our thoughts on details.

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A New Cultivar of a Native Plant

by

L.J. Metcalf

Invercargill.

Myrsine

Of the nine species of *Myrsine* which occur in the New Zealand botanical region, only two species, *M. australis* and *M. nummularia*, can be said to be relatively common in cultivation. Of those, *M. australis* would be the most common, while *nummularia* is more likely to be grown by the alpine enthusiast.

Myrsine australis is found throughout the North, South and Stewart Islands, occuring in lowland mountain forests. Often it is rather local in distribution. It is known variously as matipou, mapau, mapou, red maple and red matipo. The last two names refer to the red colour of the branchlets and petioles, and sometimes of the leaf margins as well. "Maple" is a corruption of mapau, while red matipo alludes to its similarity to *Pittosporum tenuifolium*, the tree which erroneously bears the Maori name of matipo. The pale green or yellowish leaves contrast most effectively against the red stems and petioles making it an admirable garden plant.

Throughout its range it varies slightly from district to district, the form being found about and north of Auckland being perhaps, one of the most distinct variants. Until recently nobody had taken much notice of this plant and no cultivars had been selected for cultivation. However, one cultivar has appeared and once it becomes available, to gardeners, it may stimulate interest in this rather neglected species.

Myrsine australis 'McKenzie Gold'

This is a variegated form of *M. australis* which was discovered by Mr T.R.J. McKenzie of Hastings. Mr McKenzie relates that he discovered this plant, in 1979, in a small remnant of bush, on the hillside behind the Pencarrow area of Wainuiomata township. The original plant is believed to be a seedling because it grew quite some distance from the nearest other plant of *M. australis*, and it did not give the impression of being a vegetative sport.

Mr McKenzie took some cuttings of it and successfully propagated it. He states that it propagates well, although root initiation may take up to two months. So far this cultivar appears to be quite stable and has shown no signs of reversion. It will grow in semi shade or full sun, with the best colouration being produced out in the sun.

Myrsine australis 'McKenzie Gold' is, in size, shape and general character, similar to the common form of the species. The leaves are heavily variegated in the centre with a greenish-yellow (Pod green), with the normal colour of the leaf appearing as an irregular and rather narrow margin.

Myrsine australis (A. Rich) Allan cultivar 'McKenzie Gold' cultivar nova.

This is a most attractive plant which could be quite popular once it becomes commercially available. The soft yellow and green colour of the leaves contrast most effectively against the red of the branchlets. It will probably be used for many of the purposes for which some *Pittosporum* cultivars are now used. The cultivar name is bestowed in honour of Mr McKenzie, its discoverer.

Fig. 1 *Myrsine australis* 'McKenzie Gold'.
Photo Raymond Ellery.

The Culture of Hawaiian and Fijian Hybrids of Hibiscus in the Auckland Area

by

D.J. Lynch

Extracts from a thesis for the National Diploma of Horticulture (N.Z.), submitted by D.J. Lynch in 1981.

Hibiscus is an extensive genus involving more than 150 species of herbs, shrubs and trees with origins in many countries, particularly those in a tropical climatic zone.

Some of these species can be grown in the Auckland area but none have the universal appeal to match *Hibiscus rosa-sinsensis* hybrids widely referred to in N.Z. as Hawaiian and Fijian Hibiscus.

Hibiscus rosa-senensis is indigenous to the South Pacific, China, East Asia and the East Indies, but many of the newer varieties have been hybridised by growers in other countries, especially Hawaii, U.S.A. and Australia.

POPULARITY

Since their introduction to N.Z. both Fijian and Hawaiian varieties have been greatly acclaimed and admired but both are tropical shrubs and can be grown successfully outdoors only in the warmer northern and coastal areas of N.Z. with the hardier Fijians popular in southern as well as northern parts of the North Island. The more delicate Hawaiians are confined to the top half of the North Island with both varieties being grown under glass throughout the country.

The Hibiscus bloom, especially the much larger Hawaiian, is a thing of great beauty and easily explains it's popularity.

It can last from about 4 hours to 48 hours depending on the variety, but whether it is picked or left on the shrub, whether it is placed in water or not, the period it lasts remains the same. The blooms are used frequently as table decorations using to the full their capability of lasting well without water.

Colours, especially of the many new varieties coming forward, are spectacular and the larger Hawaiian bloom is greatly sought after by those fortunate enough to have the climate and soil conditions to grow them successfully outdoors.

Several North Island areas have allied themselves to the Hibiscus by promoting their region as the "Hibiscus Coast", prominent among these is the Orewa area north of Auckland which basks in the gay tropical image that Hibiscus symbolise for most Kiwis.

GARDEN ORNAMENTALS

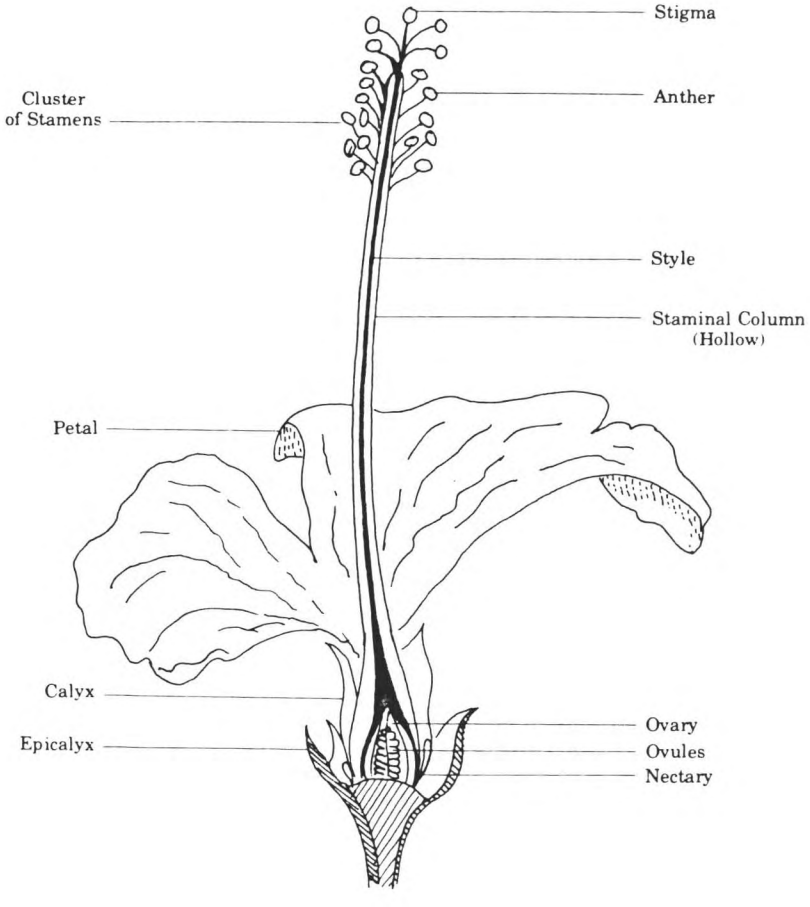
This is the major market for Hibiscus and it's hard to imagine a more rewarding shrub for those kiwis who cling tenaciously to their ¼ acre section and take a pride in their garden.

Although Hibiscus blooms last only a day or two they are generally vigorous growers and as a bloom fades another is waiting to take its place so the shrub seems to be continuously ablaze in a mass of colourful blooms.

The blooms are governed entirely by weather conditions and do best in a warm, humid atmosphere, as conditions get cooler blooms get smaller and colours less brilliant.

Cold, frost and bad drainage are the enemies of Hibiscus and in areas where these conditions can be avoided the home

HIBISCUS BLOSSOM



gardener, with a little care, can transform his garden and derive season after season of pleasure from the wonderful variety of Hibiscus hybrids now available in this country in a never ending range of colour combinations.

A metropolitan centre like Auckland would be a cheerless place of concrete canyons and sterile highways without the many trees, shrubs and lawns which the city fortunately possesses and it is gratifying to see Hibiscus taking its place in public, as well as private gardens, on civic lands, beside suburban footpaths and adjacent to city roadways to help make our city a more colourful, interesting and pleasant place in which to live.

REGIONAL CLIMATIC CONDITIONS

The Auckland urban area contains more than $\frac{3}{4}$ of a million people, most of whom admire Hibiscus and many of them grow the shrub. Most purchase their plants at their local garden centre having been attracted by its flower and have little or no other knowledge of the species. Most expect to plant their chosen variety in a position where its bloom will be displayed to advantage without regard for soil or weather conditions and then expect it to flourish without further assistance.

Surprisingly, many do.

Although Hibiscus is a tropical species they are grown successfully in our sub-tropical climate by many unskilled hands largely due to professional nurserymen who recognise, and compensate for, our climatic shortcomings by making available to the public, hardier, locally tested varieties, and in the case of Hawaiians, in supplying plants grafted onto hardier stock.

The Auckland climate is a little wetter and a little warmer than the average temperate zone, with a higher than average humidity. Wind velocities are not extreme and frost constitutes the major climatic problem of the region.

MICROCLIMATE OF THE REGION

Topography and proximity to the sea are geographical features of the area which have a great influence on climate. The isthmus is sandwiched between two large bodies of water, the Waitemata Harbour to the north and the Manakau Harbour to the south and many suburban areas are located right on the Hauraki Gulf. Reasonable proximity to water lessens the risk of frost. Undulating and hilly terrain, which typifies the entire North Shore and many other areas throughout the region from the Waitakeres in the west to the Bombay hills in the south, leave many localities well above sea level which remain frost-free and warmer in winter while many areas of lower-lying land are victim to cold air drainage and severe frosts.

The following table gives the mean daily minimum temperature and the lowest minimum recording during July at eight Auckland weather stations:

	mean daily minimum °C	lowest minimum °C
Albert Park	7.8	0.7
Mangere	6.3	-3.3
Mechanics Bay	7.6	1.4
Oratia	4.8	-4.1
Otara	6.3	-4.1
Owairaka	6.2	-2.3
Riverhead	4.3	-5.7
Whenuapai	5.4	-4.9

Hibiscus rosa-sinensis species are susceptible to frost damage especially Hawaiians which are less resistant to cold than Fijian types. It is difficult to be precise about the extreme temperature an Hawaiian is able to withstand as the age and state of the plant are major factors. Some plants are known to withstand frosts of up to -4°C but these are established plants specially treated with Bordeaux to harden the wood against the onset of frost. A younger plant, or one with a lot of soft growth would find this temperature fatal.

IMPROVEMENT OF THE MICROCLIMATE

Improvement consists broadly of control of wind, water and temperature. Shelter from the wind comes in various shapes and sizes from tall trees to low hedges and includes various forms of non-living barriers such as walls, fences, netting and plastic materials. Many experiments world-wide prove that crops benefit from the proximity of shelter provided they are

not shaded from sunshine and there is no serious competition for soil moisture and nutrients.

Auckland's prevailing winds are from the south and west quarters and protection from these directions is desirable.

Planting alongside a north facing wall or fence will give wind protection and maximum sunshine. Living protection can be provided in the form of beds of thickly planted shrubs such as *Griselinias* or *Pittosporums* which are known for their survival under difficult conditions, or non-suckering bamboo which provides excellent shelter plus the additional advantage of providing extra drainage, as bamboo soaks up moisture the Hibiscus doesn't need.

Temperature control presents no problem in the provision of shade as Hibiscus thrive on solar radiation and will soak up everything the Auckland climate can provide.

AUCKLAND AREA SOILS AND THEIR IMPROVEMENT FOR HIBISCUS.

A great amount of information on soil types, structures and value for the production of food or other commercial crops has been done by the Soil Division of the D.S.I.R. and the efforts of this authority have, naturally, been directed in the main, towards large areas of open ground, free from urbanisation, on the periphery of Auckland city where the greatest possibilities exist for the expansion of commercial horticulture.

SOIL TYPES

Soils vary widely throughout the region with some of the principal types being:

(a) Volcanic soils derived from basaltic lava flows are encountered throughout the Auckland isthmus and occur in most inner city suburbs.

(b) Alluvial soils in scattered pockets especially parts of Avondale, Henderson and Kumeu.

(c) Brown sandy loams in parts of most north western districts.

(d) Northland clays found throughout the North Shore from the Harbour Bridge to Waiwera with some peaty silts around the Dairy Flat river basins. The greater part of the North Shore is composed of the poorer type clays.

(e) Peats and silt loams are found in various parts of the region, especially in the large area of Manakau City to the south of Auckland and in Mangere.

Generally the northern brown loams and northern yellow brown loams and earths have poor drainage and this condition is death to Hibiscus.

Exact locationing of the various soil types within the Auckland urban area is a virtually impossible task due to:

(1) Residential sub-division earthworks which remove top-soil and expose the sub-strata.

(2) Road and highway construction plus other building projects where site levelling and foundation excavation cause the removal and relocation of vast amounts of earth.

(3) Reclamations involving land fill, frequently used after consolidation for residential development, schools and parks. This land can, and often does, contain anything from organic material to masonry and discarded automobiles.

(4) The practice by many city dwellers of bringing in good top-soil from another district to enable a householder to grow something on his ¼ acre of podzolised yellow brown earth.

In general the urban area has been interfered with to such an extent that a householder commonly finds good brown loam on one part of his property, and sticky plastic clay on another, one being fine for his Hibiscus and the other impossible.

SOIL IMPROVEMENTS

However, it is in this Auckland urban area that the majority of New Zealanders live and therefore the area in which the majority of Hibiscus are grown.

Those fortunate enough to live in an area affected by lava flows from one of Auckland's many volcanic cones will find they have a volcanic soil with good drainage

in which Hibiscus will thrive.

Drainage is the main criteria and poor drainage can be improved by:

(a) Raised beds: The principle is to improve both soil and drainage by raising the bed approx. 15 to 20 cms above the level of the surrounding area. This usually involves a low retaining wall of wood, brick or blocks and the building up of the bed with good top-soil and compost incorporated with the existing soil for improved depth. As water finds its own level the raised bed automatically drains off excess water.

(b) Terracing: This is usually employed in sloping locations to provide a level, or near level, bed with a vertical bank or wall down to the next level. This provides easy access to the beds on both steep and slightly sloping areas and allows better utilisation of available ground. This method retains the principle of good drainage as the water escapes from the beds easily via the bank or wall to its own water table.

(c) Planting on natural slopes: This allows water natural drainage to the lowest point.

(d) Field tiles and other installed drainage: This method requires the installation in a shallow trench of field tiles made of porous clay or one of the many other types available today such as slotted plastic pipe or flexible plastic types. This is often installed in a herring bone type layout allowing small leads to drain into a larger dimension pipe. The principle is that this underground ducting system is porous allowing excess water to enter the system and speeding its progress by gravity away from the area being drained.

(e) The addition of scoria or gravel to the soil: Two different applications may be used here. One is to break through a hard clay pan handy to the surface and fill the resulting hole with gravel allowing water to escape. The other is simply to add scoria or gravel to the existing soil in the bed which greatly helps the aeration of a heavy soil thus allowing greater freedom of escape for water.

Even good drainage will not be enough to produce good Hibiscus in poor soil and clay without considerable soil improvement. In some cases the introduction of imported top-soil may be the only satisfactory solution.

Organic matter is an important source of nitrogen, phosphorous, sulphur, boron and molybdenum and is commonly applied in these forms:

(1) Compost

(2) Leaf mould

(3) Rotted sawdust (untreated)

(4) Straw or silage

(5) Animal manures

(6) Green manure crops

Liberal use of organic matter plus the introduction of fine scoria will help aeration and encourage earthworms which will contribute further to the formation and improvement of soil structure. The use of lime is an effective means of reducing soil acidity and Hibiscus respond favourably to it.

To assist plant growth regular applications of fertiliser should also be made, the actual fertiliser used is of less importance than the use of one with a balanced NPK rating giving a high nitrogen content and a smaller potassium and phosphate content.

Another method of growing Hibiscus which appeals to those with difficult soil or drainage conditions is growing in containers or patio pots. This requires a very large container with a minimum 30 cm diameter and depth and allows the use of specially brought in soil, though care should be taken to ensure that a bark mix is not used as this dries out in summer, or a soil with a high peat content which will waterlog.

The container can be sited to aesthetic advantage and moved under cover during the frost season. The problems with container growing are feeding and watering. Feeding needs to be little and often due to the small soil area available to absorb the fertiliser, liquid feeds are very suitable for container plants. Watering needs to

be regular and often during summer as the small amount of soil involved tends to dry out rapidly.

PROPAGATION - VEGETATIVE METHODS USED IN N.Z.

The terms "Fijians" and "Hawaiians" in general use in N.Z. are not derived from any country of origin or genetic development. They are used nationwide simply to distinguish between the hardier, smaller flowered Fijian varieties and the larger flowered, but more delicate Hawaiian varieties.

FIJIANS

These varieties are propagated during spring and summer from cuttings taken from semi-hardwood stock. Propagation can also be undertaken during winter, but some important variations in technique are required and these are detailed later in this section.

Cuttings are made to a node and should be 10 to 12 cms in length with two or three leaves which need to be reduced in size if they are large.

To facilitate rooting, cuttings are dipped in a hormone such as 'Seridex 3' (Indol-Butryic acid) before being inserted into tubes containing a propagating media of 3 parts sand, 1 part peat, no fertiliser is used.

The tubed cuttings go into a glasshouse with bottom heat at 24°C and a high mist rate giving a 15 second burst every 5 minutes. After two or three days the mist is decreased by cutting the bursts to every 10 minutes. The high initial mist rate is applied to prevent wilt and the decrease is necessary to prevent rot. As either condition is disastrous for the cuttings the mist rate is most important. The cuttings should root satisfactorily in approximately four weeks and at this time a start is made in reducing the mist which should be steadily decreased over the next two weeks to nothing when their six weeks term in the propagating house is complete. They are then moved to an unheated glass-house and are top fed with a suitable nitrogenous fertiliser.

WINTER PROPAGATION OF FIJIANS

Winter propagation requires cuttings from hardwood stock usually longer in length, though this depends on the thickness of the wood, as length and thickness should be related to ensure adequate food storage in each stem and winter cuttings should be entirely devoid of foliage. Propagation is carried out as described above but no mist is used throughout the propagation cycle.

HAWAIIANS

Propagation from cuttings is not recommended for growers desiring a quality plant. Because the plant is a tropical species its survival in the sub-tropical Auckland climate is marginal and a graft onto hardier Fijian stock is essential.

There are several methods of propagating Hibiscus by grating, one such method with a proven success record is as follows:

Propagation is carried out between October and April using cuttings taken from Fijian stock making sure, in the case of an early batch that the spring leaf drop is completed before taking the cuttings. A particular stock ideal for this purpose is AGNES GALT which has a big internode and straight-grained wood. Cuttings are taken at a node and should be approximately 15 cms in length, leaving two small leaves, larger leaves should be reduced in size to lessen transpiration loss and allow more cuttings to the tray. The cuttings should be treated with a hormone to promote rooting, 'Seridex 3' is ideal, simply dipping the cuttings into the powder before placing in a plastic hygiene tray containing a propagating media of 3 parts sand, 1 part peat, with no fertilier added.

Approximately 50 to 60 cuttings can be accommodated in each tray.

Where a graft is not required, as in the case of Fijians, planting direct into containers offers the economic advantage of cutting out one operation and also reduces the risk of plant damage and interference with growth rate. In this case, however, trays are used in preference to containers because the cuttings need to be lifted before rooting has taken place to have the graft made.

Trays are kept in a glasshouse with a

bottom heat of 24°C and are provided with mist at the rate of 15 second burst every 5 minutes. After two or three days this rate is decreased by cutting the bursts to every 10 minutes and the cuttings are retained under these conditions for approximately 14 days in all.

At this time the cuttings have not started to root but have formed good callus which is the ideal time to handle the cuttings for grafting. Machine grafting is virtually non-existant in N.Z. so a sharp knife is the tool relied upon here and it must be really sharp.

First the scion wood from the chosen variety of Hawaiian to be grafted is selected from good healthy stock in thicknesses corresponding to the Fijian cuttings already prepared.

An incision of approximately 3 to 4 cms is then made in the stock wood at a point 5 to 6 cms above the callus at a narrow downward angle. The corresponding scion wood to be grafted can be quite short but should preferably have two nodes and any leaves should be greatly reduced in size. The stem is shaped to a wedge point which is then inserted into the stock wood keeping both woods as closely parallel as possible to ensure the best possible union.

The graft is then bound with a suitable material, usually plastic budding strips and is reinserted into the same propagating media, with the graft below the surface, and returned to the glasshouse with heat and mist where they remain for four weeks.

At this stage the grafts are lifted taking great care not to damage the newly formed and very brittle root systems, the buddings strips are removed and the quality of graft examined, a good callus means a good graft. The stock wood is then cut away at a point immediately above the graft.

The new plant are then potted individually using a 7 cm pot. The potting mixture used is detailed in the section on container growing.

The potted plants then go back into the glasshouse with heat and mist. After one week the mist is gradually reduced until it is stopped entirely, this occupies one further week. The plants may then be removed from the propagation house to an unheated glasshouse for growing-on.

HYBRIDISATION

In N.Z. we are seriously handicapped in producing new varieties due to lack of locally produced seed. In overseas countries, particularly those enjoying a warmer climate, Hibiscus will seed regularly and consistently, but in N.Z. only a limited number of varieties achieve this. Most varieties either don't seed at all or drop their seed before it matures.

We appear to have only three varieties which will seed consistently in Auckland. These are DAZZLER, FIREDANCE and APRICOT PARADE, consequently these three are most frequently used as the female parent by local breeders.

Hibiscus have a very considerable genetic variation world-wide which means that pollen from a chosen male parent is frequently rejected by the female parent. A good example is ROSS ESTAY, the flower of which will not accept pollen from any known variety and its own pollen is compatible with other varieties.

One advantage the local breeder does have is the absence of insects capable of pollinating the flowers thus avoiding the possibility of chance pollination.

Commercial hybridisation is extremely limited but the work done in this field by Aucklander Mr Jack Clark is used on a commercial scale.

THE JACK CLARK METHOD

This method isolates DAZZLER as the female parent.

Dazzler was bred by Mr Clark from WILDERS WHITE which was among the earliest varieties of Hawaiians to come to this country and is renowned as a vigorous growing variety with small blooms. He pollinates 'Dazzler' by selecting the best bloom of the variety he wishes to use as male parent.

Making sure that the pollen on the male parent is ripe, which usually occurs about mid-day in Auckland and can be tested by touching the anthers on clothing, to which some pollen should adhere, he simply places the two flowers together transferring the pollen from male to female with a light dabbing motion. In approximately two weeks it may be seen whether or not the seed has set.

The flower petals will fall leaving the ovary if pollination has succeeded, whereas the entire flower will fall if the result is negative.

Following successful pollination the ovary grows over a period of 6 to 8 weeks during which it forms a seed pod approximately 2.5 to 3 cms in size and receives normal food, water and protection from chewing insects throughout.

The seed pod is made up of five separate compartments which begin to open at maturity, the outer cover of each peeling back from the top. The pod, containing up to 25 seeds is harvested at this point before the seed can be naturally dispersed.

Overseas practice is to scarify the seeds before planting by lightly nicking each seed with a scalpel or sharp knife to overcome the varying thicknesses of seed skin and thus obtain faster and more even germination.

The seeds are spherical in shape, greyish in colour, have a diameter which averages about 5 mm and a large percentage will germinate without scarifying if planted on the day they are harvested. They are sown in a soil/sand media in trays.

When the seedlings have produced their first true leaves, which require 3 to 4 weeks under glass, but rather longer outdoors especially if planted in Autumn, they are planted in tubes containing a normal potting mix and grown-on.

Under Auckland conditions approximately three years are required from seedling to first flowering which contrasts with as little as 18 months in warmer climates.

Many different flowers will result from one seed pod, for example using 'Dazzler' and Golden Belle', both of which are yellow, seeds produced have grown plants bearing single, double and semi-double blooms with colourings ranging from the palest lemon through all the yellows to orange. These flowers are then carefully sorted, with unattractive varieties or those with other undesirable traits being destroyed, the best of the remainder are then named and grown-on to test their potential commercial value.

By crossing Hawaiian and Fijian varieties Mr Clark has produced a N.Z. strain which gives blooms of Hawaiian quality on a more vigorous plant, more suited to our climate, without the need for grafting.

SOME N.Z. DEVELOPED HYBRIDS

From his first hybrids produced in 1958 the following list comprises Mr Clark's best results:

TANGO	Single, dull tangerine red with carmine eye and pink halo.
FLAME	Single, rich tangerine with deeper eye.
OLD GOLD	Single, gold/orange.
DAZZLER	Double, yellow with red centre.
BEN JAMES	Single, velvety cerise.
GEM	Single, striking orange with white eye.
VIVID	Single, startling bright red with yellow edge.
APRICOT PARADE	Double, apricot shades with red centre.
FIREDANCE	Double, yellow with red centre.
LADY FERGUSSON	Single, lemon/yellow with white eye.
SUNSHINE	Double, golden yellow.
DE LUEN	Double, blood red.
TUI SONG	Single pink.
VIVIENNE	Double, yellow.
JACK CLARK	Double, orange shading with yellow edges.
RANGI	Single, red.
LADY BEATTIE	Single, pale yellow.
LADY JANE BLUNDELL	Single, pink with lemon edge.
BUCCANEER	Single, red.
EVE	Single, apricot.
ALL GOLD	Single, yellow/gold.
CARDINAL	Single, cardinal red.
BURGUNDY BLUSH	Single, pale burgundy red.

CONTAINER PRODUCTION

The nursery industry in New Zealand is geared to container production because Hibiscus react badly to transplanting and frost losses in open ground growing make any method other than container production totally impractical.

THE CONTAINER PRODUCTION CYCLE

Commercial growers plan to have a crop ready for sale by October, which, in practical terms is too early, but this timing is dictated by demand which can, to

some extent be satisfied with the hardier Fijian varieties.

In practice plants remaining unsold at a nursery about mid-March when demand ceases are held over in bags under glass.

Several batches of plants which could be up to 3,000 or more to the batch have been propagated throughout the season. The earliest of these batches are, by this time, well rooted in their containers from which they are removed and bagged using a smallish bag, usually a PB5.

The batch is stored in an unheated glasshouse on a scoria bed for good drainage and hygiene, no space is left between bags as all glasshouse space is expensive and therefore at a premium.

This batch plus last season's residue will comprise the crop that will be offered to satisfy early demand next October.

They are kept growing slowly throughout the winter by drastically cutting their water and food ration, applying just sufficient to keep the plants green without permitting any vigorous growth and are given preventive spraying with Bordeaux which hardens the wood and helps slow the growth rate. These measures, along with naturally cooler winter temperatures in the glasshouse will keep the plants growing slowly as intended.

The cooler temperatures will also lessen the possibility of damage by insect pests.

About September the Bordeaux spray is discontinued, water and fertiliser are increased as top feed on the bags and long shoots are pinched to promote bushier growth and new wood which will produce flower buds.

As the first orders for the new season come in the plants required are moved out of the glasshouse a week ahead of delivery date and are placed in a shade house to allow time for the plants to condition themselves to the changed temperature and light intensity outdoors. Plants moved from the glasshouse directly into bright sunlight will often suffer leaf burn and rapidly become unsaleable.

The later batches of plants propagated last season have also been held in the glasshouse during the winter but have been retained in their 7 cm pots, the smallest practical container, to conserve precious glasshouse space.

The aim now is to bag as many as possible to take the place of those sold. Early orders are usually considerable as retailers compete to be first on the market, thus several thousand move out almost at once.

Because temperatures are now rising steadily and water and fertiliser have been fully restored to all plants in the house rapid growth is made and the main crop is usually ready in January comprising mainly Hawaiians.

Since a further batch comprising mainly Fijians has been propagated early in November and allowed to grow rapidly these will be ready for bagging about January and sold as a late crop around February/March.

MIXES

The current trend is towards bark mixes and since most nurseries mix in bulk for a variety of plants the actual mix used varies considerably from nursery to nursery. A proven Hibiscus bagging mix to make one cubic metre is:

3300g Dolomite	425g Potash
1000g Superphosphate	4 barrowloads Peat
1000g Hydrated Lime	7 barrowloads Bark
900g Nitrogenous fertilisers	1 " Black Sand
200g Trace Elements	

Nitrogenous Fertilisers Used Above:

50% Fruitgrowers Federation Mixture NPK 5.5.5
30% Fish Fertiliser
20% Osmocote

Trace Elements Used Above:

10% Manganese Sulphate
15% Copper Sulphate
35% Iron Sulphate
17% Fetrilon
9% Borax
3% Sodium Molybdate
10% Zinc Sulphate

For potting the same mix is used but the quantity of nitrogenous fertilisers is reduced by 50%.

OPEN GROUND GROWING

Fijian varieties are grown successfully outdoors in most North Island locations. The more climatically demanding Hawaiians are largely confined to suitable areas of the Auckland province.

SITING CONDITIONS

Successful growing depends on a position giving maximum sunshine, protection from wind and free-draining soil.

In the case of Hawaiians, grafted plants or Fijian/Hawaiian cross varieties are necessary for anything short of ideal conditions.

Although Hibiscus will grow in shaded situations they will not flower without adequate direct sunlight, so shelter should not be achieved at the expense of sunshine.

Protection from prevailing winds can be obtained from locations behind a low wall, hedge, or alongside a house or similar building provided the sunny side is used. Trellis and other screen type barriers that deflect some wind also provide useful protection.

SOIL CONDITIONS

Free-draining soil with a high humus content is preferred.

Originally, in Hawaii, plants were subjected to continual watering to overcome the prevailing dry conditions. This resulted in an over supply of water causing collar rot and the practice of grafting onto hardier stock ensued.

Trials in the Avondale area have shown that plants become waterlogged each winter with ungrafted plants dying, usually of collar rot, while grafted plants easily survive the conditions.

Drainage can be improved by raising the bed, the introduction of porous material such as pumice, sand or scoria, or the installation of a drainage system.

Trials in the Titirangi area in pure clay have brought good results when a large hole is excavated, filled with very fine scoria and planting is carried out directly into this media.

Hibiscus have grown well for many years on the slopes of Auckland's volcanic cones which give natural drainage, sunshine and wind protection.

PLANT SELECTION

Selection depends on the growing situation as well as personal preference.

Fijians give an excellent tall growing bush with prodigious quantities of flowers and can be grown relatively easily in most North Island conditions. Hawaiians offer much larger and brighter coloured blooms but require warm climatic conditions and an area where frosts are neither frequent or severe.

PLANTING OUT

As Hibiscus do not transplant readily it is important to plan plant location carefully to get it right the first time.

Hibiscus also do not like competition from other plants so they do best in beds of their own planted about one metre apart with the larger growing Fijians even further apart.

The beds look best when even-growing varieties are planted together with taller varieties at the back and lower growing varieties to the front. Plants are purchased in containers and are planted in a hole twice the depth and circumference of the container at a time when any danger of frost has passed.

No fertiliser is used when planting but a little water helps the plant become established. Taller-growing varieties should be staked for support.

PLANT CARE

Regular feeding with a balanced fertiliser such as 'Fruitgrowers Federation Fertiliser' NPK 5.5.5 or 'Nitro-Phoska' NPK 13.13.21 is necessary during Spring/Summer plus judicious watering during this period taking care not to over water.

In the U.S.A. it is common practice to change the fertiliser during autumn for one giving a reduced nitrogen content and an increased potassium content to slow down the rate of soft growth and generally harden the plant to help it withstand frosts. Usual practice here is to apply fertiliser whenever plant leaves start to look yellowish but to phase out both fertiliser and watering in autumn.

Use of compost on an annual basis is a good idea as this conditions and improves the soil structure, but care must be exercised in spreading compost around the top of the bed that it does not actually

touch any Hibiscus stem as this will induce collar rot.

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The thesis contains many colour photographs of Hibiscus hybrids which unfortunately could not be reproduced here.

Ed.

The New Zealand Technical Correspondence Institute: One Component of Successful On-The-Job Training

by

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Horticulture was first taught by the Army Education Welfare Service (which later became the Technical Correspondence School) in the early 1940's when horticultural booklets were prepared to provide information for returning soldiers.

Since then, the Institute has responded to the ever-increasing demand for horticultural information by preparing new courses and appointing additional staff. In 1979, a Horticulture and Pest Control Department was formed, and the Department now has 20 horticultural tutors teaching a wide range of horticultural subjects.

The staff all have horticultural backgrounds, and tutors attend field days, visit growers, and work on horticultural properties during holidays to keep in touch with new developments in New Zealand horticultural practices. Growers are consulted when teaching programmes are being developed or revised.

TCI'S ROLE IN ON-THE-JOB TRAINING

TCI courses consist of a series of booklets containing instructional material. Each booklet is called an *assignment*. The content of each assignment is designed to cover topics listed in prescriptions provided by examining authorities or by organisations that have asked for specific courses to be prepared for them. At the end of each assignment, there is a series of questions that students answer. These answers are sent back to the student's TCI tutor, who checks that the questions have been answered clearly, concisely, and correctly. Tutors do not *mark* these answers as a school test would be marked. Instead, the tutor uses a student's answers to make sure that the student has understood the principles and information discussed in the assignment and can relate the subject matter to what is done or seen on-the-job.

TCI courses are designed to *complement* instruction given by the student's employer and the practical work that the student is likely to do on a horticultural property.

THE EMPLOYER'S ROLE IN ON-THE-JOB TRAINING

Assignments often describe how an operation can be done, but the student will pick up manual skills most easily on the job, where immediate guidance can be given and techniques practised. TCI study material provides technical background information about horticultural practices, botany, soils, and so on to give people working on a property a better understanding of *why* jobs are done. The employer can discuss with students working on his property lessons he has learnt from experience, and give encouragement when the going gets tough. If students have employers who take a continuing interest in their work both on the job and with TCI, they tend to do much better and develop a greater interest in their job than those students who are virtually ignored and treated only as work units. The importance of an employer's ability to motivate an employee to broaden his/her horticultural knowledge cannot be stressed too strongly.

THE STUDENT'S ROLE IN GETTING A HORTICULTURAL TRAINING

Over the years, the staff at TCI has

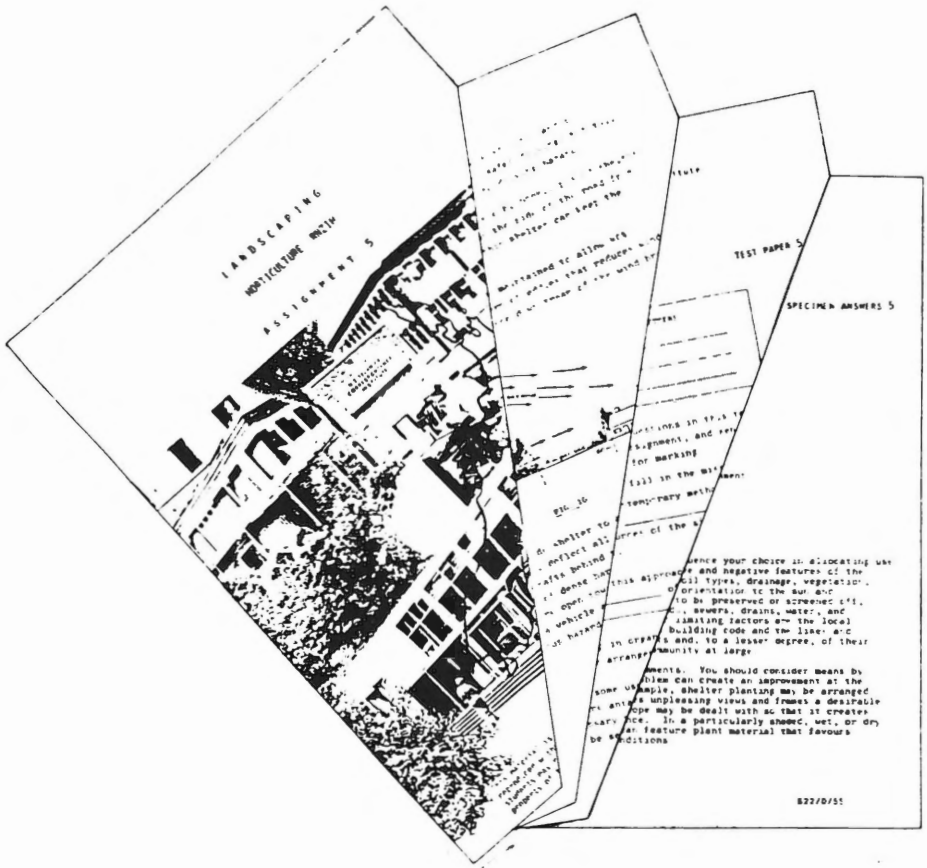

Fig. 1 Assignments contain written information on a number of topics and a set of questions that enable students to see if they understand the instructional material.

noted a large number of students who appear oblivious to all that is going on around them. However, to obtain as much as possible from a course, students need to develop an insatiable appetite for knowledge and a keen eye for what is going on around them. A keen eye comes with experience, and this is why TCI encourages students to keep a daily diary of work done on the property and to note anything of horticultural interest they see during the day.

Students do need to get out in their spare time and see how jobs are done on other properties, attend field days and so on.

TCI COURSES

Horticultural study material is available to people sitting examinations run by the Royal New Zealand Institute of Horticulture (RNZIH), the New Zealand Trade Certification Board (TCB), and the New Zealand Turf Culture Institute. Tuition in horticultural subjects is also available to people who are earning, or about to earn, an income from horticultural activities and who do not wish to sit examinations.

In 1983, TCI will be offering the horticultural courses listed in Figure 3. The differences between the numbers of people enrolled in each course in 1978,

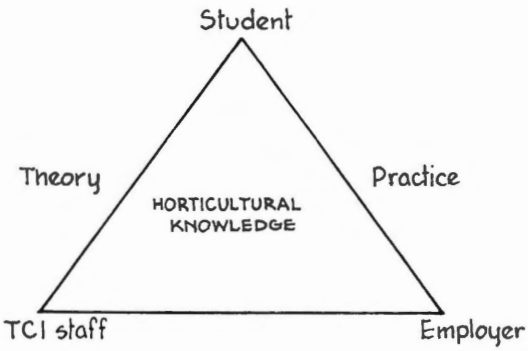

Fig. 2 For students to get a sound horticultural knowledge

(1) The students must be keenly interested in their jobs and in the TCI course they are studying.
(2) The employer must have a genuine interest in the student and be aware of the content of TCI courses.
(3) TCI staff must provide information that the student can readily understand. They must also keep up-to-date with current horticultural practices used by employers.

	No. of Students 1978	1980	1982
Royal New Zealand Horticulture Courses			
National Certificate/Diploma in Horticulture	202	244	347
Horticultural Sales Certificate	-	15	29
Certificate in Horticultural Practice	22	41	184
NZ Trade Certification Board Courses (Apprenticeships)			
Horticulture and Gardening	224	268	246
Golf Course Greenkeeping	38	70	55
NZ Turf Culture Institute Course			
Diploma in Turf Culture	-	32	35
Non-Examination Courses			
General Horticulture	445	468	322
Farm Forestry	137	121	137
Introductory Horticulture	Not Available	Not Available	Not Available (First offered late 1982)
	1068	1259	1355

Fig. 3 Horticulture enrolment figures at TCI from 1979 until 1982.

1980, and 1982 illustrate the growth that has occurred in the demand for TCI material.

TCI provides tuition for the following courses:

National Certificates/Diplomas in Horticulture:

The National Certificate course (3 years) and the National Diploma course (2 additional years) can be studied by people working full-time on a horticultural property. Instruction material is available for all Schedule 1 (Amenity) and Schedule 4 (Nursery Management) subjects, except for Oral and Practical examinations, which test practical skills picked up on the job. Some Schedule 2 (Fruit) and Schedule 3 (Vegetable) subjects are written, and we hope that in the coming years, assignments will be prepared for more subjects in these schedules (options).

Horticultural Sales Certificate:

Assignments for the RNZIH's revised 2 year Horticultural Sales Certiciate qualification have been written for use in 1983. This qualification is restricted to people working in retail garden centres or other retail outlets selling both plants and horticultural goods such as sprays and fertilisers.

Certificate in Horticultural Practices:

The Certificates in Horticultural Practices are designed for someone seeking recognition as a skilled worker in a specific type of horticulture. People wishing to study this course must be working on a suitable horticultural property.

In 1983, three options will be available:

1. Pip and Stone Fruit Production;
2. Citrus and Subtropical Fruit Production; and
3. Outdoor Vegetable Production.

In 1984, we hope to have Viticulture and Greenhouse Vegetable Options available.

Courses consist of 30 assignments, 26 of which are specifically about the different types of jobs done on the type of property a student is working on. When students are about to do a new job, they write to their TCI tutor, who sends out an assignment that discusses why the job is done and the things that the students should keep in mind when doing the job. After reading the assignment and doing the job, the student answers test paper questions about the job and sends the answers back to the TCI tutor.

Trade Certificate in Horticulture and Gardening, Trade Certificate in Golf Course Greenkeeping:

Apprentices working in parks, on commercial nurseries, or on golf courses are required to study the TCI courses written for these qualifications. The TCI also runs block courses for apprentices. These two week long courses are held at technical institutes in different parts of New Zealand. Their purpose is to reinforce correspondence studies with lectures, laboratory sessions,and visits to horticultural properties in the area.

Diploma in Turf Culture:

Tuition is provided to people who want to get a turf-culture qualification and who are working in greenkeeping or working with turf on a sports area or in a park.

Non-examination courses:

Many of the subjects normally studied by examination students may be taken on a non-exam basis. TCI also has some specialist courses for people with specific interests. Introductory Horticulture is for people with little horticultural background who wish to start a horticultural enterprise. It discusses points to consider when getting involved in horticultural production, the pitfalls to look out for, and the language horticulturists use. Farm Forestry is designed for farmers, landowners, and agricultural and forestry workers who want information about tree planting and management.

In 1984, we hope to have a course available for people interested in growing nuts and other new tree crops.

THE FUTURE

The work of a TCI tutor involves dealing with student enrolments and updating instructional material. As long as students continue to enrol, this work will need to be done. The Horticulture Department is a servant to the New Zealand horticultural

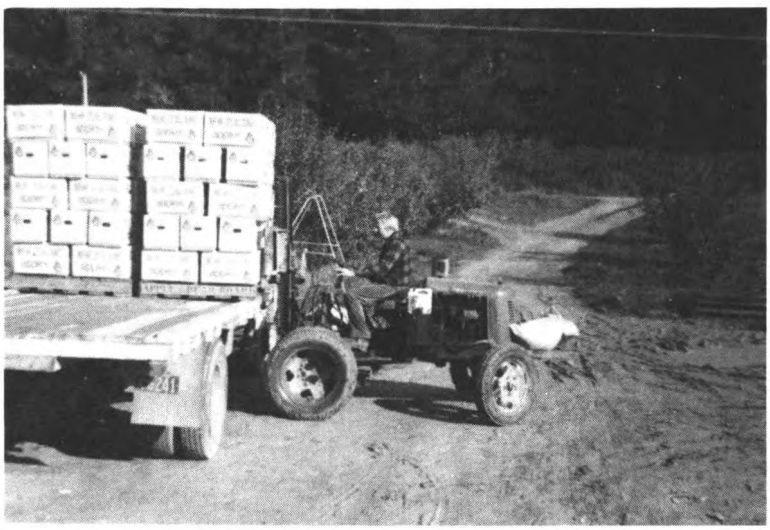

Fig. 4 This Horticultural Practice student would be studying the assignment on Packing and Despatching Pip and Stone Fruit while working on this job.

Fig. 5 Apprentices on a block course, visiting a propagation unit on a tree and shrub nursery.

industry and we are always ready to receive comments or suggestions from industry people that will help improve our courses.

TCI staff are often asked why TCI is not preparing more new courses for things such as beekeeping or cut flower production. TCI is not permitted to write new courses without Education Department approval. Any requests for new courses must be made by representatives of a sector of the horticultural industry. The decision whether a course will be taught is made by Education Department officers. At the moment, the only new horticultural course being prepared is the tree crops course mentioned earlier.

We hope that the excellent relationship that exists between horticultural producers and TCI will continue to develop and that employers, students, and TCI will continue to work together as a threesome to produce the horticultural craftsman of the future.

A Review of Research into the Nutrition of Container-Grown Shrubs at Lincoln College

by

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ABSTRACT

Aspects of the research on the nutrition of container-grown plants at Lincoln College over recent years, was discussed. Nitrogen requirements are seen as a key aspect of container nutrition and rates needed will vary according to plant species, pot/bag size and plant size. Five basic levels are recommended to cater for the culture of trees and shrubs from seed sowing to the bagging of large vigorous species. Phosphorus levels need to vary according to species, resulting in mixes with either medium or low P levels. The standard low lime mix for acid-loving plants was also recommended. It was concluded that species need to go into one of four groups and each given an N level selected from five rates, based on slow release fertilisers. This involves no radical change from common nursery practice but does allow for greater efficiency in meeting the needs of individual species which for some trees and shrubs may be quite critical.

INTRODUCTION

Repeated failure of certain shrubs to grow well or survive in nurseries around the country prompted studies at Lincoln College to discover the nutritional requirements of problem species in soilless-container culture. The objectives of this review is to outline the findings of this research and discuss the implications of the work, which began in 1971. Shrubs were grown at various levels of three macro-nutrients; nitrogen, phosphorus, and potassium. Liming or pH requirements were also examined. The media used was an equal volume of sphagnum peat with sand (or peat:perlite with initial work). Nutrient and pH requirements were generally met by slow release Osmocote, super-phosphate and lime (3:1 Dolomite:Agricultural). Work has centred on Australasian and South African genera, especially the Proteaceae. The nutrition of some Northern Hemisphere species was also included.

The Proteaceae which contains several important ornamental species, e.g. *Protea* and *Grevillea* has been especially problematic in standard media providing 90-100g N/m³/month and 2-300g P/m³. The cause of many failures, characterised by tip blackening and rapid death is now attributed to phosphorus toxicity and not *Phytophthora* infection as once supposed (3).

Looking at the native habitat of a species may give valuable insights to the likely nutrient requirements of the plant in container culture. Many Proteaceae have evolved on impoverished soils low in nitrogen, phosphorus, potassium, calcium and most micronutrients (3). Australian heathland species; *Hakea*, *Grevillea*, *Banksia* and South African table land *Protea* spp. have adapted to the low nutrient status by mechanisms to store P, reducing growth at critical times and developing efficient foraging systems such as proteoid roots. When grown in fertile conditions they are unable to prevent luxury uptake and toxicity results. However, a species is not necessarily restricted to growing in media simulating the soils of its point of origin since other aspects such as competitive pressures between species may be important. But if the plant is derived from an extreme

environment with strong selective pressure, a narrow range of environmental tolerance is anticipated. A narrow nutritional range is therefore expected for species derived from the old, impoverished soils of the Australian heathlands than for those from relatively younger New Zealand soils. Silver beech (*Nothofagus menzesii*) may show optimum growth at low to moderate N, and low N and P additions, but is able to survive within wider limits than *Protea* spp. which are unable to survive phosphorus levels in excess of about 50g/m³.

NITROGEN NUTRITION

Nitrogen is usually thought of as the main element influencing the growth of container shrubs. Management of this nutrient is critical in soilless media where base levels are negligible and available fertiliser N is subject to rapid leaching (1). Optimum growth of container plants requires a fairly uniform and continuous supply of nitrogen with a slightly greater supply in spring (6).

Deficiency appears as a slowed growth rate, or in more extreme cases a uniform loss of green over the older leaf blades, new leaves are thinner, smaller and fewer in number. A luxury level of nitrogen is manifested as soft growth prone to physical damage and disease, at extreme levels plants are hard and stunted.

The total nitrogen requirement and rate of nitrogen supply will depend on the inherent vigour of a species, the plant's age and upon environmental conditions influencing the growth potential, i.e. temperature, light, water availability and size of the container. The rate of nitrogen delivery is dependent on the fertiliser type, i.e. release pattern and the environment. The supply of nitrogen must meet the plant's requirements but also compensate for leaching loss, immobilisation and denitrification. A rate of 90-100g N/m³/ month is generally considered suitable for most container shrubs (13), but considerable deviation from this rule is noted in certain proteacious genera. Use of soilless media has permitted standardisation of the nutrient levels supplied and allowed levels to be calculated for optimum plant growth (13).

Plant species can be grouped according to nutritional requirements. Several were found with favourable growth at nil or very low levels of nitrogen in the medium. These may suffer toxicity problems at moderate N levels. Plants of *Protea repens* grown in equal parts peat and fine perlite were readily damaged by high N levels (4). However, other Proteaceae may have higher needs, such as *Grevillea rosmarinifolia* (10), *G. robusta* (5) and *Macadamia* spp. (12). In general vigorous Australian species like *Callistemon citrinus* (11) and *Eucalyptus viminalis* (9) can be given medium N rates similar to those supplied to plants grown in a nursery potting mix for general nursery stock providing P levels are not excessive.

PHOSPHORUS NUTRITION

Deficiency is seen in the lower leaves as the element is readily transported to actively growing regions. Phosphorus deficiency is probably very uncommon in shrubs in nurseries. Symptoms would be that the young leaves turn dark green while lower leaves first turn pale, later developing yellow patches (1). Excess phosphate leads to blackening and die back of shoot tips, stunted roots and may be followed by rapid decline and plant death. Phosphorus sensitivity has been the cause of the failure of many proteaceous shrubs in container culture. Typical rates of 200g P/m³ appear far in excess of the upper limit of these species. Recognition of toxicity induced by P has lead to reduced phosphate recommendations for container plants in England (2).

Soilless media are generally low in phosphorus but they less readily fix phosphorus than open-ground soils. Peats are usually composed of .01-.05% phosphorus. Australian Proteaceae often inhabit soils where P levels are below 150ppm or 0.015%. Therefore having adapted to those conditions, culture in fertile conditions may result in luxury P uptake and toxicity. In addition to a direct negative relationship with increasing phosphorus levels, phosphorus may act to depress the nitrogen response.

Australian and South African shrubs commonly require phosphorus levels below 50g P/m³ outside this range growth may be stunted or losses apparent. Many in fact show

optimum growth at added P levels between 0 and 30g/m³. Included in this very sensitive group (7) are *Leucadendron adscendens*, *Dryandra formosa*, *Protea repens*, *P. scolymocephala*, *Telopea speciossima* and *Banksia spinulosa* (which grew best on a medium with minimum phosphate addition). Other species dislike moderate P levels showing reduced growth but may survive up to 2-300g/m³, but grow best when P is at very low levels. For example, *Acacia verticillata* (9), *Boronia megastigma* (9), *Leucospermum candicans* and *Callistemon citrinus* (11) were best at less than 50g P/m³. Similarly two New Zealand natives, *Nothofagus menzesii* (silver beech) and *Agathis australis* (kauri) require low P.

A few species were unresponsive to phosphate tolerating low to moderate levels without clear preference. *Choisya ternata* proved tolerant of high P (600g/m³) but grew well at below 50g P/m³. *Eucalyptus viminalis* and *E. notablis* responded equally well to phosphorus at 30 and 300g/m³. *Camellia japonica* grew equally at 50 and 250g P/m³ (4).

The two ericaceous species, *Erica carnea* 'Springwood White' and *Rhododendron ponticum* as well as the native Titoki (*Alectryon excelsum*) were all found to respond to added phosphorus. Optimum foliage growth occurred at between 200-300g P/m³. This indicates that if slow release fertilisers supply only about 50g P/m³ then about 2 kg of superphosphate per m³ needs to be added, depending on plant and pot sizes.

Nurserymen therefore need to select P sensitive plants and grow them in a mix with less than 50g P/m³; while other plants which are either P responsive or not affected by 200g P/m³ can be grown in a mix containing this amount (equivalent to a medium rate of slow release fertiliser with 2 kg/m³ of superphosphate added).

POTASSIUM NUTRITION

Potassium requirements appear to be less important in container shrub nutrition than N and P. Responses have often been small and furthermore there appears to be a greater tolerance of this element than nitrogen and phosphorus. However, *Protea* and *Grevillea robusta* showed an increased response to nitrogen with increasing potassium (4). Many of the species mentioned here performed equally well at low (25g K/m³) and moderate (250g K/m³) potassium levels, including *Choisya ternata*, *Eucalyptus viminalis*, *Rhododendron ponticum*, *Erica carnea* 'Springwood White', *Protea repens*, *Acacia verticillata*, *Boronia megastigma*, *Hakea laurina* (11).

A few species showed a negative response, manifested as chlorosis induced by reduced foliar magnesium or iron. In the case of *Poncirus trifoliata* (8) low added K was most satisfactory. *Macadamia integrifolia* appeared chlorotic at high K while *Nothofagus menzesii* grew best at zero K. Negative interactions occurred between K and N for *Eucalyptus notabilis* and *Camellia japonica* and between K and P for *Callistemon citrinus*.

LIMING REQUIREMENTS

Plants as a whole grow in a wide range of pH's (4-8) and for the nurseryman this is an important consideration as the pH directly influences the availability of plant nutrients and in turn plant growth. Many Proteaceae are calcifuges as they have adapted to acid soils. In a few Australian heathland genera a wide variety of soils are suitable. *Callistemon citrinus* and *Hakea laurina* have been observed on limestone areas though the latter is more common on acid soils (11).

The shrubs examined can be divided into two groups:

1. Those species negatively affected by lime additions. A medium of equal parts peat and sand or perlite with no added lime and a pH of 4.5-5 appears very satisfactory for ericaceous plants. The growth of *Erica carnea* 'Springwood White', *Rhododendron ponticum*, *Hakea laurina* and *Macadamia integrifolia* was depressed with each increase in lime from 0-12 kg/m³ with the optimum in unlimed peat/sand (1:1 by vol.) of pH 4.5. Two New Zealand natives, kauri (*Agathis australis*) and silver beech (*Nothofagus menzesii*) reacted in the same manner as well as having the nitrogen response decreased by lime. Younger trees seemed more affected than older seedlings. These two inhabit "Mor" soils, typically high

in polyphenols, with very slow breakdown of the litter (hence a deep litter layer) and having a very acid and leached topsoil. Most New Zealand conifers, e.g. Rimu and the family Epacidaceae are often found on these soils.

2. The majority of common nursery trees and shrubs will grow well in soilless media limed to a pH of 5-5.5. This was found to include *Dryandra formosa*, *Leucospermum candicans*, *Protea repens*, *Choisya ternata*, *Camellia japonica*, *Eucalyptus viminalis* and *Grevillea rosmarinifolia*. *Grevillea robusta* proved tolerant of a higher pH, although a lower rate of liming was quite satisfactory. *Alectryon excelsum* grew stronger with high liming only when combined with high N and P.

RECOMMENDATIONS FOR POTTING MIXES

It is suggested that a large tree and shrub nursery should divide their mixes according to the following five fertiliser levels to achieve the monthly N release figures given:

Purpose of Mix	N rate/month g/m³	
1. Seed sowing	30	SEED
2. Growing on lines in tubes	40	GOL
3. Small and non vigorous plants (PB 3s)	60	LOW
4. Medium grade plants in PB5-PB8.	90	MEDIUM
5. Large or vigorous plants in PB 8s and larger.	120	HIGH

This could be achieved with the following rates of 8-9 month Osmocote (18/4.8/8.3) and superphosphate. (Lime and trace elements need also be added. Alternative fertilisers such as Nutricote could be used):

	8-9 month Osmocote (kg/m³)	Superphosphate (kg/m³)	Total P (g/m³)	
1.	1.4	0.75	127	SEED
2.	1.9	0.75	151	GOL
3.	2.8	0.75	194	LOW
4.	4.2	1.0	282	MED
5.	5.6	1.5	389	HIGH

A. General Species

It is recommended that general nursery stock are placed in these mixes using dolomite lime or a mixture of dolomite and calcium carbonate limes to achieve the following acidity levels:

Soil mixes	pH 6-7
Soilless	pH 5-5.5

B. Acid Loving Plants

Plants requiring acidic media should be given nil or very low levels of lime so that the acidity levels are:

Soil mixes	pH 5-5.5
Soilless	pH 4-5

Two further mixes are required:

C. N and P Sensitive Plants

Plants highly sensitive to P and sensitive to moderate N levels. No superphosphate should be added to any mixes and a lower level of slow release fertiliser should be chosen. For example, medium grade plants in PB 5s should be put into the low fertility mix suitable for non vigorous plants. Very small or young plants can most safely be raised using low N liquid feeds.

D. Vigorous P Sensitive Plants

Plants moderately sensitive to P but requiring moderate N levels. Species in this group may survive typical P levels but will grow much more successfully at low P levels.

Examples of plants in all these groups are given (note that the first example in each group is from the Proteaceae and therefore plants in this family are not necessarily all placed in group C):

A General species	B Acid Loving Plants
Grevillea robusta *Camellia* spp. *Eucalyptus* spp.	*Macadamia* spp. *Erica* spp. *Rhododendron* spp.

C N and P Sensitive Plants	D Vigorous, P sensitive Plants
Banksia spp. *Boronia* spp. *Dryandra* spp. *Grevillea* (non-vigorous spp.) *Hakea* spp. *Leucadendron* spp. *Leucospermum* spp. *Nothofagus menziesii*	*Grevillea rosmarinifolia* *Grevillea* (vigorous spp.) *Acacia* spp. *Callistemon* spp.

N.B.:
1. Camellias should not be grown in very acid media.
2. High P rates should be avoided with Macadamias.
3. *Nothofagus menziesii* should be given lime rates as for B.
4. English work (2) suggests that *Eleagnus* and *Skimmia* spp. should be in group D.
5. The response of Proteaceous shrubs and other nursery plants to N (6) and P (7) was described previously.

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In Praise of Alseuosmias

by

R.H. Mole

Otari Plant Museum, Wellington.

Alseuosmias are a small group of evergreen shrubs confined to New Zealand. Some eight species are listed in the 'Flora of New Zealand', Vol. 1, 1961, by Dr H.H. Allan, though this number is questioned by some taxonomists who consider hybridism responsible for some of the diversity in this group of plants.

In nature alseuosmias occur in forest and scrub, mostly in the North Island.

They grow 1-2m tall, have leaves of diverse shapes and sizes, produce rather small, funnelform flowers followed by berries, usually red in colour.

Visually, I consider alseuosmias lack impact. The largest flowers of the group are found on *A. macrophylla*. They are 3-4cm long, tubular and generally crimson or pinkish/cream. Unfortunately, the large leaves of this species, up to 20 x 8 cm tend to catch the eye, rather than the floral display.

The sizeable, shining, bright red berries of *A. pusilla* are certainly conspicuous when they occur on plants hardly 30cm tall. But, I find this species somewhat difficult to maintain under cultivation, whereby it fails to produce many flowers and thus, fruits are sparse too.

Fortunately, the appeal of alseuosmias is not confined to visual characteristics - they have other claims for garden use, perhaps the most significant being their delightful scent, a fragrance reminiscent to me of gardenias.

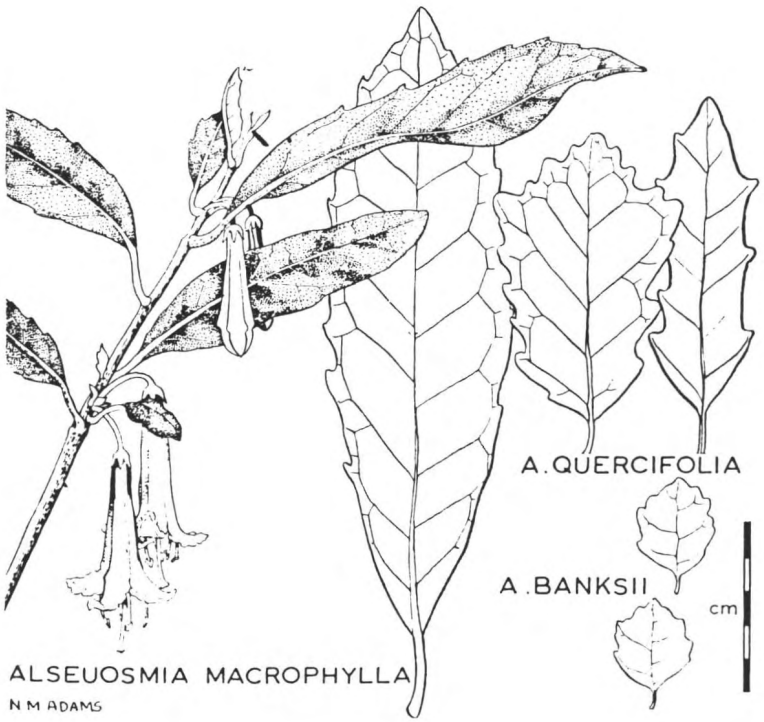
The main contributor in this regard at the Otari Native Plant Museum, Wellington is currently *A. banksii*.

This slender shrub has been represented at Otari for over 20 years. Mature specimens are currently about 1.5m tall but hardly 30cm wide. The red flecked or blotched leaves are small, varying in shape and size within a range up to about 30 x 25mm. The shape of some leaves, together with their rather puckered surface, reminds me of those found on ramarama (*Lophomyrtus bullata*). The flowers are about 1cm long, greenish/yellow slightly tinged red. They consist of a narrow tube, slightly flaring towards its mouth where it opens out into five (sometimes four) small, recurved lobes. The often numerous red, roundish berries, 5-7mm diameter, take many months to ripen in Wellington and many are often present at the time of the winter flowering.

At Otari, specimens of *A. banksii* are growing in a semi-shaded, sheltered site in a clay loam. The shrubs display a tidy habit and no pruning has ever been carried out on them. Likewise no infestations of pests and diseases have ever required chemical treatment. They flower regularly and profusely each year, commencing about the end of May, continuing right through winter until September. Although frost damage has never been seen on alseuosmias at Otari, their hardiness is questionable pending their trial in other, colder areas of New Zealand.

Some natural regeneration of *A. banksii* has occurred at Otari. In addition, it can be propagated by semi-hardwood cuttings, preferably taken February-March. Seed sown in June germinated four months later and the resultant seedlings began to flower when only 25-30cm tall!!

Like many other New Zealand plants, *A. banksii* is 'unassuming' among other



plants. That is, it tends to be part of the scenery, not a conspicuous feature of it; its flowers are inconspicuous and its fruits are barely more readily noticed since they tend to harmonize with the reddish blotches on the foliage.

On the other hand, its accommodating size, longevity, ease of culture, early regular and free flowering qualities, freedom from major pests and diseases, plus a gardenia-like scent, make this plant (and other alseuosmias) worthy of consideration for a place in home gardens, whilst cut material adds a delightful fragrance to ones home.

Citation for the Award of Associate of Honour A.H.R.I.H. (N.Z.) 1982 Dr D. W. McKenzie

Dr Donald William McKenzie was born August 9, 1924 and spent his earliest days on a farm at Warkworth, a little north of Auckland. After school in Auckland he joined the Plant Diseases Division, DSIR, at Mt Albert, taking up duties involving the culture of a range of fruit crops - pip and stone fruit, citrus and subtropicals. After a short interruption for war service he returned to DSIR, and completed his bachelor and masterate degrees in Botany at Auckland University in 1947 and 1949 respectively.

At DSIR Dr McKenzie continued research in pomology, specialising more and more with apples. At a later date he undertook further study overseas completing a doctorate at the East Malling Research Station, Kent, England, with a thesis on growth relationships of apple rootstocks. He later moved to the DSIR Havelock North Research Orchard, to begin an intensive phase of his professional career.

In the field of pomology Dr McKenzie has made major contributions to New Zealand fruit growing and has established an international reputation for New Zealand and himself. He was primarily responsible for the introduction and development of more intensive apple tree planting systems, based on radical changes in pruning and training procedures, the centre-leader method, which involved the use of new semi-dwarfing rootstocks. The value of these developments to the New Zealand fruit industry has been considerable as they increase orchard yield threefold. This work involved much detailed personal involvement in all phases of fruitgrowing - propagation, establishment, tree training, cropping economics - and demonstrated Dr McKenzie's diverse skills as a plantsman. The results of this work have been published in New Zealand scientific journals, particularly the Orchardist of New Zealand and in information leaflets.

Dr McKenzie has also made a major contribution in the continuing work to improve apple cultivars for New Zealand growing conditions. This has meant making extensive international contacts and the importation and evaluation of close to two thousand new apple types, a task calling for vast patience persistence and careful cataloguing. The introduction of well known commercial cultivars such as Gala, Royal Gala, Splendour, Spartan and Braeburn resulted from these evaluations. This field of work later led Dr McKenzie to set up breeding programmes to develop new apple cultivars better adapted to the New Zealand climate. The first results of these experiments show considerable promise.

In all this work he has retained a deep appreciation of the fruitgrowers viewpoint, always ready and willing to share results and project ideas. Recognising the contribution individual growers can make in the search for new types of apples, it was at his prompting that the N.Z. Fruitgrowers Federation introduced the Kidd Memorial Award. The award is for any outstanding new apple identified in New Zealand orchards.

As a result of his work Dr McKenzie has been invited overseas on a number of occasions to tour and lecture in fruit-growing countries and to take part in international conferences. He is the author of many articles, both technical and popular.

Apart from this specialised research activities Dr McKenzie has a broad interest in general horticulture. It is perhaps typical that, out of his extensive tests on new types of apples, he should make a special point of selecting for release to home gardeners a range of connoisseur cultivars with high quality eating characteristics which, because of other faults, were not suitable for commercial use. Examples of these are Freyburg and some of the older English russets such as Egremont Russet. Dr McKenzie has a strong interest in the potential of tree crops generally, is a long standing and very active member of the Tree Crops Association and a past President of the Hawkes Bay branch. Within this Association he regularly contributes much information on the culture of nut crops especially hazelnuts.

He has always had a strong desire to foster international horticultural contacts, not only for his own professional reasons, but also to express broader feelings. It was a highlight of his career to have lived for several months in Japan, "Japanese-style" with his family several years ago studying fruitgrowing. From this episode a strong link has developed between New Zealand and Japanese fruit-growing organisations with regular reciprocal visits now taking place. Similarly he hosts visiting fruitgrowers and fruit scientists from many other overseas countries.

We have much pleasure in nominating Dr McKenzie for the award of Associate of Honour as a mark of the excellence of his contribution to New Zealand horticulture over a long period of time, in particular to the apple-industry.

The Vegetation of Alaska

by

J.M. Follett

Centre for Resource Management, Lincoln College.

INTRODUCTION

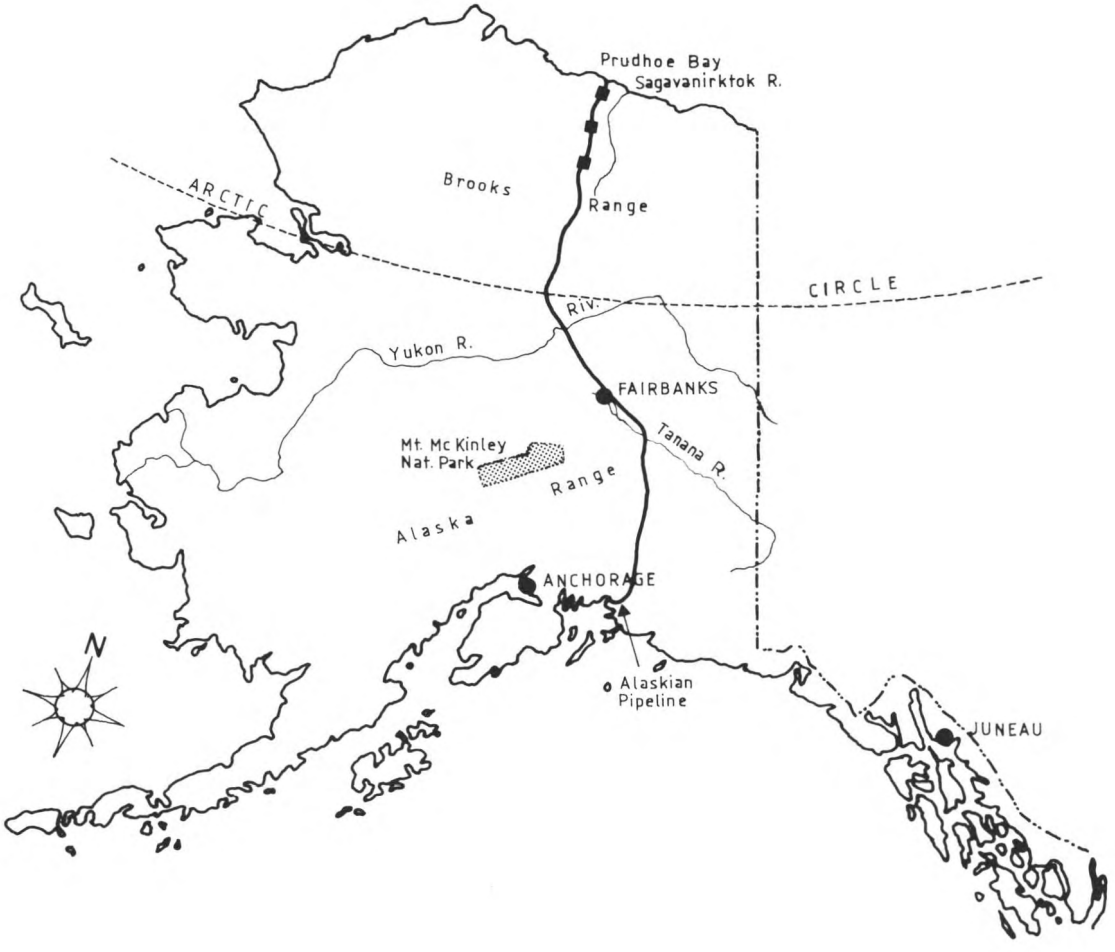
During the northern summer of 1981 I was fortunate in being associated with the University of Alaska's Institute of Arctic Biology and with help from the Institute and U.S. Forest Service staff was able to observe much of the flora and fauna of Alaska.

Containing 146 million hectares (N.Z. has 26 million), Alaska has the highest mountain in North America, as well as hundreds of square kilometres of boggy lowlands. The climate varies from mild and wet to cold and dry. Temperatures in the interior may range over 83°C in one year and precipitation may be less than 250 mm annually in contrast to 3800 mm annual precipitation and a temperature range of 38°C in the south eastern coastal parts of the State. Spanning nearly 2,100 kilometres of latitude and 3,500 km of longitude, Alaska's vegetation varies from the towering fast growing forests of the south eastern coast through the low slow growing boreal forests of the interior to the treeless tundra of the north and east.

Despite the large size and contrasts in climate and physical geography, Alaska when compared to the other States, has relatively few plant species. There are 133 native woody plant species in Alaska, comparatively low when compared with the lower 48 States. These plants are grouped in relatively few families with the Willow family (Salicaceae) containing the largest (36 species) followed by the Heath family (Ericaceae with 30 species), Rose family (Rosaceae with 31 species), Pine family (Pinaceae with 9 species), Gooseberry family (Grossulariaceae with 7 species) and the Honeysuckle family (Caprifoliaceae with 5 species). Of the remaining thirteen families nine are represented by a single species each. The relatively large number of plants from the willow and heath families indicate their successful adaption to the cold climate and abundant wet sites in the case of willows and the numerous bogs and other sites with acid soils in the case of heaths.

HISTORY

Although it is believed that human culture goes back 6,000-11,000 years, modern history in Alaska, does not start until 1741 when Vitus Bering, sent by Peter the Great, "discovered" Alaska. This was followed by explorations by Juan Perez, James Cook and George Vancouver. In 1867 the United States purchased Alaska from Russia for 7.2 million dollars. Ninety-two years later Alaska became the 49th State. Although fur hunting, the discovery of gold in 1872, oil in 1891 and the building of the Trans-Alaska pipeline costing 5.8 billion dollars have caused high influxes of people into Alaska the harsh climate has ensured a relatively small population, estimated to be 404,000 in 1980. As a result of this, large areas are undisturbed and provide ideal opportunities for studying the local flora and fauna in its natural state. In fact Alaska has 56 million acres of land of scientific or historical significance in National Parks and Monuments as well as 20.8 million acres in the National Forest Service.



Alaska, the 49th State of the
United States of America.

Fig. 1 Spruce/Hemlock Forests of the Coastal Region.

Fig. 2 Horse Shoe Lake, Mt McKinley National Park, surrounded by the White Spruce dominated forest of the interior. The Tanana River is shown in the background.

VEGETATION TYPES

Because of the early Russian history the Russian words taiga and tundra are often used to broadly describe most of the vegetation types in Alaska. Taiga, meaning land of little sticks, is used to describe woodland or forested areas. Above timberline taiga gives way to tundra where the vegetation may include a combination of shrubs, sedges, herbs, mosses and lichens. Tundra in Russian means marshy plain or siberian swamp. The term is now used to describe any ecosystem in which the plant cover consists of low herbaceous dwarf shrubs or lichen vegetation in places which have summers too cold for tree growth.

The taiga and tundra are however arbitrary terms with much variation within and intergradation between, these two vegetation types.

Other vegetation types include treeless bogs (Muskeg), where conditions are too wet for tree growth and shrub thickets which occur in a number of sites in all the major vegetation zones in Alaska.

Taiga

After arriving in Anchorage, the largest city in the State, my first visit was to the Chugach National Park where I was introduced to the productive coastal Spruce/ Hemlock dominated forests. The dense stands of western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*) that constitute the forests of the panhandle and southern parts of the State, are a continuation of similar forests along the coast of British Columbia, Washington and Oregon. Along with Sitka spruce and Western hemlock, other commonly found trees in these forests are mountain hemlock (*Tsuga mertensiana*) red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*). Red alder is common along streams, beach fringes and on soils recently disturbed by logging and landslides. Black cottonwood grows on the flood plains of major rivers and recently deglaciated areas of the mainland. Blueberries (*Vaccinium alaskaense*, *V. caespitosum* and *V. ovalifolium*), huckleberry (*V. parvifolium*), devils club (*Oplopanax horridus*) and salal (*Gaultheria shallon*) are the most common shrubs. At higher elevations the forests give way to sub-alpine shrub thickets, fields of wild flowers, berries and alpine meadows.

From Anchorage, I travelled North to Fairbanks and the Alaskan interior. Moving away from the coast towards the interior the vegetation begins to form a mosaic of patterns that is related in part to past fire history, to slope and aspect and to the presence or absence of permafrost. Most forest stands are mixtures of two or more tree species, but are usually classified by the dominant species. In general white spruce (*Picea glauca*) dominated stands are found on the warm dry south facing hillsides and adjacent to rivers where drainage is good and permafrost absent. These stands are usually open under the canopy but may contain shrubs of rose (*Rosa acicularis*), willow (*Salix alaxensis*, *S. arbusculoides*, *S. bebbiana*) as well as red fruit berry (*Arctostaphylos rubra*), crow berry (*Empetrum nigrum*), narrow-leaf Labrador-tea (*Ledum decumbens*), American red currant (*Ribes triste*), buffaloberry (*Shepherdia canadensis*) mountain-cranberry (*Vaccinium vitis-idaea*), bog blueberry (*Vaccinium uliginosum*) and high bushcranberry (*Viburnum edule*).

Just before Fairbanks, the train I was in travelled through what seemed a continuous bank of smoke from forest fires. Because of the dry climate in the Alaskan interior, fire is common, having the effect of leaving large areas in various stages of forest succession. Generally fires are followed by a shrubby stage consisting primarily of, light seed willows (*Salix arbusculoides*, *S. barclayi*, *S. bebbiana* and *S. scouleriana*) with this stage being followed by the fast growing aspen stands (*Populus tremuloides*). The climax vegetation in these south facing interior forests include white spruce as already mentioned with paper birch (*Betula papyrifera*) on east and west facing slopes and balsam poplar (*Populus balsamifera*) on the flood plains of the meandering glacial rivers.

On the north facing slopes and poorly drained lowlands forest succession leads to open black spruce (*Picea mariana*) and bogs usually underlain by permafrost.

From Fairbanks I made several field trips, mainly to look at the tundra vegetation. The tundra vegetation in Alaska is divided into three types, moist, wet and

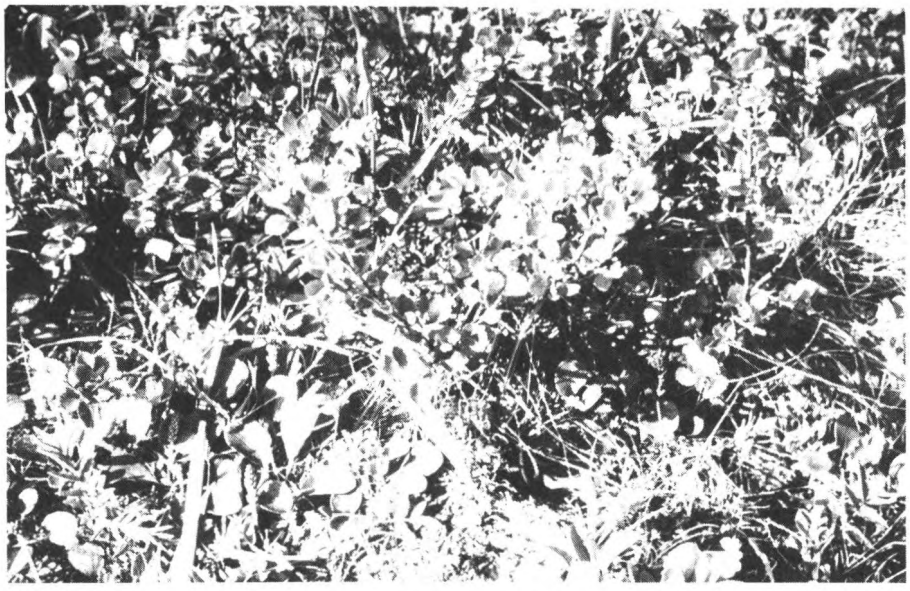


Fig. 3 Mount McKinley's alpine tundra. The dominant vegetation in this photo is the dwarf arctic birch (*Betula nana*) and the arctic willow (*Salix artica*).
N.B. Pen in bottom left hand corner for scale.

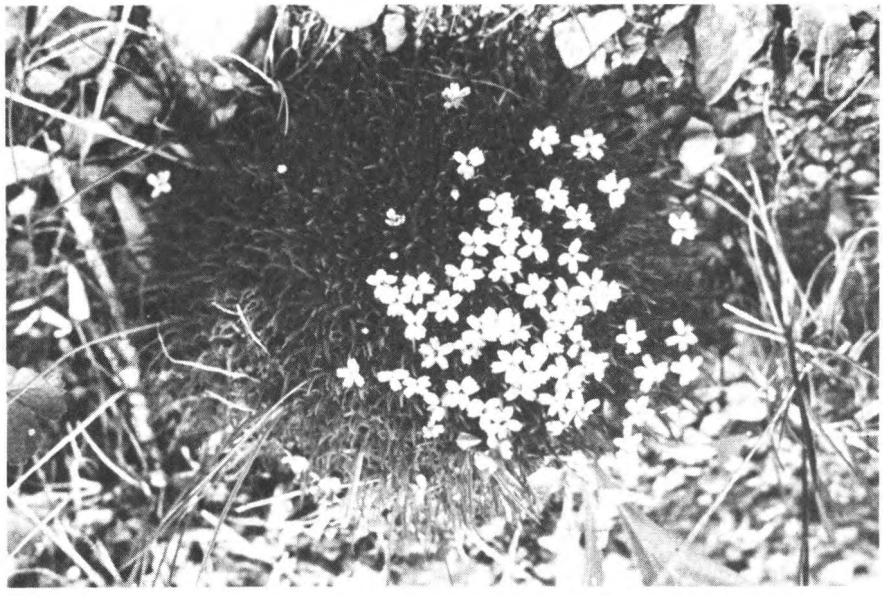


Fig. 4 Moss-campion (*Silene acaulis*) Mount McKinley National Park. This plant was approximately 15 cm across.

Fig. 5 Old Gold mining cottage at Eagle. The cottage is currently used by two students from the University of Alaska while working on their theses.

alpine. At Mt McKinley National Park which is a part of the Alaska Range, the two main types are moist and dry. In Mt McKinley the taiga gives way to moist tundra at about 2,700 ft. Dominant plants of the moist tundra are dwarf birch, willows (13 different salix species) and other shrubs including species from the genuses *Alnus*, *Arctostaphylos*, *Cassiope*, *Dryas*, *Ledum*, *Loiseleuria*, *Phyllodoce*, *Rhododendron*, *Spiraea* and *Vaccinium*. At elevations above 3,400 ft the prevailing vegetation is dry or alpine tundra. Here on exposed ridges and rocky slopes plants rarely attain a height greater than 10 cm. Dominant vegetation in these areas include white mountain avens (*Dryas octopetala*) which may cover entire ridges and slopes along with many mat forming herbs, such as moss-campion (*Silene acaulis*), black oxytrope (*Oxytropis nigrescens*), arctic sandwort (*Minuartia arctica*), various grasses and sedges as well as the inevitable willow (*Salix reticulata*) and various saxifrages.

While at Fairbanks I also travelled to Eagle which is situated north east of Fairbanks, just south of the Arctic Circle, and another area of moist tundra. Here the moist tundra was comprised of almost continuous and uniformly developed cotton-grass tussocks (*Eriophorum* spp.), with sparse growth of other sedges and dwarf shrubs.

The last part of my trip was spent travelling from Fairbanks to Prudhoe Bay along the "haul" road built for supplying the oil fields at Prudhoe Bay and the building of the trans-Alaska pipeline. The Haul Road travels through the Brooks Range onto the coastal plains of the north slope.

Wet tundra includes the low coastal marshes of Southern Alaska, however, the type is most extensive along these coastal plains north of the Brooks Range. Standing water is almost always present in the summer and in the northern parts permafrost is close to the surface.

Microrelief is provided by peat ridges and polygonal features related to frost action and ice wedges. The vegetation is primarily sedge and cotton grass mats usually not formed into tussocks. Some *Betula*, *Salix* and *Vaccinium* shrubs occur on the driest sites where micro-relief raises

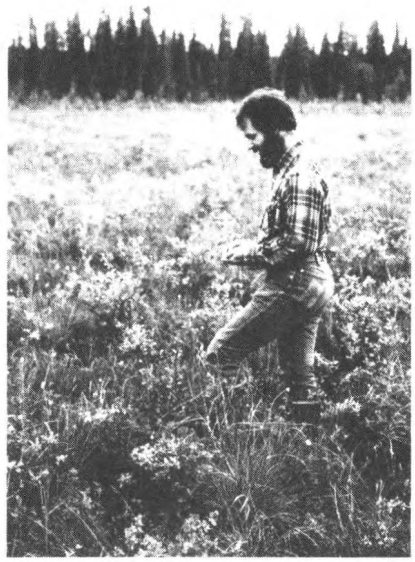


Fig. 6 Terry Chapin of the University of Alaska standing in an area of wet tundra comprised of *Eriophorum* or cotton grass tussocks and willow shrubs. A stand of white spruce fills the background.

Fig. 7 Wet tundra of the North Slope. Cottongrass is the dominant vegetation. The Haul Road and Brooks Range are in the background. Note the mosquito netting worn by the "workers".

Fig. 8 A juvenile moose feeding in wet tundra on the North Slope with the Alaskan oil pipeline in the background.

Fig. 9 Muskeg surrounded by wet tundra. Cottongrass, willow and black spruce can be seen this side of the bog.

them above the standing water table.

Other vegetation types in Alaska include treeless bogs or Muskeg and Shrub Thickets.

Treeless bogs or Muskeg are areas where because conditions are too wet, little vegetation can grow except for varying amounts of grasses, sedges, and mosses especially spagnum. Much of the surface of these bogs is too wet for shrubs but on dryer peat ridges are a number of heath or ericaceous shrubs, willows, dwarf birches and scraggy black spruce. Such swampy areas cover much of Alaska.

Shrub thickets occur in a number of sites in all the major vegetation zones in Alaska and are usually found in areas where environmental conditions are not as stable. Thickets are commonly found between the beach and the forest, between the treeline downward through the forest in avalanche tracks and along streams. They are also found on newly exposed alluvial deposits that are periodically flooded. The thickets are usually dominated by various willow species.

ACKNOWLEDGEMENTS

Thanks to Terry Chapin and Pete Tryon (Institute of Arctic Biology) for showing me the State and Les Viereck (Institute of Northern Forestry) for explaining vegetation types and naming plants.

Beautiful New Zealand

by

Ross Jackson

Senior Landscape Architect, Ministry of Works and Development, Wellington.

(Member of two man Secretariat seconded to prepare Report for Beautiful New Zealand Planning Committee.)

INTRODUCTION

The Beautiful New Zealand Planning proposal was publicly announced by the Prime Minister at a Beehive launching in early October 1981 and the reaction was immediate and very vocal. The idea obviously caught the public imagination and was loudly praised in newspaper editorials, in letters to the press and to the Ministry of Tourism. A small minority expressed reservations but the majority endorsed the proposal in principle.

The initial proposal outlined a scheme to enhance the scenic beauty of New Zealand by a massive planting campaign of the nation's roadsides.

Since that time, a planning committee has prepared a report where it recommends that:

1. A much wider view be taken and that the enhancement programme must be in harmony with or complement the surrounding area.

2. A narrow highway corridor can not be considered in isolation and the scheme must include the adjoining countryside.

The programme, as recommended, is one of landscape protection and enhancement capitalising on existing features of the landscape, adding planting and colour where appropriate and eliminating or screening undesirable elements in the landscape. The report outlines alternative methods to implement the scheme, the need for a national organisation to provide the necessary guidelines, the advantages of building on existing structures, the extension of the scheme to take in the overall landscape and the need to train a permanent work force. An examination was made of various alternatives to finance the scheme and it was concluded that at least initially the funding must come from government.

The planning committee considered numerous relevant background papers submitted to it including submissions by government departments, local authorities, statutory and other organisations and individuals. The committee also consulted various government departments that would be involved in the scheme's implementation and discussions have also been held with many private organisations and individuals who might be affected. While many problems have been met none are insurmountable.

Further benefits will come with the acquisition of skills useful to various occupations (such as horticulture); extension to the beekeeping and tree crop industries; wind protection in farmland; increased erosion control and the creation of biologically valuable habitats, especially in monocultural landscapes.

The committee also believes that Beautiful New Zealand programme will further develop a sense of national pride and it envisages voluntary extensions to the scheme.

To implement this scheme regional groups should be formed that will make recommendations to the national body which

in turn will approve and allocate funds. The regional groups will second or employ suitably qualified designers and recommend the use of the most appropriate government department, local authority or contractor in their area.

The report was presented to the Minister of Tourism in June and was then considered by Cabinet who accepted the main recommendations. The major change was Cabinet's decision to pass the project over to Ministry of Works and Development, rather than establish an independent commission. They also made a recommendation that an Advisory Committee, modelled on the lines of the original Planning Committee, be set up to provide continuing oversight and guidance for the scheme's implementation. The original report can not therefore be regarded as a detailed commitment, though, no doubt, many of its proposals will be taken into consideration by the new Advisory Committee.

Two sections contained in the report of particular interest to the readers of this journal are:

1. Landscape Design on Highways.
2. Planting Design.

LANDSCAPE DESIGN ON HIGHWAYS

Any enhancement programme should be in harmony with or complement the character of the surrounding area. One cannot consider a narrow highway corridor in isolation, and it has been agreed the scheme must include the integration of adjoining countryside.

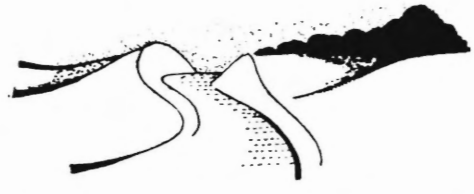
In certain areas of low visual quality it will sometimes be possible to create new forms and landscape character.

The Beautiful New Zealand programme will hopefully be seen as a catalyst to encourage land owners, be they farmers, forestry companies, industrial and commercial enterprises, local authorities or central government departments, to improve the appearance of their properties. There is ample precedence to suggest such an outcome is not overly optimistic.

In the book The Landscape of Highways the eminent United Kingdom Landscape Architect, Dame Sylvia Crowe said:

> "Advantages of treating the road as part of the countryside are not confined to economy of land. It enables the traveller to identify himself with the land through which he journeys. To feel he is contained within it in contrast to the detachment of air travel. The integrated road gives a constantly changing view with the eye relief which comes from looking at objects at varying distances and the change from one type of roadside planting to another becomes a natural corollary to the changing landscape. Not less important it enables the road to appear as part of the landscape pattern when seen from above. Whereas a road closely planted for the whole of its length must show as a solid barrier across the landscape."

While the scheme is primarily aimed at existing roads and developments, ideally the design process should begin when a new highway is being designed in order to integrate fully the road with the landscape. This does not necessarily mean only planting trees and shrubs, for that is just one facet in the total process. In some instances it may be necessary to remove some vegetation to create vistas or to reshape the adjoining ground so that it relates to existing topography in a natural and/or harmonious manner.



Road batters out of harmony with landform.

The standard of highway design in New Zealand is steadily improving in line with the increasing importance of road transport and the need for road safety. The result is that the highway is now becoming a more integrated part of the total landscape and not an imposition. Examples of this can be seen on roads such as Dunedin's northern motorway: by grading back cut and fill batters they appear to be natural formations linked with the surrounding topography, rather than man-made cuttings and embankments.

Batters eased to conform with existing landform.

State Highway 1 from Taupo to Wairakei is another example of a highway successfully integrated into the landscape in pleasant and varied manner which reflects the character of the area.

Typical roadside batters.

Elimination of batters and enclosure as farmland.

A fully integrated road in the landscape ideally begins with close collaboration between the roading engineer and other appropriate professionals at the design stage. Landscape design principles should include the very broadest and inclusive aspects of integrating the highway with its environment. Some of the important factors that should be considered at the design stage are:

1. Developing landscape features for total environmental enhancement by joint development with adjoining owners.
2. The proper relationship of appropriate geometric design to topography and natural features.
3. The conservation of environmental and natural resources.
4. The preservation of historic sites, views, and vistas. Provision of open space and recreational facilities.
5. Potential for assuring land-use harmony; screening or buffering against adverse environmental or use factors.

PLANTING DESIGN

Historically trees were planted in association with highways for a number of reasons including to guide and provide shade for the traveller. Napoleon is reputed to have instructed that trees be planted for this reason as well as to provide a source of firewood, while in England tree planting was encouraged to provide timber for ship construction.

Much of the tree planting adjoining streets and highways in Europe was a social response of that period and invariably evolved from designs adopted in the large parks and estates.

Today, tree planting is often regarded only as a treatment to improve the appearance of otherwise waste areas. In fact, there are many advantages of good roadside planting besides beauty that have been brought to the committee's attention.

The first step in the design process must be to survey and identify the natural and man-made features and the overall visual character of an area and then develop and highlight these qualities. The planting could grow out of the natural, technical, and visual conditions of the situation. The design of roadside planting can not be achieved by a standard formula. Each length of road and small section of road presents its own considerations. There are even ways in which planting can add to road safety. In the planning process planting design in the generally restricted lineal areas alongside roads can be difficult and complex.

From New Lives New Landscapes by Nan Fairbrother:

Every road runs through a visual corridor, and here surely, where most seen by most people, is where to start in the regeneration of our landscape. We need better roadscapes and we need better offscapes, and the two go together. A 'pretty road' after all means a road through pretty country, and 'pretty country' in turn means chiefly what we see from the road.

The broad aim of the designer should include the following:

1. To enhance the visual quality of the landscape seen from the road.

Tree planting for climax and vista closure.

2. To create variety and interest and thereby reduce monotony.

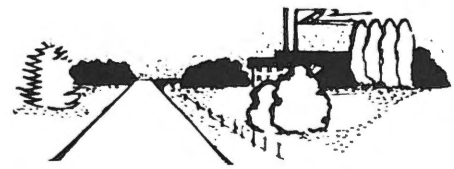
Irregular planting to create variety and interest.

3. To frame desirable views.

Trees used to frame distant vista.

4. To screen undesirable views, such as unsightly industrial areas or structures. This does not necessarily mean the planting of a full screen, but rather the use of informal planting which encloses the object or permits a partial view of it.

Use of natural features and landform for screening purposes.

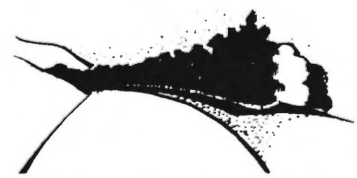


Partial screening of unsightly building.

5. To link the highway with remnant bush areas.

6. To link and enhance exotic planting.

7. To guide traffic by indicating the need for turning movements of vehicles, as around curves and intersections, i.e. planting to make the road read.



Planting to emphasise change in road alignment.

8. To focus attention on the road and reduce car speed by the sense of enclosure.

Vegetation arranged to indicate likely direction of road beyond vertical curve.

9. To assist in reducing traffic noises and fumes by planting for the benefit of adjacent land owners.

10. To catch vehicles leaving the road out of control by planting bushy shrubs which will slow them down without causing damage to the vehicle or the motorist.

Graded plant material used to reduce vehicle impact.

11. To eliminate unnecessary mowing of areas difficult to maintain in grass.

12. To control soil erosion. Here the principles of good landscape design are in perfect accord with the principles of soil conservation.

13. To provide shelter in exposed areas.

In general, plant material should be hardy, not too ornate or conspicuous. Often the fewer species used the more effective are the results. Generally, what are accepted as garden plants are misplaced in the highway landscape beyond urban limits as they are psychologically disturbing: one is aware that a garden plant has been introduced into an environment in which it is out of context. At high speeds, individual plants on the roadside do not read as significant entries. What is perceived are areas, textures, silhouettes, the contrast of large masses and voids, openness and enclosures, a flowing pattern of shapes, constantly changing as the driver goes by.

There are severe limitations on roadside planting. These include the following:

1. Lengths of road and even whole regions where the natural landscape is such a dominant quality and of such beauty that additional planting becomes superfluous and out of character or worse out of scale, trivial, and an annoying distraction.

2. Where berms are too narrow.

3. Where ground conditions are so poor that they cannot sustain growth.

4. Where planting will shade the road and cause icing.

5. Where severe exposure will stunt growth.

6. Where overhead and underground services, including electricity, post and telegraph, water and gas supplies, stormwater and sewage drains, irrigation races, will be disturbed by planting.

7. Where planting will cause unduly costly maintenance of hedges and roadsides.

8. Where grazing by stock is prevalent.

The most travelled routes in both islands are in areas where the immediate landscape is principally man made; shaped and planted by the needs of efficient farming. Pasture crops, hedges, and windbreaks, mostly of exotic plants, have replaced natural habitats.

By planting vegetation grown primarily for its flowers at rest areas or selected enclaves these bright spots will have a greater impact and will normally receive better maintenance and more suitable growth conditions than as a continuous planting.

Where continuous planting is undertaken on an open highway it should be bold and permanent. Herbaceous plant material such as flowering annuals and perennials with visual appeal for only a short period of time will have a limited impact in the rural landscape as well as being expensive to establish and maintain. In general, plants in highway planting design should be selected for their scale, shape, texture, colour, hardiness, and their relationship with existing vegetation with the flowers regarded as a bonus.

The proportion of roads that should be planted varies considerably from district to district. A thorough survey and analysis would identify derelict land, boundaries, plantations, landscape character, exposure, and the ecological factors of soils, drainage, etc. The planting design should attempt to combine fast and slower growing species to ensure continuity of planting.

In many areas suitable plant material develops naturally. Selective clearing and releasing to allow desirable species to grow may be all that is required. This approach normally requires only minimal

maintenance and can provide invaluable biological communities. However, dense bush or plantations which stretch mile after mile without variation can become very monotonous. Management is required that will create a more attractive and visually stimulating roadside.

Proposals for the use of exotic plants has resulted in two extreme schools of thought. One welcomes all the new comers on their own merits and uses them without thought of their effect on their old-established neighbours; the other claims only indigenous plants should be used. The first throws the landscape out of tune by introducing plants whose scale, texture, or form are out of harmony with their surroundings. On the other hand, the banning of alien plants outside the urban limit is untenable, historically and practically. The test of fitness of a species for a particular position is quite as much visual and psychological as ecological. One can think of numerous successful ecologically and visually harmonious native and exotic marriages along the roadsides in different parts of the country, such as hydrangeas in enclaves north of Wanganui; poplars in Central Otago; deciduous trees in Cambridge and Christchurch; plantings along the Wellington urban motorway; Rangitikei Valley soil stabilisation plantings plus numerous plantation, shelter, and ornamental plantings carried out by landowners adjoining the highway throughout New Zealand.

Every situation has variations and therefore has to be judged accordingly, but, in general, most plants thrive best when they are planted in groups. Single specimens, trees, and shrubs often die out where as groups they would survive best because of the mutual protection provided. Uneven spacing and a mixture of differently sized plants are needed to give a natural appearance. The planting should attempt to create a natural plant community where trees, shrubs, and ground cover all contribute to the earth's covering.

However, large trees should still be the most important element in any particular programme. They are visually more effective than smaller plants because they fit the scale of the highway environment and can be seen from greater distances.

According to studies, (Economics Analysis of Roadside Beautification and Recreational Development, Morris Baker, Nebraska University, 1973), the public in general prefer to travel in a park-like atmosphere consisting basically of trees and grass, with more detailed flowering plants at rest areas for the motorists to admire at their leisure. This type of planting at rest areas encourages drivers to take more frequent rests: it therefore reduces driver fatigue, and thus, the accident rate.

For the scheme to be successful it will be very necessary for liaison staff to consult and gain full co-operation with the adjoining land owners. In some instances, it may be practical to plant a waste gully adjoining a highway with a tree crop to augment the existing planting on a farmer's property. In other situations there is considerable scope on some highways for relocating fences closer to the road allowing the traveller a better view of the country-side while reducing maintenance and increasing the farmer's production area. However, any roadside planning must have the approval of the farmer to ensure it will not adversely affect his farming operations.

CONCLUSION

In summary, the planning committee recommends that the body charged with the implementation of the scheme should address itself to the following matters:

1. Throughout New Zealand regions of distinct character have evolved through the interaction of land forming processes, climate, vegetation and land use. Witness the differences between areas such as Central Otago, Westland and Northland. These differences which give identity and diversity to the landscape should be retained or reinforced and any planting must respect this character.

2. The scheme must extend beyond the highway corridor and include the landscape seen from the roads. This must involve working in conjunction with the adjoining land owners and include looking at production forests, conservation planting, shelter systems, homestead

amenity tree planting to improve the visual catchment as viewed from the highway.

3. Planting that relates to the highway must be of an appropriate scale. This suggests bold groupings of larger growing trees as opposed to smaller herbaceous type plantings. The species chosen must be able to thrive in the local conditions and be able to contribute more than just aesthetic values, i.e. planting for biological purposes, shelter, etc.

4. We are well aware there are ways of making the countryside more attractive other than through tree planting. What must be considered also are design standards, colours of buildings, the alignment and visibility of farm roads, advertising hoardings, power lines, etc.

The Beautiful New Zealand proposal may not be the answer to all the landscape woes that surround us but it is capable of having a very significant impact on the New Zealand Countryside providing an honest commitment from government continues.

Some Adventive Scrophulariaceae

by

W.R. Sykes

Botany Division, DSIR, Christchurch.

The number of adventive flowering plants in New Zealand now probably exceeds that of the indigenous flora. I define the word adventive as applying to any introduced species found wild (i.e. growing spontaneously), whether brought in accidentally or intentionally. The term adventive covers properly naturalised or established plants, as well as those which have only occurred a very few times, i.e. casuals. Here, as elsewhere, there are many examples of escapes from cultivation covering this degree of naturalisation, and it is not surprising that they include a number of attractive horticultural plants. Most of the well-known families in horticulture have members which are running wild in New Zealand and as more plants are brought in from overseas, the number of escapes from cultivation continues to grow. Of course, the great majority are most unlikely to ever become problem weeds, and in the family discussed here there are very few which are in this category, despite the fact that a number are very common or abundant.

The Scrophulariaceae are a large family with over 200 genera and 3,000 species, many of which are in cultivation. A complete list of those which are known to be wild in New Zealand, or have been reported to be so, has recently been published*. Suffice to say that 57 taxa (botanical species and varieties) are recorded, but seven of them cannot be substantiated. Several records are probably the result of misidentification. In this short account it is only possible to mention some of the more commonly naturalised species, and a few casuals of special interest, particularly those which are also well-known garden plants. Of course, in addition to the adventive species there are many indigenous ones in the well-known genera of *Euphrasia*, *Hebe*, *Ourisia* and *Parahebe*. Before dealing with individual genera it is interesting to consider the relation between the regions of origin of the adventive Scrophulariaceae and the habit of the plants.

The family is primarily a temperate one, but there are some sub-tropical and a few tropical members. The herbaceous habit predominates in the Scrophulariaceae but there are a number of woody genera, especially in warmer regions. Thus, shrubby plants in the family are prominent in South Africa and, in New Zealand there is *Hebe*, one of our largest genera of flowering plants.

In my list of adventives there is only one species which could be described as a shrub. This is *Phygelius capensis* from South Africa. Since my list was published I have had reports of *Paulownia tomentosa* regenerating naturally some distance from the parents, either reproducing from seed or root suckers. I should be very grateful for observations on the behaviour of this very ornamental, blue-flowered tree from readers.

The majority of the herbaceous adventives are indigenous to Europe, especially southern and south-western parts of that continent. Many of these species also grow in West Asia and North Africa, a fact which is very evident in three main genera concerned; *Linaria* (including its segregate genera *Chaenorrhinum*, *Cymbalaria* and *Kickxia*), *Verbascum* and *Veronica*. Apart from the Eurasian and North African species others originate from North America (5, including one from Mexico) South America (1), South Africa (2), and Australia (2). The majority

* Sykes, W.R. New Zealand Journal of Botany 19: 53-57 (1981).

Fig. 1 *Parentucellia viscosa* in a small grassy water in the Waitangi State Forest, Bay of Islands.

Fig. 2 *Verbascum certicum* at Waitangi, Bay of Islands.

of the Old World species are annuals and biennials, but all the adventive American members are perennials, including one (*Asarina erubescens*) which scrambles, a rare habit in this family. The adventive Scrophulariaceae occur throughout lowland New Zealand and a few ascend to about 1,000 metres. They occupy a very wide range of habitats from dry, stony inland areas of Canterbury and Otago to shallow bodies of water in various parts of the country.

VERONICA

This genus has provided the largest number of adventive Scrophulariaceae in New Zealand. Of the 16 species wild, most must have been introduced accidentally. All except *Veronica plebeia* from Australia are from the Northern Hemisphere, one of which is from North America and the rest are from Eurasia and North Africa. Several species must have been introduced very early in the period of European settlement because they were recorded by J.D. Hooker between 1854 and 1868. They are *V. agrestis*, *V. anagallis-aquatica*, *V. arvensis*, *V. officinalis*, *V. persica*, and *V. serpyllifolia*. Furthermore, they must have soon become properly naturalised, because between 1892 and 1899 Colenso described as indigenous *V. macrocalyx*, *V. oligantha*, *V. rugosula*, *V. areolata* and *V. hirsuta*, of which the first three are merely forms of the common European *V. serpyllifolia*, the next is based on the equally common *V. persica*, and the last the widespread *V. arvensis*. These three adventives are probably the most abundant of the naturalised speedwells. On the other hand, *V. agrestis* and *V. officinalis* have remained rare and localised. Of the three subaquatic species, *V. anagallis-aquatica* is the commonest and most widespread, while on the other hand, several ephemeral species are annuals which mainly grow on the dry, stony ground of inland Canterbury and Central Otago. One species, *V. filiformis*, is a recent introduction to the Auckland area and will probably spread, just as it has in western Europe where it has become very prominent as a lawn and general garden weed since the Second World War.

LINARIA

Seven species of toadflax have been collected wild in New Zealand and probably all but one were originally introduced for cultivation. In addition, there are four species formerly treated as *Linaria* but now in separate genera split off from it. One of the four is the well-known *Cymbalaria muralis* (*Linaria cymbalaria*), ivy-leaved toadflax, which is a common adventive on and around old walls and buildings as far south as Stewart Island. *L. purpurea*, purple linaria, is another familiar plant with a similar range to ivy-leaved toadflax, and is a very familiar weed in pavement cracks and around old buildings in most of our main cities. The pink form, correctly known by its cultivar name 'Canon J. Went' is also sometimes seen wild. *L. vulgaris*, toadflax, creates a bright splash of yellow along many roadsides in Canterbury and Otago. Three species of *Linaria* are only known wild from one or two specimens collected many years ago although they are still cultivated here.

ANTIRRHINUM

This genus is related to *Linaria* but is distinguished by the lack of corolla tube spur and by the capsule dehiscing by pores instead of a split as in *Linaria*. The commonest adventive *Antirrhinum* is the small *A. orontium*, wild antirrhinum. This is especially frequent as a weed of arable land in Nelson Province. The common garden *A. majus*, snapdragon, is occasionally seen in waste places and on road-sides, most of these wild plants having crimson or rose flowers. Closely related to this genus is *Asarina*, in which one species, *Asarina erubescens* from Mexico, is naturalised on Rangitoto Id. This attractive scrambling plant has large rose-coloured flowers. *A. barclaiana* is probably commoner in cultivation than the previous but this violet-flowered plant has not been reported wild.

VERBASCUM

One of the most characteristic plants of the dry open country down the east side of both main islands is *Verbascum thapsus*, mullein, the grey woolly leaf rosettes often

Fig. 3 *Phygelius capensis* in cultivation in Canterbury.

Fig. 4 *Linaria genistifolia* spp. dalmatica from a Douglas fir plantation at Queenstown.

Fig. 5 *Linaria purpurea* from Christchurch.

dominating the sparse vegetation of stony river beds, roadside banks, eroded gullies, etc. The tall yellow spikes need never be mistaken for the also common *V. virgatum*, moth mullein, because the latter has green leaves and in the flowers the stamens have prominent tufts of purple hairs.

The other three species of *Verbascum* which have been recorded wild here are mainly found in warmer parts of the North Island, one having only been collected in the saleyards at Rangiuru, near Te Puke. Another is *V. creticum* (syn. *Celsia cretica*), Cretan mullein, an attractive large-flowered mullein which is common in parts of Auckland and North Auckland. Finally, there is *V. blattaria*, white mullein, the only adventive species with other than a yellow corolla. In Europe there is a yellow form of *V. blattaria* and a white form of *V. virgatum*, but these are not known in New Zealand. The cultivated *V. phoeniceum* usually has purple flowers, but again has a white-flowered form, neither of which are adventive here as far as I know.

MIMULUS

Two of the three species in this genus which have been recorded wild are very common in wet places in all regions of the country. The small-flowered, hairy *Mimulus moschatus*, musk, grows inland in high country areas to about 1,000 metres. Like populations in other temperate parts of the world musk lost its distinctive scent in New Zealand early this century, and despite reports to the contrary, it appears that scented plants have not been seen since. Suffice to say here that there has never been a satisfactory explanation of why musk lost its scent everywhere about that time, i.e. well after T. Kirk first recorded it wild in 1878. *M. guttatus*, monkey flower, is a larger, glabrous plant and its yellow flowers followed by capsules in inflated calyces, are often abundant in ditches and streamsides. The third species *M. luteus*, has only been collected once or twice as a garden escape. Like the other two species it originates from North America. The form of *M. luteus* usually cultivated has a yellow corolla with large red blotches, and this is the one that has occasionally been found wild. Unfortunately, the name *M. luteus* has sometimes been misapplied to *M. guttatus* in New Zealand, but apart from the colour in the commonly cultivated form of *M. luteus*, the flowers of this species have open corollas instead of almost closed ones as in *M. guttatus*.

MISCELLANEOUS ADVENTIVE SCROPHULARIACEAE

No account of the family in New Zealand would be complete without mention of *Digitalis purpurea*, so abundant in many places, especially down the West Coast of the South Island. Often the purple and white forms of foxglove grow together but often the purple easily predominates and occasionally the reverse is true. Of the semi-parasitic tribe Rhinanthoideae, which is well represented by the indigenous species of *Euphrasia*, eyebrights, the main adventive species in *Parentucellia viscosa* (*Bartsia viscosa*), tarweed. Often grassy roadsides and rough pastures are dominated by its bright yellow spikes, especially in the North Island and northern parts of the South Island. Its red-flowered relative *P. latifolia* (*Bartsia latifolia*), is much more restricted, being mainly found in Hawke's Bay and the Wairarapa, but even there it is local in occurrence. These two species originate from South and West Europe. The genera *Calceolaria* and *Nemesia* are very well-known in horticulture of course and each has contributed a single species to the adventive flora. *Caleolaria tripartita*, is an annual with dissected leaves and yellow "slippers" which are much smaller than the big bloated flowers of the strains of *C.* x *herbeohybrida* used in bedding displays. The adventive species of Nemesia is not the common bedding *N. strumosa* but another South African species *N. floribunda*. This small white-flowered plant is apparently only seen in the Dunedin area, where in certain places it is, however, common.

An Analysis of Street Trees in the Wellington Area

by

D.D. Rowe

Extracts from a thesis for the National Diploma of Horticulture (Ornamental) (N.Z.), submitted by D.D. Rowe in 1980.

The thesis is divided into three main sections:

1) *An analysis of the existing situation in Wellington.*
2) *Street tree planting characteristics in Wellington.*
3) *Recommendations for future planting.*

There is also a very comprehensive list of all the tree types currently grown in Wellington. This list includes the characteristics of each tree type and an assessment of its suitability for planting in the Wellington area. The extracts are mostly taken from sections 1 and 3.

Ed.

LIMITING FACTORS FACING STREET TREES IN THE WELLINGTON AREA.

1. Natural

(a) Climatic - Rainfall There is moderate seasonal variation. Drought is sometimes a problem with recently planted trees but wind is probably the major cause of this.

- Temperatures are warm temperate. This in itself poses little restriction on choice of material.

- Frosts The frequency and severity of frosts are low in Wellington City but become of importance in Upper Hutt particularly, which is farthest removed from the moderating influence of the sea.

In Wellington City, frosts are a very minor problem, although the pohutukawa (*Metrosideros excelsa*) and Norfolk Island pine can suffer damage when small.

In the southern half of Lower Hutt, comments for Wellington City apply.

The northern half of Lower Hutt and Upper Hutt, however, have more frequent frosts, which are often also more severe. This places a restriction on the choice of trees which can be safely planted.

- Wind Wellington City lies on the shores of Cook Strait, which, being "... the only substantial gap in the main mountain chain, acts as a natural funnel for the air flow and is a particularly windy locality afflicted by gales from the southeast as well as from the northwest".

This climatic feature quite severely restricts the choice of trees which can be successfully used in Wellington City. Unfortunately, the fact that the gales come from two directions means that a relatively low proportion of localities within this area are sheltered.

(b) Maritime Influence

- Salt spray and its effects The Wellington area lies very close to the sea. This factor and the fact that Wellington is subject to strong winds combine to greatly influence the growth of street trees.

- Seawater is swept into the atmosphere by wind. The water evaporates (if the humidity is low), leaving residues (mainly chloride and sodium ions) dispersed as fine particles.

- These residues are often blown over the land and either settle or are washed out of the air by rain.

- If the residues which settle on the leaves and stems of plants are not washed off soon afterwards by rain, they often enter through the epidermis of the leaves and stems into the pallisade cells or underlying stem tissue.
- If entry is gained, and the concentration of toxic ions (mainly chloride) is sufficiently high, necrosis of leaves and often death will follow.

This means that in many parts of the Wellington area street trees must have varying degrees of resistance to salt spray deposits.

It is generally maintained that there is a general gradient of salt residue concentration in the wind from Wellington City (very high to moderate) to Lower Hutt (moderate to low) to Upper Hutt (low to very low).

Unfortunately there seems to have been no experimental work done which would directly support this. However, the claim is indirectly supported by Miller (7) and Blakemore (3), who collected and analysed (for salt content) rainwater in the southern part of the North Island.

Blakemore cautions: "It is not certain that the rain gauge is as efficient as vegetation in retaining sea-spray blown inland during dry-weather gales", but the general figures in Table 1 show a definite gradient.

TABLE 1

Station	Na Cl (kg)/hectare/annum
Rongotai (coastal Wgtn)	387.52
Kelburn (Wgtn central)	184.80
Taita (Lower Hutt)	155.76

That Wellington may have a peculiar problem is illustrated by the fact that Levin, 80 km from Wellington and very close to the West Coast, has a figure of only 88.48 kg/ha/annum.

(c) Soils

In the following section, D.S.I.R. Soil Bureau ratings of soil sets' natural fertility are used:

Wellington City's predominant soil - Makara stoney loam - has a natural fertility rating of medium. Its response to lime and phosphate is good. Apart from a few areas where the soil contains a high proportion of sand (thus causing over-drainage), the soil is conducive to good plant growth.

The natural fertility of Lower Hutt's soils is mostly high to very high as the majority of the city lies on recent alluvial soils. However, Korokoro and Maungaraki, suburbs in the Western Hills, are on podzolic soil (Korokoro silt loam) whose natural fertility is rated medium to low. Stokes valley and a few areas in Taita are rated medium and low respectively.

Upper Hutt lies almost exclusively on silt loam and recent alluvium whose fertility is rated medium to high and high to very high. This area, then, has probably the bests soils to encourage good street tree growth.

(d) Topography

Lower Hutt and Upper Hutt are predominantly flat, whilst Wellington is predominantly hilly.

2. Anthropocentric (Man-Centred)

(a) Traffic Safety Considerations

Trees should be planted in such a manner that they do not impair vehicular traffic movement. This has meant that traditionally street trees have been limited in location to berms, roadside reserve and central carriage-way islands.

Both Lower Hutt and Upper Hutt have a high percentage of streets well endowed with berms. Wellington, however, has a relatively much lower percentage of streets with berms.

This is partly a reflection of Wellington City's topography but also a reflection of engineering and planning in the past.

Wellington City has an almost proportionally higher incidence of Roadside Reserve area than Upper Hutt and Lower Hutt but much of this reserve area is too steep to consider planting trees on.

The occurrence of central carriageway islands is very low in the three cities. Two areas of note where central island carriage-

ways have been constructed and planted with trees are - in some of the main roads in Manor Park, a recent subdivision in Upper Hutt,
- in the commercial/retail centre of Wellington City.

Street tree planting is further limited in the three cities by the general requirement that street trees be of a type amenable to training to a standard. It is a requirement of Traffic Engineering Departments that trees should not be planted close to corners or intersections as they impair visibility.

"... it is often no fault of the obstacle that it was involved in an accident ... On the other hand there is substantial room for improving ..."

. The marking of obstacles, especially at night.
. The design of obstacles to minimise damage.
. The location of solid objects.

From "N.Z. Roading Symposium 1971" (2). Traffic Engineers generally endorse this and tend to advise that street tree plantings be:

. As far away from carriageways as possible.
. Such that they will yield and cause minimum damage if hit by a vehicle (this condition is clearly a difficult one to meet as most trees when mature are solid and usually unyielding if struck by a vehicle).

Trees should not impair road surface conditions, thereby creating traffic hazards. In this connection Traffic Engineers and Roading Engineers have two fears:

. that some trees with vigorous root systems can crack and/or distort the surfaces of carriageways,
. that close planting of trees may cause prolonged shading of carriageways, preventing drying and even encouraging icing.

(b) Pedestrian Safety Considerations

In the city centres particularly, Traffic Engineers are concerned that trees be kept some distance away from pedestrian crossings.

The Wellington City Traffic Engineer related to me how he had to reluctantly ask the Parks & Recreation Department to remove shrubs and mature trees from an area close to a busy pedestrian crossing after a pedestrian had been killed on the crossing.

Trees should not unduly physically restrict the movement of pedestrians on footpaths, thus giving further weight to the requirements that trees be trained to one leader and to a standard.

Trees should not be of a type - or planted in such a way - that they may cause distortion or heaving of footpath surface (thus creating obstacles to trip over).

(c) Consideration of the Efficient Function of Overhead & Underground Wires, Ducts or Pipes

- Overhead Services These provide for telephones and electricity, telephone lines being the responsibility of the Post Office and electricity lines being the responsibility of the Municipal Electricity Department (M.E.D.) in Wellington City and the Hutt Valley Energy Board (H.V.E.B.) in Lower Hutt and Upper Hutt.

Also, Wellington City is serviced by trolley buses and many of its main streets are characterised by over-head wires to service these.

As there are no official figures available on the percentage of streets in Wellington serviced by overhead wires, I achieved some understanding of this through Interviews. I asked the following questions of service authorities:

(i) What percentage of services are conducted above ground in streets of your city?
(ii) Are the majority of such services placed underground now?

The answers were unanimous:

(i) Approximately 50%.
(ii) Yes. In new subdivisions all services are underground.

Field Survey For four suburbs in each city I noted the incidence of overhead lines.

Overall Results

% carriageways with overhead wires on both sides: 27
% carriageways with overhead wires on one side: 55
% carriageways with no overhead wires: 18

All services, with the exception of trolley bus wires in Wellington City, are underground in the cities' administrative/ retail centres and new or recent subdivisions. In the remaining areas approximately 80% of

the streets are serviced by overhead wires.

The specified minimum heights of overhead wires in public carriageways are -

Post Office	5.49 m
Electricity	4.88 m
Trolley Bus	4.88 m

Because street trees are often planted in berms, it is contended by all Service Engineers interviewed that where overhead services exist, trees should either be small or subject to regular pruning (or not planted at all) to prevent the following problems -

. With Post Office lines:
  breakages
  interference (audible on telephones)
  partial short circuits, especially on wet days.
. With Electricity lines:
  breakages
  short circuits (both of which cause power to be disconnected);
  affording people, especially children, the means of climbing dangerously close to wires.

- Underground Services These services, providing drainage, water reticulation, sewage disposal, electricity, telephone and gas, limit the location of street trees in that - evacation at planting time can cause duct breakages;
  - tree roots can invade ducts, causing interference and blockages;
  - maintenance of, and repairs to, ducts can be made very difficult by the presence of trees.

Fortunately, stormwater and sewage mains are normally located beneath carriageways but laterals serving houses etc., despite being usually 0.5 to 1.0 m below ground level, are prone to root interference. PVC ducts with sleeve joints are a recent introduction and may well prove to be resistant to root invasion but the old porcelain ducts, especially where joined by rubber sleeves and wire ties, are definitely prone to invasion and blockages by roots of larger trees.

The main limitations to street tree planting caused by electricity, gas and Post Office ducts are:

- They commonly run through berm areas, mainly because roads and footpaths are formed prior to duct laying and paving is expensive to reinstate.
- Despite attempts to the contrary, ducts are very often not located in a standard position. It is not uncommon, moreover, for three separate ducts to be laid in three separate trenches, which severely limits possible tree planting sites.
- Although ducts and cables presently used do not seem to be prone to undue interference by tree roots, older types - still common throughout Wellington - are.

For example, the Post Office now uses insulated and sheathed ducts impregnated with grease which are not prone to root invasion and damage; but there are still areas serviced by the older discontinuous asbestos pipes joined by rubber rings. Roots of aggressive trees experience little difficulty in gaining entry into these latter pipes (especially where water seepage into pipes has occurred) through the junctions.

(d) Consideration of the Efficient Function of Street Furniture

This applies particularly to Electricity Kiosks & Substations whose access should not be impeded by trees. Street Lights whose illuminating function should not be impaired by tree foliage and branches. Road Signs - the positioning of some such signs, e.g. stop signs, being of importance. If motorists' vision of such signs is impaired by trees, it will be the trees in most cases which will suffer remedial measures.

(e) Consideration to Owners or Occupiers of Houses, Shops, etc. Along Streets.

This limits proposed tree plantings and can effect existing trees in that residents of buildings may well object to loss of view or sun, causing either existing trees to be severely pruned or removed, or proposed planting to be cancelled.

(f) Vandalism

In interviews with administrators from the three Parks Departments involved, I asked:

"What do you see as the main problems besetting young trees under your supervision?"

The Deputy Directors of each Department listed vandalism as being the main problem.

Established trees suffer less from this problem but recently planted trees are very

susceptible to breakages or uprooting by vandals. This causes problems in that

- trees suffer sometimes significant growth setbacks, especially when leaders are removed;
- expensive tree-guards are seen as being necessary by one Parks & Recreation Department - Wellington;
- any replacement planting or remedial pruning necessary is demoralising, time-consuming and costly.

(g) Expertise of Local Body Departments Responsible for the Planting and Maintenance of Street Trees

The success of street tree planting is very dependent on the management and horticultural and arboricultural skills of the Parks & Recreation Department involved.

3. The Attitudes of the Public

The attitudes of the public toward street trees varies considerably. A study dealing with this in several suburbs in Wellington found that:

(a) "For the sample as a whole, a few trees in the street were preferred to a tree-lined street ...
(b) The respondents could be divided into two groups: those preferring open spacious streets laid out with footpaths, berms and a few small trees, and those preferring the heavily treed walks."

This divergence of attitudes creates problems in that:

(a) In some streets where Council has decided that street tree planting could effect considerable aesthetic improvements, planting schemes have had to be abandoned because so many residents have objected to the proposal.
(b) The survival of street trees is to a great degree dependent on the attitudes of the householders whose streets are planted.

In areas where street trees are valued highly by residents, street trees are prone to relatively little vandalism and in many areas are cared for, to the extent of being watered in dry weather. However, where householders are indifferent or averse to street trees, young trees are more frequently mistreated or vandalised.

Moreover, established plantings suffer through this indifference in that residents often force local bodies to hard prune established trees, claiming that the trees inconvenience them in some way.

RECOMMENDATIONS FOR FUTURE PLANTING

Particular aspects of street tree planting in Wellington which I recommend for improvement and/or amendment are dealt with under the following headings:

Attitudes
Services
Administration
Choice of trees
Aesthetics
Cultural

Attitudes

As previously suggested, the success of street tree planting relies heavily on the attitudes of the public.

Trees' survival rates tend to be higher in areas where trees are wanted and appreciated and the converse of this applies.

Even indifference by residents often leads to damage to trees through thoughtless actions. For example, I have noticed some residents mulching street trees on their frontages, piling up lawn clippings against the trunks, thus encouraging rot of the bark and/or stem at the base of the trees.

I believe that this problem could be largely overcome by:

(i) Publicity and promotions - an increased output and availability of informative and interpretative literature and displays would lead to a greater public awareness of the benefits of trees. Perhaps the increased property values which trees can impart could be highlighted.
(ii) Increasing the involvement of residents in street tree planting. The Wellington City Council's practice of involving local residents' associations in planting schemes is a sound one.

The recent proposal by the Council to invite residents to form street committees which would liaise with, and assist, the Parks & Recreation Department in choice of planting sites, design and maintenance, will further involve residents.

This will ensure that trees are planted in streets where they are wanted and means

that the trees will be better cared for.

I believe that this sort of community involvement should be particularly encouraged in depressed areas, as residents in the middle to upper socio-economic areas have traditionally been more confident and better organised in their respect.

Services

I would rank the problem of services as being perhaps the most frustrating problem for those involved in the planting of street trees.

For example, in Wellington, the Parks & Recreation and Town Planning Departments of the City Council are attempting to ameliorate the depressed atmosphere of some inner city residential areas by planting street trees. The almost total absence of berm or roadside reserve makes the job difficult but finding a location in footpaths, which is clear of underground services, makes it a particularly daunting exercise.

Trees can be planted in containers but probably the best and unfortunately most expensive remedy would be to relocate the services in either one standard area of footpaths or the street.

Underground services even in newer areas are still a problem because all too often three or four ducts are placed in separate trenches in the street.

I would strongly recommend that the local authorities make moves to persuade the various service departments to place their ducts in standard locations that allow for the planting of trees. Where space is at a premium, roadside reserve areas - completely free of services - could be set aside to allow for compatability of trees and services.

Although an avenue planting may not be possible, a discontinuous and less formal pattern would lend itself well to many areas in Wellington.

Where overhead services exist, street trees should be of such a type, or planted in such a position, that they will not interfere with the services' functions. Topping of street trees is not only expensive but usually unsightly.

Finally, the Parks & Recreation Departments should always check on the existence of underground services. Not only is there the question of staff safety to consider but also the dictates of the Construction Act.

Two electrical engineers related to me several instances of Parks staff severing power cables and many instances of trees being planted within 5 to 10 centimetres of ducts.

Administration

In this area the improvement I would recommend relates to staff training. I do not believe that the staff on the Wellington and Lower Hutt Parks & Recreation Departments are sufficiently versed in basic arboricultural skills.

Courses could be easily organised to foster particular skills which are discussed under the next three headings.

Choice of Trees

In most cases, the ideal Wellington street tree would have the following basic characteristics:

(i) Uniformity
(ii) Tolerance of salt and wind.
(iii) Tolerance of drought and frost.
(iv) Rapid growth rate to desired dimensions.
(v) Non-aggressive root systems.
(vi) Upright growth habit.
(vii) Small to medium height.
(viii) Non-poisonous parts.
(ix) Absence of fruits or leaves which are messy or slippery when fallen.
(x) Non-suckering.
(xi) Longevity.

In addition, of course, this ideal tree would be aesthetically appealing with attractive architecture, bark, leaves, flowers, fruits and seasonal variations.

When selecting trees the above characteristics should always be considered. It is apparent that tolerance of wind and salt has often been the only characteristic considered.

Given the climatic rigours of Wellington, which are indeed limiting, I believe that the range of trees grown in Wellington is wide. However, many of the trees have either been inappropriate to their sites or just generally unsuitable.

Of the desirable characteristics, I believe the following need much more consideration especially by Wellington City and Lower Hutt.

Uniformity - It is essential in avenue planting that trees be of uniform growth

habits. Too often street trees have been raised from seed with great variation often resulting. One spectacular example is the great variation in autumn colour and growth habit of *Liquidambar styraciflua* in Lower Hutt. More vegetatively propagated trees should be used.

Upright growth habit and medium maximum height are desirable. Large, broad-around trees should not in most cases be used. Interference with services, traffic, views and sun too often results.

The pohutukawa *Metrosideros excelsa* has caused many problems in Wellington City and Lower Hutt, where it has often grown too large. It is a tree which also has another undesirable characteristic: aggressive roots which invade ducts and heave footpaths and roads. (For these reasons I would strongly suggest that the use of the pohutukawa as a street subject be greatly reduced.)

Ideally, the Parks & Recreation Departments should, I believe, be breeding and selecting better trees from their current range. Within many of the species used there is variation in many characteristics: form, ultimate size, wind and salt tolerance, pest resistence.

The screening, selection and subsequent vegetative propagation for trial of promising seedlings could yield better results.

"... there are many cases where an improvement in a single, simple characteristic might change the status of an otherwise undesirable tree."(12)

It is encouraging to note Upper Hutt's trials with trees, particularly clones of upright growth habit.

Notwithstanding, of the trees growing in streets in the three cities, those which I believe merit continued use (or trial) as specimen trees, in the appropriate sites, are:

Wellington

willow myrtle,	*Agonis flexuosa*
black alder,	*Alnus glutinosa*
Norfolk Island pine,	*Araucaria heterophylla*
strawberry tree,	*Arbutus unedo*
coast banksia,	*Banksia integrifolia*
cabbage tree,	*Cordyline australis*
strawberry tree,	*Dendrobenthamia capitata* (syn. *Cornus capitata*)
ake ake,	*Dodonaea viscosa*
alpine ash,	*Eucalyptus delegatensis*
fig tree,	*Ficus carica*
claret ash,	*Fraxinus oxycarpa* 'Raywood'
rewa rewa,	*Knightia excelsa*
	Ligustrum licidum
Kermadec Island pohutukawa,	*Metrosideros kermadecensis*
olive,	*Olea europaea*
tanguru,	*Olearia albida*
	Olearia paniculata
kohuhu,	*Pittosporum tenuifolium*
	Pseudopanax 'Adiantifolius'
lancewood,	*Pseudopanax crassifolium*
holm oak,	*Quercus ilex*
	Syzigium paniculatum
golden elm,	*Ulmus procera* 'Louis Van Houttei'

Lower Hutt

kauri,	*Agathis australis*
willow myrtle,	*Agonis flexuosa*
juniper myrtle,	*Agonis juniperina*
strawberry tree,	*Arbutus unedo*
upright hornbeam,	*Carpinus betulus* 'Columnaris'
golden hinoki cypress,	*Chamaecyparis obtusa* 'Crippsii'
	Cryptomeria japonica 'Elegans'
strawberry tree,	*Dendrobenthamia capitata* (syn. *Cornus capitata*)
ake ake,	*Dodonaea viscosa*
scarlet flowering gum,	*Eucalyptus ficifolia*
claret ash,	*Fraxinus oxycarpa* 'Raywood'
	Gordonia axillaris
rewa rewa,	*Knightia excelsa*
sweetgum cultivars,	*Liquidambar* cvs
	Magnolia grandiflora
Chinese elm,	*Ulmus parvifolia*
golden elm,	*Ulmus procera* 'Louis Van Houttei'
puriri,	*Vitex lucens*

Upper Hutt

	Acer hookeri
	Acer platanoides 'Columnare'
strawberry tree,	*Dendrobenthamia capitata*
yate,	*Eucalyptus cornuta*
cup gum,	*Eucalyptus cosmophylla*
red-flowered yellow gum,	*Eucalyptus leucoxylon* var. *macrocarpa*
candle bark,	*Eucalyptus rubida*
scarlet pear gum,	*Eucalyptus stoatei*
ash,	*Fraxinus* spp./cvs (all those currently being used)

hungere,	*Hoheria angustifolia*
tarata,	*Pittosporum eugenioides*
plane,	*Platanus x acerifolia*
Cyprian plane,	*Platanus racemosa*
kowhai,	*Sophora tetraptera*
Siberian elm,	*Ulmus pumila*

A final recommendation regarding the choice of trees is that each tree to be planted should be carefully assessed in its own right and that the selection of the appropriate tree be made only after consideration to: design - services - drainage - exposure - traffic - street furniture - residents.

Aesthetics

I firmly believe that greater consideration should be given to design, in the context of both the localised streetscape and the wider cityscape.

The pattern of planting, trees selected and planting finish should all be carefully planned.

A small winding road up a hillside may not lend itself to a regimented avenue-type of planting: discontinuous mixed groups of native plants may well better complement the streetscape. On the other hand, in a small inner-city area planting of an exotic small tree of neat habit of growth would be in keeping with the mood of the area.

Planting finish is important:

(i) The trees should be of a standard size and of healthy appearance.

(ii) Planting holes should be of uniform size and well finished. In Wellington City, in some inner-city residential areas, the finish of planting is displeasing because holes cut in the pavement are not neat and have not been either under planted or paved to help the young trees visually nestle into the streetscape.

(iii) Staking and tying should be uniform, neat and tidy.

(iv) Tree guards should not be visually obstrusive or clumsy.

Not only could attention to these matters improve the appearance, particularly of recent plantings, but I believe it could, in some cases, tend to discourage vandalism or thoughtless behaviour. Well-tended annual floral bedding display borders suffer less vandalism than untidy ones and I believe the same rule applies to trees.

Cultural Techniques

(i) Pre-Planting

(a) Propagation - Whether plants are purchased or propagated, I recommend that a far greater emphasis be placed on clones.

(b) Growing on method - For all evergreen trees, and deciduous trees where possible, I would like to see container growing introduced. This would reduce planting shock, particularly for larger stock and also extend the planting season.

(c) Pre-Planting training - For most areas, except where plantings are predominantly native, or where traffic consideration is unwarranted, trees should be:

. To a single leader - rival leaders often form junctions which are weak especially when trees grow to a larger size and prejudice the tree's strength, safety and appearance. A broken leader is a menace to the public and may ruin the form of a semi-mature or mature tree.

. To a standard - so that as soon as possible the tree will have a single clean bole, free of branches, up to at least 2.00 metres in height. Both Wellington and Lower Hutt should make this training STANDARD practice.

(d) Sizes of trees when planted - Whilst acknowledging that all three Parks & Recreation Departments in Wellington sometimes plant larger semi-mature trees in prestige areas, especially inner-city retail and administrative areas, many street trees are planted out when they are still too small. I suggest that a minimum height for most trees to be planted be 3.00 metres. A 3.00 metre tree is of some visual impact whilst still being relatively straight-forward to handle, transport and plant. The larger the tree is when planted, the greater will be its visual impact (particularly important with slower growing trees) and the less prone it will be to vandalism.

(ii) Planting

(a) Non-paved areas

Planting hole preparation - My recom-

mendations are:

. Planting holes should always be a minimum of 15 cm wider and deeper than the tree's rootball.
. Unless the existing soil is of good quality, I believe that topsoil should be imported to replace the existing soil.

I would recommend also that bulky organic matter, preferably spent mushroom manure or similar, be incorporated into the planting hole. This should:

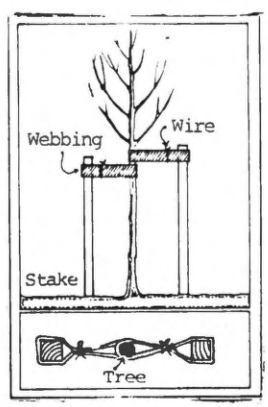
. Yield a balance supply of nutrients to the trees.

(This would have to be confirmed by trial.) From bitter experience in my own garden, I have learned that the application of inorganic fertilisers to trees can produce lush, succulent growth which is unable to withstand Wellington's winds.

. Improve the water retention capacity of the soil.
. Provide good soil structure.

Planting - Apart from ensuring that the tree is planted at the same level as it was growing in the nursery and that the planting medium is well firmed and watered in, I firmly suggest that all planting should be dished to allow for maximum water retention during rainfall and irrigation. This is particularly important when trees are planted on a slope.

Staking & Tying - I advocate the two-stake method of staking for most trees.



The merits of this system are:

. The tree is held firmly but very flexibly.
. There is no danger of the stakes rubbing the tree stem.
. There is little chance of the tree snapping off level with the tops of the stakes.

Rubber strips could be used instead of webbing (and nailed to wooden stakes) but I have a preference for painted 2.5 cm diameter galvanised water pipe stakes as they have a less heavy appearance than wooden stakes (which must be at least 5 x 5 cm through).

(b) Paved Areas

Recommendations for trees planted in non-paved areas apply to paved area trees.
Moreoever, I believe that the planting should always be finished off with some form of permeable paving.
If tree quards must be used, they should be visually unobstrusive as well as functional.

(iii) Post Planting

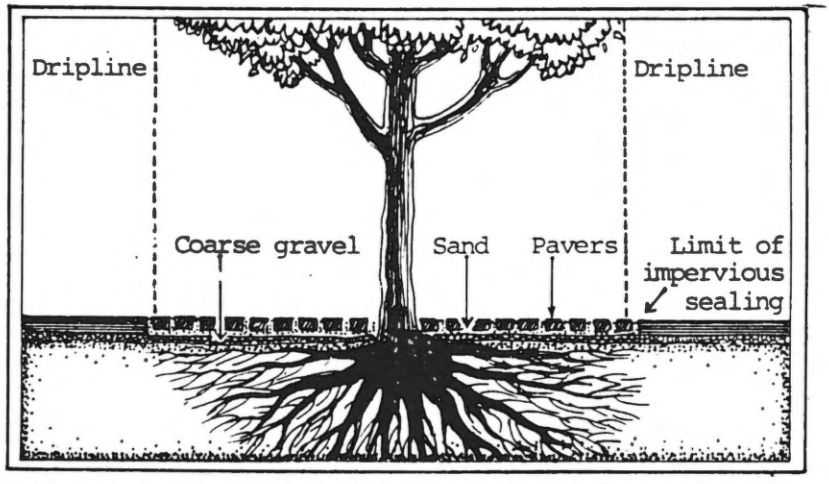
In general terms, I recommend that street trees should be subject to a regular maintenance programme, concentrating on the following tasks:

(a) Regular checking of ties.
(b) Careful attention to training.
(c) Weed control, especially for young trees. Trees should be kept vegetation-free over their roots for at least two years to prevent vital herbaceous vegetation from competing for nutrients and water.

Where possible, I would favour mulching with an organic material. This would have the added benefits of:

- Maintaining good soil structure.
- Aiding in moisture retention by impeding evaporation of water from the soil.
- Maintaining a supply of nutrients to the soil.

(d) Irrigation Young or newly planted trees must be regularly and deeply watered for at least two years post-planting. If mulching were introduced, trees would need to be watered once a fortnight (or a fortnight after



Permeable paving for street trees planted in paved areas.

substantial rainfall). If good liaison existed between the Parks & Recreation Departments and local residents, the local residents could be asked to effect watering. If this were not practicable, a water truck would have to be used.

(e) Pest & Disease Control Only trees with low susceptibility to pests and diseases should be planted. Careful choice of trees is the most important pest and disease control, I suggest.
If susceptible trees are grown, then consideration will need to be given to introducing a regular spraying programme.
I also believe that my advocated policy of manuring trees with only bulky organic material would result in growth less susceptible to pests and diseases.

(f) Pruning of Established Trees
- Pruning should be carried out by Parks & Recreation Departments and, within those departments, by staff well versed in arboriculture.
- Pruning paints, where used, should not be blue and should preferably be black (research now indicates that tree paints' only value is cosmetic and black is certainly the best cosmetic colour to paint tree cuts with).
- Where trees are creating too much shade, topping should be practised only when absolutely necessary. Crown lifting and thinning are more desirable remedial treatments. (I believe many residents complain about trees on their frontages not only because they create shade but also because the trees look and feel dense and appressive.
Crown lifting and thinning both let more light through and also psychologically lighten trees).

5. Conclusion

Street trees have very important roles to play in urban centres. Their full cosmetic and functional potential, in the three cities I have studied, has until now been illustrated but by no means realised. There are still many, many streets in the area whose bleakness and lack of warmth (and I must here acknowledge my partiality in that I find vegetation not threatening but somehow comforting) could be greatly ameliorated by tree planting.

I believe that local authorities and their Parks & Recreation Departments must accept wholeheartedly the responsibility of increasing the numbers of street trees planted, and to caring for those already

planted, and to commit more of their knowledge, expertise and sensitivity to this very important task.

I hope that I have shown that despite the physical rigours, especially climatic, facing trees in Wellington that there are many trees that grow and grow well.

If as much effort was afforded to the selecting, planting and care of streets trees as is currently afforded to ephemeral annual floral displays, I am sure that significant progress would be made.

I am confident that greater numbers of urban dwellers will increasingly expect and demand that more attention be paid to street tree planting; I am less confident that the Parks & Recreation Departments I have studied will respond well to this demand (which they need to do as officers of democratically elected local governments). Strenuous efforts need to be made quickly to take much better care of existing trees and to ensure that carefully chosen and raised trees are planted in the appropriate sites and subjected to the organised and regular maintenance which they deserve.

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Introduction to New Flowercrops

by

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The following article is a summary of a talk given to the Nelson Flower Growers' Conference, August 1982.

Rather than discuss the latest new flower crops I have used a certain amount of poetic licence with this topic and instead, intend to talk about the concept of new crops. From my travels around the country, and my involvement with horticultural marketing I think it appropriate to discuss strategies for new crops.

The first thing to do is to consider the phrase "new flower crops". Depending on a grower's personal situation, a new flower crop to him may not be so to his neighbour and vice versa. There are four broad categories in which a grower may slot with regard to a "new" flower crop.

The first category is the situation where we have a completely new flower grower, i.e. the situation where a sheep farmer or lawyer is going to "make a fortune" out of growing flowers. No matter what crop he grows it is to him a new crop, a new experience.

The second category is where the established grower is diversifying. For example, a rose grower may be moving into carnations. Even though carnations are by no means a new crop, they are to the rose grower.

The third category is the new commercial crop. Often a plant has been around for years and someone finally gets the idea that it could have commercial value. The classic case of recent times is gypsophilia. This plant has been around in home gardens for years but it is only recently that it has been cultivated for its commercial value.

The final category is the complete new crop itself, i.e. a crop that has been bred especially for the cut flower trade. The most notable example here is Safari Sunset, a leucodendron cross that was bred here in New Zealand and is now the basis for the N.Z. proteaceae cut flower trade. (It is now being marketed under the name Kiwi Star.)

Having discussed these four categories, I will now approach the growing and selling of new flower crops. The growing side is relatively easy as there is a myriad of publications giving the crop requirements. Selling is a different story.

There are basically two approaches to producing a crop for sale. The first, and unfortunately the more common method, is to be "production orientated". In this situation a producer grows a crop and then tells the market place that it is ready and people can now start buying it. Unfortunately as is often the case, the crop is too expensive, or at the wrong time of the year, or simply of no interest to anyone. By contrast the second approach is "market (or consumer) orientation" whereby the producer finds out what the market wants and then sets about to produce a flower that satisfies (at a profit) those particular needs. This is the approach that we are endeavouring to foster within N.Z.

MARKET ORIENTATION

The general approach to the selling of new crops should be the same no matter what category (as discussed previously) you are

in. In a competitive situation such as cut flower growing, the person who tailors his product closest to that which is wanted in the market place is the one most likely to succeed. Cut flower production is expanding world wide and each producing country has certain advantages which determine its competitiveness. To succeed a grower must be market orientated and of course this requires some form of market planning.

MARKET PLANNING

Market planning can be very simple or very complicated. Massey University Market Research Centre have published an excellent bulletin on market planning (The Marketing Plan Flow Chart - An Innovative Approach to Product Planning Tailored to The Needs of Small Companies. Bridges, J.S. 1978, Research Report No. 21) which would be of great use to all flower growers.

Basically the market plan involves such aspects as; situation analysis (i.e. collecting all the data relevant as to how the crop is produced, what it is used for, who your competitors are, what price they are selling it for, is there an out of season demand, etc.) identifying the consumer benefit (which you hope to supply by your product) and associated target market, objectives (e.g. market penetration, increasing market share, etc.) market strategy, elements of the market mix to be used and a market audit.

Obviously having a market plan doesn't guarantee success, but by getting everything down on paper it encourages orderly management and hopefully reduces risk. Market planning should be a general requirement for all crops including "new" ones (as defined earlier).

Going back to the four categories of "new" growers/crops and likely problems, and considering each individually; the new grower has the least chance of success. Cut flower production is the most intensive form of horticulture and requires the greatest level of expertise. If a mistake is made during crop production it often proves to be a very costly one (bearing in mind the quality requirements). Many new growers are poorly informed about overseas market conditions and the way in which cut flowers are handled and sold. The best advice here, is that before a new grower starts rushing off overseas to tell the world how marvellous his crop is going to be, etc., he should produce for a season first on the domestic market and initial exporting thereafter should be done through an established and experienced exporter.

In the second category we have an established grower who already has the required crop husbandry skills, so from a production point of view it generally follows that his crop will also tend to be of a high standard purely and simple from the fact that he knows what problems to look for. If he is already exporting he can tap into current distribution channels and so generally speaking established growers who diversify have the greater chance of success.

The third category is the new commercial crop and the strategy here is either "band wagon jumping" or "me too", depending on your experience. Jumping on the bandwagon is that situation where someone looks over his neighbours fence sees that he has a new car and also happens to be growing agapanthus under glass and so decides to follow suit, generally with disastrous results for all parties. A "me too" strategy on the other hand is to appreciate the limitations of the grower/country with regard to market research, etc., and so to look closely at the marketing situation of a country which has these resources (for instance Israel) and see if there is a slot for N.Z. (this could be off season) with due regard to the economics of production.

The fourth situation involves the genetically new crop and this is where great care and market expertise is required. In this situation New Zealand has something the rest of the world does not have (Safari Sunset). Unfortunately resources for market development of a new crop on an individual grower basis tend to be very small and so it is highly desirable that such market developments be handled on an industry basis. This would involve market planning on an industry basis (generally by a market development council), and would become an integral part of the MAF Quality Assurance Scheme whereby the crop produced by the Industry is that for which consumer need has been recognised and a target market identified. It must be appreciated that the

New Zealand domestic base is very small (3 million) and it would be very difficult and uneconomic to try and unload 100 hectares of safari sunset onto the New Zealand consumer should such a "new crop" fail on the overseas market.

Maroochy Macadamia

by

S.N. Dawes

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The macadamia cultivar known as N7 is being propagated to some extent by nurserymen in New Zealand as an ornamental of neat upright habit, with good nut-bearing characteristics, and suitable for home gardens. This macadamia selection was introduced into this country by Dr H.M. Mouat, of DSIR, Mt Albert, from the Queensland Department of Primary Industries' Horticultural Research Station at Maroochy.

The Queensland Department of Primary Industries has a long-standing programme for the evaluation of superior macadamia selections. Grafted plants from promising seedling trees are placed in numbered collections for further evaluation. Queensland has an established macadamia industry, and only selections that prove to be of exceptional quality are later named for commercial evaluation against established cultivars. The selection N7 is not considered to be sufficiently promising in Queensland to warrant naming.

In New Zealand, commercial macadamia growing is still in its infancy, and many selections have not yet been fully evaluated. N7 has produced nuts of good quality under New Zealand conditions, but it is by no means certain that it will become a commercial cultivar. However, the attributes of N7 are such that the cultivar is suitable for use in home gardens, and for this reason it warrants naming.

The Division of Horticulture and Processing of DSIR, in consultation with the Queensland Department of Primary Industries, has therefore decided to give the macadamia selection N7 the formal varietal name 'Maroochy', in recognition of its source of origin.

Some Lesser Known Temperate Root Crops

by

J. Palmer

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Before the first European contacts with N.Z. the Maori had introduced three root crops from the Pacific Islands: the yam *Dioscorea alata*, taro *Colacasia antiquorum*, and the kumara *Ipomoea batatas*. The first two species are strictly tropical and could be grown in New Zealand only in sheltered spots of the far north. New techniques for growing and storing kumara were developed, and they were cultivated as far south as Temuka. But here early voyagers reported the tubers were scarely larger than an index finger, and the adoption of the better adapted potato by the Maori soon after its introduction must have had substantial effects on their diet. One facet of this change is the number of old and often nameless potato cultivars still grown in the more isolated settlements. 'Urenika' with purple-fleshed tubers is the most spectacular and widely known. The flavour is not affected by the colour and a few tubers cooked with a meal are always a talking point.

The only other tuber crop grown on anything other than an experimental scale in New Zealand is the oca *Oxalis tuberosa* (Fig. 1), sometimes referred to, quite unfortunately, as Bolivian yam. Several true yam species (*Dioscorea*) appear in N.Z. markets from time to time, imported from the Pacific Islands. None would have tubers less than fifty times the weight of an oca tuber.

The oca belongs to a group of small-tuber crops grown alongside potatoes in the Andean region of South America. All are alternatively dried and frozen, in the sun by day and the cold by night, in the rarified air of the high Andes, to form the concentrated and long-keeping 'chuno' of that region. Many oca tubers contain significant concentrations of oxalates, making the taste acid or bitter; these are removed by the chuno-making process. The small pink-tubered oca common in N.Z. is fortunately not very high in oxalates, but tubers are nevertheless improved by a few days of sun drying before use.

Oca plants seldom flower, but when they do there are three distinct forms (tri-stylous). In an attempt to induce flowering, assuming the problems to be that they are sensitive to day length, we established cuttings from local oca and two recently imported accessions in March to grow them on over winter in the glasshouse. All the cuttings rooted but in April the two recent accessions died back to form small basal tubers. We have yet to produce flowers on the local cultivar. This day length sensitivity is a factor to be considered in all the Andean tuber crops, including Andean potatotes. Oca plants do not begin to form tubers at the tips of axillary shoots until the days become shorter in autumn. In Canterbury they begin developing in mid-March, so plants should not be dug until the last possible moment, usually after frost has cut down the foliage. Incidentally the foliage is edible and makes an attractive addition to summer salads.

The tubers of the related Mexican species, *Oxalis deppei*, are also edible, but of no economic value.

Growing in the same areas of the Andes as the oca is the ulluco *Ullucus tuberosus*. This plant has broad cordate leaves and pink stems. The tubers (Fig. 2) are rather larger than oca tubers, and many are pink in

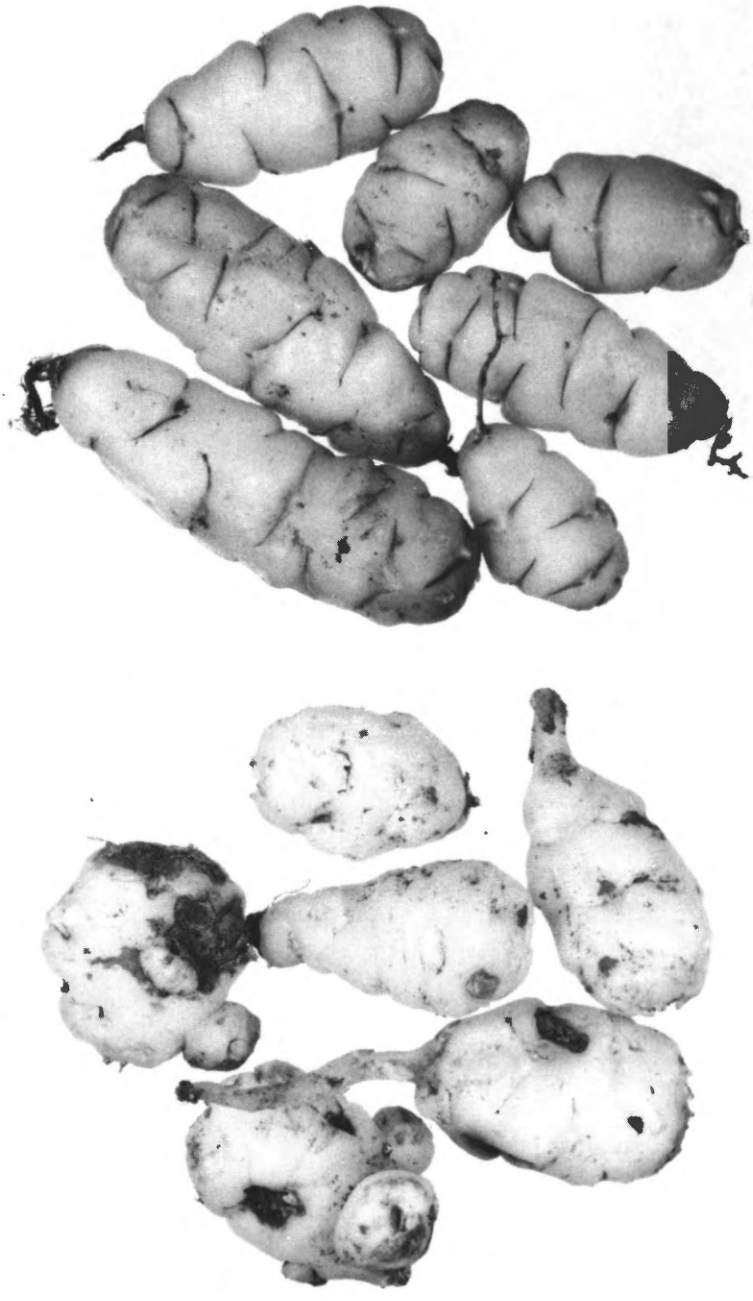

Fig. 1 Oca tubers. Local N.Z. tubers top and less well adapted cultivar from Ecuador bottom.
The longest tubers 57mm long.

Fig. 2 Ulucco tubers

Fig. 3 Skirret. Photo 6/8/82
Note shoots arising around the collar. The lower portion of the fleshy roots are snapped off and the remainder of the plant divided for propagation.

colour; they resemble a smooth-skinned potato. The flavour is bland and somewhat mucilagenous. In the past ulluco was thought to have anti-aphrodisiacal properties, and it allegedly formed the staple diet of Inca soldiers.

The third species, associated with the above in both cultivation and ultimate use, is the isanu or mashua, *Tropaeolum tuberosum*. In Europe this plant is sometimes grown as an ornamental, as are two other tuberous tropaeolums, *T. speciosum* and *T. tricolorum*, in New Zealand. The yellow, purple-splashed, knobbly tubers are not much appreciated away from their native habitat.

A tuber in the same size range as isanu and ulluco is the so-called Chinese artichoke. This plant, *Stachys sieboldii*, looks like a typical dead nettle, with opposite leaves and square stems. It would appear to be only occasionally cultivated in China and Japan, but for some reason has always enjoyed a following in France. There it has been the recent subject of tissue culture in an effort to expunge the latent viruses common to vegetatively propagated crops (J-Y. Peron (1980) Le crosne du Japan, PHM Revue Horticole 219, 11-17). I can find no record of this plant's introduction to New Zealand and would welcome advice on this or other crops mentioned from any knowledgeable person.

Skirret is an umbelliferous root crop once common in Europe but now little grown. This species, *Sium sisarum*, has been widely confounded in early works on agriculture with the related parsnips and carrots. The Roman author Pliny mentions the 'sium' was a favourite vegetable of the emperor Tiberius, but he is thought now to have referred to parsnips. Skirret (Fig. 3) was probably introduced to Europe from further east some time around the 15th century. Confusion in the literature is not helped by the fact that early carrot cultivars were yellow-rooted. The now ubiquitous red carrot came only recently to the scene.

It is not difficult to see from figure 3 why Skirret fell from favour with the cook, if not the gourmet. This is a perennial species which can be propagated from parts of the root, provided this includes an axillary bud from the collar region. Roots are normally dug in winter when the tops die back. The distal portions of the roots are snapped off and all or part of the top replanted. The flavour of skirret is sweeter and milder than parsnip. Worlidge in his 'Systema Horticulturae' of 1682, says "they are the sweetest whitest and most pleasant of roots", but I must add, not entirely free of fibre.

Arracacha is another umbellifer, practically unknown outside South America. The species, *Aracacia xanthorrhiza*, is again a perennial, and largely vegetatively propagated. The species is said to flower irregularly and seldom to set seed. The scarcity of arracacha outside its native territory is not for the same reason as with skirret. The quality of the roots is said to be excellent; they are a reasonable size and easy to prepare for the table. Considerable effort was expended in attempting to introduce this root to Europe in the mid-19th century as a possible replacement for the potato, then recently devasted by the blight, *Phytophthora infestans*. These attempts failed. Araccacha requires a long growing season. The thick, wrinkled part of the root below the collar is edible but is not the portion most sort after. Axillary roots arising below this part become thickened with age, and are smooth skinned and virtually fibreless. The upper section is usually divided and replanted at the time of harvest.

It is thought that parts of Buller may be suitable for the cultivation of this species, but plants recently introduced by the DSIR in Auckland did not survive. So it may be some years before we see N.Z. grown arracacha.

Silva

An Old Classic

reviewed by

M. Oates

In 1664 a book was published that was to have an enormous influence on British Arboriculture for the next two hundred years. The book called SILVA, or a "Discourse of Forest Trees and the Propagation of Timber in His Majesty's Dominion" was written by John Evelyn, a country gentleman.

It was written at a time when increased planting of trees was necessary to provide timber and firewood for the nation. Much of this timber was needed to maintain supplies to the rapidly expanding ship-building industry. The main wood required was oak, and the situation was to remain this way until the coming of Indian Teak and later Iron. The King at that time, Charles II, realised the importance of large, new plantings. He knew, however, that compelling people to plant under threat of fine or forfeiture would not work. He felt that an animated exhortation from the press would do more.

In an article from the Quarterly Review of the Royal Society in 1813, Dr A. Hunter described the qualities which made Evelyn suitable for the task.

> "A proper person for the purpose therefore was sought and found; a man of family, fortune and learning; an experienced planter; a virtuoso, and not a little of an enthusiast in his own walk. Such was Mr Evelyn."

Silva

The discourse was written in four books. The first book deals with the basic elements needed to grow trees. In Evelyn's time there were said to be the Earth, Soil, Seed, Air and Water. It then describes briefly the growing cycle of trees from sowing the seed until the final transplanting, and included many pieces of advice, useful to nurserymen even today. The first book finishes with a description of the main timber trees growing at that time, including the Oak, Ash, Beech and Elm.

The second book describes less commonly grown trees and large shrubs including 'Philyrea, Syring and other Exotichs'.

The third book describes the management of the trees with their final utilisation. It includes the seasoning and uses of timber and finishes off with some of Evelyn's own proposals for the planting and improvement of the King's forests.

The final book is best described as it appears in the contents of the book.

> "An historical account of the sacredness and use of standing groves, etc."

Sylvia is not only a comprehensive guide to the propagation, cultivation and utilisation of trees in the British Isles in the seventeenth century. It is a witty and humorous book, full of stories and anecdotes which hold the reader's attention. An article which appeared in the Quarterly Review of the Royal Society in 1838 describes the book thus:

> "Half the charm of this work lies in his contriving to make us feel interested about his trees; he gossips about them, he tells us where they come from and what they are used for ..."

It then goes on to state the consequences of the book on the British countryside.

> "... and thus it was that he gave an impulse to planting those goodly woods and forests, the absence of which, in

SILVA,
Or a DISCOURSE of
FOREST-TREES,
AND THE
PROPAGATION of TIMBER
In His MAJESTY's DOMINIONS.
As it was Deliver'd in the *ROYAL SOCIETY* the xvth of *October*, MDCLXII upon occasion of certain *Queries* propounded to that *Illustrious Assembly*, by the *Honourable* the Principal *Officers* and *Commissioners* of the *Navy*.
In TWO BOOKS.
Together with an Historical Account of the *Sacredness* and *Use* of Standing *Groves*.
TERRA,
A *Philosophical ESSAY of EARTH*, being a *Lecture* in Course.
To which is annexed
POMONA:
OR, AN
Appendix concerning *Fruit-Trees*, in relation to *CYDER*;
The *Making*, and several Ways of *Ordering* it.
Published by Express *Order* of the ROYAL SOCIETY.
ALSO
ACETARIA:
Or, a DISCOURSE of *SALLETS*.
WITH
KALENDARIUM HORTENSE;
OR THE
GARD'NERS ALMANACK;
Directing what he is to do *Monthly* throughout the *Year*.
All which several *Treatises* are in this *FOURTH EDITION* much *Inlarg'd* and *Improv'd*,
By the AUTHOR
JOHN EVELYN, Esq; Fellow of the *ROYAL SOCIETY*
.....*Tibi res antiquæ laudis & artis*
Ingredior, sanctos ausus recludere fontes. Virg.
LONDON,
Printed for *Robert Scott* in *Little-Britain*; *Richard Chiswell* in St. *Paul's* Church-yard; *George Sawbridge* in *Little-Britain*; and *Benj. Tooke* in *Fleetstreet*. MDCCVI.

Fig. 1 Title page of original book.

his own time, he so feelingly laments, and now which crown our hills and enrich our valleys."

Although many of his arguments could be shown to be incorrect today, many of the practices he describes have changed little. The extract below shows that Evelyn knew the importance of mulching:

"When your seedlings have stood thus till June, bestow a slight digging upon them and scatter a little mungy, half-rotten, litter, fern, bean-hame or old leaves among them, to preserve the roots from scorching, and to entertain the moisture."

In the chapter on the Oak he describes the technique of root pruning, prior to transplanting large specimens.

"... cut through all the collateral roots till with a competent strength you can enforce him down upon one side, so as to come with your ax at the top-root; cut that off, redress your tree, and so let it stand cover'd about with the mould you loosen'd from it."

He concludes as follows:

"... take it up on a fit season; it will likely have drawn new tender roots apt to take, and sufficient for the tree, wheresoever you shall transplant him."

Evelyn also lists some of the qualities required of a nurseryman, especially with regard to seed propagation.

"He therefore that undertakes the nursery, should be knowing not only in the choice of the seeds, where, when and how to sow them; but to know what time of gestation they require in the womb of their mother earth, before parturition."

Even in Evelyn's day they seemed to have problems with weeds. His description of these unwanted plants is appropriate even today.

"... by which we may consider, that what is reputed a curse, and a cumber in some places is esteem'd the ornament and blessing of another."

Throughout the work, Evelyn's wit and humour constantly show through. The extract below refers to the buying of Oak trees for timber, and the problem of not knowing what the wood will be like.

"There is not in nature a thing more obnoxious to deceit, than the buying of trees standing, upon the reputation of their appearance to the eye, unless the chapman be extraordinarily, judicious; so various are their hidden and conceal'd infirmities ..."

He finishes with a humorous comparison:

"A timber tree is a merchant-adventurer, you shall never know what he is worth till he be dead."

In the chapter on the Ash tree, he refers to the high value of the timber:

> "... so as in forty years from the key, an ash hath been sold for thirty pounds sterling: And I have been credibly inform'd that one person hath planted so much of this one sort ... as hath been valued worth fifty thousand pounds to be bought."

He then compares the life of a man with and without this type of industry.

> "These are pretty encouragements, for a small and pleasant industry. That there is a lower, and more knotty sort, every husbandman can distinguish."

To do justice to such a work in such a short article is indeed impossible. I only recommend that it should be read by anyone interested in plants, both amateur or professional. It's a book, written by a man who loved plants, and who wanted to impart his knowledge to others. I can do no better than to finish with an extract from 'The Garden' an article by Abraham Cowley in the form of a letter to Evelyn.

> "I know no body that possess more private happiness than you do in your garden; and yet no man makes his happiness more publick, by a free communication of the art and knowledge of it to others."

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