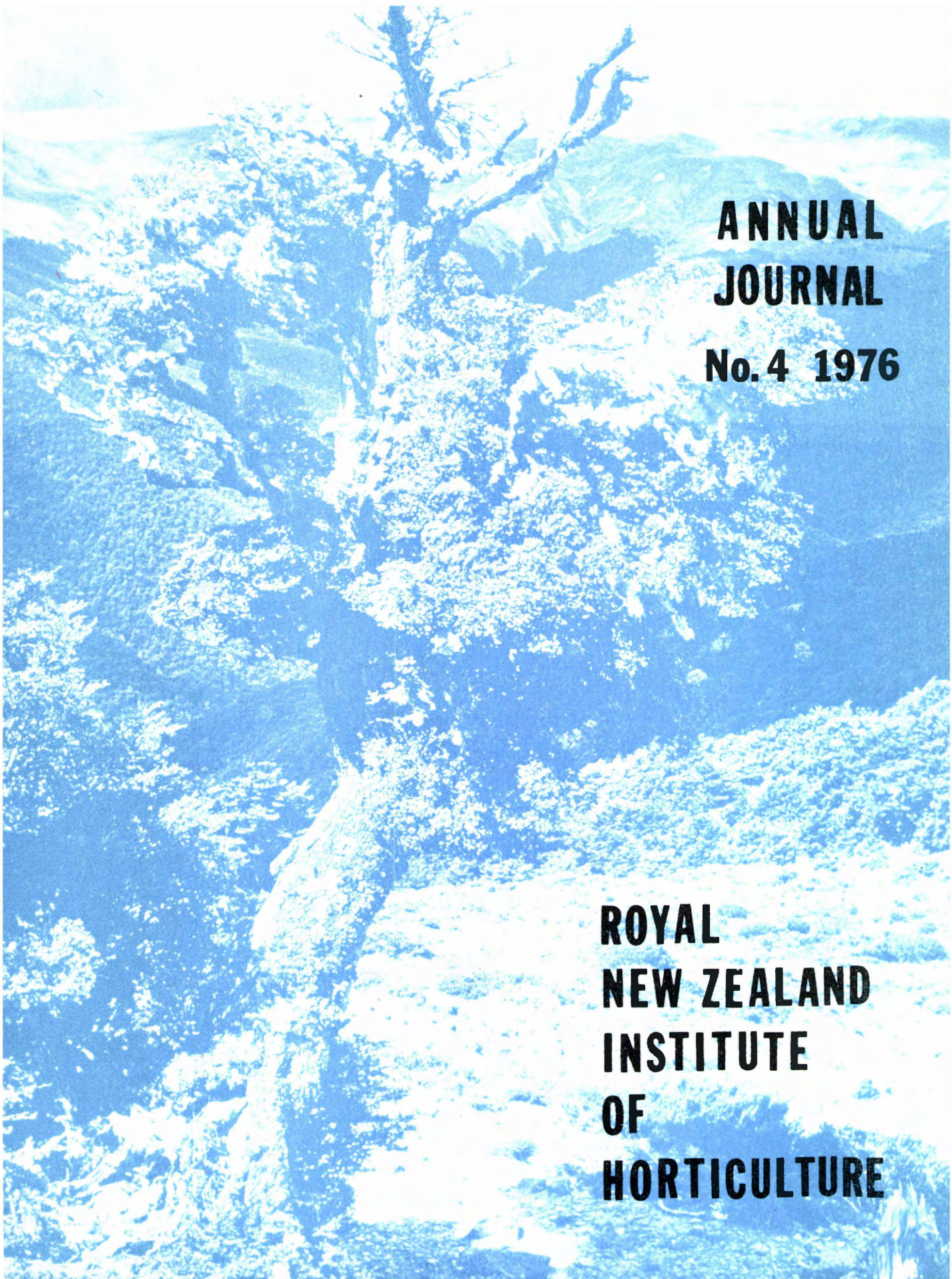


ANNUAL JOURNAL

No. 4 1976

ROYAL NEW ZEALAND INSTITUTE OF HORTICULTURE

ROYAL NEW ZEALAND INSTITUTE OF HORTICULTURE (INC.)

Dominion Secretary : Mr. J.K. Lemmon, A.C.A., A.C.I.S., First Floor, British Sailors' Building, 10 Brandon Street, Wellington 1; Postal Address, P.O. Box 450, Wellington.

Communications concerning membership, subscriptions, change of address, Extra copies of the Journal, should be made to the Dominion Secretary.

Editor : Mr. M.B. Thomas, M.Hort Sc., N.D.H.(N.Z.), Dip.Hort.(Linc.)
Assistant Editor: Mrs. J.A. Thomas, B.Sc.

Correspondence relating to the contents of the Journal, articles for publication etc. should be sent to The Editor, 94A Clyde Road, Christchurch.

COVER PICTURE

Gnarled mountain beech, *(Nothofagus solandri)*, growing on the Puketeraki range.

By K. Platt.

ROYAL NEW ZEALAND INSTITUTE OF HORTICULTURE (INC.)

ANNUAL JOURNAL No. 4 1976

Contributors

Dr. J. Wardle	Scientist, Forest and Range Experimental Station, Rangiora.
Mr. F. Berrysmith	Horticultural Advisory Officer (Viticulture) Ministry of Agriculture and Fisheries Auckland.
Mr. W. R. Sykes	Botanist, Botany Division, D.S.I.R. Lincoln.
Mr. R. Clark	Farmer and Horticulturist, Mt. Somers, Canterbury.
Dr. L. B. Moore	Botanist, Botany Division, D.S.I.R. Lincoln.
Dr. M. A. Nichols	Senior Lecturer in Horticulture Massey University
Mr. L. C. Hurndell	Horticulturist Crop Research Division, D.S.I.R. Lincoln.
Mr. J. R. Reeve	Horticultural Inspector Ministry of Agriculture and Fisheries, Hastings.
Mr. J.P. Salinger	Senior Lecturer in Horticulture, Massey University.
Mr. T. B. McDonald	Director, McWilliam's Wines (N.Z.) Ltd., Napier.
Mrs. E.P. Stuart	Horticulturist, Waipahi, Otago.
Mr. D. D. Riach	Nurseryman, Christchurch.
Mr. R.I. Mulholland	Horticulturist, Plant Diseases Division, D.S.I.R., Lincoln.
Mr. T.I. Crossen	Lecturer in Amenity Horticulture, Department of Further Education, Adelaide, S.A.

Contents

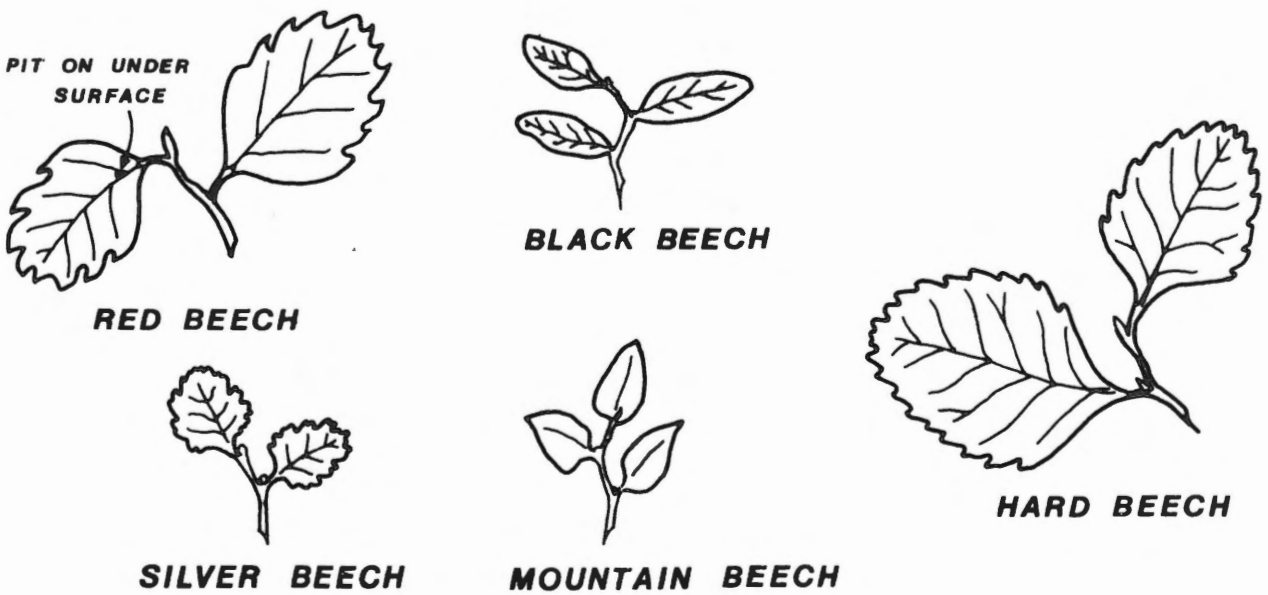
New Zealand Beeches

by J. WARDLE

Forest and Range Expt. Station, Rangiora.

The genus *Nothofagus*, commonly known as southern or false beech, belongs to the Family Fagaceae which includes the northern hemisphere or true beech, the oak and the chestnut. The genus includes approximately 40 species of trees, some of which are evergreen and some deciduous. It is restricted to the southern hemisphere and occurs only in New Guinea, New Caledonia, eastern Australia and Tasmania, South America and New Zealand. There are four species and one variety indigenous to New Zealand and all of these are evergreen. A number of other Chilean and Australian species have been introduced but are not grown extensively. These include *N. cunninghamii* from Australia, and *N. obliqua, dombeyi, alpina* and *antarctica* from Chile and Argentina. The four New Zealand species are *Nothofagus fusca* or red beech, *N.menziesii* or silver beech, *N. truncata* or hard beech and *N. solandri* or black beech. The variety is *N. solandri* var. *cliffortioides* or mountain beech.

The New Zealand species are usually identified by leaf shape and size (diagram). Both red beech and hard beech have large leaves around 30 mm long with toothed edges. The teeth are finer and more regular in hard beech and there are usually 8-11 veins compared with 5-8 in red beech. There is usually also a small pit at the junction of the mid rib and lower vein on the undersurface of the leaf of red beech which is absent in hard beech. The leaves of silver beech are also toothed but the teeth tend to be double pointed. The leaves are smaller (6-15 mm long), thicker and more glossy on the upper surface than with the previous two. Black beech and mountain beech both have entire leaves, usually between 10 and 15 mm long. The leaves of black beech tend to be oblong in shape whereas in mountain beech they are almost triangular. All the species other than silver beech hybridise freely though and intermediate forms of leaf are common. The most prevalent hybrids are between black beech and mountain beech, mountain beech and red beech and black beech and hard beech.



The beech species form the strongest element of our native forest. Over two-thirds of the total forest area in New Zealand is either dominated by or has a strong representation of one or more of the beeches. The most extensive beech forests usually occur in the vicinity of the main mountain ranges. Even though beech is such a strong element of our forest there are some notable areas where all species are absent or scarce. The genus is rare north of Hamilton and absent north of Kataia. All are absent from the vicinity of Mt Egmont, from the west side of the South Island between the Taramakau river and Paringa, and from Stewart Island.

The distribution of beech can mainly be explained by the competitive ability and ecological tolerances of the genus. Generally the beeches are unable to compete with the broadleaved hardwood species such as tawa *(Beilschmedia tawa)*, hinau *(Elaeocarpus dentatus)* and *Quintinia* on the optimum sites for forest growth. On the other hand, the beeches are able to tolerate far harsher conditions. Even within the genus, each species has its peculiar range of tolerances and specific ability to compete. Thus mountain beech has the least competitive ability but the greatest range of tolerance. It is nearly always found on poor soils and climatically harsh sites. It usually occurs at high altitudes where, especially in areas with relatively low rainfall, it may form the treeline. It only descends to low altitudes where soil drainage is poor, where there is slow weathering parent rock, or where soils are very low in fertility. It may occur as a transient on new surfaces such as slips and river terraces, but in these areas it becomes replaced by other more competitive species if the site remains stable for long enough. Silver beech is tolerant to the cold temperatures and short growing seasons at high altitudes provided humidity is high. It forms the treeline in our wetter mountain ranges and descends to sea level only in the south. Red beech and black beech both demand moderate soil fertility. Red beech usually grows on moist sites and black beech on dry sites. Both are usually found at mid altitudes though red beech may rarely form an upper treeline. Both species may descend to low altitudes near sea level, especially in the South Island, but where they do it is again

Nothofagus solandri var. *cliffortioides* (mountain beech) growing in the Southern Alps

usually only as a pioneer on new soil surfaces, or as isolated small stands on exposed ridges. Hard beech generally occupies a lower altitude than the other New Zealand beech species. It is not often found in forest subjected to heavy snowfalls and the seedlings appear to be susceptible to frosts below 10-12°F. On the other hand it seems more capable of co-existance with the broadleaved hardwood species.

The approximate site distribution of the various beech species and the inter-relationship of them with the broadleaved hardwood species at low altitudes, and the subalpine shrublands and alpine grasslands at high altitudes is shown in the following table. The habitat is divided into 6 compartments using two categories, high and low, for rainfall, and three categories, high, medium and low for altitude. Within each compartment, five site types are recognised. These are: very hard site which is one with very poor drainage, very shallow soils on slow weathering parent rock, or very low fertility; hard site which implies slightly better soil drainage, soil development or soil fertility; medium site which is average for soil drainage, soil development and soil fertility; and, good which is approaching the optimum for forest growth.

All the New Zealand beech species flower between September and November and flowering is usually later at high altitudes than lower down. Male and female flowers are separate but borne on the same twig. The female flowers in all species are small, green and insignificant but the male flowers may be quite attractive. In red beech, hard beech, and silver beech the anthers are usually straw coloured or dull red but in black and mountain beech they are a bright showy red. The flowers are small though and it is only because they are borne in such large numbers that the trees of the latter two species produce an attractive display. Flowers are not produced in abundance every year.

ALTITUDE

HIGH

SITE	SPECIES	SITE	SPECIES
Very Hard	Subalpine shrubland	Very hard	Alpine grassland
Hard	Silver Beech	Hard	Mountain Beech
Medium	Silver Beech	Medium	Mountain Beech
Good	Silver Beech	Good	Mountain Beech
Seral	Subalpine shrubland	Seral	Alpine Grassland

MEDIUM

SITE	SPECIES	SITE	SPECIES
Very hard	Mountain Beech	Very hard	Mountain Beech
Hard	Silver Beech	Hard	Mountain Beech
Medium	Red Beech	Medium	Black Beech
Good	Red Beech	Good	Black Beech
Seral	Red Beech	Seral	Mountain Beech

LOW

SITE	SPECIES	SITE	SPECIES
Very Hard	Mountain Beech	Very Hard	Mountain Beech
Hard	Hard Beech	Hard	Black Beech
Medium	Broadleaved hardwoods	Medium	Black Beech
Good	Broadleaved hardwoods	Good	Broadleaved hardwoods
Seral	Red Beech	Seral	Black Beech

All species have occasional good flowering years interspersed with a couple of years where very few flowers at all are produced. Likewise seed production is intermittant. The New Zealand *Nothofagus* species behave in a similar fashion to the northern hemisphere beech in that good seed years, known as 'mast' years, are spaced several years apart. The interval between 'mast' years varies between the different species and with site but on the average usually occur about 7 years apart. In these years as many as 50 million seed may fall per acre. Between masts there are usually a couple of partial 'masts' when some seed falls but in the remaining years very little seed at all is produced. Much of the seed which falls is eaten by birds and rodents and large increases in mice populations have been noted following good seed years.

Ripe seed is produced between February and June with a peak between March and April. In a 'mast' year up to 80% of this seed may be capable of germination but in a poor seed year very little is viable. Germination usually proceeds in the following spring but at low altitudes, especially in the North Island, it may occur in April or May, immediately following seed fall. The young seedlings of all species other than silver beech have notched colytedons, but in silver beech these are entire.

The best conditions for germination and early seedling development are where there is light overhead shade. For subsequent development, silver beech continues to favour some degree of continued shade but the other species become more light demanding. The seedlings of all species are capable of remaining in a quiescent state under the parent canopy for a number of years. Subsequently they die unless mortality in the parent stand provides an opening for growth. When released they can grow rapidly and saplings of red and black beech are capable of 1 m in height growth in a single season. The other species are slightly slower.

Some characteristics of New Zealand Beech Species

Species	Height (m)	Diam. (cm)	Max. Age (yr)	Leaf lgth mm	Leaf width mm	Male Flower colour.	Bark Colour.
N. menziesii	20-30	50-120	600	6-15	5-15	Dull Red	Greyish-white
N. fusca	25-35	60-130	550	20-40	15-25	Straw Colour	Dark
N. truncata	25-35	60-130	500	25-35	20	Straw Colour	Slaty to dark grey
N. solandri	20-30	50-120	400	10-15	5-10	Bright red	Very dark.
N.s.cliffortioides	15-25	40- 80	350	10-15	7-10	Bright red	Dark.

All the beech species, particularly red beech, black beech and mountain beech, are easily transplanted and cultivated provided they are given some overhead shade while small seedlings. Silver beech and hard beech are the most difficult. These two species are not as capable of surviving exposure to drying winds as are the other three species. Silver beech in particular requires a sheltered, humid site in which to become established. All species form attractive specimen trees especially when young, and black beech and mountain beech have attractively coloured though small flowers. Unfortunately, apart from some provenances of mountain beech, the beeches eventually grow too large for the average town garden but in parks and around farm homesteads, these species would be a definite asset and should be utilised to a greater extent than they are at present.

Viticulture in New Zealand, 1819-1975
Climate and Varieties

BY F. BERRYSMITH

MINISTRY OF AGRICULTURE & FISHERIES

Viticulture has been ecologically phased in with the development of mankind from time immemorial. This mainly relates to the regions of the world with a mediterranean to temperate climate which is best suited to development of grate vines.

Prospects for viticulture in N.Z. are already known in areas where grapes have been grown, but in other districts an opinion on the prospects for viticulture must be based largely on climatic data.

The climatic factor of most importance for assessing the viticultural prospects of a region is the total amount of solar heat recorded over the growing season. The term "heat summation" is used to indicate the total amount of heat received above the minimum for active growth. Grape vines make practically no growth at temperatures below 50 degrees F, so the heat summation is calculated as the sum of the mean daily temperatures above 50 degrees F over the October to April growing period in New Zealand. For example, if the mean temperature for November was 60 degrees F, the summation for that month would be 300 degree-days - 10 degrees multiplied by 30 days.

The heat summations for viticultural regions throughout the world range from about 2,000 to 5,000 degree-days. Commercial grape growing is not known to be successful anywhere the heat summation figure is much below 2,000 degree-days.

Meteorological statistics show that the degree-days heat ratings for places that may be considered as possible viticultural areas throughout New Zealand range from 2,919 at Kaitaia, in Northland, latitude 35°04', down to 1,615 at Alexandra, latitude 45°14', in Central Otago. It appears that every degree of latitude in New Zealand accounts for a difference of about 100 degree-days in heat rating.

In Europe all viticultural regions with temperatures similar to ours specialise in producing light table wines. These regions include the northern provinces of France, the Rhineland in Germany, and the warmer parts of Austria, Czechoslovakia, and Switzerland.

The best of the heavier dessert and sherry wines are produced in warmer latitudes. Table wines are also produced in these warmer regions, but usually do not attain the high quality of the cooler latitudes.

In the grape-growing countries of Europe and elsewhere a significant proportion of the crop is marketed as table grapes. Only in the warmer latitudes, with heat ratings above 3,500 degree-days and a drier climate are special grapes dried for raisins, sultanas, and currants.

In one of the most northerly vineyard regions of Europe, around Geisenheim, Germany, the heat summation is only 1,709 and the additional 300 degree-days needed to reach the minimum heat rating of 2,000 degree-days are gained in the sunny, sheltered situations of the vineyards. Thus, in similar instances of a low heat rating from the local meteorological records, viticulture could be successful on selected sites with somewhat warmer conditions than are general for the area.

Over the 212 days in the growth cycle of the vine in New Zealand, from October to April inclusive, a selected, sheltered site with a favourable sunny aspect could be 1.5 to 2 degrees F warmer than the meteorological recording site for the area, and thus gain an extra 300 to 450 degree-days for its heat summation.

On deep, friable soils a rainfall of about 12 in. during the growing season is adequate, if preceded by good winter rainfall of about 15 in. Of course, with

adequate irrigation vines are independent of rainfall. Ideal rainfall conditions as harvest approaches in New Zealand are heavy rains in January and very little for the remainder of the season, as late rains will damage most grape varieties.

The following table shows the heat ratings, October-November frosts, and rainfall figures for several towns throughout New Zealand.

The table shows that the main areas of commercial production in the Auckland, Hawke's Bay, and Gisborne areas are likely to provide satisfactory conditions for increased grape production.

Other promising areas in the North Island are parts of Northland, Thames, Tauranga, Te Kauwhata, and Wanganui.

The most favourable localities in the South Island appear to be near Nelson (Appleby) and Blenheim, with possible suitable micro-climates in Canterbury and Central Otago. Success in the south may be limited to the selection of suitable early-maturing varieties.

LOCALITIES SUITABLE FOR VITICULTURE

Location	Heat Ratings Degree-days	Days Ground Frost		Rainfall (inches)				
		Days Screen Frost						
		Oct	Nov	Feb	Mar	Apl	Season	Year
Kaitaia	2,919	0.1	-	3.4	2.8	4.9	26.0	54.0
Lat. 35° 04'		-	-					
Henderson	2,659	0.5	-	5.0	4.0	5.0	31.8	62.1
Lat. 36° 54'		-	-					
Thames	2,876	0.2	0.1	3.8	3.6	4.3	26.2	49.6
Lat. 37° 09'		-	-					
Tauranga	2,481	4.0	1.6	3.5	3.8	5.0	27.1	51.2
Lat. 37° 40'		-	-					
Te Kauwhata	2,594	-	0.1	3.4	2.8	4.0	23.8	46.3
Lat. 37° 25'		-	-					
Wanganui	2,227	0.2	0.1	3.0	2.2	2.8	19.5	34.4
Lat. 39° 55'		-	-					
Gisborne	2,454	2.6	0.6	3.2	3.0	3.4	19.2	39.8
Lat. 38° 40'		0.2	0.1					
Hastings	2,412	3.8	0.6	2.7	2.0	2.5	16.1	30.6
Lat. 39° 39'		0.5	0.1					
Appleby (Nelson)	1,962	3.1	0.7	2.4	2.2	3.3	19.5	36.9
Lat. 41° 17'		0.1	-					
Blenheim	2,040	6.5	1.6	1.9	1.6	1.9	13.6	25.8
Lat. 41° 30'		0.5	0.1					
Christchurch	1,740	5.2	2.4	1.8	1.7	1.8	13.4	24.5
Lat. 43° 29'		1.2	0.1					
Alexandra	1,615	12.9	6.0	1.4	1.3	1.3	9.4	13.2
Lat. 45° 15'		1.9	0.2					

Acknowledgement: Meteorological data obtained from Department of Civil Aviation Publications.

Most places in the North Island, particularly in the Auckland Province,are somewhat handicapped by the high rainfall during the critical grape-ripening period of February to April. This limits varieties to weather-resistant types for economic production.

Of the districts with a low rainfall during the grape-ripening period, Canterbury and Central Otago have a degree-days heat rating that is too low, and late spring and late summer frosts can also be a problem. Sprinkler irrigation for both irrigation and frost control and the location of vineyards in micro-climatic conditions with heat ratings higher than general, could lead to successful viticulture in carefully selected areas. However, it is unlikely that large-scale grape growing would be successful.

Days of ground frosts are recorded at ground level, and screen frost recordings are taken in a ventilated screen about 4 ft above ground. It can be seen from the climatic table how the incidence of frost is reduced at this slight elevation. For instance, at Alexandra the average number of frosts at ground level in October is 13, and on the screen the average is only two. In November the average number of frosts at ground level is six, whereas at screen level the average is only about one frost in five years

High trellising could therefore reduce the risk of frost damage. In marginal viticultural regions in Europe the risk of frost damage is reduced and maximum heat obtained by establishing the vineyards in elevated positions on sunny hillsides.

Botanical records classify the grape vine under the plant order Rhamnales in the family Vitaceae and genus *Vitis*. All species of grape vines are included in the *Vitis* genus but the one of outstanding significance to man is *V. vinifera*.

Vitis vinifera includes all the finest table and wine grapes which originated in Europe and the Middle East prior to the discovery of America. Many new grape vines were found in America. Of notable economic significance is the *Vitis labrusca* species somewhat extensively used for wine and juice production in the U.S.A. and Canada. Of special viticultural importance are such native American species as *V.berlandieri; V. rupestris; V. champini; V. riparia; V.solonis*.

These wild American grapes have been selected and hybridised as rootstocks to improve the performance of quality *Vitis vinifera* grapes throughout the world. *V. vinifera* and most Franco-American hybrids are usually damaged and eventually destroyed from predacious soil insects and diseases unless grafted on to resistant rootstocks.

Botanically related to grape vines is the well known Virginia creeper also in the family Vitaceae. Thus to the botanists and others the grape vine is a creeper and naturally likes climbing. The professional botanist also tells us the grape vine is a true berry fruit in that the seeds are surrounded by pulp in a soft skin package. It rightfully shares the ratings as a berry fruit with gooseberries, blueberries, cranberries and tomatoes, whereas strawberries, raspberries and blackberries are not true berries.

Viticulture was a leading horticultural activity in the colonisation of New Zealand. Outdoor or vineyard grape growing had limited success in varous parts and historic records were made of viticultural endeavours at Akaroa, Waimate, Kerikeri, Wellsford, Wanganui, Golden Bay, Hawkes Bay, Auckland.

From early colonisation grape growing in glasshouses has featured prominently throughout New Zealand.

In 1974 the Dominion total area in glasshouse vineries was 50,000 sq. metres and production 200 tonnes. A promising air freight export market for select quality glasshouse grapes has been developing in recent years. Under glass Gros Colman is almost exclusively grown for late grapes and Black Hamburgh for the early market.

For the 1974 vintage production of grape wine was 324,250 hectolitres (7.1 million gallons). Production comprised 53% various low alcoholic strength, table wines and 47% a range of strong dessert wines.

Every five years the Ministry conducts a national vineyard survey. The 1975 survey has been completed and is pending computation and will be published in the N.Z. Journal of Agriculture about June 1976.

A provisional estimate for the national area in vineyards at 1975 was 2,700 hectares or 6,750 acres. Over the last decade vineyard area and wine production in New Zealand rather more than quintupled.

Each vineyard survey has shown a changed pattern with the grape varieties in production. The most recent trend has been fuller recognition of the superior wine making qualities of Vitis vinifera or old world grape species compared with the Franco-American hybrid grape varieties. The greatly improved cropping ability from recently acquired *Vitis vinifera* grapes free from debilitating virus diseases largely accounted for this advanced attitude.

One of the earliest grape varieties, which had highly significant impact on establishing the viticultural industry in New Zealand was a grape variety named here as Albany Surprise. It appeared as a natural sport or mutation of the American grape Isabella in a commercial vineyard at Albany near Auckland. The same sport from Isabella appeared in America where it was called Pierce.

For many years Albany Surprise was used to make white and red dessert wines and market as a table grape. In the tide of progress Albany Surprise has been superceded by better quality wine and table grape varieties.

Varieties which have mainly superceded Albany Surprise for the table grape market in New Zealand are Golden Chasselas; Iona; Schuyler; Keuka; Seyre Villard 20473; Muscat Hamburgh; Red Malaga; Alphonse lavallee; Queen of the Vineyard; Diamond; Niagara; Muscat Italia, Palomino; Riesling-Sylvaner.

Grape genetists recently recognised Albany Surprise as a tetraploid mutation of Isabella (38 chromosomes). That is, it is the same grape with twice the number of chromosomes (76), which has greatly changed its characteristics. The modified version has larger berries with improved cropping, more consistent bearing and advanced maturity.

In recent years grape genetists have bred and selected many good tetraploid grapes for the viticultural industries around the world. The door to this field of plant breeding was opened by the discovery of colchichine an alkaloid chemical obtained from meadow saffron often capable of influencing mitosis and tissue metabolism.

Many new tetraploids and vine crossings have been carried out by West German research institutes in recent years. The offspring vines have the genetical pattern for improved performance under various adverse conditions in the field.

At our present stage of development one of our top rated high quality, white table wine grapes is Riesling-Sylvaner, also known as Muller Thurgau. Highly regarded as a productive good sherry wine grape is Palomino. Other classical grape varieties extensively grown are Cabernet Sauvignon; Pinot Gris; Merlot; Pinotage; Pinot Chardonnay; Pinot Noir; Golden Chasselas; various Muscats etc.

The establishment in 1975 of the Wine Institute of New Zealand was a momentous advent for the viticultural industry. This federated body uniting somewhat contentious factions of the industry will foster co-operative, co-ordinated effort in the best interests of viticulture in New Zealand.

Shrubby Datura Species in the South Pacific

By W. R. SYKES

Botany Division, D.S.I.R., Lincoln

Of the 24 or so species of *Datura* about 14 are shrubby, and three of these are found in New Zealand and the subtropical and tropical islands to the north. These shrubs were once put in a separate genus called *Brugmansia* and the name *Datura* only referred to the more or less herbaceous plants with spiny fruits which we call thorn apples. However, today most botanists put these two genera together because their members have so many other characters in common, and are easily distinguished from other genera of the Solanaceae. All the *Brugmansia* group originate from the northern Andean region.

In our part of the world the commonest of the three species is *Datura candida*, the angel's trumpet, Fig 1, once known as *Brugmansia knightii* and sometimes erroneously called *D. arborea* or *D. Suaveolens* in New Zealand. *D. arborea* is a very closely related plant which has a smaller corolla than *D. candida* but which may not really be a distinct species from it. I have not seen it in the South Pacific and at least some records of it refer to *D. candida*. *D. suaveolens*, Fig. 2, is also closely related but unlike *D. candida* has a calyx with 5 unequal lobes or large teeth instead of single segment which splits down one side like the spathe of aroids and some other monocots. I have only seen *D. candida* in the semi-double or double form and *D. suaveolens* with single flowers, but they both have similarly shaped leaves (*D. candida* is hairier), and similar sized pendulous, white, very fragrant flowers.

D. candida is a common garden plant of almost or quite frost-free areas of New Zealand. This means that it mainly grows in coastal areas apart from warmer parts of the North Island north of the Volcanic Plateau. In the South Island it grows in warm areas around Nelson and in the Marlborough Sounds, down the West Coast, and in a few favourable eastern localities; the Kaikoura area, Banks Peninsula, Otago Peninsula. North of New Zealand it flourishes in tropical Melanesia and Polynesia and is more or less adventive in islands such as Niue. In the South Pacific at least, it rarely forms the smooth, oblong, green capsules and only in Waimate North and Auckland have I seen or heard of ripe fertile seeds being formed. On the other hand, the true *D. suaveolens* seems to be a rare species in the region. It has grown on Norfolk Island for many years, but is uncommon and probably not cultivated now. It is almost certainly from there that plants were taken to Raoul (Sunday) Island in the Kermadec group during the earlier part of the time of Thomas Bell and his family late last century. It flourished and spread in a small gully where it still grows adventively. This is the plant called "Night Bells" in the saga of the family on Raoul, called "Crusoes of Sunday Island". I have not seen this species in New Zealand itself but it is a rare cultivated plant on Mangaia and possibly Rarotonga in the Southern Cooks. I have never seen the oblong green capsules.

The other species of shrubby *Datura* in this region is *D. rosei*, usually but wrongly called *D. sanguinea*, *Fig. 3*. This shrub has similar large hairy foetid leaves to *D. candida* but has pendulous corollas which are yellow or yellow with orange-red lobes. These are always single and the smooth green capsules are produced more commonly than in *D.candida*. However, as with its relatives, vegetative propagation by cuttings is easy. The form with red corolla lobes is the commonest and in fact the only one that I have seen mentioned in overseas literature. Apart from the colour they are indistinguishable. *D. rosei* does not seem to be cultivated in the tropical and subtropical Pacific islands. In New Zealand it is widely cultivated but is not as common as *D. candida*. *D. rosei* seems to be a little hardier than *D. candida* and can survive much dying back from frost damage, although recovery is then so slow that flowers are not formed until the following autumn.

The *Datura* species have achieved notoriety in recent years in countries outside their South American home because of the hallucinogenic affects that have been obtained from them. Unfortunately for the user, the toxic properties of members of this genus mean that the results can be very unpleasant indeed, in fact it is an adventure from which there could well be no return. American Indian people from Chile to Columbia have used *Datura* species in their religious ceremonies for centuries for their mind-bending properties, but it is a delicate balance and no-one knows for how many it has been a one way trip. It is because of this use that they were cultivated and sought after by the Incas, Chibchas and more modern peoples like the Jivaros of Ecuador. In addition, some selection must have taken place in bringing plants from the wild and afterwards in cultivation. Certainly today some of the difficulties of defining the species is apparently related to the failure to find wild populations of some of them. Despite the fact that certain people in such countries as ours will experiment with them whatever they know about their toxicity, this should not in my opinion mean that the horticulturists of New Zealand should feel morally obliged to destroy all plants in their gardens. After all, there are many other attractive ornamental plants which are poisonous and some of these also have mind-altering properties e.g. *Ipomoea, Papaver,* certain legumes and even labiates, and if we set out to eradicate them all, our gardens would be much the poorer without them.

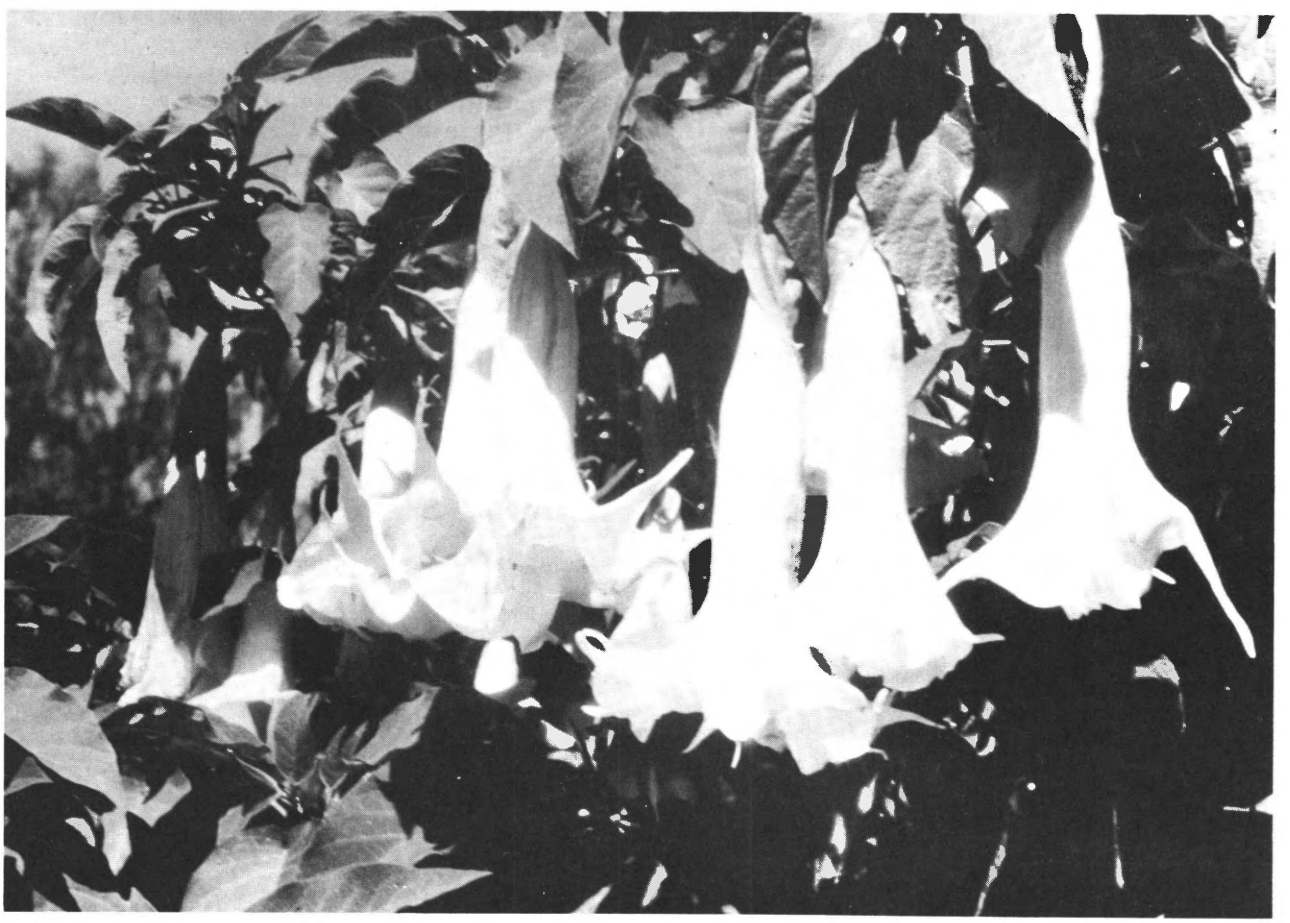


Fig. 1. *Datura candida* in a Port Hills, Canterbury garden.

Fig. 2
Datura suaveolens
in Nightbell Gully
on Raoul Island
in the Kermadecs.

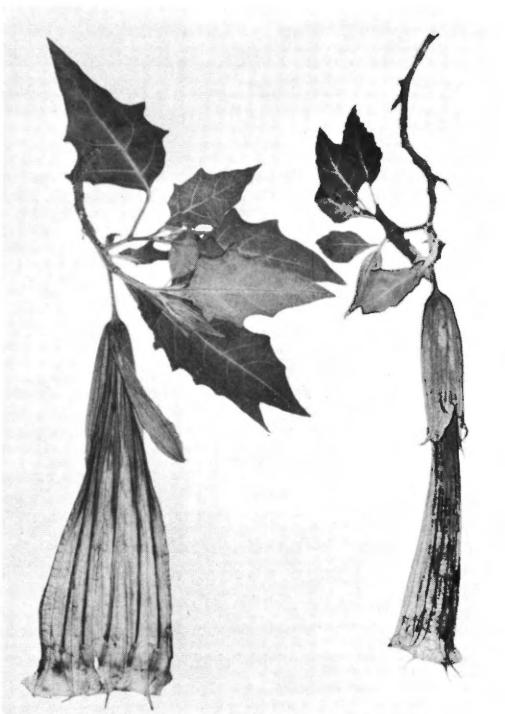


Fig. 3
Datura rosei
From a dried specimen
in the Botany Division,
D.S.I.R. Herbarium,
(Lincoln).

Walnuts in New Zealand

by

R. CLARK

Our walnuts are like our politicians, some are poor, some mediocre and darned few first class. Most of the trees stem from early introductions and without any exceptions that I can think of, they are seedlings. Consequently they are very variable in quality, prolificacy and frost resistance.

Inevitably with such a host of seedlings, there are some first class trees like one I know at Akaroa which averages 300 lbs. a year and which has gone as high as 500 lbs. in a good season, and this without any fertilisers. Another good one grows on Jack Kane's farm at Mt. Somers. It is a smallish tree which produces a good crop of nuts every year, despite being a long way from any other walnut. Hence it must be self pollinating (which may be disappointing for it), but does mean that it would be an excellent tree to provide grafting wood for the home gardener who just wants a single tree. Further it never misses a season, despite being at an altitude of 1100 feet, exposed to late frosts.

Obviously the answer is to propogate trees like these by grafting or budding as we do other fruits, but it is not all that easy. I think there is only one nursery in the country that sells grafted trees and the nurseryman finds his success rate is pretty low.

Yet in California there are no less than 175,000 acres in walnuts alone, a large scale industry, which is based on grafted trees, selected for prolificacy, early bearing and nut quality.

After a lot of false casts, the answer came up loud and clear. We could not produce grafted walnuts because we seldom had a temperature of 80 degrees F, which is essential for callusing. In other words we cannot graft walnuts out of doors unless we strike a heat wave at the right time.

Then we came across some Czech work describing how they grafted seedling walnuts in the winter when the callusing does not stop even though the plant is dormant. They put the newly grafted trees in a hot box and kept them at a temperature of 80 degrees for three weeks. I have tried it. It works a treat. It means that we are now able to reproduce walnuts of the best varieties from anywhere in the world. Further grafted trees will start bearing in five to seven years compared to 12 to 15 for seedlings.

However there is far more to this than just helping the home gardener. We import no less than $300,000 worth of walnuts every year and just a hop skip and a jump across the Tasman, the Australians import a million dollars worth. Further, there is no country in the Southern Hemisphere which exports walnuts. Thus we should be able to grow and sell the new season's crop six months earlier than the main growers in the Northern Hemisphere.

The Pecan nut industry in the States grosses $80,000,000 a year and the Americans have planted pecan orchards in Australia to fill the off season gap. Nuts are a very high risk crop to deal with owing to insect damage and rancidity problems, and of course no dealer will wish to hold stocks longer than he can help with current liquidity difficulties. So there would seem to be every chance of starting another export industry.

Recently a walnut expert from California toured this country and when asked about the prospects of growing walnuts here, said that in his opinion we had all the climatic advantages of California with far cheaper water and land, right here in Canterbury.

This prospect fired the enthusiasm of John Hall, an importer of nuts in Auckland, and he arranged to import 70 improved trees from California. They were dug 300 miles from San Francisco, airfreighted to New Zealand and were in the ground 26 hours after they had been dug up. He has arranged for

them to be grown near Ashburton which is his pick as an area for starting a walnut growing industry. Very kindly he gave me one each of the four cultivars. Of course they will have to be proved suitable for our area. Hopes are high. One of them called Hartley covers no less than 40,000 acres in California. It is a natural selection but the other three, Vina, Chico and Serr, have been bred for prolificacy and early bearing. They do that all right. They're only four feet high and two of them have nuts on already! If they can stand our conditions of frost, they will be the foundation stock for our orchards.

Walnuts are very high in food value with 64% fat, 15% protein and 6,500 calories a kilogram. Our Californian friend estimated that we should produce 3000lbs an acre. Let's be conservative and work on 2000 lbs. If they crack out at 50%, then we will be producing no less than 150 lbs of protein an acre, year after year after year. This is far ahead of anything we are doing with the grazing animal.

As population pressures push the human animal towards vegetable foods and away from meat, he could have an ample source of protein available from walnuts to upgrade his starchy staples.

We are only just beginning to work on walnuts here. We have formed the New Zealand Tree Crop Association and have issued our first Journal. This will be vital as we must share all the information we can as widely as possible.

Any enthusiast can get in on the act right now.

Start off by getting some good nuts and soak them in water for 48 hours next August. Then put them in a container full of damp sand.

Once a week, go over them and pick out any that have started to germinate. They can be sown in the vegetable garden. It is important that you plant them the right way up. They should be planted so that the suture line is vertical and with the longest axis of the nut parallel to the ground. This means that the root and shoot have the best possible chance of emerging without getting caught up in the shell.

Next move is to identify the best local walnut tree. The best time to look at it is in March/April when it should be laden with nuts. Some trees are positively dripping with them, and if the nut is sweet and a good size, mark them down.

Once the tree is dormant you can cut the scion wood. Choose growth from the current year's growth. It is hard to find good scion wood on an old tree as it will make very little new growth. Preferably you want strongly growing wood with the buds well apart. On an old tree, it may be necessary to cut off a branch in the spring and use the new wood sent up from the wound.

This should be stored in the refrigerator wrapped in a plastic bag with a little damp moss or newspaper to prevent it from drying out. For the same reason it is a good idea to wax the cut ends.

Now to make the heat box. My first one was made from a wooden packing case that had been loafing round the farm. Dimensions are unimportant. It should be lined inside and outside with aluminium building paper to provide insulation. I used Pinex for the lid.

You'll need to buy a covered electric bar heater and a thermostat. The heater goes at the bottom of the box with a platform above it to hold the containers full of grafted trees.

Next move is to dig the seedlings. The problem, so often quoted, about excessive bleeding of the stock, doesn't seem to matter with this winter grafting technique. In my experience you can graft any time during June, July and August.

The ordinary splice and tongue graft seems to be satisfactory. I got rather professional and used the East Maling double tongued graft for the last big batch I did and think I would use it in

future. I found that plastic budding tape was better than rubber grafting bands and wax. Of course I waxed the cut ends of the scions.

Both the stock and the scion should be dipped in fungicide. I use Thiram. I think this is important as obviously a temperature of 80 degrees, with a high humidity, is just the job for fungus to grow.

After grafting, pack the bare rooted grafts into a plastic container and cover the roots with perlite, sand or something similar that can be moistened, to keep the roots damp. Don't use sawdust. One lot of mine using sawdust started composting, and I cooked my wretched trees with a temperature of 110 degrees!

Finally cover the top of the container with a plastic bag to keep in the moisture and pop the whole thing into the heat box. Turn on the heat and leave it for three weeks before taking it out and potting up the trees.

Quite a few of the buds will swell and break which is very exciting. Aftercare is important. Obviously any growth is weak and sappy so ideally the temperature should be brought back gradually. I kept my grafts in the house for some weeks before putting them out in a shade house.

We want to know the whereabouts of the best nut trees in this country. Some could be better than anything overseas for our conditions. We also want to identify really good hazels and chestnuts. Maybe you can help. If so please contact me.

And if you are getting really interested, why not join the N.Z. Tree Crop Association by sending $3 to Dr. David Jackson at Lincoln College. You'll be most welcome and will be in on the ground floor of this exciting new venture.

Citation for the Loder Cup Award, 1975

Dr. Alan Mark.

(This Award is made annually by the Minister of Agriculture and Fisheries to encourage the protection and cultivation of native flora in New Zealand. Nominations for the Award, supported by a statement of their work within the theme of the Award, are invited each year. The Cup was presented for competition within New Zealand by the late Gerald W. Loder, later Lord Wakehurst of England. The competition is now in its 46th year, the first award being made in 1929.)

Dr. Mark, who is Associate Professor of Botany at Otago University, has established a sound reputation both within the University and amongst outside public bodies, greatly helping to mould public opinion through the publication and use of the findings from his painstaking research and studies of the Otago and Fiordland mountain environment and of the native plants and forests which grow there. He has done much formal teaching and a great deal of research work, leading to the publication of nearly 40 scientific papers, and has also made a great impression and exerted considerable influence as an educator in the field of natural science outside his busy academic life. His claim to the Award of the Loder Cup rests mainly on what he

has done to extend his teaching into the community and apply his professional knowledge to important practical issues.

These activities began some years ago with the organisation of parties to clear weeds from the Dunedin Town Belt. This laid the foundation for the successful work that Ecology Action now does in Dunedin. During the Manapouri controversy Dr. Mark took parties of students to obtain measurements relating plant distribution to lake levels and a great deal of our present knowledge of the consequences of fluctuating lake levels in the Manapouri/Te Anau area comes from his work. He is presently Chairman of the Guardians of the Lakes Committee established by the Government, and as such has played an important role in stressing and demonstrating the place of ecological research in long-term decisions affecting the environment.

More recently proposals have been made to use native beech forests for commercial purposes. Once again Dr. Mark has been active in arguing that research is necessary both to establish the long-term viability of the proposal and to preserve the multiple environmental values dear to many New Zealand people. He has been primarily responsible for the establishment of two scientific reserves near Dunedin - one for snow tussock at Black Rock, much of his research having been on the ecology of high altitude tussock grasses, and the other for sub-alpine vegetation in the Mangatuas. The Scientific Reserve on Mt. Cargill was also established largely through his efforts. He is constantly in touch with the Lands and Survey Department, in Dunedin and Invercargill, about the maintenance of present scenic and scientific reserves and the selection of new ones.

Dr. Mark has shown exceptional energy and initiative in the extension of his professional discipline into the public arena. At all levels, from Government Ministers to youth groups, he works to increase public interest in the ecology of New Zealand's indigenous flora, for its own sake and also for the benefit of the planning process. For over two years he devoted all his free time to a vegetation survey for the Mount Aspiring National Park Board and this will initiate a new series of Scientific Publications by the National Parks Authority. He has also presented to the Park Board voucher specimens of the Park's flora as a nucleus of an Herbarium which is located at Wanaka. Photographic points were set up in 1969-70 by Dr. Mark covering a representative range of the vegetation types in the Park in an endeavour to provide a permanent record of the existing vegetation and to allow any changes therein to be followed. He has also established a native mountain plant garden at the Otago University.

During the last five years Dr. Mark has used much of his remaining spare time to compile a book "New Zealand Alpine Plants". This work is in collaboration with artist Miss Nancy Adams who was awarded the Loder Cup in 1963. With this book the authors set out both to educate and delight the public with a work that is scientifically and artistically accurate. It cannot fail to foster a wider public interest in the mountain environment and the plants that grow there and is perhaps the most conspicuous evidence to date of Dr. Mark's enthusiasm for proper appreciation and protection of the New Zealand flora. His efforts have far exceeded the normal call of duty within the objectives encouraged by the donor of the cup.

(Summarized from nominations by New Zealand Ecological Society (Inc.), Mount Aspiring National Park Board, and the University of Otago.)

Libertia, New Zealand's Native Iris

by

L. B. MOORE

Botany Division, D.S.I.R., Lincoln

When the genus *Libertia* was originally described in 1824 the author (Kurt Sprengel, 1766-1833) said nothing about the derivation of the name but it has been generally accepted that this genus of modest iridaceous plants was named in honour of Marie Anne Libert, (1782-1863) "a Belgian lady writer on liverworts" (Royal Horticultural Society, 1951). The Catalogue of the Library of the Linnean Society of London lists under her name "Memoires sur les Ascoxylacei, Lille, 1830". No one explains why the German Professor should wish to honour the Belgian lady.

Libertia is one of the genera with representatives in New Guinea, Australia, Tasmania, and South America, as well as in New Zealand where four species are recognised. The first introductions into Northern Hemisphere gardens date back to 1823. Among the half dozen species grown is *L. coerulescens* from Chile in which the flowers are pale blue, not white as is usual in the genus.

A detailed study of New Zealand *Libertia*, begun at Botany Division, DSIR, in 1961, involved not only examining hundreds of specimens in local and overseas herbaria, but also the close observation of growing plants in many districts. Plants from numerous localities (more than 100 accessions) were assembled,many through the good offices of amateur botanists, to be grown side by side at Lincoln, most of them in pots in a shade house but some set out in open beds and a few in glasshouses. In general transplants established well, and several different plants from one locality could be compared with one another and with those from other places. Chromosome counts (Hair et al.1967), made on 30 plants, helped to establish relationships. Several progenies were raised from seed, and a small experiment indicated that self-fertilisation is effective. Seeds have in general germinated satisfactorily in a John Innes seed mix. In the shadehouse seedlings appear in great numbers each spring both in the pots and on the surface of the breeze in which they are plunged. Plants from seed have usually flowered at three years old, occasionally at two years. Plants should be easy to divide for increasing numbers but we have had little occasion to do this.

The taxonomic results of this study, reported with illustrations and distribution maps (Moore 1967), formed the basis for the treatment in the Flora of New Zealand, volume II (Moore and Edgar 1970). More directly horticultural aspects are now discussed.

Three of the native species and one from South America (indicated by *) are quite commonly grown in New Zealand, some for attractive foliage, some for a brief show of flowers, and some for the long-lasting, colourful capsules. Plants are by no means always correctly named, partly because of the wide range of form within each species (Fig. 1). Technical differences, mostly involving flowers and/or fruits are set out in a key on p. 25 Admirers of Just So Stories may prefer a rhymed mnemonic for the two commonest species.

Grandiflora, stems tall,
Flowers big, fruits small.

Ixioides, leaves tall,
Fruits big, flowers small.

1. *L. grandiflora*

The best characters for identification are the small size of the ovary just before the flower bud opens and the rapidly ripening, early (and usually widely) dehiscing, brown capsules. The openly branched panicle almost invariably stands well above the leaves and the flowers are large for the genus, often 2 cm or more in diameter. This species has been collected in many parts of

the North Island, but South Island collections are fewer and come mostly from near the coast, from Marlborough Sounds to Nelson.

Variability. Three distinct groups were recognised:

A. Tufted plants (i.e. lateral branches short and new fans coming up amongst the old, and therefore spotbound); 6 ploid; widespread geographically and diverse in form and size (Fig.1).

B. Tufted plants; 12-ploid; known only from a single colony near the summit of Mt Tamahunga in Rodney County (Grid ref: NZMS 1, N34--227272) at an altitude of c.430 m. Two collections (December 1961 and January 1967) both had this unusual chromosome number. Leaves are long (e.g. 55 x 1.2 cm), drooping and grass-like, indistinguishable from those of 6-ploid plants from a few kilometres away, but quite different from those of 12-ploid *L. ixioides* growing on the lower slopes of the same mountain.

Fig. 1. *Libertia grandiflora:* Four contrasting forms, all from the Wellington-Marlborough area, grown side by side at Lincoln; all are tufted and all 6-ploid. Scale in inches.
Photo: C. J. Miles

C. Rhizomatous plants (i.e. lateral branches long and sending up new shoots many centimetres away from the original); 6-ploid; mostly with short narrow leaves (e.g. 30-60 x 0.4-0.6 cm., but some to 70 x 1.1 cm); known only from above the western shore of Lake Wairarapa, both on clay and on stream banks in part shade.

Cultivation notes. Four progenies of tufted plants (a) were grown from seed and in each the 5-7 plants grown on formed a uniform set, the sets differing from one another, as did their parents. One progeny was from a plant isolated from others in a bush house. This suggests that plants come true from seed and can be self-fertile. Apparently good seed set on another plant isolated in a glass house but no seedlings resulted from seed sown. Closely related plants grown under different conditions retained their common characteristics though becoming larger and greener with more moisture and shade and shorter and yellower with less. Grown side by side representatives of different populations retained their differences.

Leaf size within the species ranges from 30 cm. by less than 4 mm to 75 mm by more than 1 cm. Smallest-leaved plants come from Wellington and Nelson, though some southern populations have medium-sized leaves. Plants from Auckland tend to have large leaves though medium sizes are not uncommon there. Leaves that are flat with only a broad, ill-defined midrib tend to droop from about the middle, others with strong, narrow, often raised and sometimes pale midrib may stand quite erect and perhaps tend to be darker green. Rough margins on adult leaves characterise certain populations only and are perhaps more associated with broad leaves.

Rhizomatous plants (C) with small narrow leaves and a twitchy habit form tight, fibrous turf extending over a square metre or more but even stronger than these are some with larger leaves. These might be troublesome to control in a garden.

2. *L. ixioides*

The best identification marks are the size of the young ovary which almost equals the perianth in late buds, and the very durable yellow capsules. The ovary swells quickly and the fruits are full grown but still green by January; then they gradually turn yellow and most remain brightly coloured but unopened through the winter. If picked at the right stage they retain both shape and colour and are permanently useful for dry arrangements. Left on the plants they ultimately split apart at the tip and the walls wear whitish. The flower stalk is usually shorter than the leaves and the head is more closely and heavily branched than in *L. grandiflora*, with smaller and less pleasing flowers. This species has been found in many places throughout the North and South Islands and in Stewart Island. It is the only species known from Banks Peninsula and the Canterbury foothills, but in Marlborough Sounds at Resolution Bay, in parts of Wellington, and also in North Auckland it occurs not quite in company with but certainly not far from *L. grandiflora*.

Variability. Two distince groups were recognised ;

A. Tufted, closely growing plants; this, the usual habit, is associated with a wide range of form and size.

B. Rhizomatous, widely spreading plants, known certainly from only one locality and plants from there are uniformly robust.

Cultivation notes. The range of leaf form rather parallels that found in *L. grandiflora* and plants without flowers or fruits are often difficult or impossible to place certainly as to species. Two progenies grown from seed were uniform among themselves and resembled the parents. One of these ("big pods") is an outstandingly good garden plant. It is strong-growing but spotbound and has pleasing foliage but it is most remarkable for its large, very well coloured capsules up to 2.5 cm long. Our seed was presented by

Mrs. F.C. Duguid of Levin whose plants originated from Miss B.E.G. Molesworth, labelled as from Waitakere Ranges, Auckland. Herbarium specimens suggest that equally large capsules may occur in other northern localities.

The excessively vigorous plants (B) produce yellowish rhizomes, up to 2 mm thick, that run either under or over the ground and sprout new tufts as much as 30cm from the parent. The flower is large for a *Libertia*, with oblong tepals, but the capsule is not especially big. The only certain locality for this plant is at the head of the Kopuapounamu Valley, west of Te Araroa, under the Raukumara Range, where they were discovered and grown by Mr. W.F. Metcalfe. We received our plants in 1963 through Mr. N. Potts of Opotiki, some labelled as from Waiwera, north of Auckland. No rhizomatous plants are to be found at Waiwera and it seems probable that confusion arose in the garden through the East Cape plant migrating to become associated with adjacent plants from Waiwera. Seed from Mr. Potts, labelled "originally from Te Araroa" was sent from Botany Division to Kew in 1957 and plants from it were fruiting in the Temperate House in 1963; they were immediately recognisable, as were nearby plants of *L. peregrinans* from seed collected on Chatham Island by N. T. Moar and sent from Botany Division in 1960. Though attractive, the strongly invasive East Cape form would be hard to control in most gardens and is probably best excluded.

3. *L. peregrinans*

This species had a strong rhizomatous or twitchy habit and it grows well in sand, sandy peat or pumice where its rhizomes have a free run. It is distinguished from the few anomalous rhizomatous forms of *L. grandiflora* and *L. ixioides* by its rather full flowers -- the inner tepals broad and often a little frilly and the outer ones often more than half as long. Flower stalks are short and the fruiting heads, like the flowers, reach only to about half leaf length. Capsules are small, warm brown to black when ripe; they remain unopened through the winter and in fact seem to break up rather than dehisce regularly. It is known from one record from sand dunes near Kawhia (R.I. Bell), from the pumice of the Volcanic Plateau, from Mt Egmont and various places in the southern North Island, from Nelson to north Westland, eastern Otago to southern Southland and Stewart Island, but not along the dry eastern South Island or, as yet, from southern Westland. Worsley Arm, Te Anau, is the only record I know from Fiordland (A.J.Anderson). It is the only *Libertia* I have seen from Chatham Islands.

Forms differ but no distinct groups have been recognised. For many years a good form was grown, in company with other libertias, in the sunny beds beside the big wooden Government Building in Wellington. At Lincoln we grew two slightly different forms in a very dry place, under some outside stairs on a north wall; both thrived and flowered and coloured up well, repeatedly spreading out into a regularly mown lawn. The leaves take on the strongest red-brown almost coppery tones and they make a fine show on a damp flat amongst sand dunes, especially when liberally sprinkled with white flowers. Like other twitchy plants this could cause problems in a small garden or in a rockery.

4. **L. formosa*

This Chilean species has long been in cultivation in Britain. It is a very robust plant, making heavy tufts up to a metre tall. The flowering stem is taller still, stiff and rod-like and up to 5 mm in diameter. Creamy flowers are borne in close clusters amongst broad brown semi-transparent bracts, the clusters separated by lengths of clear stalk. A border of this species was, and perhaps still is, an effective and attractive feature (labelled as *L. grandiflora)* along a path in the native section of the Dunedin Botanic Garden. An illustration of *L. formosa* in Harrison's "Handbook of Bulbs and Perennials" (Ed.2, 1963, p.152) is erroneously named *L. grandiflora* though the accompanying text correctly describes *L. grandiflora* as having "tall, wiry, lightly branched flower stems up to three feet high, with dainty white flowers, elegantly arranged". (See also Macintosh, 1968 and Moore, 1968).

5. *L. pulchella*

In New Zealand this is a small plant, often less than 10 cm tall, growing in forests in high-rainfall districts, both on the ground and on mossy logs. The small six-rayed, pure white flowers often appear in great numbers and would effectively lighten a dim corner in a well-watered fernery.

We have found this species unsatisfactory to grow in pots. Almost invariably it lifts itself above the substratum, surviving when attached only by a few thin wiry roots, but rarely living more than three years. Constant attention and perhaps packing up with moss might extend its life, especially where the air could be kept continuously moist.

The name of this plant presents two problems. First, is it really a *Libertia* or a *Sisyrinchium?* It differs from other libertias in several features of the capsule and the anthers and in that the leaf has a definite, more glossy, upper surface and is duller on the under side. The outer tepals are almost as big as the inner ones, and in this it agrees better with *Sisyrinchium*. Geerinck (1974) reverted to Robert Brown's old name *Sisyrinchium pulchellum* but perhaps we had better keep to the familiar *Libertia pulchella* until a more comprehensive revision is made.

The specific name is also in some doubt. It was first given to a specimen from New South Wales and is now applied to plants from the mountains of New Guinea to Tasmania. Compared with New Zealand plants those seen from New South Wales and those that we have grown from New Guinea are much larger; leaves are up to 18 cm long and 5 mm broad, flowers stand to 27 cm tall, and rhizomes 3mm in diameter may reach a length of 25 cm. Ours, which are fairly uniform, can be matched in Tasmania where there is a wide range of size without any clear differentiation into two kinds. Those who consider the New Zealand species distinct may use the name *L.micrantha* given by Allan Cunningham in 1837 to plants growing at Whangaroa and below the falls at Kerikeri, Bay of Islands.

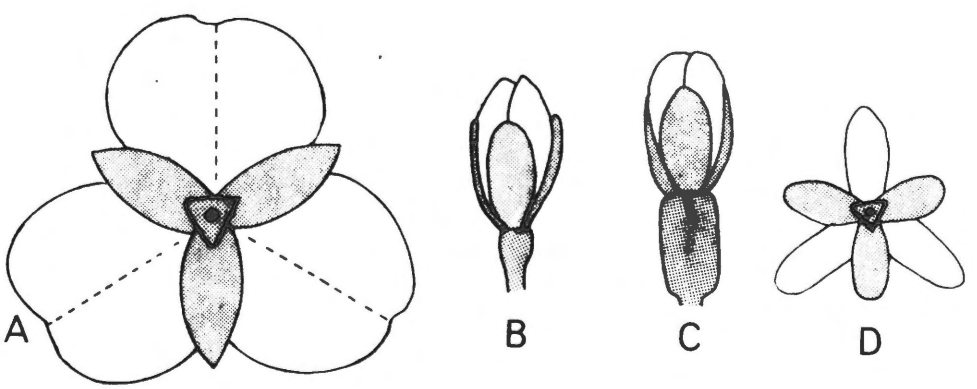


Fig.2 A.*Libertia grandiflora:* flower seen from below-small outer tepals contrast with large inner ones. B. *L.grandiflora :* bud with small ovary. C. *L.ixioides:* bud with large ovary. D. *L. pulchella:* flower seen from below--outer tepals little smaller than inner ones.

Drawn by: J. A. Watson

Conclusion:

A wide range of forms is available to anyone wishing to grow New Zealand's native irises. A careful choice should be made according to what the attraction is to be: the three-petalled waxy white flowers; the form and colour of the leaf - stiff or drooping, all green, green ribbed with cream, or colouring to yellow or red-brown; or perhaps the long-lasting golden fruits. Would plants of twitchy habit be acceptable? The species name alone, even if correctly applied, does not indicate which of these characteristics the plant will display. If the most garden-worthy forms are selected it should be possible in time to isolate and name good cultivars.

Key to Species :

1. Tepals about equal; the two surfaces of the leaf dissimilar (dorsiventral); diploid ... 5. *L.pulchella*

   Tepals unequal; the two surfaces of the leaf similar (isobilateral) ... 2.

2. Flowers and fruits in crowded whorls close to the rod-like stem ... 4. *L. formosa*

   Flowers and fruits standing away from stem ; polyploid. 3.

3. Panicle dainty, widely branched with large flowers on slender pedicels, usually standing well above leaves; ovary shorter than tepals in bud; capsules soon turning dark brown and opening; almost all 6 - ploid. ... 1. *L.grandiflora*

   Panicle heavier, narrowly branched; flowers small on thick pedicels,usually overtopped by leaves; ovary rarely shorter than tepals in bud; capsules long-lasting, rarely opening before the spring following flowering ... 4

4. Capsules turning bright yellow, usually large, later splitting open and finally bleaching white; plants mostly tufted; 12-ploid. ... 2. *L.ixioides*

   Capsules turning brown or nearly black usually small, mostly indehiscent; plants rhizomatous; 6-ploid. ... 3. *L.peregrinans*

REFERENCES :

ANON 1951 : Royal Horticultural Society "Dictionary of Gardening". Clarendon Press, Oxford.

GEERINCK, D. 1974: Revision of Australian Iridaceae. Bull. Jard. Bot. Nat. Belg. 44:29-60.

HAIR, J.B.; BEUZENBERG, E.J.; PEARSON, B. 1967: Contributions to a Chromosome Atlas of the New Zealand Flora - 9. N.Z.J. Bot.5 : 185-96

HARRISON, R.E. 1963: "Handbook of Bulbs and Perennials for the Southern Hemisphere" Ed. 2. A.H. & A.W. Reed, Wellington.

MACINTOSH, M. 1968: A laudable *Libertia*. Gard. Chron. 1963(7):7.

MOORE, L.B. 1967: The New Zealand Species of *Libertia* (Iridaceae). N.Z.J. Bot 5:255-75.

MOORE, L.B. 1968: New Zealand Libertias. Gard. Chron. 1963(22): 4-5.

MOORE, L.B. ; EDGAR,E. 1970: "Flora of New Zealand" Vol. II. Government Printer, Wellington.

SPRENGEL, C. 1824:"Systema Vegetabilium" Ed. 16. Gottingen.

Professional Horticultural Training in Australia and New Zealand

by

M. A. NICHOLS

Department of Horticulture, Massey University

The type of professional horticultural training carried out in a country is dependent upon the requirements of the country, and the interests of the people involved in deciding what type of training to provide. There is no single correct method of training horticulturists, although it appears to be generally accepted that being a science based technology (like medicine or engineering) it is essential that the applied aspects of horticulture should be taught in addition to the science service subjects. The type of training provided is likely to be influenced by the employment opportunities open to graduates, although far-sighted educators can stimulate demand by providing trained graduates in areas where there is no apparent demand.

Historically (with few exceptions), horticulture has developed as an adjunct to professional agriculture training, and in a number of situations e.g. North America, the degree obtained is a B.S.A. (Bachelor of Science Agriculture), even though the student may have majored in Pomology or Floriculture. The grouping of horticulture with agriculture appears to be to the detriment of horticulture, because although there are a number of interface areas, e.g. potato, tobacco etc. horticulture is important in its own right, not only because of the rapidly expanding amenity side, but also because of an affluent society's demand for quality (as opposed to staple) food, and also because in many underdeveloped countries cropping is horticulture.

NEW ZEALAND

Professional horticultural education is carried out at only two places in New Zealand, Massey University and Lincoln College, where it is taught conjointly with Agricultural Science degrees. At both institutions the degree courses in horticulture were introduced in the late 1940's, following the introduction of sub-degree 'Diploma' courses in the mid 40's. The first Agricultural Science degrees were awarded at both institutions in the early 1930's.

The development of Horticulture at Massey owes much to the right person being in the right place at the right time. The establishment of the sub-degree Diploma was a result of the view of Emeritus Professor G.S. Peren that there was a need for University based horticultural education. The late Mr. K.C. Hockey headed Massey's Horticulture Department from 1946-64 and he was a vigorous advocate of horticulture and much of the credit for the introduction of the degree programme is his.

Similar developments occurred concomitantly at Lincoln, because throughout this period both Massey and Lincoln were constituted under a single council as the New Zealand School of Agriculture. Both Departments remained virtually two-man Departments until 1960 when a growing appreciation of the need for and value of horticultural graduates lead to both institutions appointing Foundation Professors; Professor J.A.Veale in 1964 at Massey and Professor T.M.Morrison in 1966 at Lincoln. There are now a total of twenty academics in these two Departments of Horticulture.

At both institutions the teaching responsibility has expanded over the past decade, and although the sub-degree Diploma is still taught, the Bachelor degree now has an Honours option for students with a high academic performance. At the post-graduate level it is possible to take both a Masters and Ph.D. degree, or to study for a post-graduate diploma in horticultural

science.

The main horticultural differences between the two institutions at this time are:

1) The development of the amenity area at Lincoln at the post-graduate level, through the Diploma of Landscape Architecture and the Diploma in Park and Recreation Administration.

2) The development of the amenity area at Massey at the undergraduate level by providing environmental or production streams for the final two years of the 4 year degree.

The Bachelor degrees at both institutions are of two forms:- B.Hort.and B.Hort.Sc. as 3 and 4 year programmes respectively. With few exceptions students read for the B.Hort.Sc. At both institutions the degree is science based and to a large extent follows the pattern of agriculture teaching of most mother universities. This provides a first year of Biological and Physical Sciences followed by a second year of predominantly Applied Sciences and a third year in which husbandry subjects are emphasised. The fourth year allows specialisation in terms of the sciences - for students interested in a research career, in production aspects for those interested in extension or in becoming growers and in management and economics for those interested in a career in horticultural management. At both institutions the Honours Degree requires additional work to be carried out by the candidate in the fourth year. There is an on farm practical work requirement at both institutions, in total 48 weeks at Massey and 44 weeks at Lincoln, when students work during their vacations on two or more types of approved holding. This would appear to have many advantages over the year's practical before entry into University, in providing continuity of learning between the lecture theatre and the field. The major weakness is that the practical experience is all gained at one time of the year, and seasonal effects are not then clearly appreciated.

Both institutions have similar Masters degrees (M.Hort.Sc.) regulations comprising 3 written examinations and a thesis. Though nominally of 12 months duration, the pattern has been for this degree to take between 18 - 24 months. The Ph.D is examined by thesis only.

The number of undergraduates reading horticulture at the two institutions has increased steadily since the early 1950's. In a recent survey, it was found that in the period 1952-1973, 72 horticulture students graduated from Massey. One third of these were later involved in research or University teaching, one sixth in Extension and a further one-sixth in production aspects of horticulture. Of the remainder, 10% were engaged in post-graduate studies, and the remainder did not continue in a horticulture career. It is relevant to note that many people now in research and in University teaching have been extension officers earlier in their careers.

There are about 100 students at the present (1975) reading for a first degree in horticulture at Massey and this exceeds the number which have graduated over the past 20 years! This is even more relevant when one considers that of the 72 students who graduated in the 20 year period 22 were from overseas (mainly Malaysia), and that in recent years the number of students from overseas in any one year has not changed appreciably. Figures obtained from Professor Morrison at Lincoln show a similar growth pattern. This will pose a very real problem in terms of employment opportunities, for up to 40 horticultural graduates a year in a country of 2.9 million, with a gross value of horticultural products (at the farm gate) of $100 million.

AUSTRALIA

There is at present no specialised degree in Horticulture offered at any Australian university, although horticulture (or more often horticultural science) is frequently an option or a small compulsory component in the Agriculture degree courses at a number of universities, and has been (in some cases) for a number of decades. Horticulture is taught also as a component of the Agriculture

courses at a number of other tertiary education institutions, namely the Agricultural Colleges of Advanced Education, but it is only at the Queensland Agricultural College that a specialised programme of horticultural training is carried out, leading to the award of a degree - the Bachelor of Applied Science (Horticultural Technology).

In spite of considerable industry agitation it was not until 1971 (when Professor M. Mullins was appointed at Sydney University) that the first Professor of Horticulture was appointed in an Australian University. Horticulture is a part or an option of the Agriculture degree at the following universities :- Adelaide, New England, Queensland, Sydney, Tasmania and Western Australia. The "ivory towered" attitude within many of the Australian universities with an emphasis on science rather than on husbandry has led to the Federal Government diverting funds from the universities towards other tertiary institutions with a more applied outlook. Tertiary training in all subject areas at all levels has been in the process of change. A number of previously Diploma-awarding agricultural and horticultural training institutions have become Colleges of Advanced Education. The qualification awarded varies with the State, but it is accepted by the Public Service as being equivalent to a 3 year University degree.

The University of Adelaide

The University of Adelaide employed outside lecturers to teach horticulture until 1957 when Dr. G.R. Edwards was appointed to be the first full time academic responsible for teaching horticulture in an Australian University. Dr. B.G. Coombe was appointed to a second position in 1959.

The course in Horticultural Science taught at Adelaide attempts to relate the students' science background to the technology of horticulture. It is a 4th year option and a large course comprising approximately half of one academic year. Physiology is emphasised and individual crops are considered only in the third term.

Students majoring in Horticulture averaged 4 per year between 1959-69, but numbers have increased in recent years; 7 in 1969, 9 in 1970, 11 in 1971 and 14 in 1972. There has been no appreciable change in the number of 4th year students reading Agriculture which has averaged 30 for many years. Therefore this may reflect an increasing interest in horticulture, relative to agriculture in South Australia.

The University of Tasmania

Horticulture has only been taught at the University of Tasmania since 1967 when Dr. R.C. Menary was appointed. The Faculty of Agricultural Science is only a fairly recently established faculty.

Horticulture I, which is a compulsory one term subject taken by all agriculture students in the 3rd year is concerned with the distribution of horticultural crops in Australia, fruit and flower morphogenesis in fruit crops and specific subjects such as propagation, wind breaks and spacing.

In the final and fourth year, students can select Horticulture II as one of their three elective subjects and approximately half of the students do select horticulture. The main topics are: plant nutrition, photosynthesis, metabolic control in plants, phytohormones and post harvest physiology.

University of Queensland

About 4 students specialise in horticulture each year, and these students are generally employed, after graduation, by the State Department of Primary Industries.

There is both a "field" and a "subject" called Horticulture. The subject comprises one-quarter of the course units in the fourth and final year. It consists of 56 lectures and 84 hours of laboratory and field studies, half of which is common with Agronomy. The other half is directly related to Horticulture and this comprises:

1) plant physiology concerned with growth and development relevant to horticulture,

2) a study of selected horticultural crops

3) visits to horticultural research establishments.

Thus, horticulture is only a relatively minor part of the fourth year and of the entire degree course.

The rationale for this is that the University is training students to work as scientists in horticulture and in which subject they would normally be using their particular skills such as crop physiology and mineral nutrition.

University of New England

The New South Wales Government announced early in 1971 that it would support financially the establishment of teaching in Horticulture at the University of New England during the 1970-72 triennium. In 1973 the University introduced both a third year and a fourth year course in Horticulture, and a post-graduate Diploma in Horticultural Science.

The University of Sydney

Horticulture has been taught at Sydney as a component of the Agriculture degree since 1910, when the late Professor R.D. Watt taught 'Principles of Fruit Culture and Viticulture' as one of the seven subjects in Principles of Agriculture II. Since 1912 Horticulture was taught by external lecturers from the New South Wales Department of Agriculture, namely, E.K. Wolstenhome (1913-41), C.G. Savage (1932-47), Dr. F.T. Bowman (1948-60) and B.O. French and G.R. Gregory (1961-68). Throughout this period, Horticulture was a compulsory part of the third year Agronomy option.

In 1969 Dr. W.J. Greenhalgh was appointed as the first full time lecturer in Horticulture. A fourth year option in Horticulture was then introduced to supplement, where required, the 18 horticultural lectures currently taught in the 72 lecture third year Agronomy II course.

This final year option consists of Advanced Horticulture (18 lectures primarily on Pomological topics), Plant Protection (18 lectures) and Horticultural Physiology (36 lectures).

The number of students who select horticulture as a fourth year option is increasing. There were 2 in 1969 and 1970, 3 in 1971 and 8 in 1972.

Queensland Agricultural College.

This is at present the only institution in Australia to offer a specialized degree in Horticulture, and as such it warrants special attention.

The course is very similar to the courses taught at Massey and Lincoln, with the exception that there is a little more emphasis on the production side, and less emphasis on the sciences. The main differences occur in the final year, where the subjects offered have a predominantly production theme. Horticulture is a very wide ranging subject, particularly if (as is done at Q.A.C.) the environmental areas of horticulture, such as landscape gardening, ornamental horticulture and turf culture are taught in addition to the more normal horticultural foods crops. Relatively low student numbers have meant that a few staff have to teach over a very wide area. There is some consideration being given to the introduction of a Masterate programme, which could put even greater pressure on lecturers.

Hawkesbury Agricultural College (N.S.W.)

Fruit and vegetable production are taught as a part of the 3 and 4 year Agricultural programmes, but no teaching is done at present on the amenity side, although the Principal, Dr. Swain, is interested in developing this area.

Roseworthy Agricultural College (South Australia)

As at Hawkesbury the Agricultural programme includes fruit and vegetable production. Viticulture and wine production are offered at this College as a specialised

post-graduate diploma.

Reference should be made at this stage to other colleges. In Victoria, the Burnley Horticultural College and Dookie Agricultural College have yet to gain C.A.E. status, but both teach horticulture. At Burnley this is a specialised course, while at Dookie it is a part of the Agriculture programme. No doubt there will be further developments, particularly at Burnley.

There is also considerable interest in the development of tertiary horticultural education in Western Australia - based on the Western Australia Institute of Technology, but no decisions appear to have been made to date.

New Research Centre at Massey

(Extract from "Commercial Horticulture.")

Discussions between Massey University and the N.Z. Nurserymen's Association have culminated in the formation of the N.Z. Nursery Research Centre at Massey University. The Centre plans to conduct research on plant production, disease and marketing problems of importance to the nursery industry.

The Director of the Centre, Mr.M.Richards Reader in Horticulture at Massey University said that several projects have been commenced including evaluation of peat substitutes for soilless media suitable for growing plants in containers, methods of improving propagation of certain New Zealand native plants and production of daphne plants free of virus diseases.

Projects such as these are of significance to nurserymen and gardners in New Zealand but in addition are likely to increase export plant sales. Much of the work of the Centre will involve use of glasshouse and associated laboratory facilities currently being completed in the Plant Growth complex at Massey University. However, co-operative projects with staff, and utilising facilities at other plant science laboratories in Palmerston North - such as Plant Physiology Division, Department of Scientific & Industrial Research - are also planned.

Mr. D. S. Tustin will be taking up the position of Research Officer following the completion of his Ph.D. in Horticultural Science; Mrs. I. Cooke, who is currently completing a Bachelor of Horticultural Science degree has been appointed Research Assistant. The Centre will be administered by a Committee, chaired by Dr. K.S. Milne, Senior Lecturer in Plant Pathology at Massey University, and will include representatives from the N.Z. Nurseryman's Association and Massey University.

Culinary Herbs

BY L.C. HURNDELL

CROP RESEARCH DIVISION DSIR, LINCOLN

Introduction

Herbs are grown for use in cooking, medicine, confectionery and perfumery. Spices are used similarly. The question arises - what is a spice and what is a herb and how are they defined? To be a little clearer, but not wholly clear, the Concise Dictionary defines a spice as an aromatic or pungent vegetable substance used to flavour food. It also defines a herb as a plant whose stem is not woody or persistent; a plant of which the leaves and possibly the stem are used for food, medicine, scent and flavour.

Frederic Rosengarten Jr. in his book of Spices (1973) says that generally speaking when the aromatic or fragrant vegetable product used to flavour food or beverages is from plants of tropical origin it is considered a spice. When from plants of temperate regions it may be considered a culinary herb. It is therefore extremely difficult to determine where a spice ends and a herb begins.

The purpose of this paper is to describe some of the better known culinary herbs together with notes of culture and possible uses. Before doing so it may perhaps be of interest to deal briefly with the history of herbs, and their establishment in New Zealand.

The use of herbs for flavouring food dates back into antiquity. Herbs and spices are mentioned in records of the Age of the Pyramids in Egypt, and throughout the Roman and Greek eras. Most of the well know ones used today originated from Mediterranean countries during the time of the Crusades.

Europeans in those dark ages placed a high value on herbs and indeed spices, not only to flavour drab and often partially decomposed foods, especially meats, but to mask unpleasant odours. Hence the ancient habit of strewing herbs on the floors of living quarters. Herbs and spices are mentioned in the folklore of many countries and indeed are woven into poems and writings of bygone days. The demand for both as flavourings for food, medicines and perfumery opened up trade routes in the earliest days of exploration. Suffice it to say that condiments have played a remarkable part in world history.

Obviously many of the culinary herbs grown in New Zealand were introduced by the early settlers, and none are indigenous to New Zealand. This early introduction is evidenced by the escape and subsequent spread of garden thyme in Central Otago. The similarity of the climate in this country to that of some Mediterranean countries has contributed to the rapid growth and spread of several of these herbs to the point where they have become established as weeds, indeed some like fennel and horseradish as very troublesome weeds.

Over the years, culinary herbs have generally remained as an adjunct to the kitchen gardens, many people having collections of mints, thymes, sage, parsley and chives. Recently, however, there has been an increasing demand for dried or processed herbs. This is probably due to many reasons, not least the ease of using herbs from a packet. Almost all the dried culinary herbs purchased in packets from the grocer's shelf are imported in bulk from overseas. Very little is produced and processed commercially in New Zealand as yet, although a number of small commercial growers produce certain herbs such as parsley for sale as fresh produce.

In the commercial world of processed and prepared foods the manufacturer is now looking towards essential oils, oleoresins, essences, emulsions and decoctions derived from herbs and spices. Despite these trends, however, herb societies have been formed on a domestic scale by enthusiasts in various parts of the country and are stimulating interest in the culture and uses of fresh herbs for food flavourings.

The following notes describe some of the better known herbs which should grow well in New Zealand.

ANISE - *(Pimpinella anisum L.)*

Anise, more commonly known as aniseed, is an annual herb, indigenous to Asia Minor, Egypt and Greece. It is one of the oldest of the aromatic herbs and is widely cultivated in most temperate and warm climates. The bulk of the world's supply is produced in Mexico, Germany, Spain, Italy and Turkey.

The ripe dried seed, botanically described as a fruit, is the source of flavour or odour and can be used whole in cakes and soups. Leaves of the plant can be used as seasoning or as garnishing for salads. The principle use however is in the essential oil, extracted or distilled from crushed seed. This pale-yellow highly-aromatic voltile oil is widely used for flavouring beverages, cakes and breads, confectionery and liqueurs. It is used also in medicines for masking nasty or bitter-tasting drugs, in dentifrices and even as an additive for baiting traps in trapping noxious animals.

The anise plant is slow growing, requiring a frost-free growing season of 120 or more days. Seed should be sown directly in the garden in the spring. Being a sensitive tap-rooted plant it is very difficult to transplant. Anise grows well in a light, fertile, sandy loam with good drainage and a warm sunny situation. Its high moisture requirement demands a well-distributed rainfall, and in dry areas irrigation is necessary. For domestic purposes a small amount of seed can be sown and seedlings thinned to about 15 cm apart. Anise should grow well in the north-east regions of New Zealand. In the south the climate is marginal, especially where night average temperatures are low. Seed should be ready for harvesting about a month after flowering.

BASIL - *(Ocimum basilicum L.)*

Basil, also known as sweet basil, is an annual herb, indigenous to Asia but now grown in many of the warmer and drier temperate countries of the world. It grows as a small bushy plant up to about 50 cm in height, with pale green glossy leaves and small greenish-white flowers. The aromatic spicy leaves make basil one of the more important of the food flavouring herbs. It is grown commercially on a large scale in the U.S.A. where the leaves are harvested and dried for the packet trade and to produce essential oils.

Basil is an important ingredient of certain liqueurs, and for flavouring pizza pies it rivals oregano. Leaves may be used for flavouring stews, sauces, meats, salads and soups. This herb has a special affinity for tomatoes and tomato-based recipes.

Basil is propagated by seed, which should be sown in rows at 15 cm plant spacings. For domestic purposes it can be pot grown and the leaves used as required. The plant can be cut back part way more than once just prior to flowering, to induce growth for supplies of fresh leaves throughout the season. The cut material can be dried artificially, at temperatures not exceeding 50°C, or left to dry naturally in a dark, well-aired place. This ensures the retention of colour and flavour.

Basil will grow in most well-drained soils, but it is most important to shelter plants from wind. A sunny situation is preferred.

Commercial plantings may be made on sheltered weed-free land. Seed can be sown with ordinary seeding equipment, but row plant spacings would need to fit in with cultivation and harvesting methods.

BAY LEAVES - *(Laurus nobilis L.)*

The Bay tree, an evergreen member of the laurel family, is hardly a herb, but mention should be made of it as its leaves are used as an important flavouring of stews, meat, fish and poultry dishes. Today leaves for culinary uses are purchased in a dried form, but a bay tree is a useful addition to the ornamental design of a garden and the leaves can be used fresh. *Laurus nobilis* should not be

confused with the cherry laurel *Prunus lauro-cerasus* whose leaves contain prussic acid and are therefore poisonous.

The tree grows best in well-drained soils and will stand several degrees of frost when mature. Young trees however need some protection during the winter. Bay can be propagated by half ripe cuttings but these need careful treatment as they take a long time to produce roots - up to nine months. Cuttings are preferably taken with a "heel" and are better placed in a mist propagating unit with bottom heat. To encourage root formation a suitable hormone should be used.

CARAWAY - *(Carum carvi L.)*

Caraway is a biennial herb indigenous to Europe, Asia and North Africa. It is similar to a carrot in appearance and of course, like carrot, it is a member of the parsley family. Caraway is now widely cultivated in many temperate zone countries including northern Europe. The seeds (botanically fruits) are the part of the plant required most, although young leaves can be used in soups and the root eaten as a vegetable. Like all biennials caraway requires a second year to set seed. In New Zealand seed sown in the early autumn should produce a seed crop the following summer. Caraway should grow well in most New Zealand soils, but prefers a moderate heavy soil rich in humus. The land should be free of perennial weeds, annual weeds within the crop being easily controlled with chemical herbicides similar to those used on carrot crops. For domestic purposes caraway can be grown in a similar fashion to carrots, using a few plants as required as a vegetable or for flavouring. Seed harvested in the second year can be stored for flavouring purposes and for further sowings.

Seed heads or fruting clusters, known botanically as umbels, are inclined to shatter on ripening, with a consequent loss of seed. In harvesting seed of individual plants each umbel can be cut as the seed turns brown, and placed in a linen bag and hung to ripen fully before threshing. On a commercial scale the plants may be cut when the majority of umbels have turned brown, and the crop windrowed to ripen before threshing.

Caraway seeds are used to flavour bread, cakes, biscuits, cheese, and sauces. An essential oil distilled from crushed seed is used to flavour meats, sausage, and perfumes and is the principle flavouring of the liqueur "Kummel".

CHERVIL -*(Anthriscus cerefolium. Hoffm)*

Chervil is an annual herb native to southern Russia and Asia. Its leaves are used for seasoning and garnishing. The plant is similar to parsley, being of the same family. Usually looked upon as a domestic herb, chervil can be grown in the open ground or in pots or containers. As the plant is intolerant to hot dry conditions frequent irrigation is necessary. Direct seeding is best as transplanting is difficult. Chervil must be harvested frequently to encourage new leaves, or several sowings can be made in succession. The leaves can be dried and stored.

CHIVES - *(Allium schoenoprasum L.)*

Chives are a small grasslike perennial, native to Europe and a member of the onion family. The flat hollow leaves have a mild onion flavour and are used in salads, soups and omelettes: indeed chives are used in many recipes. Chives grow freely in most soils and can be propagated by seed or more commonly by division of the bulbs. In a domestic garden it is necessary to lift, divide and replant in fresh ground every two to three years. They can be grown in pots or small boxes or as a border to a kitchen garden or herb bed. Commercial production of chives for drying has recently been developed in the U.S.A. The dried product is used in flavouring cheese and is also sold in packets.

DILL - *(Anethum graveolens L.)*

Dill is an annual herb of the parsley family and is indigenous to the Mediterranean region. Dill is closely related to caraway, fennel and parsley and is now grown in most temperate climates. In fact it will grow well in much cooler climates than those of the

Mediterrnaean area.

The small feathery leaves of dill can be chapped and used fresh or dried in soups, salads and with sea foods. Dill seed is used as a condiment, either whole or ground, as a flavouring in pickled cucumbers or gherkins (hence the term "dill pickes"),or in bread and other cooked vegetables. The seed can also be used for medicinal purposes (dill water being used as a carminative for babies) and is an ingredient of curry powder.

An essential oil is obtained from the plant and from the seeds, and is similar in many ways to caraway oil. Dill oil is used in the pickle industry.

Dill can be easily grown in most parts of New Zealand and requires a reasonably well-drained sandy loam. For home use a few dill plants may be grown in pots or boxes or in a corner of the garden and used as required. Direct seeding is essential. Because of its taproot dill is difficult to transplant.

As the plant grows fairly tall some shelter from strong wind is necessary. Dill will also cross-pollinate with other umbelliferous plants, especially so if these are grown together in the same area it would be unwise to retain seed for subsequent sowings as the resultant plants may not contain the true flavours.

FENNEL - *(Foeniculum vulgare. Mill)*

Fennel is a tall, vigorous, hardy perennial, a member of the parsley family and native to southern Europe and the Mediterranean. It is distinguished by its fine, green, feathery foliage and its golden yellow flowers and in New Zealand has become a troublesome weed in certain areas. Fennel is closely related to dill but is more aromatic, sweeter smelling and less pungent than dill.

The use of fennel dates back into antiquity and is mentioned in ancient Greek and Roman writings. The Chinese and Indians have long used it as a condiment.

Although fennel is grown mainly for its seed or aromatic fruits which are used for flavouring breads, pastries, confectionery, liqueurs and medicines, its fine foliage can be used for garnishings and for flavouring salads and fish dishes. It is often called the fish herb. Ripe seeds can be used whole or ground according to preference.

The seed also yeilds a volatile essential oil which can be used as a flavouring for pickles, liqueurs and confectionery, and as an ingredient of perfumes and soaps.

Fennel grows well in most parts of New Zealand, more especially on the better-drained silt and sandy loams. It can be grown readily from directly sown seed or propagated by crown division of established plants. For domestic purposes only a few seeds need to be sown and later thinned to one or two plants. Seed can be harvested as it turns greyish in colour. Care should be taken to prevent seedlings from spreading. The seed is borne on umbels which ripen progressively and shed their seed. This is the principle means by which fennel has become a weed in its escape from domestic gardens.

The thickened base of a shoot can be cut and used boiled as a vegetable. This is popular in Italy where a cultivar known as finocchio or Florence fennel has been selected. The flavour apparently is akin to that of celery.

HORSERADISH - *(Amoracia rusticana* Gilib)

Horseradish is a very hardy perennial of the mustard family, and is native to the temperate European region and through Russia to Poland and Finland. It grows well in most parts of New Zealand and in certain areas has established itself as a bad weed by natural escape, and is very difficult to eliminate.

It is a recent addition to the list of condiment herbs in terms of history - Rosengarten mentions it being propagated in Western Europe by the thirteenth century and being brought to America by

Sage
(Salvia officinalis)

Bronze fennel

Fennel *(Foeniculum vulgare)*

Dill *(Anethum graveolens)*

A Young Bay Tree
(Laurus nobilis)

early settlers.

The horseradish plant grows to a height of 2-3 feet and produces large, broad, wrinkled leaves. It produces small white flowers which as a rule do not produce viable seed. Although young tender leaves can be chopped and used in salads the plant is grown mainly for its large white fleshy roots which when scraped or grated emit a highly pungent penetrating odour. The grated root is used to make the well known piquant sauce which is popular with roast meats, especially beef.

Although horseradish will grow in most soils, for commercial growing a sandy soil is best as the roots can be dug without too much damage. It is a gross feeder, so the soil should be well supplied with organic matter, such as farmyard manure.

For domestic purposes it would be better grown in a deep container to prevent spread to other parts of the garden. The plant is propagated either by crown division or by root cuttings. For good, large, straight roots the cuttings should be about the size of a pencil and approx. 20 cm. in length. Plants can be dug after an 18 month growing period provided growth is vigorous and healthy.

MARJORAM (*Origanum marjorana L.*)

Marjoram, also known as sweet marjoram, is characterised by a pleasant fragrant spicy odour and flavour and is popular for seasoning soups, stews, salad dressings and similar dishes. A native of the Mediterranean regions, sweet marjoram is a low bushy perennial 30-40 cm high and is susceptible to cold winter temperatures. It should however grow well in most parts of New Zealand except perhaps the southernmost regions.

Marjoram is very closely related to the herb Oregano which apparently has a stronger and more piquant flavour and is known as the "pizza spice" because of its popularity in flavouring the famous Italian pizzas. Both were well known in the Graeco-Roman era and sweet marjoram was also well known as a condiment in England in Shakespeare's time. In those days marjoram was used for medicinal purposes as well but at present its importance is limited to the culinary field.

Marjoram can be propagated by seed sown in the spring or vegetatively from slips or cuttings. A warm, well-sheltered situation is most suitable. A good loamy soil is best and adequate drainage is essential. Leaves may be harvested as desired for fresh use. However, if the l-aves are required for drying and subsequent storage, the plant is cut some 8 cm above the ground as it is beginning to flower and dried carefully out of direct sunlight.

MINT - (*Mentha spicata* L.and *Mentha piperita* L.)

Of the mint group, spearmint, *M.spicata*, and peppermint, *M. piperita*, are among the better known flavouring herbs. Both are hardy perennials indigenous to Europe and the Mediterranean regions but both are now naturalised throughout the temperate regions of the world. Spearmint is the one most used as a condiment and was well known during the Graeco-Roman era as a culinary herb. It was also used in perfumery and in medicines. Today however, spearment is the mint commonly grown in domestic gardens and used for seasoning meats and beverages. Peppermint is not used as much for culinary purposes but both were used as strewing herbs in ancient times, and to repel rodents from households, among many other uses.

Both species produce a volatile oil which is used in flavouring a wide range of confectionery, dentifrices and medicines. Peppermint is perhaps grown the more widely on a commericla scale, especially for the production of oil. Both are grown commercially for the production of dried leaves which can be found in packets on most grovers' shelves.

Plants of both species should grow well on most soil types with adequate moisture throughout New Zealand, whether domestically or commercially, but as mentioned previously spearmint is the species more

in use for culinary purposes, being less pungent than peppermint. Several commercial plantings of the latter have been established recently near Christchurch.

The distinction between the two species, spearmint and peppermint, may be clarified by the following memory aid: P for peppermint which has a petioled (stalked) leaf, while S for spearmint which has a sessile (non-stalked) leaf. (Ref. Rosengarten 1973).

Peppermint is also much more reddish in stalk colour, with brighter green leaves than spearmint.

PARSLEY - *Petroselinum orispum* Mill)

Parsley is a hardy biennial, indigenous to the Mediterranean region, which is grown so widely throughout the temperate areas of the world as to be virtually naturalised in many countries. It has a somewhat morbid history as being regarded by ancient Greeks as a symbol of death. It was their custom to scatter it over the tombs of the dead. It was seldom eaten but in later times both Greeks and Romans ate the leaves and also wore wreaths of leaves in the belief that the scent would absorb the fumes of wines thus preventing intoxication. In medieval times parsley was apparently involved in black magic rituals.

There are a number of cultivars of *P. crispum*. The Plainleaf or Italian, resembling the original species, is grown for processing as dried parsley flakes. Modern curled-leaf cultivars are popular for flavouring and garnishing and are the ones more commonly grown in domestic gardens. Some curled leaf varieties are grown commercially either for sale fresh for garnishings or for processing as dried parsley. One species, *P. sativum* or Hamburg Parsley, has turniplike roots and is grown and eaten as a vegetable.

Parsley can be grown in most soils throughout New Zealand and is common in most domestic gardens. Propagation is by seed sown in the early spring. Germination is slow requiring three to four weeks before seedlings emerge. Although essentially a biennial, parsley is better regarded as an annual and sown fresh each spring. For commercial production, whether fresh for garnishing or for processing, it is imperative that it be grown in ground free from troublesome perennial weeds. Annual weeds can be easily controlled by the use of chemical herbicides applied both pre-emergence, and post emergence.

Parsley with its characteristic agreeable flavour is an excellent source of Vitamin C and iron and is one of the most versatile of all herbs. It is used in almost all foods with the exception of sweet dishes and will even sweeten or deodorize the breath from the worst of halitosis. It would be true to say that parsley, whether fresh or processed, is the most popular and widely used culinary herb of all.

ROSEMARY - (*Rosmarinus officinalis* L.)

Rosemary is a small evergreen shrub, native to the Mediterranean region, found in coastal areas and able to withstand sea winds and sprays. Its history dates back to biblical times, and in later periods it was the main condiment used for salted meats by Europeans. It had association, with funerals and weddings and became a symbol of fidelity, hence "rosemary for rememberance".

Commercial cultivation of this herb is still restricted to countries bordering the Mediterranean. It is cultivated mainly for distillation of its essential oil, which is used in medicines and perfumery. Dried leaves are packeted and sold as a condiment and all supplies in New Zealand are imported.

Rosemary is mainly propagated from slips or cuttings and does best when grown on light free-draining soils in a warm sheltered position. Provided shelter and drainage are good, rosemary should grow well in most parts of New Zealand. Being intolerant of "wet feet" it would be better grown in a container than on soils where drainage is inadequate. As a condiment rosemary is used to flavour stews, soups, vegetables and meats, especially lamb and mutton.

SAGE - *(Salvia officinalis* L.)

A small perennial shrub or bush with wrinkled, velvety, greyish-green leaves, indigenous to the Mediterranean regions. In ancient times sage was regarded more for its therapeutic value, and used in medicines, potions and tonics. In more recent times, however, the use of sage as a condiment in cooking has increased and use for medicinal purposes has declined.

Sage is a well-established culinary herb in most temperate climates, and one which is found in most domestic kitchen gardens.

The odour of sage leaves, whether fresh or dried, is highly aromatic,although the flavour is pungent and a little bitter. Because of its unusual flavour it has an affinity for fats - hence its importance in stuffings for meats and poultry and as a main ingredient in sausage manufacture. Chopped leaves can be used to flavour salads, pickles and cheese.

Sage is as popular as a dried herb as well as a fresh one. The leaves yield a spicy essential oil which is used extensively for flavouring sausage, prepared meats, seasonings, liqueurs, perfumery and toilet lotions. The bulk of the world's supply of sage, as a dried product and oil, is produced from countries in the Mediterranean area.

There are a number of species of Salvia which have culinary or medicinal uses but of the garden sage there are two distinct types: a non-flowering form with broader leaves which is easily propagated by slips or cuttings, and a form which produces purplish-red flowers on long spikes and seeds freely. The main disadvantage of the latter form is its inherent ability to show genetic variations, although the advantage of propagation by seed makes it possibly more popular than the non-flowering form for domestic purposes.

The non-flowering form has the distinct advantage of longer productive life, hence its popularity as a commercial type. Also it remains relatively true to type, especially useful where selection has been made for any special requirements.

This herb should grow well on most soil types throughout New Zealand, and indeed is perhaps one of the most popular of the herbs in our domestic gardens.

SAVORY - *(Satureja hortensis* L., *Satureja montana* L.)

Summer savory, *S. hortensis*, a small herbaceous annual indigenous to southern Europe, is the culinary herb of commerce. The highly aromatic leaves and tips, used fresh or dried are a popular condiment in Europe with beans, peas and other legumes, hence the common term "bean herb". Its close cousin Winter savory, *S. montana*, a more bushy perennial, is less popular as a condiment because of its harsher or more piquant flavour.

Savory was used in ancient Rome as a seasoning for sauces and vinegar. It was also reputed to have some medicinal value and was used in potions and ointments.

Propagation of summer savory is by seed, and although not well known as a condiment in New Zealand it perhaps deserves a place in domestic gardens. Dried savory can be purchased in packets from grocers and apart from its use in bean dishes it can be blended with other herbs in a seasoning for flavouring poultry, meats, soups, egg dishes and sauces.

Winter savory can be propagated by cuttings or grown from naturally layered slips. With its less delicate flavour it may be used to season meats and pickles.

Both species should grow well in most parts of New Zealand but generally Summer savory prefers a light, well manured and well drained loam.

TARRAGON - *(Artemisia dracunculus* L.)

This fine culinary herb is a fairly vigorous herbaceous perennial of the sunflower family, indigenous to southern Russia and Western Europe. There are two species, and there is some confusion as to which is the

true tarragon. French tarragon (*A. dracunculus)* has leaves that are smoother, darker and more shiny and very much more pungent and aromatic than the Russian tarragon *(A. dracunculoides* Purah.),which is almost flavourless.

French or true tarragon rarely sets seeds and is usually propagated by cuttings or root division. Russian on the other hand can be propagated by seed, as well as in the same manner as the French tarragon.

Tarragon is a relatively recent introduction among the culinary herbs, as history does not record its use until about the 16th century. Today tarragon is grown commercially in the U.S.A. and throughout most of Europe, and is sold fresh or dried. In New Zealand it is imported for use in the dried form as a condiment. Some domestic gardens have tarragon among their herbs, either French or Russian.

As tarragon grows well in most temperate climates it should grow well in New Zealand. However, it is susceptible to excessive moisture and will not stand "wet feet", therefore on the heavier soils it may be better to grow it in a container, provided adequate moisture is given during dry periods. It does best in a well-drained light soil in a sunny position. The tops die down naturally in the winter and the plants remain dormant. Where severe frost occurs dormant plants or crowns need some protection as they can be easily killed. It therefore pays to mulch heavily in these areas.

When plants are established the tender top growth or shoots may be harvested as required. Tarragon should be divided and replanted every three or four years.

With its distinctive flavour, almost a blend of licorice and anise, it has a special affinity for chicken and seafood dishes, but it can be used to flavour soups, stews and sauces. It can be chopped and used fresh in salads and is excellent in egg dishes. One of its major uses is to flavour vinegar, and tarragon vinegar is well known by culinary connoisseurs for making salad dressings and various sauces.

Tarragon produces an essential oil with an anise-like odour used for flavouring pickles, vinegars and liqueurs. It is also used in perfumery and scented toilet preparations.

THYME - *(Thymus vulgaris* L.)

Although there are numerous species and many hybrids of this small herbaceous shrub, indigenous to the Mediterranean regions, the common or garden thyme (*T. vulgaris)* is the one grown as a herb for seasoning foods. Many of the fragrant thymes, both upright and prostrate growing forms, are used as ornamentals in rock gardens and path edgings.

Ancient history depicts thyme being used as an incense to perfume and purify, and as a strewing herb to overcome unpleasant odours. It was also a symbol of courage in ancient Greece. The Romans used thyme to flavour cheese and beverages, and in herbal medicine thyme was said to be a cure for nightmares and melancholy, among other ailments.

Thyme's flavour is distinctive, warmly aromatic and pungent. It is used to flavour meats, sausages, poultry stuffings and dressings, fish dishes and many others. The essential oil of thyme also has many uses, including the flavouring of food products and in perfumery. It is also an ingredient in the liqueur Benedictine and in medicines and pharmaceutical preparations.

Thyme grows well in most parts of New Zealand and indeed, as previously mentioned, because of natural escapes it grows wild around the hills and valleys of Central Otago. Thyme, along with parsley, sage and mint, would be perhaps one of the more popular domestic garden herbs in this country, mainly because of its use in poultry stuffings.

Thyme prefers a well-drained sunny position, and will survive drought conditions to some degree. It can be propagated easily by seed or by cuttings or naturally layered slips. It is essential to keep thyme well weeded as it can be easily smothered. Fresh shoots with their tiny leaves may be picked and used when required or, if wanted for

drying, the tops of the bush can be cut as it begins to flower, and shade dried to preserve its colour.

Plants develop a certain woodiness after a few years and should be renewed, although some bushes in a good situation will keep on producing soft leaves and shoots for many years.

One other species of thyme which is used as a culinary herb is Lemon Thyme *(Thymus citriodorus)*. It is similar to *T. vulgaris* in every way except in flavour and its cultural requirements are the same. It has a distinctive lemon flavour and is popular in mixed herbs or where its unique flavour is required.

Conclusions

In New Zealand culinary herbs are not grown commercially to any degree, with perhaps the exception of parsley (curled types for garnishing). Most are imported in a processed form and are used by food processing companies or sold in packets from the grocers' shelves. Whether commercial production of herbs in New Zealand would be a viable enterprise is being investigated. If it were so, and an export market found, it would be a valuable adjunct to horticultural production and processing.

Many people do grow the odd culinary herb in their kitchen garden, some are enthusiasts and grow a wide range. However with the increasing interest in different foods and exotic dishes expounded by advertising, radio and television today, there is a parallel increase in interest in culinary herbs and spices to produce the flavours desired. The trend, however, seems to be towards the use of prepared herbs, and this could suggest that commercial production in New Zealand, even on a small scale, may have a future not too distant.

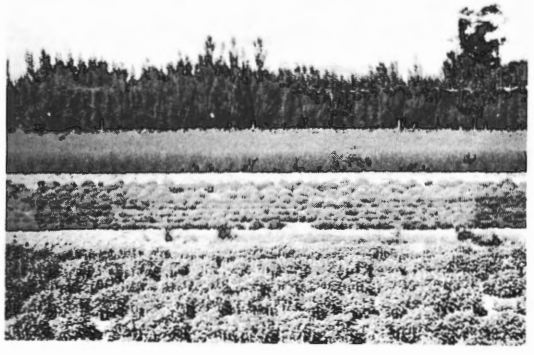
References and further reading.

ANON. 1960 Ministry of Agriculture, Fisheries & Food Bulletin No. 76. Culinary & Medicinal Herbs.

ANON. 1964. Lavender Herb Garden. Christchurch N.Z. Herbs - Culinary & Aromatic, List of seeds and plants.

ANON. 1948. U.S.D.A. Farmers Bulletin No. 1999. Production of Drug and Condiment Plants.

ROSENGARTEN, F. 1973. The Book of Spices, Pyramid Communications, U.S.A.



Herb Research Area.
Top to Bottom: Horseradish, Lavender, Thyme, Sage.
Left to Right: Tarragon, Lemon Thyme, Lovage.

The Use of Bark in Potting Mixes

(Being extracts from a thesis presented for the National Diploma in Horticulture (N.Z.), 'A Study of Wood Wastes' submitted by J.R. Reeve in 1974.)
SUMMARISED BY M. B. THOMAS

Introduction.

As suitable soil becomes scarcer nurserymen have turned to soil-less composts for raising their container grown plants. Many are using variations of the University of California composts. Problems of transport and costs are making peat expensive. Much of the peat used in New Zealand comes from Ireland, as this is considered of better quality than the local peats and there is little difference in cost. Both Hauraki peat and Irish cost $25 per m^3.

One alternative to peat is bark, which is a waste product from the pulp mills with no economic use at present. Work that has been carried out overseas seems to indicate that bark is a suitable alternative.

1. History of Bark Useage

Interest in the use of bark in composts started in the early 1950s in the Western States of United States of America, as peat became more expensive to import. Up until this period it had been thought that bark had toxic properties which prevented growth. This poor initial growth was found to be mainly due to temporary nitrogen shortage due to bacteria utilising available nitrogen to breakdown the bark. The particle size also has an effect on growth (1) bark from some genera have been found to have unsuitable properties causing the retardation of growth, as shown by Cedrus, Juglans and tomatoes (13).

Research work gained impetus and showed that a wide range of plants could be grown in bark compost with little difference from those grown in composts of peat.

By the late 1960s hardwood barks were also being used in America and interest in the use of bark was being shown in the United Kingdom and Finland. In all these countries a ready mixed compost based on bark is sold in retail packs. The two firms in United Kingdom supplying bark claim that pulverized bark with added nutrients is suitable for potting plants and block making. It is cheaper than peat composts but as yet not a severe competitor. In Finland one of the mills offers an advisory service on how bark can be utilised as a soil improving material.

2. Availability of Bark

Bark has been found to comprise 10% of the fresh weight of timber (1). There is therefore a large amount of waste produced from any timber milling operation, especially where the timber is for pulping, as this requires a clean product. It is difficult to obtain an accurate estimate of the amount of bark which is produced annually in New Zealand. A rough estimate of bark being produced from exotic softwoods would be in the region of 200,000 tonnes oven dried weight. Of this about 50% is burnt either as an industrial fuel or with domestic firewood. A further 25% is either burnt or dumped attached to slabwood. The remaining bark is on its own and is either burnt or dumped. This in round figures is about 50,000 tonnes. This figure is likely to rise. The Whirinaki Pulp Mill alone is expected to produce 25,000 tonnes of bark. By 1980 the total weight of bark being produced in New Zealand is forecast to have risen to 653,000 tonnes. The tighter restrictions on atmospheric pollution will make it more expensive to burn, but on the other hand the environmental effect of dumping with the increasing cost of transport make this alternative less attractive.

The cost at present rates of disposing of bark is about $3 per tonne for burning in a clean air burner (based on Australian data). Dumping could be nearly the same when any fees for dumping are taken into consideration.

In the year ending 31st March 1971,the following amounts of rough sawn timber

were produced in New Zealand : -

Rimu and Miro	554.2	million m^3
Indigenous total	755.3	" "
Exotic Pines	2156.0	" "
Douglas Fir	211.5	" "
Total Exotic	2398.0	" "
Total all types	3154.0	" "

(Figures from the N.Z. Forest Service (1970) and Mr. A. J. Prince).

3. Toxins

One of the reasons that the use of bark in horticulture has been slow to become accepted is the belief that the bark contains toxins which are injurious to plant growth. It is suggested that with a pure bark medium, the toxic levels may cause damage to the plants. The suggested toxicity is said to be due to phenolic compounds present in the bark which are difficult and costly to overcome. In general this view is not borne out by experimental work which has been carried out both in the United States and England. Aaron (1) who carried out trials with Coleus and tradesentia using various softwood barks found no ill effects. When he grew the hypersensitive tomatoes there were symptoms of toxicity, in that there was black discolouration around the veins of some of the terminal leaflets. The plants however continued to grow. The two types of bark causing these symptoms were *Pseudotsuga menziessi* (Douglas Fir), *Picea abies* (Norway Spruce) and *Picea sitchensis* (Sitka Spruce). Further trials with mushrooms (*Agaricus bispora)* showed some symptoms of toxicity with the *Pseudotsuga menziesii*. Treating the bark by stacking it for six weeks or by heating it to 50°C seemed to destroy the harmful volatiles. Decomposition did not seem to result in any further harmful products being produced.

In the United States, W. Bollen (22) found that the apparent toxicity that had been found in bark or other wood products was usually due to nitrogen deficiency that could be easily remedied by adequate fertilizing. This view is supported by Lunt (13); although he did find that there was marked retardation of growth of tomatoes in mixtures containing bark of Juglans or Cedrus. Finally, Pokorny (18) stated that if the bark was aged for six months, he found no toxicity problems, nor did he find problems with 100% bark and in fact this medium was successful. Gartner (9) found that by stacking the bark, it heated up to a temperature of 65 - 70°C for at least ten days and this destroyed any growth inhibitor.

It would appear from this research work that there are some toxic materials present in bark, but there does not seem to be any difficulty in overcoming these problems, either by stacking or by heating to 50°C. Some of the early confusion on the effects of nitrogen depletion with effects on growth, due to phenols and tannins in the bark, still seem to exist.

4. Nitrification.

As stated in the previous section on toxins, one of the reasons that plants may not do well in a bark compost is that there is a locking up of the available nitrogen, leading to poor initial growth, which can be confused with a toxin. The percentage of nitrogen present in bark varies according to the type and source, but has been found to be usually not more than 0.4% dry weight in hardwoods (9). Bollen (22) gives a figure of 0.12% dry weight nitrogen for *Pseudotsuga menziesii*. The actual percentage of nitrogen can vary according to source and type, but could be expected to be between these two figures. A carbon nitrogen ratio of 491:1 for the Pseudotsuga, which is compared with a ratio of 373:1 for wheat straw.

There are a number of methods of overcoming this nitrogen deficiency which have been tried in America. The first and probably the most successful, is by treating the bark with anhydrous ammonia (5). This involves the exposing of the bark for one minute in a closed augen to 3- 6 parts of anhydrous ammonia (NH_3). This would raise the amount of nitrogen in the product to 1.5% of dry weight. The actual treatment is quick and fairly cheap, but

the capital expense of the machinery required on American figures would be in the thousands of dollars.

One of the alternative methods therefore has to be considered and these involve the addition of a solid form of nitrogen. This could be organic nitrogen in the form of blood and bone (expensive and now not so readily available in New Zealand). Of the inorganic forms, low biuret urea and diammonium phosphate are used by some nurseries (19). The use of ordinary urea can lead to biuret poisoning, especially with Azaleas. Gartner (10) tried a number of forms of slow release nitrogen and found that Osmocote 14:14:14* gave the best results with hardwoods.

The third alternative is to compost the bark. This again involves the addition of some form of nitrogen, either as an inorganic form, or by the addition of fresh vegetable refuse, manure or sewage sludge. This method produces an end product which is pleasant to handle and is a good growing medium. However it involves more labour in that the compost heaps will require turning and watering. In America there are a number of composted bark products offered for sale, in attractive polythene bags (22).

5. Bark Mixes

Bark has been tried in combination with most of the common growing media - perlite, pumice, sand and soil. From all these results it would seem that the material supplying the organic matter has the greatest effect and the selection of the inorganic material can be made on the factors of cost and availability. With the range of particle size that can be obtained with bark, the need for any additional inorganic material can be questioned, especially as both Pokorny (14) and Rigby (19) say that good results can be obtained with a medium of 100% bark, if correctly screened.

In many instances the research has shown that composts of bark and sand in a ratio of 1:1 have given better results than those which contain either soil or peat. Both Klett (11) and Pokorny (17) have compared a selection of mixes and both found some variability between the different species' responses. For instance, Pokorny found Pyracantha and *Ilex cornuta* 'Rotundofolia' grew the best in a peat perlite mixture, *Ilex cornuta* 'Burfordi' in bark perlite and *Rhododendron obtusum* 'Hinodegiri' best in bark sand

6. Fertilizers in Bark Potting Composts.

As the nutrient state of the bark can vary, it is important to find out what the requirements of the bark are. The nurseries in America that are growing plants in bark generally carry out routine checks on the nutrient level throughout the growing period.

The problem of the additional nitrogen requirement in the early stages has already been dealt with (Section 4). There is however a continuing need for nitrogen and this can be supplied either by using liquid feed or by incorporating a slow release fertilizer in the compost initially.

Gartner (10) found that Osmocote 14:14:14 at the rate of 8.9 kg/m^3 was the most successful of the slow release forms used. Other forms tried were a 12:12:12 agricultural grade fertilizer Mag Amp 7:40:6 magnesium ammonium phosphate in slow release form and Ureaform 38:0:0 slow release urea formaldahyde product. This was in addition to 3.2 kg/m^3 of gypsum, 3.2 kg/m^3 20% super phosphate and 13kg/m^3 dolomite lime to a hardwood bark perlite mixture. The other rate of Osmocote used was at 4.5 kg/m^3 and although this still gave better results than other slow release fertilizers, the composts tested were significantly poorer than at the higher rate. This experiment was carried out using chrysanthemums.

A different method was used by Pokorny (14) who does not use any fertilizer in the original mixture, except for correcting the pH to 6.5 with dolomite lime. He

* Osmocote - trade name of Sierre Chemical Company, Newark, California.

uses a soluble N:P.K fertilizer 20:20:20 with added minor elements at the rate of 0.78g/l every week.

The information sighted on the two commercial holdings using bark for container production in America (5 and 7) seems to be based on the above recommendations, although it is noticeable that both incorporate iron sulphate and one adds trace elements.

From these results it appears that the fertilizer requirements under New Zealand conditions, need investigating before using bark commercially.

7. Plants Tested.

A wide range of plants have been tested in bark mixtures and with the exception of tomatoes and mushrooms, already mentioned in the section on toxins, there is no reference to any adverse effects, although Gartner (10) found that chrysanthemums showed symptoms of nitrogen deficiency more readily that *Pelargonium zonale*, which he also tested.

Aaron (2) states that without lime, bark would be too acid for narcissus and tulip forcing. Other than these examples, none of the other plants tested, such as *Euphorbia pulcherrima* and *Begonia semperflorens*, Azalea, Forsythia, Ilex and Euonymus showed ill effects.

8. Conclusions on Research Work.

The different aspects of bark have in this section been considered, using the findings of research workers throughout the world over the last twenty years. Even if they are not completely unanimous in their opinion of bark as a suitable material, the majority of the work now being done indicates that any problem can be overcome.

Bark is a waste material at present being dumped in New Zealand and is available in large quantities.

Early workers confused the nitrogen deficiency with that of toxins. These problems can be overcome. The American suggestion of treating the bark with anhydrous ammonia involves heavy capital expense and on the possible New Zealand demand may not be justifiable. However, research has shown the slow-release fertilizers or liquid feeding are both successful.

The existence of toxins that are going to retard growth is doubtful, but as a safeguard, heat treatment or stacking are easy precautionary measures.

Bark is free from pest and diseases likely to affect growth.

With the correct particle size, water retention is good, as is the retention of chemicals. Most barks are acid, but this is easily corrected by adding lime with other fertilizer requirements.

Not only can bark be used for container grown shrubs, it has other uses, of which weed control with an added herbicide seems very promising.

From all this information there is no reason why bark cannot be substituted for peat in soil-less composts.

SUMMARY OF RESEARCH (N.D.H.)

Two main experiments (Trials A & B) were carried out to evaluate plants grown in bark mixes compared with those grown in other media.

TRIAL A.

Two media were used as follows :

(1) Peat: fine perlite (1:1)

(2) Bark: (Particles less than 2 cm diameter): fine perlite (1:1)

Fertilisers were added to each mix as follows:

	G/M^3
Osmocote 18:2.6:10(W.P.K.	2.94
Superphosphate	1.47
Dolomite	4.42
Carbonate of lime	1.47
Trace elements sporumix	0.11

A third treatment (bark plus) was obtained by adding Sulphate of Ammonia (after mixing)

to a bark mix at a rate of 0.59 kg/m^3.

In Trial A junipers and maples were grown outside in the 3 mixes in PB8 bags on 3 separate sites. During the growing season the lengths of the main leaders were measured:

Total Plant Height Increases in cms.

ACER.

Site	Peat	Bark Perlite (1 : 1)	Bark Perlite (1:1+Sulph.Amm).
A	255.4	272.0	342.7
B	382.5	154.6	388.2
C	64.3	53.6	102.1
Total	702.2	479.8	833.0

JUNIPER

A	135.1	131.6	150.4
B	235.0	206.5	247.9
C	159.5	163.8	177.1
Total	529.6	501.9	575.4

Costs are low except that more labour is involved in the preparation of the material. If the bark is to become commercially feasible, it will need to be graded, preferably at the mill. This would increase the purchase cost and would depend on the demand.

No problems were found with toxins. Initial growth was similar for both "bark plus" and peat. The standard bark was slower initially, due probably to the locking up of nitrogen by the nitrifying bacteria. This was overcome when the Osmocote had released sufficient nitrogen to satisfy the needs of the bacteria and growth and shows the need to nitrify the bark before use.

The size of bark particle was larger than recommended and this could have led to problems of drying out.

An additional treatment was added on one site using 100% bark with the standard fertilizer incorporated. This mix proved satisfactory for maples but inferior to other mixes for junipers.

TRIAL B

In this Trial, peat (100%) and bark: perlite plus standard fertilizer were used. The peat was the same as that used in Trial A.

Four additional treatments were included, using 28,57,85 and 113g of additional Sulphate of Ammonia per pot.

Calloused cuttings of *Rosa multiflora* were planted into PB8 planter bags containing the 6 different mixes on 9th September 1973.

The length of the two shoots on each rose was measured at weekly intervals for the first two months, by which time the lateral shoots had started to make growth so that the length of the main shoots no longer gave a true indication of the growth that had been made. It was for this reason that after three months (on 17.12.73) the top shoot was removed and weighed. The lower shoot was removed and weighed on the 16.6.74.

The four high rates of sulphate of ammonia caused severe losses and therefore only the results of measurements and weighings of plants grown in peat and bark: perlite are shown in the following tables:-

Total Lengths (c.m.) of the Two Laterals on Rosa Multiflora

Date	Peat	Bark: perlite
6.10.73	33.65	68.58
13.10.73	57.14	137.79
20.10.73	85.71	176.52
27.10.73	122.55	261.62
3.11.73	199.38	408.94
10.11.73	280.66	591.82
18.11.73	375.92	793.74
24.11.73	467.36	934.72

Weights of Rose Shoots in grams.

Compost	Top Shoot Dec.1973	Lower Shoot June, 1974	Total Weight.
Peat	735.8	370.3	1006.1
Bark: perlite	1301.8	597.5	1899.3

Rose plants grown in bark:perlite grew longer shoots which were a higher weight than those grown in peat with the same fertilisers.

At the same time as top shoot removal (17.12.73), leaves were taken and sent to the Ministry of Agriculture at Ruakura for nutrient analysis. Foliar analysis results are shown in the following table :

Analysis of Rose Leaves Removed in December, 1973

Major Elements %

Compost	N	P	Mg	Ca	Na	K
Peat	2.90	.341	.433	2.10	.07	1.62
Peat: perlite	2.32	.338	.302	2.31	.06	1.53

Trace Elements p.p.m.

	Mn	Zn	Cu	Fe	B	Mo
Peat	180	21	12.5	141	150	.89
Peat: perlite	223	17	7.2	177	88	.16

The results of the leaf analysis showed little difference between the two media except that molybdenum was higher in foliage taken from the plants grown in peat.

A questionnaire surveying use of materials by nurseries in Hawke's Bay showed the following.

Materials Used Per Year in Hawke's Bay Nurseries

	M^3
Peat	887
Soil	344
Sand	34
Pumice	77
Vermiculite	0.5
Perlite	700
Sawdust	259
Bark	6
Mushroom Compost	17

The survey showed the wide range of material used.

Conclusions

Bark has proved a suitable peat substitute for use in potting mixes overseas. This study indicates the potential use for a peat substitute such as bark and the experimental work gives a preliminary indication that bark can be a satisfactory replacement for peat in soil-less potting mixes.

BIBLIOGRAPHY

1. AARON, J.R. 1972. Bark a potentially useful by product.

2. AARON, J.R. 1972. Pulverised pine bark. R.H.S.Journal 1972 97/5

3. AARON, J.R. 1972. The utilisation of bark. Forestry Commission Research and Development Paper No. 32.

4. ANON 1971. Pine bark for compost? N.Z. Commercial Hort. May 1971 p8

5. BOSLEY, R.W. 1967. Ground bark - a container growing medium Proc. International Plant Prop. Sci 17 366-371

6. CLARKE, J.C. 1973. The advantages of bark as a growing medium Nurseryman and Garden Centre 25 Jan.1973 pp 127-128

7. FAIRWEATHER, C. 1972. Container production in Oklahoma. Gardeners Chronicle. HTJ Oct. 27 1972 pp 30-31

8. GARTNER, J.B. CARBONNEAU M.C. SAUPE,D.C. 1968. Tree bark for growing potted plants. Illinois Research 10 (3) 16.

9. GARTNER, J.B. HUGHES, T.D. KLETT, J.E. 1972. Using hardwood bark in container growing mediums. Amel Nurseryman June 15 1972

10. GARTNER, J.B. MEYER JR, M.M. SAUPE, D.C. 1970. Hardwood bark as a growing media for container grown ornamentals.

11. KLETT, J.E., GARTNER, J.B., HUGHES, T.D. 1972. Utilization of hardwood bark in media for growing woody ornamental plants in containers. J. Amer Soc Hort Sci 97(4) 448-450.

12. LAICHE A.J. JR, 1972. Peat moss or pine bark for woody ornamentals. Mississippi Farm Research (1972) 35 (6) 1,7. (En 3pl) South Mississippi Branch Experiment Station, U.S.A. (Hort Abst Vol 43 (6) 3838)

13. LUNT, C.E. AND CLARK, B. 1959. Horticultural applications for bark and wood fragments. For Prod. Joul 9 39a-42a.

14. POKORNY, F.A. AND GUGINO, J.1967. Pine bark shows promise as a potting media comparison of potting media for herbaceous pot plants. Geo Agr Res Fall 1967 Vol 9 No. 2

15. POKORNY, FA.A. AND PERKINS, H.F. 1967. Utilization of milled pine bark for propagating woody ornamental plants. Forest Prod J. Vol 17 No. 8.

16. POKORNY F.A. AND THURMAN 1965. Milled pine bark can replace peat moss in rooting woody ornamentals. Ga Agric Res Vol 7 No. 1: 9-10 Summer.

17. POKORNY F.A. AND THURMAN 1966. Pine bark as an organic amendment in product-

18. POKORNY, F.A. 1970. Interview by Gerald Smith Nov. 1970.

19. RIGBY, F.A. 1963. Ground bark as a grow-medium for container nursery stock. Comb Proc Int Plant Prop Soc 1963 - 13 pp 288 to 291.

20. SCOTT, E.G. AND BEARCE, B.C. 1970. Bringing the forest into the green-house. West Virginia Agriculture and Forestry Vol 3 No. 3 pp 2-3.

21. SCOTT, E.G. AND BEARCE B.C. 1972. A hardwood-bark-sawdust compost for greenhouse pot flower production. for Prod Jour 22 (1) January 1972

22. BOLLEN, W.B. 1969. Properties of tree barks in relation to their agricultural utilisation. USDA Forest Service Res. Paper PNW-77.

The Banks Lecture, 1975
The Role of Horticulture in a Changing World

by

J. P. SALINGER

Department of Horticulture, Massey University

Travel broadens the mind, and it was a desire to travel, to breach new horizons, that compelled Sir Joseph Banks, after whom this lecture is named, to join Captain Cook's expedition to the South Seas and investigate these unexplored or unrecorded regions.

Admittedly time was little or no object in those days and there were many activities other than plant introductions that occupied this expedition. Even so, this particular voyage occupied nearly three years.

This brings me to the contrast between that time and today, when air travel can transport us in a day and a half from New Zealand to Europe. Transport us physically, but not biologically or mentally. Jet lag as it is known is a genuine phenomenon, and although we do not require as much acclimatisation as do plants when they are transported to the opposite hemisphere, yet personal acclimatisation is needed.

This rapid rate of change has been well coumented by Alvin Toffler in his book, "Future Shock" and we must accept that change is now the norm in all our lives. Hence my emphasis on the changing world and to the role of horticulture.

Like Sir Joseph Banks, recently I had the privilege of traversing the globe and studying horticulture in other areas. Firstly one soon realises that horticulture, and particularly horticultural crops, are international commodities. Despite their perishable nature, plant quarantine requirements and tariffs, horticultural products move freely in world trade. We have long been aware of New Zealand exports of apples and pears, and more recently of Kiwi berries, but the general public does not know of our increasing export of nursery stock, particularly to Japan, of chrysanthemums and rose blooms to Australia, of orchid flowers and lily bulbs to Europe.

The trade in fact is reciprocal. Last winter in addition to our own crop there were oranges on sale in our markets from Australia, California, South Africa and even Swaziland; nectarines and plums from California, and our main source of bananas is now Ecuador and not the South Pacific Islands. Orchid flowers are regularly imported from Singapore. For this reason, events overseas immediately have an impact on New Zealand. The size of the crop of Golden Delicious applies in France may directly affect the profitability or otherwise of our pip fruit industry.

Yet another aspect is the increasing importance of the ornamental plant industry. Nursery production and commercial flower growing were literally blooming, especially in what are called the advanced countries, e.g. Europe and North America, while environmental awareness, so adequately put forward by the Hon. Duncan McIntyre at the 1973 conference, is becoming more significant.

I think however much that is said about preservation of the environment is lip service, for in Britain in many towns and cities the old heart of the city is being ripped out to make way for high rise buildings and traffic arteries. Perhaps it is in contrast with these that urban dwellers brighten their homes with flowers and pot plants. Even in New Zealand nearly 80% of the population live in urban communities.

As suggested earlier, since horticultural products are international, two recent developments are the increase in production of crops in areas of more favourable climate to supplement supplies in colder regions. Thus in the U.S.A., output, especially of cut flowers and pot plants, is

Part of a container nursery of 100 ha. in California. These 5 gallon containers are the normal size for retail sale in the U.S.A.

Vegetables grown under plastic tunnels in Israel for export to European markets.

increasing in California and Florida, even in Colombia in South America, the products being transported to Northern and Eastern States; while Israel is becoming a major supplier of vegetables and cut flowers in winter to Western Europe.

Though these are areas of higher sunshine and warmer temperatures, many crops are grown under plastic film structures or smaller tunnels. In fact the use of plastic film to protect and hasten crops has been a major development overseas. In Japan in 1973 nearly 50,000 ha. of crops were covered with plastic film, with an annual usage of 110,000 metric tonnes, thus making full use of the world's greatest inexhaustable energy source, the sun.

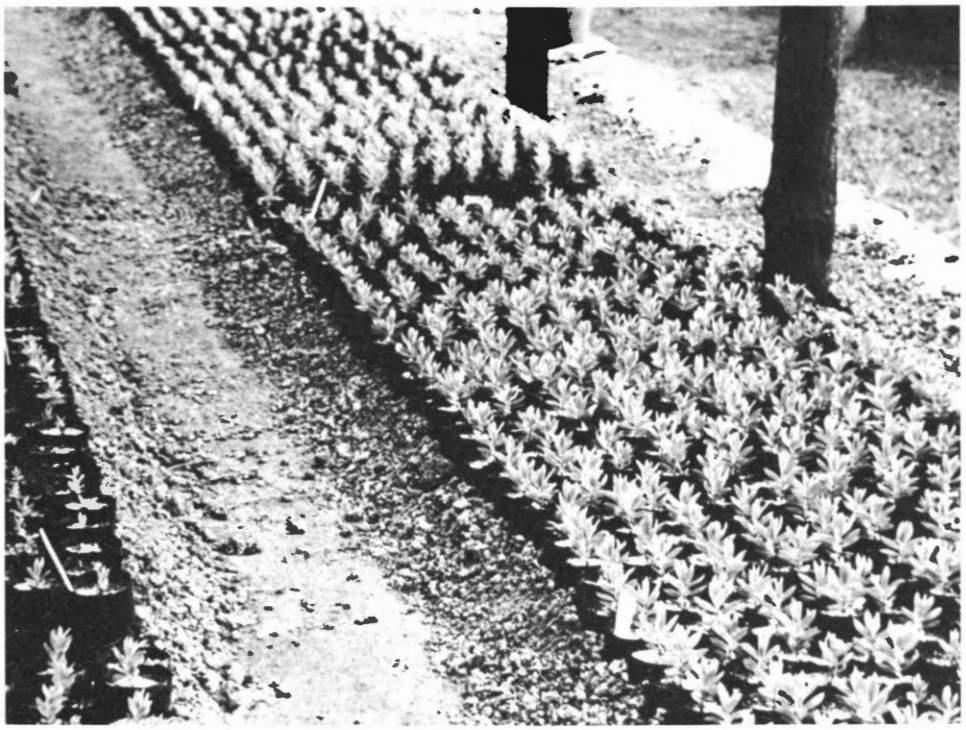
Naturally such problems as the increase in oil prices affect the availability of materials derived from oil; but there is yet another problem, that of disposal of used film, for it cannot be incorporated in the soil, amd if burnt it pollutes the atmosphere.

So far I have discussed horticulture mainly in temperate regions, especially in what are known as the developed countries. More and more we must taken an interest in the developing areas where the great mass of the world's population lives. It is not adequately realised in New Zealand that apart from grain crops like rice and sorghum, the majority of crops grown in the tropics can be considered horticultural; tea, coffee, pepper, oil palm, yams and the vegetables which form a large part of the people's diet, can all be considered as tropical horticulture and are included in Horticultural Abstracts. We should accept our responsibilities by applying our expertise in horticultural production in assisting these other countries to develop their horticultural potential. Elsewhere universities in many advanced countries have adopted universities in less developed regions. By mutual consent New Zealand universities could do the same with higher educational establishments in the South Pacific, in addition to voluntary or Governmental aid programmes.

We are all aware of the exploding world population and even here, horticulture can assist in providing employment. It is an interesting paradox that while we continually invent labour saving devices, especially for harvesting crops, much of the production at one stage or another depends on labour, in fact in Western Europe and parts of the United States, the horticultural industry depends on imported labour from less well developed countries.

Similarly, as economic forces reduce an individual's wealth, these people return to their gardens. In 1974 there was a shortage of vegetable seeds, as more and more home owners decided to grow their own food in place of processed vegetables. Currently the cost of these seeds is markedly increasing.

In summary, then, I can foresee at least three trends. For the urban dweller, an increasing interest in ornamental plants, both inside and outside the home. Greater emphasis on recreational areas in which amenity horticulture is an essential element. Thirdly, a realisation that horticultural crops play a major role in employing and feeding the majority of the world's population in the developing regions of the globe. Horticultural crops make use of two finite sources, soil and water, and two infinite resources, human ability and the sun. Whatever temporary setbacks we may suffer, horticulture will have an even more important part to play in the future, and we must ensure that the dreams that old men dream and the visions that young men see will come in the future.



Pots of Protea plants in South Africa. In many warmer regions, proteaceous plants are being increasingly planted for cut flower purposes.

Chrysanthemums and carnations cultivated in a heated plastic greenhouse at Lee Valley Research Station, England. The plants are being tested for the Plant Breeders Rights Scheme.

A History of the New Zealand Wine Industry

BY T.B. MCDONALD

McWilliam's Wines (N.Z.) Ltd. Napier

GRAPE-GROWING IN THE 19TH CENTURY

It is known that Smauel Marsden, the well known Anglican Missionary, then domiciled in N.S.W., brought 100 vines with him on his second visit to New Zealand in 1819. These were planted at Keri Keri.

James Busby, British Resident in New Zealand from 1833-1840, planted a vineyard at Waitangi in 1833. Part of the vineyard was destroyed by Maoris in 1845 and mention was made of wine being sold to soldiers in 1846.

D'Urville, the French commander of the Astrolabe, when visiting the Bay of Islands in 1840 reported having tasted a light white wine on Busby's estate.

In 1840 when the French formed a settlement on the Akaroa Peninsula they brought vine cuttings with them, and it is reported they made excellent wine. In 1895 when Bragato visited Akaroa he saw several vineyards and was presented with ripe grapes of the Chasselas, La Folle, and Muscat Frontignac varieties. Evidently the decendants of the original settlers lost their interest in viticulture and today few grapes and no wine is produced at Akaroa.

In 1838 Bishop Pompalier landed at Hokianga and like most Marist Missionaries throughout the world evidently brought vines out with him or obtained some on the way. It is recorded that the Marist Fathers expected to be using their own wines for celebrating the Mass by 1844.

The present Mission vineyard at Greenmeadows is directly descended from the efforts of Bishop Pompalier.

Joseph Soler in 1890 testified that he had been growing grapes in Wanganui since 1865. It is also reported that Soler obtained awards for the wines made at Wanganui, in Australia and London. In 1906 at the Christchurch International Exhibition he did obtain 3 gold meals out of five against overseas competitors.

William Beetham established a vineyard in 1883 near Masterton and made wine for the use of his family and friends. Beetham was the fore runner of several of the large land owners who became interested in the cultivation of the vine. Three well known in Hawkes Bay were H.S. Tiffen of Greenmeadows, Bernard Chambers of Havelock North and J.N. Williams of Hastings.

Beetham and Soler testified before the Flax and Other Industries Committee of the House in 1890. Following on the report of the Committee the Department of Agriculture was formed in 1892. In 1894 Richard Seddon requested the Victorian Government for the loan of the services of Ramon Bragato to investigate the possibility of establishing grape-growing and winemaking as a Commercial venture.

During the latter part of the nineteenth century the "Austrians" or Dalmatians came to New Zealand mainly to work as gum diggers. They were hard workers, lived sparsely, and being used to wine in their own country soon commenced producing wine for their own use. When the gum digging proved unremunerative many of them commenced making wine commercially. They were to become the largest ethnic group of winemakers in New Zealand, and many of their decendants are today leaders in the industry.

In 1895 Ramon Bragato, the Government Viticulturist of Victoria was loaned to the N.Z. Government to visit and report on the suitability of New Zealand as a wine making country.

Bragato arrived at Bluff in February 1895 and travelled throughout both islands. In September of the same year he submitted to the Premier a most enthusiastic report on the visit. He strongly advocated that associations be formed in each District to

determine the most suitable varieties for planting. He said few places in New Zealand were unsuitable for the cultivation of the vine and that Hawkes Bay and Wairarapa were pre-eminently suitable.

He discovered phylloxera in two vineyards in Auckland and recommended the importation by the Department of Agriculture from Europe of cuttings of American resistant vines.

Bragato returned to Australia leaving behind him settlers excited with the prospect of wealth from viticulture. Unfortunately the general enthusiasm was dampened by the lack of interest by the Agricultural Dept. and the ravages of two pests, phylloxera and powdery mildew.

With the exception of the aforementioned wealthy settlers and a new breed of winemakers, the Dalmatians, little interest was taken in developing the wine industry.

In 1901 the N.Z. Government invited Bragato to come back and report on the phylloxera which by now was exacting a heavy toll on the vineyards.

This time he was offered a permanent position as Viticulturist and head of the Viticultural Division of the Department of Agriculture.

He accepted the position in 1902 and established his head quarters at Te Kauwhata. Te Kauwhata had been set up as a small experimental nursery in 1898 and planted out in vines and fruit trees.

Bragato developed it into a full scale vineyard and winery producing wines of excellent quality. His enthusiasm continued and he travelled widely speaking on the merits of setting up vineyards and wineries at suitable areas in the country. He published through the department books and pamphlets on grape-growing and wine-making.

In 1906 Bragato reported 550 acres under vines, by 1909 this had risen to 668. This was to be the peak, neglect in high places and threat of prohibition proved too much for the budding industry. Bragato resigned in 1909 and left the country.

During Bragatos period the Mission Vineyard was extended and moved to Greenmeadows. Tiffen continued his modern winery and B. Steinmetz planted his vineyard on part of the original Tiffen Property. Chambers, T.M.V. winery became more commercial under the management of Jock Craike.

In the Auckland Province the Dalmatians continued to plant and develop small vineyards. Assid Abraham Corban established the Mt. Lebanon vineyard at Henderson in 1902. This was to grow into a very large organisation with wineries and vineyards at Gisborne and Henderson.

Conditions were not good for the budding industry. It was purely small time wine making with the growers depending on their local sales for a livelihood.

Wine and spirit merchants were not interested in the local wines and with a two gallon minimum sale winemakers had great difficulty in disposing of their wines. Lack of Government support and threat of prohibition saw a great decline in acreage of grapes grown. By 1923 it had reduced to 179 acres.

GROWTH IN 20TH CENTURY

In 1927 when I took over the business of B. Steinmetz the whole of New Zealand was producing 70,000 gallons of wine.

When Import Licensing was introduced in the 1930's the demand for N.Z. wine began to increase. During the 1939-45 war the demand became greater than the industry could conveniently handle and much inferior grade wine was placed on the market.

By this time several N.Z. Wine and Spirit merchants realised that the overseas supply was seriously curtailed and became interested in the local wine industry.

Ballins of Christchurch was one of the first. They purchased McDonald's of Greenmeadows and commenced a programme of

expansion which was still being carried out when McDonald's amalgamated with McWilliam's in 1962. This company McWilliam's Wines (N.Z.) Ltd. became one of the largest combining winemaking, brewery and wine and spirit merchant interests.

Corbans of Auckland were to follow forming a company with several N.Z. Wine and Spirit merchants. Rothmans later invested a large amount of capital and have a more or less controlling interest in the Company.

Penfolds of Australia bought out an old established winery and like Corbans allowed several N.Z. merchants to invest in the Company.

Montana Wines the most rapid growing of the larger companies formed a public company with listing on the Stock Exchange. This firm set out on an enormous (for New Zealand) expansion programme, establishing large vineyards at Mangatangi and Blenheim, Modern wineries at Auckland and Gisborne and a colossal bottling hall at Auckland. Like Corbans they have a considerable number of people growing grapes under contract.

Most of their development was evidently designed for export and to foster this trade Seagrams of America now control nearly 50% of the shareholding.

Cooks another public company was established at Te Kauwhata with a very modern winery designed with all the latest methods of wine making.

Seppelts of Australia bought in to the old established firm of Vidals at Hastings. Economic conditions in Australia forced them to reconsider the position and they recently sold their interests to a New Zealander.

The end result of this introduction of merchant and overseas interests has been the growth of individual firms to a size where they can carry fully qualified technical staff and build and maintain efficient and modern wineries, equal in many respects to the best in the world.

Overseas companies' knowhow has been introduced, technical staff loaned or appointed from overseas and opportunity given to our own New Zealand people to go and study winemaking with their associated overseas companies.

During the time of this rapid expansion of the larger nationally known firms many of the small winemakers have expanded their vineyards and modernised their wineries. They have benefited considerably from the expertise available locally to improve their wine making and in many cases have sent their sons overseas for technical training. They cannot hope to grow large enough to establish a national market, but with improved quality they should always have a good local market.

OVERSEAS TRADE.

Much has been written and spoken of the great opportunity available for N.Z. to establish an export market for our wines.

Personally I am not very confident that we can economically export any great quantities. The whole wine world appears to be suffering a glut of wine at the present time. Californian production has increased to such an extent that it is reported that some 300,000 tons of grapes will be surplus to winery storage this 1975 vintage. Sales have levelled off and vines planted over the past four years are now coming into production in ever increasing quantities.

Australia has something of the same problem of overproduction and with the poor economic position in both countries sales must suffer to a degree.

In Europe production has also risen and prices for the top quality wines reached exorbitant rates with resultant buyer resistance. Prices have receeded somewhat but wine stocks in Europe are still very high.

There does not appear to be any shortage of wine in any of the major wine producing

or drinking countries of the world.

For these reasons I cannot see a stable market for our wines overseas. Some we will sell and continue to sell to an experimental or "gimmick" market.

We must continue to foster and expand our local market, avoid the importing of the cheap overseas wines and trust that our own economic situation allows us to trade profitably.

MARKETING CONDITIONS.

During this period of expansion in the industry greater opportunities of sale became available on the local market.

Over the years many alterations have been made to the licensing laws, all designed to promote and encourage the sale of New Zealand wines.

The old 2 gallon minimum has been reduced to a 13 oz bottle minimum and efforts are now being made to allow the sale of wine by the glass at the winery.

Special licenses were, and are still being granted, for the sale by wine resellers. This is a great advantage and it has been estimated that over 50% of all N.Z. wine sold is handled by wine-resellers.

Licensed restaurants were established. These gave people a greater opportunity of dining out and when the success of this venture became apparent hotels enlarged and extended their dining facilities. Although the licensed restaurants are not restricted to the sale of N.Z. wine only, something desired by many in the industry, they certainly educate many people to wining and dining and helped foster the greater use of wine in the home.

It is safe to say that the majority of wines sold in licensed restaurants and hotels are of N.Z. origin.

INDUSTRIAL MATTERS WITHIN THE INDUSTRY

A Wine-Making Industry Committee was appointed by Government in 1957. This committee investigated all aspects of the industry and brought down a report which considerably assisted the wine trade. It is now freely acknowledged that whatever political party is in power favourable consideration is given to the wine-industry.

The industry has been plagued with various differences of opinion over the years. Most of the growers are individualists, very independent in their outlook, and suspicious to a degree of what their neighbour suggests.

We are a mixture of many nationalities and it has taken years to get to know and appreciate the thoughts and wishes of each other.

Today after many years of endeavour and hours of discussion the whole industry has unanimously agreed to set up a Wine Institute to which every grape wine maker in New Zealand must belong.

This Institute has an executive of seven Elected to represent groupings of wine makers according to size of production.

With careful attention to the relative requirements of each section of the industry the Institute should be able to foster the establishment of a truly N.Z. Wine industry.

With the power to levy for finance it should be possible to raise sufficient funds to carry out an active campaign to publicise N.Z. wines, appoint capable executive officers to look after all matters connected with Government and Departmental regulations and generally speak as one voice for the whole of the industry.

The new Wine Institute has constituted seven committees to handle the important facets of industry affairs. These committees have power to co-opt members and a full and representative opinion of the whole industry should eventuate.

In the past the industry relied on local organisations of wine makers, working in the main individually to handle all matters requiring attention.

Some years ago a semi statutory body was formed called the Viticultural Advisory Committee. This Committee comprised members of the wine industry and representatives of the different Government Departments concerned with industry affairs. This committee met regularly and over the years has been instrumental in introducing a number of very worthwhile activities.

Perhaps the most lasting and useful has been the fostering, with the Department of trade and Industry, of the annual wine exhibition. This is now recognised as the major exhibition in N.Z. and this year became a four way activity with Trade and Industry, Tourist Hotel Corporation, Air N.Z. and the Wine Industry sharing the cost. The Tourist Hotel Corporation gave a handsome trophy in 1971 and this has become the premier award of the exhibition.

In 1964 under the control of the Agriculture and Customs Departments experiments were carried out by several wine makers on the feasibility of producing grape brandy. Experiments were conducted over a period of five years and some interesting results obtained. It was generally agreed that a good brandy could be produced, but unless some very favourable excise was granted, not economically.

Regulations and conditions for the establishment of brandy production have been drafted and, I understand provisional application made by three firms for a license to distill. No one appears to be demanding immediate action. I personally consider brandy making should be something available to the winemaker if he chooses to convert his surplus grape-juice into spirit. As a separate industry I cannot see any future for it.

Over recent years there has been a great change in the production of grapes for the industry. In the early days and right up until quite recently wine makers had to produce their own grapes. Today it would be safe to say that nearly half the grapes used for wine making are grown by people who are not wine makers. Many farmers are now growing grapes under contract (some without enforceable contracts for the major wine-makers. Prices being paid for the grapes are sufficient to enable the farmers to make a good living and the wine maker is enabled to put money into plant and wine making facilities which would otherwise have to go into the purchase of land and establishment of vineyards.

Altogether it is a partnership which is a great benefit to the industry.

From 1819 when Marsden planted the first grapes until today the wine-making industry has suffered many trials and tribulations. Economic conditions have been the controlling force. When New Zealand prospered the wine industry expanded, in reverse the industry was hit very hard with recessions.

Over the past ten years we have seen a vast increase in acreage of grapes planted, both by wine makers and farmer-growers. Production of wine has expanded four fold during this period. Can we continue to expand at this rate?

There is great enthusiasm and interest throughout N.Z. in the wine industry. It reminds me of what I read of the period of Bragato's influence in the early part of this century. Can we sustain that interest and continue to grow?

AREAS OF GREATEST PRODUCTION

Geographically the industry is centred in three major areas.

Auckland which embraces an area from Hamilton to Whangarei. Easily the largest number of wine makers and recognised as the centre of activity in the trade. Five of the large nationally known firms are in this area. Montana, Corbans, Villa Maria, Penfolds and Cooks as well as many smaller. Not considered by many as the ideal grape-growing area, several of the wine makers have established vineyards or contracts to purchase grapes from the Gisborne district.

Gisborne has perhaps had the greatest expansion of grape-growing of any district in New Zealand over the past ten years. Originally the home of two small wineries there are now three modern wine making plants established there, Corbans, Montana and Waiherere, an associated company of Montana. It is understood that the wines are made in Gisborne but finally processed in Corbans and Montana bottling halls in Auckland. Hawkes Bay is the third area and has the longest history of commercial wine making in N.Z. The Mission Vineyards claim pride of place in age, being established in 1866. There are only eight wineries in the district and four, Glenvale, McWilliam's, Vidals and McDonalds, an associate company of McWilliams, are nationally advertised and distributed.

It is difficult to obtain accurate figures of acreage of vineyard or winery production. With the Wine Institute operating these figures should be available in the future.

The following figures are interesting and show the increase in vineyard plantings and wine-making over the past 50 years.

1927	72.44 HA	318,220	Litres
1939	242.81 HA	1,069,398	"
1958	404.69 HA	2,911,770	"
1970	1214.08 HA	18,820,812	"
1975	2428.16 HA	35,000,000	"

As mentioned above it is difficult to obtain accurate figures, and it is difficult to reconcile some of the above. There has been a changing pattern of wine types over this period.

Initially the demand or taste was for fortified wines in the main, principally Port. This changed to Sweet Sherry and gradually to dry sherry and the light table wines. We followed the overseas trend and Cold Duck and similar types of sparkling wine became in great demand. Today it is difficult to say which types are the popular taste. All varieties of well made wines are in demand with particular emphasis on good sparkling wine, either bottle or tank fermented, not carbonated.

With the great increase in the production of vitis vinifera grapes of the true classical style there is an increasing demand for the better brands of these varieties.

Wine makers are learning to handle these varieties and it is from the true use of this better type of grape that the future of our industry depends.

The Propagation and Properties of New Zealand Plants used in Floral Art

BY E. P. STUART

(Extracts from a thesis for the National Diploma of Horticulture (NZ), submitted by E. P. Stuart in 1974)

Until recent years, many indigenous plants have been grown by few people other than the enthusiastic collector. The average New Zealander has been inclined to overlook our native flora, preferring the more colourful or showy exotic.

Overseas, our indigenous plants are keenly sought. *Phormium* species and their cultivars command high prices both for cutting and as a specimen. Demonstrators of floral art who come to New Zealand are enthusiastic about the abundance and availability of flax which is so expensive overseas especially in Britain. Possibly, this demand has made New Zealanders more conscious of the wealth of beautiful plant material growing almost at our back door.

Phormium "Dazzler" used with a red *Corokia* hybrid.

With emphasis on the modern functional living of the seventies, importance is placed on form, space and texture and a more general blending with the architecture of the period.

What better examples of harmonious planting could there be than some of our more handsome and arresting plants such as lancewood, *Pseudopanax* sp. especially *P. ferox*, *P. lessoni*, *P. discolor*, *P. discolor* 'Rangatira' and the cultivar 'Gold Splash', although some of these latter species and cultivars are not quite hardy in the southern part of the South Island. However, they make excellent indoor or patio plants.

Many of the *C. ordyline* cultivars are well worth growing, in particular *C. australis* 'Purpurea' and some of the cultivars of *C. banksii*. Given a favourable situation and sufficient space, a group of *C. indivisa* makes a bold and arresting feature.

Our Fiordland daisy, *Celmisia holosercea*, *C. traversii*, *C. hookeri*, *C. verbascifolia* and some of the *C. coriacea* type are handsome the whole year, whether they are in flower or not. They are sometimes difficult to acclimatise in a lower altitude, although *C. holosericea* and *C. verbascifola* grow right down to lake level at Manapouri and the Sounds beyond Deep Cove. *C. hookeri* also occurs naturally at river level near Mid Dome in Northern Southland. Generally speaking, a generous amount of peat and sand in equal quantities will help them adjust.

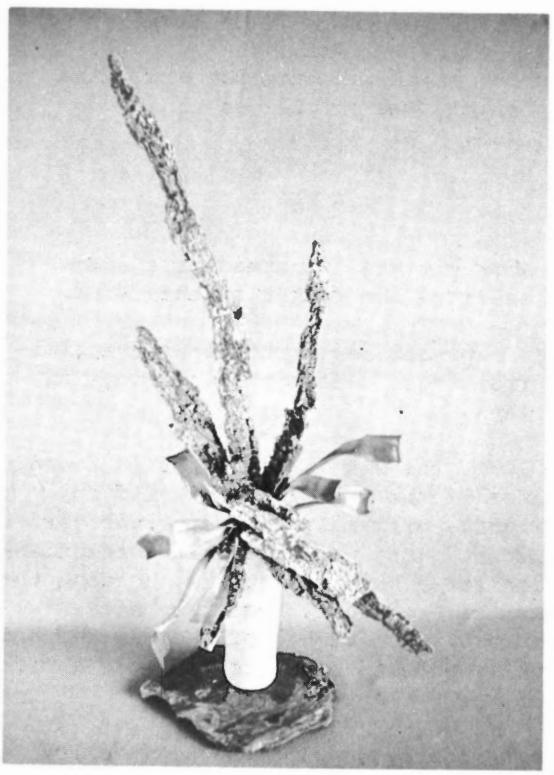
Astelia species will usually adapt easily to garden cultivation if given conditions similar to their natural habitat. Although not commonplace, pink, and sometimes red coloured forms of *Astelia* are to be found in parts of Otago and Southland.

A list of plants with leaf impact would not be complete without mention of

Myosotidium hortensia (Chatham Is. forget-menot). Although it is tolerant of most situations in Southland, it prefers a semi-shaded position, possibly where it gets the morning sun.

Chionochloa flavescens and *C. flavicans* are most useful subjects for pebble gardens. They resemble a miniature toe toe. In November they produce most attractive flower heads of very beautiful lime green. Incidentally these dry very successfully.

From this brief list, you will see I have chosen those plants which have some particular claim to form. No matter what art form is practised, whether it be painting, sculpture, architecture, landscape gardening or floral art, the same principles apply.



Bark of red beech with dried leaves *(Dracophyllum menziesii)*.

Celmisia holosericea with fungus covered branches of *Nothofagus solandri*.

The R.N.Z.I.H. handbook 'Flowers for Shows' defines design as follows : - "Design is a preconceived idea which uses the design elements of line, form, texture, colour and pattern according to the art principles such as balance, proportion, scale, dominance, unity, accent or contrast and rhythm to achieve the art objectives which are beauty, expressiveness and suitability."

Not so very long ago, on the show bench as in the garden, "Native Flora" consisted of a large number of species jumbled together with no thought of highlighting the individuality of any one of them. Latterly, with people becoming more conscious of good design, individual species are featured in all their bold beauty.

By bringing New Zealand plant material to the fore in floral art, the general public will become more aware of its virtues from a horticultural point of view, as well as in its art form.

Citations for the Award of Associate of Honour A.H.R.I.H. (N.Z.) 1974

Associates of Honour:

(i) The title of Associate of Honour may be conferred only on persons who have rendered distinguished service to horticulture.

(ii) The annual procedure for electing Associates of Honour shall be : -

(a) Nomination by National Executive, District Council or by an elected Associate of Honour.

(b) Consideration of all nominations received by the National Executive.

(c) The recommendation by the National Executive of not more than three names for consideration for election at the Annual General Meeting.

(iii) The number of Associates of Honour shall not exceed sixty at any one time.

(iv) A suitably inscribed Certificate shall be prepared and presented to each person elected an Associate of Honour.

(v) Associates of Honour shall be entitled to use after their names the words "Associate of Honour of the Royal New Zealand Institute of Horticulture, Inc." or the distinguishing letters "A.H.R.I.H." and shall have all the rights and privileges of members of the Institute subject to rule 8 (d).

Mrs. Doris Benstead, F.R.N.Z.I.H.

Our nominee, Mrs. Benstead, has resided at 8 Cornwall Street, Lower Hutt, for over 50 years. She has cultivated her quarter acre garden during this period, growing many garden treasures.

Horticulture has been an integral part of her life since childhood, as her father was a very keen amateur gardener who imparted his extensive knowledge to his children. He was particular in instructing his family in the correct naming of plants and this factor coupled with Mrs. Benstead's four year tuition in Latin at Victoria University, established a firm basis for her expertise in nomenclature.

In 1905, the family moved from Wellington to Lower Hutt, where they settled in Queens Road. When Mrs. Benstead's father retired from business, he devoted his later years to commercial plant growing, especially in the supply of cut flowers to the prominent Wellington florist, Miss Murray. Mrs. Benstead as a school girl assisted her father in this work.

She expanded her horticultural activities from these childhood beginnings in many ways.

In 1930, she was instrumental in founding a branch of the Townswomen's Guild in Lower Hutt, primarily to foster the gardening aspect. She was active in this organisation for a number of years, holding the offices of President, Secretary and Treasurer, was a member of the New Zealand Executive and was subsequently made a life member.

In the early days of the Hutt Valley Horticultural Society she was an active member of the Evening Garden Circle. When this group went into recess, she was responsible in forming the Afternoon Garden Circle, which today numbers 260 members.

It was this Garden Circle under the leadership of Mrs. Gower which originated the seasonal display of interesting and unusual flowering and foliage plants at each of the Society's Shows, which in the early years, numbered five a year. Mrs. Benstead is still responsible for the organisation of the exhibits on this stand and it is her interest and enthusiasm which has made this display table such an integral part of each show for over thirty years.

The correct naming of plants brought forward for display is still attended to by Mrs. Benstead and it is her background of knowledge that has maintained the correct naming of plants exhibited. At one show this display table staged 357 plants, all identified by name.

In all the years of involvement with this activity she has been absent from only two shows. Her activities in the Garden Circle have been recognised by the award of Life Membership of the Hutt Valley Horticultural Society. Since 1967, the Garden Circle stand has included a special section of plants that have been accorded the "Award of Garden Excellance" by the Royal New Zealand Institute of Horticulture. This arose from her membership of the Wellington District Council of the Institute from 1967 to 1971, from which she was appointed to serve on the Award of Garden Excellance Sub-Committee for the Wellington area.

Throughout her life, she has given many talks to garden clubs in the Wellington area, up as far as Levin. She has also given regular monthly talks on seasonal work in the home garden to the Garden Circle. For the last two years she has no longer been able to regularly attend these meetings but still supplies topical notes to be read out to the meetings. The collection of these over a period of eight years or more are now of more than considerable value as a guide to home gardeners.

She has given valuable community service to horticulture in her own way, by advising and answering garden queries by personal contact, telephone and letter. She has also maintained a correspondence with many people throughout New Zealand and particularly with Mr. Sykes of the D.S.I.R. Botany Division, Christchurch, checking on the identification and correct naming of plants.

She has specialised in herbaceous perennials throughout her life although her deep knowledge involves ornamental trees; shrubs, bulbs and annuals. For over thirty years and at her own expense, she has imported seeds of many species and cultivars of plants from California and the United Kingdom and from plants grown from these, she has distributed offsets and seed throughout the Wellington area and to other parts of New Zealand. In her own garden at one period, she had an example of every herbaceous perennial available commercially. Before distributing plants, she ensures that each is true to botanical name and description.

In 1967, she wrote an article entitled "My Own Garden" which was published in the September edition of "Plants and Gardens".

For many years she has been on the contact list of the Hutt Hospital, for identification of plants suspected of being contributable to poisoning cases admitted and has been called on for this service from time to time. She was instrumental for widespread publicity of dangers from eating berries of the Jerusalem Cherry, Solanum pseudo-capiscum, following a severe case of poisoning admitted to hospital.

Mrs. Benstead is an unassuming contributor to horticulture and has stated that she is not worthy of this nomination.

However, the Wellington District Council of the Royal New Zealand Institute of Horticulture feels that her lifetime in gardening and her unselfish sharing of time, knowledge and plants makes her a most fitting person for consideration as an Associate of Honour.

KNUD HORBY MARCUSSEN

"Marc" Marcussen's career in Horticulture commenced with an apprenticeship in Denmark in April, 1929. He gained wide experience in plant and flower production in the open and under glass and also in vegetable and fruit production, park work and landscape design.

As a journey-man he spent a year in Norway and a year at Engleman's in Saffron Walden, England.

For most of 1939 he worked in Denmark for one of Copenhagen's leading florists and plant hire establishments where experience in the decorating field was gained in addition to that obtained at the Danish Florist School during a course in 1934.

Arriving in New Zealand late in 1939 Mr. Marcussen commenced work at J.N. Anderson & Son Ltd., Napier and a year later joined the staff of the Napier Parks and Reserves Department. Duties were varied during the early war years and he was in charge of various gardens, including Clive Square and Marine Parade.

Volunteering for military service in 1942 he served for three years with the 2nd N.Z. Division in the Middle East and Italy.

Soon after returning to New Zealand and to the Napier Reserves Department he was put in charge of the Nursery Department but was also responsible for laying out several new ornamental areas, the major ones being The Kennedy Park Rose Garden and the War Graves Cemetery.

While in Napier he served on committees of the Napier Horticultural Society and the Hawkes Bay Rose Society, being a foundation member of the latter. He was also a member of the Hawkes Bay Horticultural and Gardening Apprenticeship Committee.

After the war Mr. Marcussen studied for the Institute's examinations and gained the N.D.H. (N.Z.) in 1948. In 1953 he took up his present appointment with the Ministry of Agriculture and Fisheries in Christchurch.

As Horticultural Advisory Officer he has been involved with nursery, commercial bulb and flower production. In the early days he covered the provinces of Canterbury, Otago and Southland but later this was extended to the whole of the South Island. In recent years duties outside the Christchurch district have changed from advising nurserymen and growers to providing assistance to local Advisory Officers and Horticultural Inspectors in the specialised field of ornamentals. He has served on the Nursery Stock Research and Extension Advisory Committee since its formation and has been the Secretary since 1968. He is currently producing the Summary of Research done in New Zealand on ornamental crops.

Mr. Marcussen has been closely associated with the commercial organisations relative to his work throughout the South Island, especially the New Zealand Commercial Flower Growers' Association and Associated Bulb Growers of New Zealand, both of which he was actively associated with during formation. For many years he was also associated with the New Zealand Institute of Parks and Recreation Administration.

He is an honorary vice-president of the New Zealand Gladiolus Council and an honorary member of the New Zealand Commercial Flower Growers' Association.

Articles by Mr. Marcussen have appeared in many publications and he has been a regular contributor to the New Zealand Journal of Agriculture. He has prepared several editions of the Bulletin "Roses in the Home Garden" and various leaflets on commercial production of glasshouse flower crops. He is also one of the authors of "Flower Gardening with the Journal of Agriculture" first published in 1962.

In earlier years he lectured to many horticultural societies, garden clubs and specialist societies and judged at shows, but activities in later years in this sphere have been devoted mainly to

commercial and professional audiences to whom also radio talks are directed. He remains a judge in the Garden Competition held by Christchurch Beautifying Association and Canterbury Horticultural Society. He has for many years organised field days and short courses for Nurserymen and flower growers in many centres of the South Island followed by the production of high standard proceedings.

Mr. Marcussen has served on the Canterbury District Council Executive Committee of the R.N.Z.I.H. since 1953 with several terms as Vice Chairman. Since 1955 he has been an examiner for the Institute's oral and practical examinations. At present he is also a member of the Role of the Institute and Publications Sub-Committee.

In 1955 he was elected a Fellow of the Institute.

Mr. Stanley Walter Burstall

Mr. Stanley Walter ("Bob") Burstall was born in Brisbane in 1904 and came to New Zealand in 1912, where he was educated at Te Puke. He left school at the age of 12, and gained experience in a variety of occupations - including periods with a jobbing printer, a grocery and a garage in different parts of the country. For 14 years he lived in Palmerston North. From 1938 to 1948 he had his own business in the Bay of Plenty as a distributing agent for stock foods and fertilizers; this included 3 years as agent for the NZ Pig Marketing Association in Whakatane and district.

In 1948 Mr. Burstall went to the Forest Research Institute, Rotorua, as an assistant in the Mensuration Branch. His job was to help obtain the data for designing methods of estimating tree volume and growth. This work was partly in the office and partly in the field. Within a few years he had travelled widely in both islands and had begun to record dimensions of unusually big trees so that their volumes could be calculated. He personally measured sectional diameters of many of the bigger trees by climbing with ladders. From 1958 to 1963 he was the senior field man in the National Exotic Forest Survey done by the Forest Research Institute. The purpose of the survey was to assess the area and standing volume of exotic forests in all ownerships in New Zealand. That survey took Mr. Burstall into virtually every part of the country where there might be exotic forest and gave him an unrivalled opportunity to find and record trees of unusual dimensions and species. In trying to assess tree age he began to search old records, and accumulated a lot of valuable information on many trees.

Incidental to this work Mr. Burstall developed his interest in local history, particularly the activities of those pioneers and settlers who had often newly introduced and planted exotic trees and shrubs, whether specially imported from overseas, purchased from enterprising nurserymen, or gifted by friends or travellers. He also took the trouble to document where he could the history and Maori folklore associated with particular notable and historic indigenous trees which he had recorded.

By the time Mr. Burstall retired in 1970 he was one of the senior technical officers in the Forest Service, he had written many reports on measurement investigations traditionally done by professional officers, and he had published five papers, together with a list of notable trees (the latter in "New Zealand Plants and Gardens", journal of the RNZIH, September 1963). He had become an acknowledged expert on notable and historic trees, and when he retired he had accumulated the information for a series of internal Forest Research Institute reports with limited distribution. Some of these reports have since been issued and when the series is complete there will be eight regional reports and a national report.

In furtherance of his interests Mr.Burstall has been a member of the International Dendrological Society since 1968, and in 1971 he took part in that society's tour of northwest North America.

Hardy Cyclamen

by

D.D. RIACH

(Extracts from a thesis for the National Diploma of Horticulture (N.Z.), submitted by D.D. Riach in 1975).

This genus consists of 17 or 18 species, not widely known in New Zealand apart from the hybrid varieties of one of the least hardy species, *Cyclamen persicum*(florist's cyclamen).

All are native to the old world with their main distribution being within the countries bordering the central Mediterranean. One species *C. purpurascens* is found native in Britain whilst *C. persicum* extends the genus to its most easterly limits, the Caucasus and north-west Iran.

The plant grows from a stout tuber, its shape, external surfacing and the position from which the roots arise, providing valuable clues to the identification of individual species. Leaves all radical, stalked, broad; flowers solitary, pendant, petal lobes reflexed and often twisted; corolla tube short; fruit a many-seeded capsule.

After fertilization the flower stalk, with the exception of *C. persicum*, coils up spirally drawing the ripening fruit down to soil level.

C. coum Mill.

This species has given botanists more trouble in definition than all others put together and until much more detailed work has been done the species is here treated as a large and variable aggregate. It has a wide natural habitat stretching from the Black Sea coast of Bulgaria and Turkey discontinuously through Asia Minor to the Caucasus and North West Iran from sea-level to over 6,000 feet.

C. coum as I know it, has dark olive green nearly orbicular or slightly kidney-shaped leaves completely unmarked with zoning or spotting on the upper surface and beautifully glossy in the best forms. Today the species covers not only plants of the above description but a number of forms with a variety of silvery markings previously listed as *C. obiculatum, C. vernale, C. ibericum* etc. Their undersides vary from green to a rich beetroot red which does not seem to bear any relationship to the surface markings.

The leaves, and later the flowers, travel some distance just under the surface of the ground before breaking through and are attached to the corm by such a slender union that any but the slightest disturbance of the plant in growth so dishevels its appearance as to completely destroy its charm for the whole season. They appear well before flowering, often in late February, certainly by mid-March, and although with some individuals the flower buds may appear at the same time these seem to cease development until just prior to flowering from late May.

Flowers squat, with short reflexed petals almost as broad as long; colour, variable, the rim of the corolla tube white, the base of the petal with an arch-shaped deep crimson or plum blotch; anthers yellow, neither they nor the style being exserted; tuber rounded below, flattened above, thin skinned, often with a "bloom" of fine dark brown hairs. The roots spring from the lower surface only whilst the upper surface sometimes produce short floral 'trunks'.

Propagation

(a) Vegetative

The tubers of quite old specimens are rarely large enough to divide and whilst it is probably possible to grow it from cuttings, made from the occasional floral trunks produced, neither methods are really practicable.

(b) Seed

Seed is ripe soon after Christmas and germinates readily in from 6-12 weeks. Unlike *C.hederifolium** and *C. graecum* most seedlings of *C. coum* will flower in their second growing season and all will have most certainly done so by their third.

Cultivation

Because of its wide area of distribution and differences in altitudes at which it is found in the wild, *C. coum* is adaptable to a wide range of soils and situations in cultivation. In its native habitat it is said to grow best in inland sites in woods of deciduous trees, particularly hazel, or under bushes in damp places or near running water, and to commence flowering after the passing of winter,often with the melting snow. At sea level it is found in particular profusion in sand hills along the Black Sea coast of Turkey growing in the company of bracken, *Helleburus orientalis* and *Galanthus rizehensis*. In Canterbury the first flowers usually open in May and although the plant is perfectly hardy because of heavy driving rains and high winds often experienced during its month of flowering it is best grown in the most sheltered position that can be found. Where grown in a position that is too exposed the flowers are either pounded into the mud or at least so mud-splattered as to be completely spoilt as a decorative garden feature. As with many other cyclamen species and varieties *C. coum* thrives best in a well-drained soil with a high organic matter content. It is ideally suited to growing under deciduous trees in the company of snowdrops and English primroses although the latter two bloom at their best towards the end of the *C. coum* flowering span in late August. A light dusting of bone dust applied in autumn is most beneficial. Plants do well and are long-lived when grown in containers but like *C. hederifolium*, look more attractive in the garden than in a pot where the creeping habit of the leaf and flower stalks is inclined to produce a sprawling effect.

Pests and Diseases

Of the species of cyclamen I have grown *C. coum* would appear to be the most frequently and severely attacked by the grubs of the black vine weevil. Evidence of attack shows first as a general flagging of foliage and perhaps flowers, despite soil conditions being moist. In light of early infestations only a few leaves may wilt at first but as the grub, or grubs, become larger and more roots are destroyed the plant becomes progressively more distressed until in severe infestations a total collapse occurs. Under such conditions it is often possible to pick up the corm at its point of eruption. Usually only a very perfunctory search will be necessary to uncover the grub in the hollow left by lifting the corms from the soil.

The roots are occasionally attacked by the root aphis.

The foliage seldom seems attacked by the looper caterpillar but both the roller caterpillar and the olive scale, particularly the latter, can cause considerable damage if an infestation is left unchecked. Aphids do not cause trouble with this species but on occasions birds will pick and leave the flowers lying. The extent of this seems to vary from district to district or from year to year for no apparent reason. Plants are sometimes subject to attack from grey mould.

C. graecum Link.

A species with a wide area of distribution in the Mediterranean area particularly in mainland Greece, Crete, Cyprus and other offshore islands and in south west Turkey.

The tuber is rounded with a somewhat flattened top, resembling with age a small globular beetroot. It is distinguished from all other species in being covered, even when small, with a longitudinally splitting corky covering and by a central basal spot producing a cluster of long thick fleshy roots. Although other species under some circumstances will produce "trunks" from the upper side of the corm,

* (*C. hederifolium* was previously known as *C. neapolitanum* - Ed.)

from which the flowers and leaves later grow, I know of no other species producing them with such frequency, or of such length.

The leaves appear usually in March as the flowers fade and are very variable in both their shape and amount of patterning on the upper surface. Particularly when young, the patterning of the best forms is overlaid with a most beautiful sheen but as the leaf ages, both pattern and sheen, have a tendency to fade. The underside is usually green but may vary from a pale to a dark beetroot red. Unlike both *C. coum* and *C. hederifolium* they do not creep under the soil surface before emerging and unlike them also they have a rather thick fleshy "feel" to the touch and are edged with blunt, rather horny teeth.

Flowers small, with close-set, untwisted, much reflexed petals; colour deep pink, with two large deep plum-red blotches at their bases, auricles small, bluish-pink; anthers violet, neither they nor the style being exserted. After fertilisation of the flowers the peduncle of this species, unlike those of all others, starts to coil from the ground upwards.

Propagation

(a) Vegetative

With age the tubers of this species become very large but because the root system is developed from a single central basal zone it is not practicable to divide it as a means of propagation. It is possible to use the floral trunks, where these are formed, as cuttings and although new plants can be produced in this way it is again hardly practicable.

(b) Seed

Seed ripens during January and when sown immediately is the usual means of propagation. However, because of the tendency to be a shy flowerer it is not easily obtained in any quantity. When available and fresh it germinates in from 8-14 weeks, often sending up two leaves instead of the usual one.

I have a form from Turkey, again collected in 1967 (No. 3888), which like the form of *C. hederifolium* obtained at the same time from the same expedition, does not come into leaf until late April-May. The plant is a vigorous grower, the leaves somewhat smaller than usual, most beautifully patterned in silver and with a fine sheen which, together with the patterning, it tends to hold longer than all other forms I have grown. The collector's notes say the tuber was dug out from a dry, exposed, stony bank at the depth of 18" and when I unpacked it, it was certainly notable both from the number (6) and the extreme length (5") of its floral "trunks".

As yet I have been unsuccessful in getting my specimen to flower.

Cultivation.

This species, more than most, has the reputation of being difficult to flower. In the wild it is found growing in woodlands and in the shelter of low bushes or in open stony slopes and rock clefts. As quoted in the Turkish expedition notes, "the tuber tends to be deeply buried where found in stony ground but in rock clefts may be very near or on the ground surface." Of all the plants I have seen flower, the best display has invariably been made by those plants growing in some form of deep porous container such as those made of concrete or tuffa. During its short resting period from late November-January the tuber requires all the heat it can get and at this time all water should be withheld until growth starts again in January-February. Even though the species is quite hardy during winter the long fleshy roots are particularly prone to rotting if the drainage is not perfect. To achieve this the soil, either in containers or in the open ground, should have incorporated in it, a high percentage of rotten rock and/or sharp gravel and sand and the humus content should be kept to a minimum. I have found best results are achieved by using the following

mixture:

2 parts John Innes based potting soil
1 part rotten or crushed rock
1 part coarse sand.

The sand to advantage may contain pieces up to the size of pea gravel i.e. the average sized metal used for drives and paths, and when planted the soil surface should be topped with ½" layer of coarse gravel.

Pests and Diseases

Similar to those attacking *C. coum*, though it does not appear to be so prone to attack from the black vine weevil. The long fleshy roots are particularly prone to rotting in very cold wet winters and if this should occur it is very difficult to prevent it affecting the tuber itself. This is a physiological disorder and can be avoided by better drainage and careful attention to watering. If plants do become affected they should be lifted, and as much damaged tissue removed as possible, and the exposed surfaces dusted with a good copper fungicide.

C. hederifolium Willd.

Of the truly hard species *C. hederifolium* would be the best known and most easily cultivated. In the wild it is the most widely distributed of all species extending from southern France to western Turkey, being found in a variety of soils usually in association with deciduous trees in open woodland sites.

Tuber, smooth, rounded below and slightly flattened above when young, becoming slightly corky and shallowly hollowed with age, long-lived, tubers the size of saucers not being uncommon, roots emerging from the top half of the tuber only, this feature serving to distinguish it from all others; leaves variable in shape and size and in almost all cases beautifully mottled and marked in greens, greys and silvers on the upper surface, the underside, plain green, though occasionally with variable shades of crimson-red; flowers usually appearing before, but sometimes with the leaves, variable in size in the best forms, large and well shaped; petals oval-lanceolate, pointed, constricted at their base before flaring to form a wide rim to the mouth with conspicuous auricles, colour variable, lilac, pinks and white, the latter, if pure, being very rare since most so called whites have a pink flush either at, or in the mouth; anthers reddish-brown; stigma not exserted.

After fertilisation the peduncle begins to coil spirally from the top drawing the ripening fruit down to soil level.

The stems of both the leaves and flowers run under the surface of the soil for some distance before emerging.

Propagation

(a) Vegetative

It is possible as new growth commences in February-March to carefully divide a tuber into sections using a very sharp knife and by making sure each section retains an active growing crown. Such sections should be dusted with a fungicide and the sections left for a day or so for their cut surfaces to dry before being boxed in seed trays and lightly covered with coarse sand. The trays should then be placed in frames provided with lights to protect them from both rain and excessive sun and given only the minimum of water required to prevent the sand from becoming dry at any time. When both leaves and roots are well established and in active growth the sections should be potted separately into the smallest possible pots and grown on thereafter as for seedlings.

It is particularly important to watch for attacks from wireworm and other pests until the cut surfaces are completely calloused since these exposed surfaces are most attractive to them. Careful watering is also necessary and at no time should sand, and later the potting compost, be allowed to become over-moist and encourage the invasion of fungal or bacterial rots.

Because of the ease with which this plant is raised from seed, it is not usually worth while propagating by this means, but it could be justified where it was required to increase a particularly fine form.

(b) Seed

Seed of all cyclamen is best sown as soon as ripe, this stage being recognised initially from the slackening of the coiled flower stalk and later by the splitting of the seed capsule. When fresh, each seed is covered in a clear sticky shelac-like coating which, because of its presumed sweetness, is much sought after by ants so that unless collected promptly, numerous seeds will be lost by being carted away by these little creatures, the coating to be eaten at leisure nearer "home".

By binding the seeds together the sticky coating makes for messy and uneven sowing unless it is first removed. This is easily done by gently rubbing the seed in fine, dry, sand, until each is completely covered and in such a state they separate without difficulty and can be sown individually without further trouble.

Since I have never had any but *C. hederifolium* seed in any great quantity I prefer to sow all cyclamen in pots having had most success when using the R.H.S. recommended prewar plastic 3½". Where quantity is available however, it is easier and takes less space if the seed is sown individually at ½" spacings each way in standard 15 x 20" seed trays. Sown in this manner, seedlings may be left much longer before they require potting without fear of their becoming drawn or spindly.

I prefer to fill these boxes to approximately ½" of their depth with seed compost and lightly cover with sand, before gently firming with a wooden float. A shallow depression at the appropriate spacing is then made in the sand with the point of a thin dibber and a single seed placed in each. In this manner approximately 800 seeds will be catered for in each box. When all seeds are in place they should be covered with a ¼" layer of sharp sand and the surface again "floated" to press the sand firmly round the seed. The box is then placed in a shallow tray of water. When once dampness can be seen spreading on the sand surface, the box should be removed and allowed to drain before being placed in a sheltered, partly-shaded frame.

Although fresh seed of *C. hederifolium* germinates at from 6-12 weeks seedlings will not normally reach flowering size in under four growing seasons, although the occasional one may flower in three.

Cultivation.

No other species is as easily grown in so wide a range of soils and situations. However, best results are obtained where they are planted in well-drained soils with plenty of leaf mould and given the protection of partial shade. They naturalize readily under deciduous trees, particularly silver birch, oak and beech, but since the tubers are in leaf for a long period, February-December, they are unsuited to planting under trees set in formal lawns requiring frequent mowing. The occasional dusting of bonemeal round the corms in later spring will encourage size and texture in both leaves and flowers.

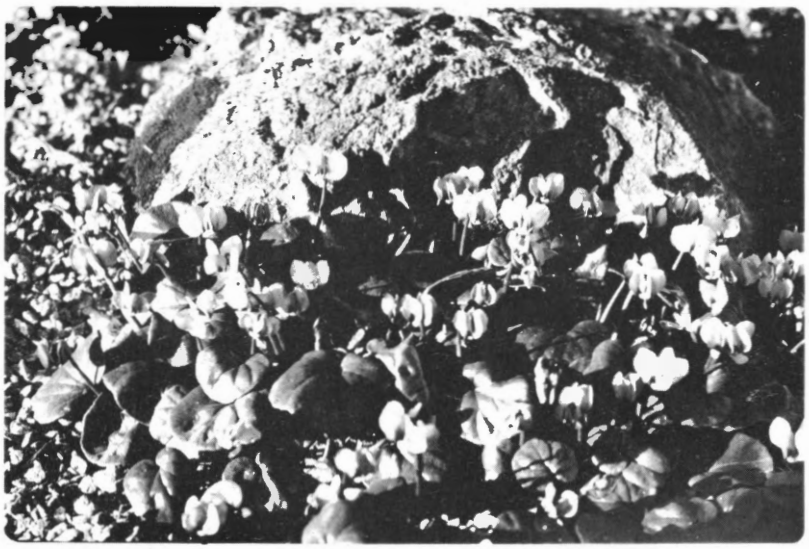
Although easily grown in containers the plant usually looks more attractive in the garden than in a pot, where the creeping habit of the leaf and flower stalks is inclined to produce a sprawling effect. However, I have succeeded in growing two very large tubers in clay pans 11" wide x 3" deep for a number of years with little attention other than an annual topdressing with fresh soil prior to their coming into growth, keeping their drainage free, and a sharp watch for the grubs of the vine weevil.

Although I had read of such plants being found I had never personally grown a *C. hederifolium* which bore scented flowers until acclimatised tubers received from Messrs. Cheese, Mitchel and Watson's 1967 expedition to Turkey finally flowered

for me in 1971 (Collector's No. 3871). Most plants of *C. hederifolium* are in full leaf with perhaps an odd flower remaining by the second week in April. It is only then however, in company with tubers of *C. graecum* received at the same time from the same expedition, that the leaves and flowers of the form begin to push through the soil surface. The leaves are much smaller than those of the more usual forms I have grown, beautifully mottled and marked with silver and with a fine overall persistent sheen. The flowers are also somewhat smaller than usual, soft pinkish-lilac and although freely produced, have failed to set any viable seed to date.

Pests and Diseases

Similar to those attacking both *C. coum* and *C. graecum* but to a much lesser degree except for leaf roller caterpillars which seem particularly bad on *C. hederifolium* in some seasons.



Cyclamen coum

Cyclamen hederifolium

Control of the Aphid Vectors of Plant Virus Diseases by the use of Systemic Insecticides

BY R.I. MULHOLLAND
PLANT DISEASES DIV., D.S.I.R., LINCOLN

(Extracts from a thesis for the National Diploma of Horticulture (N.Z.), Submitted by R.I. Mulholland in 1963.)

The role of insects as vectors of virus disease was demonstrated in 1900 when mosquitoes were shown to be responsible for the transmission of yellow fever. Takami (1901) showed that the stunt disease of rice was transmitted by a leaf hopper, *Nephotittix apicalis*. However, in spite of these important discoveries the implications were not appreciated.

Twelve years later Orton had pointed out that potato degeneration took more than one form and described three types under the names of leaf roll, mosaic and streak. Degeneration of potatoes was so severe by 1775 that growing had been abandoned in many parts of Europe and yet it was not until 1916 that leaf roll was shown to be transmissible from plant to plant. The part which aphids played was not suspected until 1920.

Schultz and Folsom (1923) and Murphy(1923) were the first to identify the aphids responsible for its transmission. Breaking in tulips, which had been known for more than 300 years was first shown to be transmitted by aphids in 1929. Today of 300 known plant viruses, two thirds are transmitted by insects, with leaf hoppers and aphids as the most important groups.

The relationship between insect vector and virus.

Viruses can be divided into persistent or non-persistent types and this grouping is determined by the method of transmission from one host plant to another.

Transfer of a non-persistent type virus may only involve a mechanical transfer of particles from one plant to another without any effect on the vector; with a persistent type of virus a most complex biological relationship may be involved between virus and vector.

Non-persistent plant viruses are usually found in high concentration in the plant epidermis and are picked up on the aphid stylets. With this type of virus an acquisition feed of only a few seconds is required and the aphid is able to transmit the disease to a new host without any incubation (or particle multiplication) period. Infectivity is lost rapidly as the virus particles are removed from the stylets during probing and feeding.

Persistent type viruses appear to be most commonly acquired from phloem tissue and they require an acquisition feed of at least an hour before the aphid vector can transmit the disease. Virus in the phloem is usually in low concentration and long feeds may be necessary to ingest enough virus. Evidence shows that the virus can multiply in the vector and a latent period is needed, following the acquisition fee, before the aphid can transmit the disease.

Persistent viruses may so modify the plant that it may become more nutritious for the vector which then becomes more fecund, and grows more rapidly than on healthy, non-infected plants. This is an example of symbiosis where both insect and virus multiply at the expense of a common host and where both aid one another; the insect in spreading virus to healthy plants, the virus then modifying the host plant to favour multiplication of the insect.

Aphid flights and behaviour.

Any attempt to control aphid transmitted virus disease requires a knowledge of aphid dispension and of movement within the host crop.

Several workers - Johnson (1957), Broadbent, Burt and Heathcote (1956) have shown that most of the spread of aphid borne

virus is due to the alate (winged) form and not to apterous (wingless) aphids.

The flight capacity of aphids responsible for virus spread has been studied by Johnson (1954) who found aphids can be carried for hundreds of miles at altitudes ranging from a few hundred feet to a recorded maximum of 18,000 feet. More than 70% of the flying aphid population was found at heights exceeding 1,000 feet.

During his work at Rothamsted where he employed suction traps to continuously sample the air from ground level to a maximum of 4000 feet it was found the numbers of aphids flying depended both upon crop population levels and flight activity. The number of aphids in the air varied according to the season and fluctuated from hour to hour during the day. Aphid flight was found to be passive, and depended upon the velocity and direction of the wind.

Aphids must fly before finally settling down to feed and reproduce, and without a satisfactory flight will even reject suitable host plants. The longer the duration of the flight the less discriminating the aphids become in their choice of host. After flights lasting two to three hours the wing muscles autolyse and flight capacity is lost.

As well as long dispersal flights aphids also fly over very short distances and these flights, within the host crop are of far greater importance than the total aphid population within the crop. This fact has turned attention away from the apterus aphids, which make up the bulk of the observed population, to the less numerous but more active winged migrants. Aphids will also fly from suitable hosts and this suggests the dispersal flight is an essential phase of the life cycle of the aphid. It cannot be assumed that winged migrants do not visit and feed on plants they do not colonize.

The most important considerations which determine the virus spreading efficiency of a given aphid species are its ability to transmit the virus and the abundance and activity of its winged forms, rather than its potential as a direct pest of the crop. When *Myzus persicae* and *Aphis craccivora* (black bean aphid) are compared the former appears outstandingly restless while the latter species shows clearly that aphids and plants best suited to one another do not form the best system of virus spread. *A. craccivora*, which can become a direct pest of brad beans by settling and rapidly colonizing the plants, is a relatively poor vector of pea leaf roll virus which affects broad beans. *M. persicae*, however, which can only be induced with difficulty to colonize broad beans, is a highly efficient vector of P.L.R.V. (Table 1).

An aphid trapping programme showed that a knowledge of the flights of aphid virus vector could aid in the control of virus disease. Knowledge of the intensity and duration of aphid migration flights is necessary in indicating the danger period for the spread of a particular virus.

Stubbs (1948) showed how carrot crops in Victoria are exposed to motley dwarf virus during the period April to December, but a disease free period occurs during the summer months. Control of the disease has been achieved by delaying the sowing of susceptible varieties until the early summer. Trapping figures for the vector *Cavariella aegophodii* show that it disappears almost completely during the summer months, while being present throughout the autumn and winter with a pronounced increase in spring.

Symptoms of plant viruses

A great variety of symptoms is seen in the virus diseases. Virus symptoms of all types have a tendency to be most evident under cool growing conditions, and to be less apparent or entirely masked at high temperatures. The leading types of virus symptoms are :

Inhibition of Chlorophyll Pigmentation.

In the *mosaic* diseases the chlorophyll in leaves formed following inoculation is suppressed in certain areas resulting in light and dark patches scattered at random over the leaf surface. In parallel-veined

plants the mosaic usually occurs as broken yellow streaks. In *ring spot* the variegation has the form of yellowish rings against a green background. *Clearing of veins*, sometimes the first virus symptom seen after inoculation, is a transient pattern in which the veins are light against a dark background.

The reverse of this condition, dark veins against a lighter background can occur and in this case is called *vein banding*.

Anthocyanin and other blossom pigments may be inhibited as in the case of chlorophyll, giving the red and white and other variegations seen in many ornamental plants.

Reduced growth.

Following the failure of chlorophyll formation, virus diseased plants are usually reduced in size, a reduction of 30% or more being not uncommon. This reduction takes the form of shorter internodes, smaller leaves and blossoms and results in reduced yields.

Distortion.

Leaves and flowers of affected plants are not only discoloured but often very irregular in shape, twisted or abnormally narrowed (strap shaped leaves) or raised blisterlike areas due to greater growth in the green areas than in the chlorotic ones.

Hypertrophy

Excessive growth is sometimes a characteristic of virus disease. It is seen in the excessive branching that is characteristic of witches broom or potatoes and in the production of fin-like outgrowths (enations) as in certain cases of tobacco and pea mosaic.

Abnormal growth form

The habit of the plant can be greatly changed by virus disease. An example is the rosette disease of peach in which the internodes are greatly shortened to produce a rosette habit in place of normally elongated one, and spindle tuber of potato where the tops are abnormally stiff and erect, the leaves pointed upward, and the tubers growing with an elongated point.

Necrosis

Necrosis or killing of tissues due to viruses may be either local or general. Roundish dead spots are produced on the leaves of certain plants (local lesions) when inoculated with viruses that do not become systemic. In some cases the necrosis takes the form of dead rings with green centres (necrotic ring spot) or streaks on stems. In severe cases the necrosis may become general, spreading to the growing point, which is killed, soon resulting in death of the entire plants.

Combination of symptoms

Usually when a plant is infected with a virus disease it can display one or more of the symptoms described: for example it may first show vein clearing followed by a general mosaic pattern, resulting in stunting, often accompanied by some form of distortion and perhaps finally exhibiting local or general necrosis.

Systemic insecticides

Systemic insecticides are toxicants which, when applied to the roots, stems or leaves of the plants are rapidly absorbed and translocated to various parts of the plant in amounts lethal to insects feeding thereon (Metcalf, 1955).

The development of modern organic phosphorous insecticides is largely the work of Schrader (1947) who began his pioneering work in 1943. Since then many thousands of compounds have been evaluated, their suitability as insecticides depending on their solu bility and stability. The O.P. materials listed in this article depend for their effect on the inhibition of the enzyme, cholinistenase which results in interference to the normal mechanism of nerve impulse transmission. It must be noted the most efficient of the O.P. insecticides are also the most toxic to

the higher animals, including man.

Granular formulation of O.P. toxicants

Widespread use of the O.P. insecticides was followed by equally widespread reports of poisonings of those people distributing and applying them, and this resulted in the withdrawal from general commercial use of some of the materials then in use, or the introduction of less toxic formulations. When used as seed dressings it was found the toxicants could enter the body directly by absorbtion as well as by inhalation and swallowing.

The toxicants were next formulated by absorbing on to activated charcoal, but when a high proportion of dust or 'fines' was present the material still presented a hazard.

In the materials available today the toxicant is absorbed on clay granules or chips, with a complete absence of fines or dust and this provides greater safety for the operator.

Advantages of granular insecticides.

Longevity of toxic action is the outstanding feature of granular formulations. Roth (1959) showed the control of the spotted alfalfa aphid (Therisophis maculata) for up to 10 weeks on field grown lucerne. Treatment did not affect germination and there was no reduction in nodulation. Protection from the same aphid for 4-5 and 5-6 weeks with phorate and disulfoton respectively was reported by Reynolds (1958) who found that the toxicant was distributed in a gradient ranging from the highest levels in the oldest leaves to the lowest level in the youngest leaves. When seed was sown during the periods of slow growth, control persisted for a longer period. Control of aphids was lost when the plants had grown to a height of 6 inches.

Granular formulations have proved more practical than treating the seed directly, especially when dealing with very small seeds. Effects of phytotoxicity are reduced although seed differ considerably in their tolerance to O.P. compounds.

Broadbent, Burt and Heathcote (1958) showed early spraying of potato crops had the greatest effect in controlling leaf roll virus by wiping out the infective aphids as they flew into the crop. By sowing granules when the potatoes are planted a long period of protection is given at the most critical period and the damage which can be caused by spraying operations is avoided. This has been calculated as amounting to 4% of the crop yield (Broadbent *et al.* 1958).

Natural predators of aphids can be wiped out by spraying operations but granules are selective in action and are toxic only to the aphids which feed directly on the treated plants.

By applying granules with seed, or at planting time there is little chance of residue problems with food crops when they are harvested.

Insect resistance to insecticides.

The ability of insects to develop resistance or tolerance to insecticides was first observed by Melander in 1914 where lime sulphur sprays were used to control San Jose scale. In California hydrogen cyanide was failing to control red scale and this was reported by Quayle in 1916.

It was however the widespread development of resistance to DDT by the house fly *(Musca domestica)* which focused attention on this extremely important phenomena. Because of the importance of certain insect vectors in the field of public health, much of the published information on increased insecticide tolerance has concerned the house fly.

In the agricultural field the widespread use of organic insecticides has resulted in the appearance of resistance in leaf hopper, thrips, aphids and mites and by 1954, 30 well authenticated cases were known (Metcalf 1957).

The origin of resistance is to be found in the population of insects to which toxic

spray is introduced. The chemical can act as a selective agent by destroying the susceptible types, leaving the resistant strain to multiply and eventually replace the original population. It may also act as a mutagenic agent. As the result of a specific interaction between the chemical and the organism a resistant adaptation may be produced.

Use of the broad spectrum insecticides (DDT, BHC) was followed in many areas by an increase in economically harmful insects which resulted from the elimination of their natural predators. These results were widely reported and considered a necessary and permanent result of using these insecticides. However, there is some circumstantial evidence which suggests that the apply woolly aphid parasite, *Aphelinus mali* has developed field resistance to the chlorinated hydrocarbons (Spiller 1958). It could be stressed that an effective biological balance would be re-established if predators and parasites also develop resistance to insecticides.

The O.P. materials are more efficient insecticides than any previously introduced and with few survivors from a treated population on which selection can work the rise of resistance should be slow. Also, by leaving many predators unaffected, surviving insects would be eliminated as a result of natural predation.

Trials with granular insecticides

Glasshouse tests

Seed of broad beans *(Vicia fabae) were* sown in pots of sterilized compost to which 5% disulfoton granules had been added at a rate equivalent to 20 lb granules/acre. Black bean aphids (*A. craccivora)* were placed on the plants when they were six inches in height. Aphids multiplied rapidly on check/control plants which had received no chemical, and wilting due to aphid feedings occurred within 14 days.

On treated plants only isolated aphids remained alive after 24 hours. Aphids were removed from control plants every 3 days and added to treated plants to maintain a colony and after 30 days aphids were still unable to become established. Three months after introducing the first aphids plants were still toxic and aphids could survive but not reproduce.

Phorate granules similarly employed on broad beans were toxic to aphids for a period of 21 days.

Disulfoton was also tested to find the speed of uptake when added to soil after plants were established. Broad beans were inoculated with aphids when 9" high and when the colony was well established disulfoton was worked into the soil and watered in. Within 36 hours of application the plants were clear of aphids.

Field trials for the control of pea leaf roll virus (P.L.R.V.)

During the season 1960-61 trials were conducted to reduce the spread of PLRV in broad beans by using systemic insecticides to control the aphid vectors.

The first symptoms produced in broad beans by PLRV are a pronounced curling and vertical erection of the leaves. Later the leaves turn yellow, starting with the lower leaves. The veins of the leaves remain green for some time and premature leaf drop is common on infected plants. When infection takes place in autumn the plants remain stunted and yellow but do not die and remain as a source of infection during the spring months. Infection can reduce yield by up to 50% mainly by a reduction in the number of pods set and not by a decrease in pod size. Infected pods were also more susceptible to infection by the chocolate spot fungus, *Botrytis fabae* L.

The trial consisted of eighteen plots (2 rows x 40') of three treatments replicated 6 times. The materials demeton and demeton-methyl were used at the rates recommended by the manufacturers (6 fl.oz and 16 fl. oz/acre respectively). The first spray application was applied when plants were 9-12" high (21 September) and the second and final spray on 5 October. Plant population counts, made before the

first spray was applied, revealed a high level of PLRV in the plots and suggested that protecting the crop by autumn spraying might prove more beneficial than a spring spray.

The final virus count in Table 1 shows the spray applications to have halved the virus infections from that found in the unsprayed plots. At no stage were colonies of *A. craccivora* found and the pattern of infection indicated that infected aphids had been carried into the crop by the prevailing westerly winds and landed on the earlier developed plants on the west side of the crop.

In the second season four spray treatments were used and timed to prevent autumn primary infestation as well as the secondary spread in the spring. The layout consisted of 15 single row plots 60 feet long with an intervening row to act as a buffer. Stands in each plot averaged 107 plants. The recording in Table II shows an early autumn spray was as effective as combined autumn and spring sprays. No significant differences were shown between the chemicals used.

Discussion

Although aphids in general were in very low numbers treatments gave a significant reduction in virus infection indicating that winged migrant aphids were carrying virus into the crop. The pattern of spread suggests that isolated plants are infected early and serve as a source of infection to the surrounding plants. By the end of the season many groups of plants are infected where a dozen or more groups of plants are infected from the initial plant.

No improvement was obtained when plots were sprayed in both autumn and spring, compared with those sprayed in autumn only. Control of spread from early infected plants is of the greatest importance. Autumn only treatment would eliminate the difficulties of spraying when pollinating insects must be protected; at the same time it will give satisfactory control of the aphid vectors.

Motley dwarf virus of carrots and its control.

This disease was first described in Australia where it caused severe stunting of early spring crops. Motley dwarf virus in New Zealand was first noted in Blenheim in 1954. Leaves and roots were stunted, and the younger leaves showed a yellow mottle which became reddish-purple in colour as the leaves age. In subsequent years it was found to be prevalent in early sown carrots in Canterbury.

Glasshouse tests by Smith *et al.* (1960) confirmed that the carrot-willow aphid *(Cavariella aegopodii)* was the vector in New Zealand. Their field trials showed that losses from motley dwarf virus could be minimized in three ways: by sowing resistant varieties, by spraying crop with insecticides and by timing sowings of susceptible varieties, so as to avoid the periods when flights of the carrot aphid are most likely to occur. The varieties preferred for early production, Chantenay, Manchester Table and Early Horn suffered up to 50% yield reduction when used for early sowings.

Two seed pelleting materials, phorate at 4% a.i. and PP175 at 2% a.i. were compared with phorate granular at 30 lb/acre for controlling the aphid vector. 2% phorate failed to protect the plants for long enough, PP175 eliminated early infection and improved yield by 18%. Granular phorate almost halved virus infection and gave a yield increase of 30%.

A final trial during 1962-63 compared phorate and disulfoton at high (30 lb/acre) on carrots drilled in October. Results given in Table III show no differences at the low rate but high phorate was phytotoxic, resulting in yields no higher than control. High rates of disulfoton showed no improvement over low rates and both increased yield.

FIELD TRIALS WITH SEED PEAS

Glasshouse tests (Table IV) had shown the green peach aphid (Myzus persicae) was the most efficient vector of pea leaf

roll virus. In this trial the effect of two granular insecticides on this vector were tested. Dark Skinned Perfection (D.S.P.) was the variety chosen, as it is severely affected by P.L.R.V.

Each insecticide was mixed with a granular fertilizer and applied with a seed drill, disulfoten at the rate of 20lb/acre and phorate at 40 lb/acre. Drilling was carried out during October and aphid counts were made 30 days later, and showed that aphid numbers were reduced in treated plots but there were no practical differences between treatments (Table V). Samples were harvested and the weights, given in the same table, show no advantage for treated as against untreated.

Infection of the pea crop is due to the alate aphids of possibly three species which fly into the crop and immediately settle down to feed and reproduce. The aphids are already viliferus and although the plants are sufficiently toxic to kill the feeding aphids, this feed enables the vector to transmit the virus. The large population of alates is sufficiently dispersed to infect the crop without the need of secondary spread from points of original infection.

DISCUSSION

Virus diseases have been shown to spread in two ways :

1. by virus that is brought into a crop from outside (primary infestation),

   and

2. by spread from infected to healthy plants in the same crop (secondary spread).

The spread of virus diseases is dependent on the season of growth of the host plant and the aphid vector affecting the host and this in turn will decide when to carry out control measures and how successful these measures will be.

The broad bean crop is one which in Canterbury is invariably sown in autumn, to stand over the winter and flower and crop during September-October. The aphid flight of *Myzus persicae*, which shows a secondary peak in April and May, settles into the crop and spreads very slightly before cold weather stops further activity. It is from this primary infestation that early spring spread arises; this must occur before the normal spring aphid flight. It has been shown that the spraying of this initial infection is the most logical and economical method of virus control.

Crops such as potatoes, carrots and peas, which are planted or sown in spring and emerge at the onset of the spring aphid flights, require an insecticide which can act immediately. Granular formulations provide protection at the time necessary. If granular materials are not suitable a systemic insecticide with rapid knockdown and persistent action would be the best to use.

It is in the field of horticulture that the granular materials would appear to hold great promise. The materials are toxic, but no really effective insecticide lacks this property. They can be handled safely provided the simple precautions of using dust mask and rubber gloves are observed. The toxicant can be added to seed boxes and seed beds or propagating beds for softwood cuttings, simply by mixing with the compost or diluting with fertilizer and applying by hand over the surface.

Long lasting toxicity, which may prove to be a disadvantage with crops for animal or human consumption, would be an advantage for slow growing or long term cuttings, bulbs, tubers and corms.

Although phorate has shown some degree of toxicity to certain plants, this is not general and all the systemic granular toxicants would appear to have a place as soil insecticides. As well as being added to the soil before planting, use has been made of topical applications of granular insecticides on above ground crops (Reynolds, Tukuto, and Peterson, 1960).

With the wise range of herbaceous and

bulbous plants which is valuable horticultural material, treatment at planting time or early spring application would appear to afford excellent protection of the rapidly emerging spring growth. Aphids move into this growth, rapidly colonising the growing points. This plant growth is difficult to keep adequately covered with insecticide. Granular systemics however tend to be translocated to the growing point and move up with the extending shoots and stems. Systemics applied as a spray tend to fall off in efficiency as the increasing volume of the plant lowers the percentage of toxicant to a level where it is no longer effective, and repeated spray applications are necessary.

Most systemics at present available tend to be de-toxified by the plant's growing processes, but the granular materials applied in the soil, are reached and obsorbed by the plant over a longer period, resulting in longer term protection.

Virus diseases, in only a few cases, cause the death of plants. More insidious but equally damaging, is the gradual loss of vigour and quality, and the less obvious the disease the greater the final loss is likely to be, "for loss is the product of prevelance times virulence and is not to be measured solely by effects on single plants". (Bawden (1955)).

Horticulture suffers as much or more than agriculture because so many plants in the industry are clonal lines, propagated vegetatively. When stocks are virus infected no rapid or simple method ex ists for the control of the disease. However, planting material can be freed of virus disease by heat therapy or apical meristem culture and must then be kept free from re-infection.

With non-persistent viruses a regular spray programme would keep disease down to a low level, but with a persistent type virus carried in by alate aphids, both spraying with systemic insecticides and rigorous "roguing", would be needed to maintain healthy stock.

Horticulture tends to be concentrated in areas adjacent to centres of population. With their plantings of a wide range of alternative hosts for aphid vectors, such areas make control of aphids more difficult, although all year round growth in these surrounding areas would suggest suitable breeding and shelter sites for beneficial insects. The granular systemic materials would appear to be suitable for use in such areas by reason of their selective action against aphids, leaving natural predators and parasites unharmed.

Final control of virus disease will lie with the development of resistant or tolerant plant species; until then, control of the vectors offers a good measure of control, by materials that are selective and rapid in action, acting with the least possible disruption of neighbouring biological communities.

SPRAY TRIAL BROAD BEANS

TABLE I

CHEMICAL	REPS 1	2	3	4	5	6	TOTAL INFECTED PLANTS
disulfoton	6	6	6	4	3	2	27
sayfos	7	7	7	6	1	2	30
CHECK NO SPRAY	12	17	8	12	2	3	54
	25	30	21	22	6	7	

WIND DIRECTION →

BROAD BEAN SPRAY TRIAL

TABLE II

CHEMICAL	TIME OF SPRAYING	INFECTED STEM EXPRESSED AS % OF TOTAL, AS AT		
		3:10	26:10	28:11
DEMETON-METHYL	AUTUMN ONLY	0.5	2.5	15.0
	AUTUMN + SPRING	1.0	5.0	25.0
ENDOSULFAN	AUTUMN ONLY	1.0	4.5	15.0
	AUTUMN + SPRING	1.0	5.0	15.5
CK. NO SPRAY		3.0	10.0	42.5

CARROT FIELD TRIALS

TABLE III

EFFECT ON YIELD OF TREATMENT WITH TWO GRANULAR MATERIALS

CHEMICAL	RATE	YIELD (in lbs)
PHORATE	HIGH	38.0
	LOW	55.0
DISULFOTON	HIGH	51.0
	LOW	58.0
CHECK (NO TREATMENT)	-	37.0

GLASSHOUSE TESTS

TABLE IV

APHID EFFICIENCY IN TRANSMITTING PEA LEAF ROLL VIRUS

APHID SPECIES	TRANSMITTED/TESTED
APHIS CRACCIVORA	6/26
MYZUS PERSICAE	49/64
MYZUS ORNATUS	6/60

GARDEN PEAS - FIELD TRIALS

TABLE V

CHEMICAL	INFESTED/100	YIELDS IN GRAMMES (2 ROWS X 4'. 10 SAMPLES) EACH TREATMENT
PHORATE	6	1149
DISULFOTON	7	1163
CHECK	20	1159

REFERENCES

BAWDEN, F.C. (1950): Plant viruses and virus diseases 3rd revised edition. Edit by Frans Verdoorn Chronica Botanica Co.

(1955): The spread and control of plant virus diseases. Ann. appl. Biol. 42: 140-147.

BROADBENT, L.; BURT, P.E.; and HEATHCOTE, G.D. (1956): The control of potato virus diseases by insecticides. Ann. appl. Biol. 44: 256-273.

(1958): Insecticidal control of potato virus diseases. Wageningen, 91-106.

JOHNSON, B.(1955): The flight capacity of aphids in relation to the spread of viruses. Proc. 2nd Conf. potato virus diseases. Wageningen 70-73.

(1957): Studies on the dispersal by upper winds of *Aphis craccivora* Koch in N.S.W. Proc. Linn. Soc.N.S.W. 82: 191-198.

(1961): The activity and behaviour of aphid vectors in relation to plant virus transmission. Plant Path. Conf. Waite Agri. Red. Inst. Adelaide Oct. Vol. 1.

METCALF, R.L. (1955): Organic Insecticides: their chemistry and mode of action. Interscience Publishers.

MURPHY, P.A. (1923): Sci. Proc. Roy Dublin soc. 18: 169.

SCHULTZ, E.S.; and FOLSOM, D.(1923): J. agr. res 25: 2.

SMITH, H.C.; GIESEN, H.J.; and ALLEN, J.D. (1960): Control of motley dwarf virus in carrots. N.Z. Commercial Grower Aug.

SPILLER, D. (1958): Resistance of Insects to Insecticides. N.Z. Ent. 2: 34-48

STUBBS, L.L. (1948): A new virus disease of carrots, its transmission, host range and control. Aust. J. Sci. Res. Series B (Biol. Sci.) 1: 303-314

TINSLEY, T.W. (1959): Pea leaf roll, a new virus disease of legumes in England. Plant Path. 8: 17-18.

REYNOLDS, M.T. (1958): Advances in pest control Research. Research advances in seed and soil treatment with systemic and non-systemic insecticides. Vol. 1: 135

REYNOLDS, M.T.; FUKUTO, T.R.: and PETERSON, G.D. (1960): Effect of topical applications of granulated systemic insecticides and of conventional application of other insecticides on control of insects and spider mites on sugar beet plants. J. econ. Ent. 53: 725-729.

ROTH, V.D. (1959): Alfalfa seed treatments for spotted alfalfa aphid control in South Western Arixona. J. econ. Ent.52: 654.

SCHRADER, G. (1947): B.I.O.S. Final rept. 714 Item 8.

Amenity Planting in Dry Land Centres of Australia

by T. I. CROSSEN

DEPARTMENT OF FURTHER EDUCATION, ADELAIDE S.A.

INTRODUCTION

The more severe the climate in any region the greater is the need for trees and shrubs to ameliorate the extremes of temperature or to reduce the effect of strong winds. Also the more scattered the population and remote the rural urban centre the greater is the need to take full advantage of plants for amenity and ornamental purposes.

The current striking increase in arid zone urban population as a result of the great development of mining operations has provided an opportunity for governments and the large Companies to make provisions for the encouragement of tree planting through advice and the supply of plants either free or at cost price.

New planting is only one aspect of the wise use of trees and shrubs in the dry country. Of considerable and sometimes greater importance is the conservation of existing vegetation.

The drier and hotter the climate of a district the more important it is to give high priority to the retention of as much as possible of the natural vegetation, this is particularly important in belts half a mile wide or more around the edges of urban settlements. Trees and large shrubs should be kept for their value as shade, shelter and ornament, whilst all vegetation contributes to the protection of the soil and hence reduction of the dust hazard. In much of arid Australia winds are usually light and many calm days occur, but when heat wave conditions prevail these are often accompanied by strong winds which may attain gale force. These winds pick up very fine dust which may be lifted into the upper atmosphere and travel up to thousands of miles.

Large scale industry operating in the arid zone of Australia has found that in order to retain a stable work force of the type which they wish to employ it is desirable even essential, to initiate amenity planting in "company" towns.

This paper discusses seven examples of inland centres where amenity planting of trees and shrubs has been used to ameliorate the climate in the cities and towns of dry land Australia.

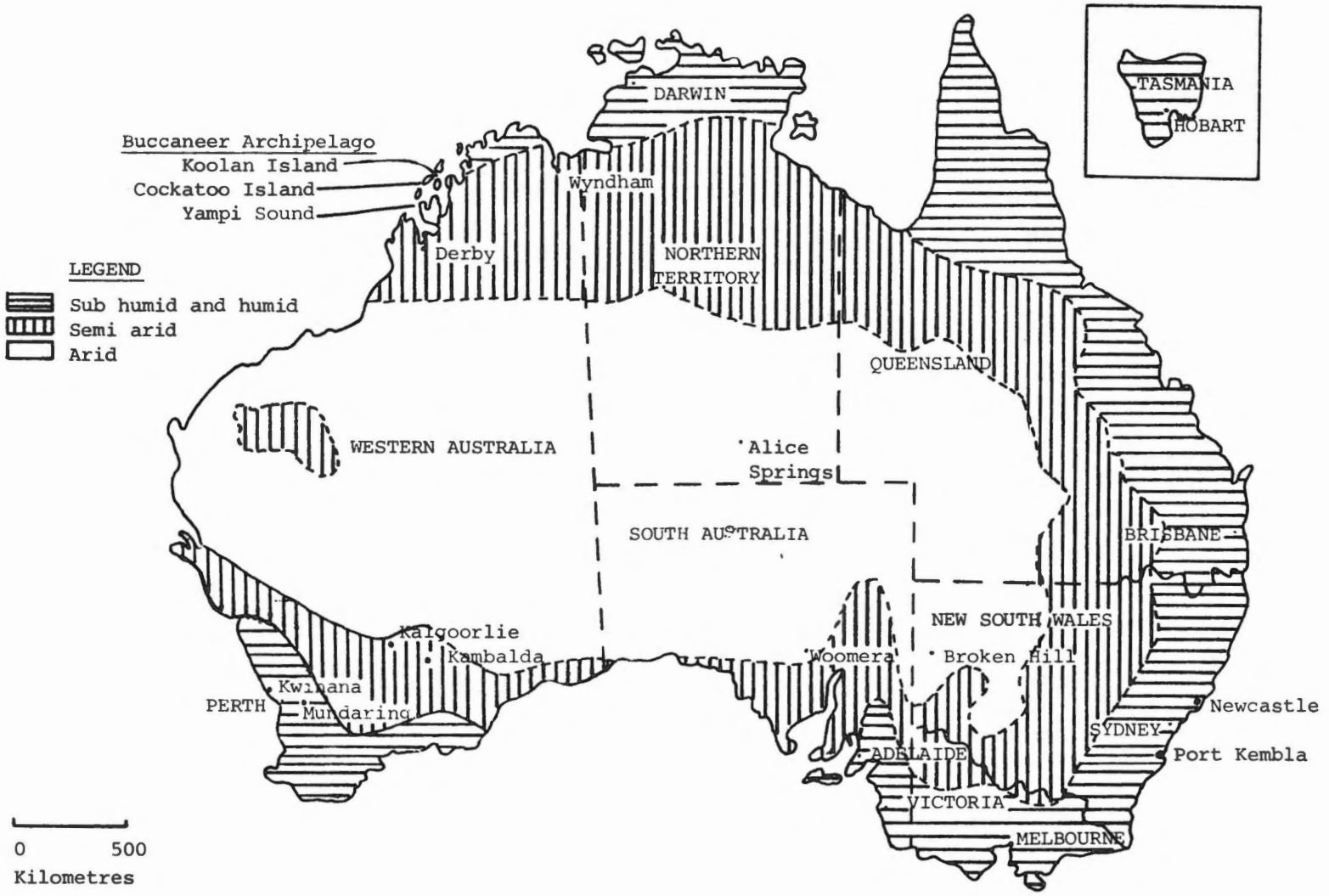
Conservation of the native vegetation has been practised by some centres, notably the city of Broken Hill which initiated natural regeneration areas in 1936 and planned extension in 1969, and the new nickel town of Kambalda which retained native trees and shrubs when the residential and recreational areas were established in 1967-71.

Other areas discussed range from the centre of the continent (Alice Springs) to the coast (Cockatoo and Koolan Islands), and from Southern Western Australia (Kalgoorlie and Kambalda) to the geographic centre of South Australia (Woomera). Whilst most of the towns and cities have originated from the mining and processing of minerals others have a different background. Alice Spring's goes back to 1871 when a Telegraph Station was established there, whilst Woomera is a residential area for Commonwealth Government Research Work.

ALICE SPRINGS

Situated on the Todd River in the southern half of the Northern Territory not far from the centre of the continent it is 1,535 kilometres by road from Darwin and 1,653 kilometres from Adelaide. The name Alice Springs was originally given to a useful waterhole by the builders of the Overland Telegraph, when the local telegraph station was established in 1871, and was not officially applied to the town until 1933. Previously it had been known as Stuart, that name having been given to the site in 1889 in honour of the early explorer John McDouall Stuart. The estimated population

LOCATION MAP



of the town is 12,000.

The summers are hot to very hot, with a mean maximum for the hottest month of 35°C and many days with temperatures between 38 and 40°C, but the mean minimum for the same month is not unduly high at 21°C.

The day temperatures in Winter are very pleasant: the mean maximum for the coldest month is 19.5°C, night temperatures are comparatively cool, with a July minimum of 40°C. Although Alice Springs is at 23° 38'S latitude, almost on the Tropic of Capricorn, there are an average of 12 frosts a year, partly a reflection of the altitude of 579 metres.

Rain is low and highly variable - the 50 percentile value is 254 m.m., whilst the 10 percentile is 139 m.m. and the lowest on record over a period of 92 years is 58 m.m. It is not unusual for there to be several consecutive years with rainfall below the 50 percentile value.

There are several species of trees which grow naturally in the area and are retained in suitable locations or used for new public and private planting; amongst the eucalypts, ghost gum *(Eucalyptus papuana)* and river red gum (*E.camaldulensis)* are the two main species. Ghost gum grows both on alluvial flats and on plateaux and cliff faces and has often been the subject of paintings by aboriginal artists. River red gun grows to moderately large size in the relatively low lying country which receives run off from adjacent slopes or where there are water bearing sands and gravels within reach of its root system.

It is reported that trees and shrubs which are native to Queensland or Western Australia are, in general, more successful than species from southern states. This agrees with the principles of plant introduction, especially similarity of the general climatic pattern.

Following planting, young trees are watered three times a week but, as they become well established this is reduced to once a week, and eventually gradually tapered off until at 5 to 6 years of age they can survive without watering.

In Alice Springs, as elsewhere, there are limitations on the species of trees which may be planted within specified distances of sewers and other water carrying pipelines. The athel tree *(Tamarix articulata)* is not allowed to be planted on the land of government house sites because of its tendency to block sewer lines, whilst white cedar *(Melia azedarach var australasica)* is not favoured for street planting due to its ability to disturb kerbing and because of the annual leaf shed.

Brachychiton populneum, "Kurrajong."

TABLE 1

SOME OF THE MORE IMPORTANT TREES AND SHRUBS USED FOR PUBLIC AND PRIVATE PLANTING AT ALICE SPRINGS

BOTANICAL NAMES	COMMON NAME	GROWTH FORM
Native species Indigenous to Australia.		
Acacia aneura	mulga	shrub
A. pycnantha	golden wattle	shrub
Brachychiton gregorii	desert Kurrajong	shrub
Callistemon macropunctatus	bottle brush	shrub
Cassia nemophila	cassia, yellow cassia	shrub
Casuarina cunninghamiana	River sheoak	tree
Eucalyptus salmonophloia	salmon gum	tree
E. torquata	coral flowered gum	small tree
Gossypium sturtianum	Sturt desert rose	shrub
Malaleuca incana	grey honey myrtle	shrub
Exotic species		
Dalbergia sissoo	Himalaya Raintree	Tree
Schinus molle	pepper tree, pepperberry tree	small tree
Tamarix articulata	athel tree	small tree
Thevetia peruviana	yellow oleander	shrub

BROKEN HILL

Situated in the Western area of New South Wales,with several claims to fame; one is that it is the site of the richest silver-lead-zinc lode in the world, and another is the wise use made by the city authorities, mining companies and citizens of trees and shrubs for the amelioration of the local climate. The city is situated in the arid zone of Australia. The mean annual rainfall 1889 - 1964 was 236 m.m. but this only tells part of the story, since there is a one in ten probability that it will be less than 130 m.m. as well as a one in ten probability that it will exceed 368 m.m. The lowest on record is 56 m.m. For most of the vegetation it is the lower one in ten probability which is critical to survival, and introduced plants which are expected to survive without artificial watering must be able to survive such low annual rainfalls. Site, of course, is important, since many species will grow satisfactorily on extensive flats but will not survive in rocky hills during periods of below average rainfall.

Broken Hill has a hot summer, but maximum temperatures are not as high as in many other parts of inland Australia; the mean maximum of the hottest month is 31.5°C, whilst the mean minimum of the same month is comparatively moderate at 18°C. In winter, days are usually sunny and warm but nights cool, with temperatures sometimes falling below freezing point. Like most inland areas there are many days of very light winds from all directions of the compass; the worst local winds associated with dust storms and sand movement are westerlies to southerlies.

The Barrier Range, on the southern end of which Broken Hill is located, was discovered by Charles Sturt in 1844 and it was from the broken appearance of the hills that the name of the city was derived.

The first discovery of minerals was silver-lead deposits at Thockeringa, some 32 kilometres from Broken Hill in 1875. These finds were however of minor importance compared with the discovery of the Broken Hill lode by Charles Rasp and his colleagues in 1883. At the time of the discovery they were under the impression that the contents were mainly tin and it was only on assay that silver chloride was found to be the most valuable mineral present. Rasp and his six associates formed the Broken Hill Proprietory Ltd. (B.H.P.) in 1884. This giant of Australian heavy industry subsequently expanded into steel manufacture, ship building and mining elsewhere and eventually withdrew from active operation at Broken Hill in 1939 at the present time there are only four companies engaged in mining - The Zinc Corporation Ltd., and the associated New Broken Hill Consolidated Ltd., North Broken Hill Ltd., and Broken Hill South Ltd.

The mineral discoveries resulted in the usual rapid growth of population and because of the richness and nature of the finds the population has remained comparatively stable at a high level since the late 1880's. By 1914 Broken Hill had a population of 35,000. To meet the demand for food, fuel and transport local resources were used to a considerable extent. Sheep and cattle for meat were pastured adjacent to the city prior to slaughtering, whilst the large numbers of horses, bullocks and even camels needed for local transport made a heavy toll on ground and shrub vegetation. In addition there were appreciable numbers of goats, mainly kept for milk and these animals maintained their reputation for eating almost any type of plant growth.

Trees and shrubs were felled for timber, domestic cooking and heating, use in the mines and for steam raising. Horses and bullocks were used for transporting it for distances up to 38-64 kilometres from the city.

The first half a century of heavy animal population in an ecologically delicately - balanced habitat had already denuded the land of vegetation around Broken Hill. By the early 1930s, any subsequent reduction in the number of animals was insufficient to enable re-establishment of the vegetation. The inevitable happened, strong winds caused

movement of the soil, moving sand dunes were created and when dust storms prevailed in the district their load of fine particles was increased by pick up of local material. On Western and Southern aspects of the city fences were covered and roadways were only kept open to traffic by removing the accumulating sands.

During the late 1920's and early 1930's the Zinc Corporation put forward the proposition that protection from grazing animals of land adjacent to the city and the planting of suitable trees and shrubs would control sand drift and reduce the local severity of dust storms. With the approval of the Zince Corporation small plantings were initiated in 1936 on corporation land. These trees received adequate watering and showed such a favourable response that in co-operation with the city council and various local associations more extensive plantings were started in 1937. Other mining companies have also contributed to operations. There have been two major aspects in the rehabilitation of the locality. The largest scheme consisted of encircling the city with belts half a mile or more in width, fenced against grazing and burrowing animals. These areas have been allowed to regenerate with the shrubs and herbs natural to the area - especially various species of acacia, such as Mulga *(Acacia aneura)*, eremophilas *(Eremophila spp)* cassias *(Cassia spp)* and hopbush *(Dodonea sp)*. Some of the areas on the southern side of the city have had small trees and shrubs planted in them, particularly several species of eucalypts *(Eucalyptus spp)* as well as some paperbarks *(Melaleuca spp.)* The present condition of these regeneration areas is now probably better than at the time of the lode at Broken Hill, since the fencing has protected them from native as well as domesticated animals. Given continuation of the present degree of protection from grazing these areas should remain in a stable state, not only should these areas of regeneration be maintained but plans are to expand them.

The most important lesson to be learnt from Broken Hill planting is not the example of fine trees growing in regularly watered parks, because given sufficient water many species can be grown satisfactorily in such a climate, but in the species which will grow at least, moderately well without watering other than in the first few months after planting. There is a limit to the number of trees which a local authority can water throughout the year, even if supplies are available, but large areas can be planted with trees which will grow satisfactorily without attention.

Eucalyptus viminalis ribbonwood, "Manna Gum"

TABLE 11

SELECTED LIST OF TREES AND SHRUBS WHICH HAVE PROVED SUITABLE FOR GROWING AT BROKEN HILL WITHOUT REGULAR WATERING

NATIVE SPECIES		
Eucalyptus *(Eucalyptus spp)*	*E. dundasii (s)*	*E. brockwayi (s)*
	E. stricklandii (s)	*E. salubris (s)*
	E. torquata (s)	
	E. sargentii (s)	
	E. oleosa var. *angustifolia*	
Acacias		
(Wattles = *Acacia spp)*	*A. salicina*	*A. notabalis*
	A. gladiformis	*A. pycnantha*
		A. saligna
		A. sowdeni
		A. victoriae
Saltbush *(Atriplex spp)*	*A. nummularia*	
Paperbarks *(Melaleuca spp)*	*M. pubescens*	*M. armillaris*
	M. halmatorum	
EXOTIC SPECIES		
	Schinus molle	
		Tamarix articulata
		Olea europaea

S = tolerant of salt in the soil

COCKATOO AND KOOLAN ISLANDS: YAMPI SOUND

The term "Yampi" is the local aboriginal word for fresh water. These two islands are amongst many located between the northern end of King Sound and Collier Bay on the N.W. coast of Western Australia and form part of the Buccaneer Archipelago. Major factors in the climate are the latitude of close to 16°S latitude and the location within a dry monsoonal belt. Rain fall gives a 50 percentile value of 666 m.m., a 90 percentile value of 991 m.m. The highest on record is 1498.6 m.m. Some 85-90% of the rain occurs in the four months of December to March, with five to six months completely dry.

Temperatures are high at all times of the year and based on long term records for Derby (17°S'S) and Wyndham (15° 27'S) the mean maximum of the hottest month (November) is in the range of (37.5 - 38.5°C), whilst that of the coolest month is still high at about 27.5°C.

The extractive industry associated with Cockatoo and Koolan Islands is that of iron ore under the control of B.H.P.

The development of large scale open-cut mining involved the establishment of a prefabricated town which now has a population of about 350, and a jetty with a luffing head because of the exceptionally great tidal range. Once wives and children joined the company employees the question of living amenities arose as a factor in stability of the work force and amongst out-of-door amenities a high priority was given to the establishment of small trees, shrubs and other plants for shade, shelter and ornament. The soils are shallow light sands or sandy loams, reddish in colour due to the presence of iron oxides (over sandstones, shales, slates and schists). The sites where trees are planted need to be excavated to a suitable depth, often 1 metre or more, and top soil added. In the case of children's playgrounds, where lawns are desired it was necessary to level the sites and import sufficient top soil. The native vegetation is sparse though better in depressions where the natural soil is deeper and there is benefit of drainage. Amongst the small trees and larger shrubs are several species of *Eucalyptus, Acacia, Grevillea, Terminalia* and a few representatives of*Brachychiton* and *Ficus*. The dominant tree is Darwin woolly butt *E. miniata*.

A decision to start amenity planting on Cockatoo Island was made by B.H.P. and late in 1951 commonwealth advice was sought on species to be used and Techniques of establishment. By 1953 plans had been proposed and the first plants established. This work was continued and extended to Koolan Island where ore extraction commenced in 1964. The growing of trees and shrubs in this area involves a number of difficulties, not all of which can be overcome. There is the need for additional watering on islands without any worthwhile local supply.

The townships on Cockatoo and Koolan Islands are probably unique in the world, in that water is transported by sea from the opposite side of the continent - a distance of about 9,700 kilometres (6,000 miles). This is done by one boat returning from Kwinana, Port Kembla and Newcastle. Some control of the very damaging termite *(Mastotermes darwiniensis)* is only possible within selected areas and a careful watch needs to be kept for incipient attack in the larger woody plants. In the case of the occasional cyclone wise selection of species can reduce the amount of damage but nothing can prevent all damage.

One means of ensuring quick recovery is to have a suitable proportion of fast-growing though possibly short lived plants, which can either be replaced or cut back to shoot again. Plants such as those of the genus *Musa* (bananas) are particularly susceptible to wind damage, but do make a quick recovery. A very large number of trees and shrubs have been planted and amongst those which have proved satisfactory or promise success are :

Adenanthera pavonina (red sandalwood tree)

Albizia lebbeck (albizzia, siris tree or East Indian Walnut)

**Calophyllum inophyllum* (beach calophyllum or Indian oil nut)

**Callitris intratropica* (Northern Cypress pine)

Cassia fistula (golden shower or purging cascara)

Kigelia Pinnata (sausage tree)

Lagerstroemia speciosa (tabek or Pride of India)

**Melia azedarach* var *australasica* (white cedar)

Peltophorum pterocarpum (golden flame of Malaya or golden shower)

Poinciana regia (flame tree or flamboyante)

Samanea saman (raintree)

Tamarindus indica (Tamarind)

* Indigenous

Amongst the smaller shrubs and other garden plants are aralias, acalyphas, crotons, frangipani, gardenias, hibiscus, oleanders, poinsettias and bananas.

Most of the species listed grow well in Darwin, which has similar temperatures but a much higher rainfall. They are mainly exotics and it is considered that there is greater scope for the use of indigenous speciles, especially those which are native to Northern Australia.

In the early days a number of dry country southern western Australian eucalyptus were planted but these are reported to have been destroyed by fire. More recently *E. phoenicea* (scarlet gum) native to Northern Australia, and *E. torquata* (coral flowered gum) from Southern Australia, have been recommended for planting on Koolan Island. There is little doubt that other attractive australian species could be used which would have a smaller demand for water than many of the exotic species which are at present used.

KALGOORLIE.

The discovery of gold on the site of what is now the city of Kalgoorlie in Western Australia, led to the rapid growth of a centre of population which soon reached 20,000, this was in 1895. Earlier there had been prospecting in the nearby Coolgardie area, where gold had been discovered in September 1892. Before the first located alluvial deposits were exhausted rich gold bearing lodes were discovered beneath an area which has become famous as the Golden Mile. From the time of this discovery there was no doubt on the future development of Kalgoorlie as one of the major gold mining centres of the world.

After World Ward II reduced recovery of gold and its comparatively static price led to a serious lowering in the profitability of operations and threatened the survival of the city. Fortunately, in the late 1960s nickel was found in several localities near Kalgoorlie, so that the future of the city is assured. The construction of the town of Kambalda about 58 kilometres to the south of Kalgoorlie was commenced late in 1967, whilst there is another new town near Mt. Windarra, the site of the famous Poseidon strike some 225 kilometres north of Kalgoorlie.

With an altitude of 379 metres, Kalgoorlie is located on the border of the arid and semi-arid zone, about 579 kilometres east of Perth and 353 kilometres from the southern coast of the state. The summers are distinctly hot but maximum temperatures are not as high as in many parts of inland Australia, the mean maximum of the hottest month is 30.2°C whilst the mean minimum of the coldest month is 5.2°C. On an average only one frost occurs a year. Rainfall is low, with a 50 percentile value of 229 m.m. and there is a moderately marked winter maximum.

In spite of the aridity of the climate and that the water for the city is pumped from Mundaring Weir, near Perth a distance of 559 kilometres - Kalgoorlie is one of the better examples of successful tree planting in dry Australia. Some street and park tree establishment was done in the

first half of the century, but an extended programme was initiated in 1946. Based on earlier experience the city decided to concentrate on eucalypts native to the dry country, especially species from the arid and semi-arid zones in the S.W. of the state.

The Forestry Dept. developed an arboreteum in 1954, and this is providing useful information on a number of species of the native trees and shrubs other than eucalypts which have been tried-there are only a few worthy of rate. Pittosporum *(Pittosporum phylliraeoides)* grows satisfactorily in light soils and develops a dense crown; desert Kurrajong *(Brachychiton gregorii)* is ranked as an excellent shade species but is a slow grower. Species such as Kurrajong *(B.populneum)* and some of the cypress pines for example black cypress pine *(Callitris endlicheri)*, find the climat too dry and the soils, in general, either not fertile enough or too heavy.

The gardening staff of the city of Kalgoorlie has had good results with the raising and planting of street trees and an outline of their methods is given. About the first week in November seed is sown direct into 18 litre containers, kerosene tins being used when available. The soil is selected as close as possible to the type occurring where it is intended to plant the trees; and after sowing, the seed is covered with lawn clippings to keep the surface soil moist. Germination of the seeds takes 10-21 days and as the young seedlings become established they are progressively thinned until only one plant remains. By the end of the following June - a period of nine months, the young trees are a few feet in height. The planting sites are prepared by digging holes about 1.2 m. in diameter and 600 m.m. deep, with the soil in the bottom of the hole broken up to allow still deeper penetration of roots. Unless rock has been removed from the hole no imported soil is added. On placing the young plant in its permanent position, the tin or drum is cut away to leave the block of soil intact. By this method the success is 99-100%. Guards are placed around the young trees to protect them from animals and vandals, and watering at the rate of 136 litres a week per tree is done in the first summer and autumn until there is adequate rain. It has been found that most trees only need watering for the first year, rarely does it need to be continued into the second year. The guards are retained for two years.

KAMBALDA

Major finds of nichel ore were made at Kambalda in 1966 and commercial operations commenced the following year. As the need arose for a large work force there was the necessity to establish a town for a population of several thousand inhabitants, a number likely to increase to about 6,000 within a few years as mining operations are expanded. Kalgoorlie which is less than 64 kilometres distant is likely to remain the major centre for transport, secondary education and various forms of shopping and entertainment. Kambalda and Kambalda West are, however self contained with regard to primary education, local shopping, clubs and hotels.

Kambalda is located within semi-arid country but near the border with the arid zone; the latitude is about 31½°S. Climatic condition is similar to Kalgoorlie.

The Western Mining Corporation, which operates the nickel mine and has built the town, has shown a sensitive awareness of the desirability of conservation of as much as possible of the local flora. In the development of the residential and associated recreational areas a policy was adopted of leaving as many trees as possible, both on street verges and housing blocks. A visitor receives the impression of a long established town in which successful tree planting has been conducted for two or three decades. The trees, nearly all eucalypts, being native to the area, have advantages of hardiness to dry conditions and of requiring minimum attention.

TABLE III

TREES AND SHRUBS USED FOR STREET AND PARK PLANTING IN KALGOORLIE

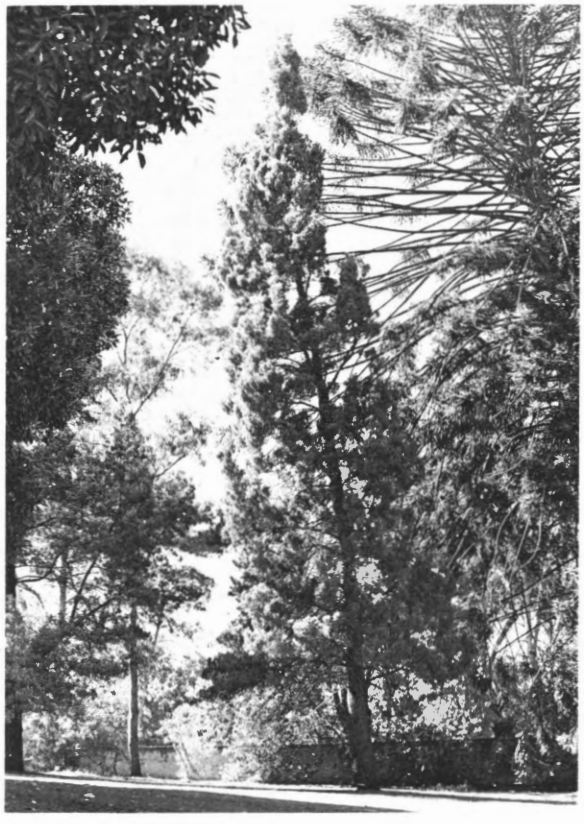
Botanical Name	Common Name	Comments.
Eucalypts The more important species		
Eucalyptus brockwayi	Dundas mahogany	Suitable for rocky sites and sandy loams on flats near hills. A fast grower in early life.
E. camaldulensis	river red gum	Very good on deep retentive soils. A fast grower in early life. One of the best eucalypts for the area.
E. cladocalyx	sugar gum	This is an excellent shade tree in parks or other places where it receives some extra water, but where unwatered has a life span which may not exceed 20 years.
E. dundasii	Dundas blackbutt	Considered the best tree in the State for hot dry inland areas. Will grow on loams of varying texture, including gravels and alkaline soils.
E. gardneri	blue mallet	A useful species on sandy to moderate textured loams.
E. gracilis	yorrell	Considered one of the best which has been tried in Kalgoorlie; a small tree with attractive shiny foliage. Adaptable as to soil.
E. longicornis	Morrell	An excellent shade tree; adaptable as to soils and tolerant of salt.
E. salmonophloia	salmon gum	The largest and best of the inland trees, but requires good soils for best results. Somewhat slow early growth but hardy and long lived. Very attractive glossy foliage.
E. salubris	gimlet	A small tree with dense, glossy foliage; does best on heavy soils.
E. torquata	coral-flowered gum	a very ornamental small tree which will grow on rocky sites. A first class shade tree for streets and parks.
Other Species		
E. astringens	brown mallet	An excellent shade tree on good deep loams.
E. campaspe	silver-topped gimlet	Hardy to drought, tolerant of soil conditions. In Kalgoorlie a hybrid form is superior to the species.
E. erythronema	red-flowered mallee	One of the most attractive of the smaller growing eucalypts, with blood-red flowers.
E. flocktoniae	merrit	An attractive small tree; does best on sandy to moderate-textured loams.

TABLE III

TREES AND SHRUBS USED FOR STREET AND PARK PLANTING IN KALGOORLIE

Botanical name	Common Name	Comments
Other Species (cont.)		
E. kondininensis	Kondininen blackbutt	A useful shade species on good quality loams.
E. occidentalis var. *stenantha*		A small tree with attractive foliage and large greenish-yellow flowers.
E. stricklandii	yellow-flowered blackbutt	Considered one of the best eucalypts in Kalgoorlie; has large yellow flowers; adaptable as to soil.
E. wandoo (inland form)	inland wandoo	A good street species; grown on lateritic soils.
E. woodwardii	lemon-flowered gum	A hardy, small tree which does well on light loams. A hybrid, E. woodwardii x E. torquata, is extensively used for street planting and, as would be expected, shows a variety of colour in its flowers.

Ficus macrophylla.



Callitris propinqua

WOOMERA

This township of several thousand inhabitants is of interest on two accounts,

1. It is an example of a settlement which was fully planned at its inception and adequate provision made for residential areas with minimum of through traffic, sites for schools, shopping centres, churches, sporting and social organisations;

2. It is an excellent example of the wise, planned use of trees and shrubs to improve living amenities in an adverse environment.

Woomera is close to the geographic centre of South Australia. It is about 320 kilometres from the southern ocean, altitude of about 182 metres, latitude of approximately 31°S, there is a moderately large temperature range from a mean minimum for the coldest month of 2.0 - 4.5°C to a mean maximum of about 35.0°C for the hottest month. The days in winter are pleasant with a mean maximum of about 18.3°C, which is also approximately the mean annual value at Woomera. Over a 20 year period the 50 percentile rainfall value is 190.5 m.m., the 10 percentile 101 m.m. and the 90 percentile 280 m.m. The lowest rainfall was 94 m.m.

The topography of the area may be described as very gently undulating. It can be divided into very broad tablelands and broad, shallow valleys and smaller drainage channels which may be as much as 30 metres lower than the tablelands. Since this is a part of Australia which has internal drainage most of the shallow valleys lead to basins which may hold water during years of above average rainfall but are only large salt pans at other times. The accumulation of salt especially common salt and gypsum, in depressions is usually so high that either no vegetation can survive or only plants which are highly tolerant of such conditions. e.g. salt bush and blue bush. Where the vegetation has been damaged and where there is no layer of gibbers, small sand dunes arise and present problems in control. Around most of Woomera township there is only a shallow sandy surface layer in the soil so that there is not sufficient material for very large dunes.

Most of the soil in the township area is Woomera clay loam, which carries scattered gibbers over a very thin (25-76mm) sandy loam, beneath which is a tight clay, red to brown in colour and with varying amounts of salt and gypsum. This clay is not readily penetrated by plant roots and when trees are established it is necessary to remove clay from large holes and replace with sandy loam from the surface. In valleys the same type of clay soil is present but it is beneath a variable depth of sand and sandy loams. The soils generally are slightly to markedly alkaline, with pH values from 7.5 to over 9.

In view of the adverse conditions it is not surprising that there is little vegetation more than 25-50 m.m. high on the tablelands. The most prominent plants are species of salt bush *(atriplex sp)*, blue bush *(Kochia sp)*, many grasses and some members of the family compositae; shrubs and small trees are very rare.

In the valleys and other depressions in addition to the plants already mentioned there may be scattered shrubs; the pea family is the most prominent with several species of Acacia and Cassia. Other shrubs include hop bush *(Dodonea attenuata)*, needlewood *(Hakea leucoptera)*, some paper barks *(Melaleuca sp)*, one eucalypt *(Eucalyptus oleosa* var *glauca)*, white cypress pine *(Callitris glauca)* and pittosporum *(Pittosporum phylliraeoides)*. Some of these such as the cassias, may only grow to a few millimetres in height, whilst the tallest are some of the paperbarks, acacias and white cypress pine, which may attain 6-15 metres under favourable conditions.

As would be expected from its location in the arid zone, Woomera has no local water resources, but obtains its supplies by pipe line from the Murray River via Port Augusta, an airline distance of over 400 kilometres. The principal catchments of the Murray and its tributaries are up to 1600 kilometres away. The water is first used for domestic purposes and is subsequently treated and used for watering trees and

Eucalyptus maculata, "Spotted Gum."

shrubs. After treatment which includes chlorination, the water is fit for human consumption except for the presence of significant quantities of detergent. Except perhaps during heat wave conditions in Summer the quantity of water available from the township sewerage plant is more than sufficient for maintenance of the present scale of planting, but there is an obvious limitation upon the extent to which the plantation can be expanded.

Most of the small trees are eucalypts native to the arid and semi-arid zones of S.W. Western Australia, whilst both these and most other native and exotic species are the same as those which thrive without watering, or with only limited watering.

The success of nearly all the species planted at Woomera illustrates the wisdom of selecting mainly species which have a proven record in comparable climatic areas, either naturally or following introduction over a period of many years, and to limit the use of previously untried species. Above all Woomera is an excellent example of what can be done, where water is available, to convert a comparatively barren area into one where small trees and shrubs provide shade and shelter and bring beauty to a residential and recreational centre.

TABLE IV

SELECTED LIST OF TREES AND SHRUBS WHICH HAVE PROVED SUCCESSFUL AT WOOMERA WITH REGULAR WATERING

NATIVE SPECIES	VERY GOOD	GOOD
Eucalypts	*E. brockwayi*	*E. camaldulensis*
	E. campaspe	*E. flocktoniae*
	E. dundasii	*E. griffithsii*
	E. forrestiana	*E. grossa*
	E. salubris	*E. lesouefii*
	E. sargentii	*E. stricklandii*
	E. torquata	*E. transcontinentalis*
		E. woodwardii (b)
Acacias (wattles)	*A. pendula*	*A. cyanophylla*
	A. salicina	*A. sowdenii*
		A. stenophylla
Other Species	*Agonis flexuosa*	*Callitris glauca*
	Dodonea attenuata	*Casuarina cristata*
	Melaleuca pauperiflora	*Grevillea robusta (c)*
Exotic Species	*Schinus molle*	*Hakea laurina*
	Tamarix aphylla	*Cupressus arizonica*
		Rhus lancea

All the species listed above can be assumed to be at least moderately resistant to salt and to tolerate a high pH reaction.

(b) with maturity this tree usually develops an unattractive, straggly form.

(c) this rain forest species needs better than average soil and watering if it is to grow into an attractive tree.

New Zealand Theses Recently Presented of Interest to Horticulturists

N.D.H. THESES

CROOKS, M.R. (1974)	Propagation of avocados. N.D.H. Thesis 34p.
HUBBERS, P.J. (1974)	The treatment, planting and maintenance of dry banks in the Auckland area. N.D.H. Thesis 112p.
MOFFITT, R.G. (1974)	Windbreaks and shelterbelts for horticulture N.D.H.Thesis 87p.
OLIVER, C.A. (1975)	The propagation and establishment of *Coriaria pteridoides*, W.R.B. Oliver and *Helychrysum bellidioides*, (Forst. f.) Willd on Mount Egmont. N.D.H. Thesis 45p.
REEVE, J.R. (1974)	A study of wood wastes. Utilisation of bark in horticulture and its possible uses as a growing media for containerised plants. N.D.H. Thesis 55p.
RIACH, D.D. (1975)	Some more uncommon and unusual hardy and half hardy bulbous plants with special reference to their culture and potential use in Canterbury. N.D.H. Thesis 259p.
SMALL, R.W. (1975)	An investigation into methods currently employed to control damping-off in seedlings. N.D.H. (Nursery Mgt.) Thesis 102p.
STUART, E.P. (1974)	The production and properties of New Zealand plants used in floral art. N.D.H. Thesis 128p.

(N.B. All theses listed above are deposited in the Lincoln College library and are available (along with theses deposited in previous years) through the N.Z. libraries interloan service.

THESES PRESENTED AT UNIVERSITIES IN N.Z.
(Taken from 1975 University Calendars)

BAIN, L.	The Tahakopa Valley, with emphasis on the coastal holiday settlement at Papatowai. Dip. L.A. (Linc).
BOYD, A.J.	The motorist's landscape, with particular reference to the highway through Kaikoura. Dip. L.A. (Linc).
CHAN HAU LEE	Price formation at the Palmerston North fresh vegetable market. M.Sc. (Mass.)
FISHER, K.J.	Studies on the growth and development of the tomato (*Lycopersicon esculentum* Mill.) PhD. (Mass).
FORSTER, R.L.	Viruses infecting daphne in New Zealand. M.Sc. (Mass).
GANESAN, S.	Studies on the growth and development of cauliflower (*Brassica oleracea* var. botrytis). M.Sc. (Mass).
GRIFFIN, G.	A study of the Styx River and river catchment with regard to its recreational value. Dip. L.A. (Linc).
LAMB, J.F.	Programming the financial and capital development of a horticultural property. M. Hort Sc. (Linc).
ODUFUWA, S.O.	Studies in the control of Boytrytis Cinerea Pers ex. Fr. on Strawberries. M.Agr. Sc. (Linc).
RAUT, R.K.	A study of effect of density on carrot. M.Hort Sc. (Linc.)
TITCHENER, A.	Proposals for a residential subdivision and park in Flaxmere, Hastings. Dip. L.A. (Linc).

Key: Linc. - Lincoln College.
Mass. - Massey University