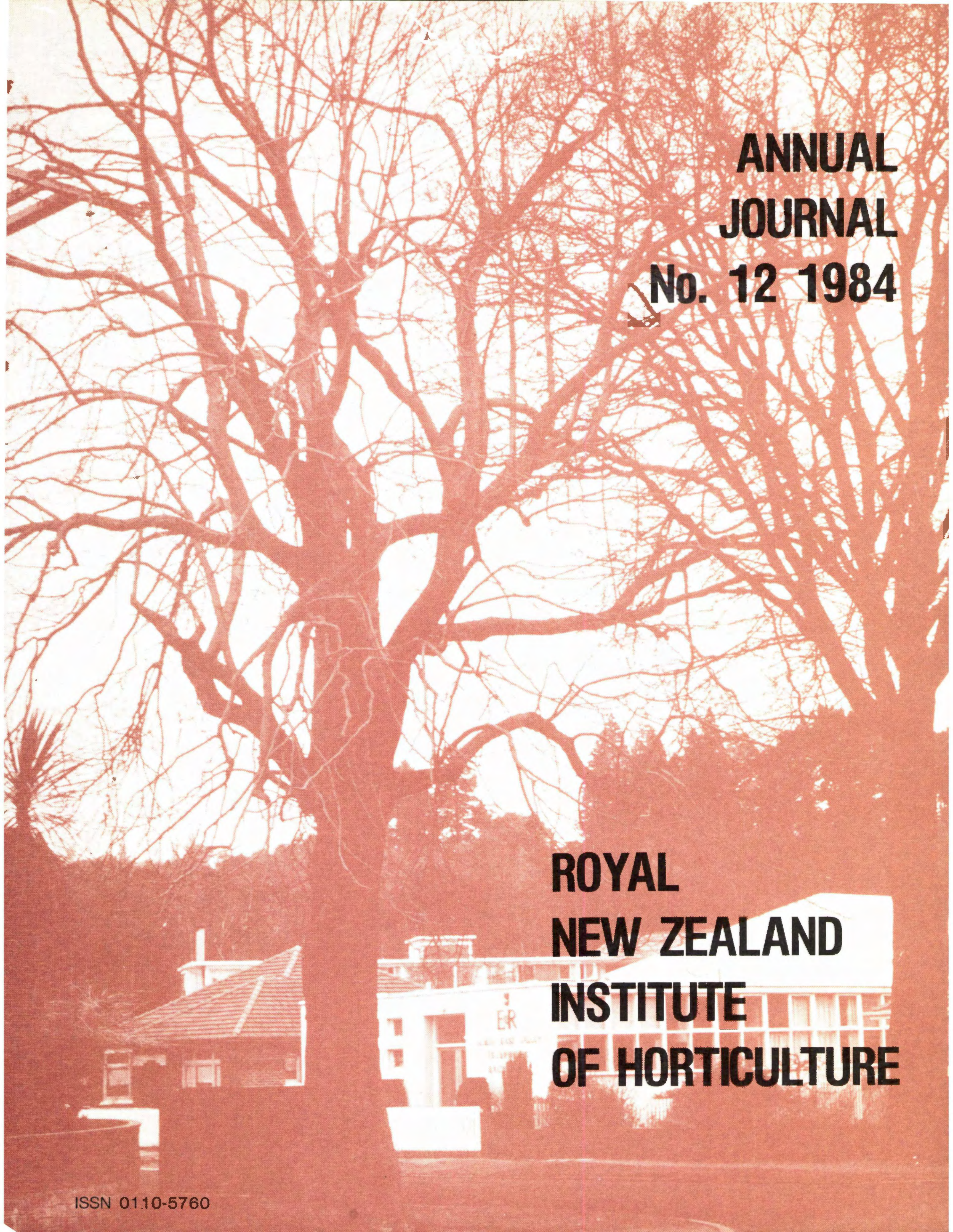

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ROYAL NEW ZEALAND INSTITUTE OF HORTICULTURE (INC.)

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COVER PICTURE

The Glendinning Oakes, Dunedin. These trees marked the entrance to the Glendinning Estate and one of the conditions imposed on its subdivision was that they be preserved. (Photo - Notable & Historic Trees Sub-Committee.)

Contents

The Greening of New Zealand

by

Mr K. Piddington, Commissioner for the Environment

Opening address given to the R.N.Z.I.H. Annual Conference, Wellington, May 1984.

It is a great pleasure for me to be invited to open this Conference. You have a stimulating and varied programme ahead of you and you will be looking at many aspects of our regional environment. You will also see how the theme of your Conference is reflected in and around Wellington. Here indeed one can boast that we have a "green approach" to urban spaces.

Many of your guides, and indeed many of your own members, can speak with far greater knowledge than I can about the details of these developments. I am however qualified to talk from two standpoints; one is that of a citizen of Wellington and, if you like, a "consumer". The second is part of my work in the Commission for the Environment; from a not very green environment in the Terrace, I think I can pick up the threads of what is happening in and around Wellington and try to fit them into a national pattern.

Both perspectives are I believe important. Indeed one of the themes which the Commission for the Environment is trying to reinforce is that environment is democracy and ultimately it will be the people of New Zealand who decide what happens to their environment. Our job is to inform and I hope facilitate the decisions of individuals, as well as tendering advice to central Government and other official bodies.

One must be encouraged by what one sees in Wellington. Over the last 25 years or so I have been able to watch different slopes and different vistas assume a more mature aspect, if you like, a greener look. Some of these changes are caused by ecological energy - there are large parts of the region where natural process is bringing back the succession of indigenous cover which follows the gorse. If we could look at time lapse photographs over the post war period we would see that these developments have been dramatic.

Elsewhere, deliberate intervention by local bodies and private citizens has brought a different blend of indigenous and exotic plantings. I find that these patterns blend together quite happily to tell us where Wellington is, in the 1980's. At this gathering, however, you should perhaps be looking ahead to where Wellington will be in the year 2000.

Let us dwell for a moment on the private citizen. Since planting and cultivation in private gardens is, according to research, the principal pastime of New Zealanders and since the use of time in this way reflects completely free "market" forces, it is highly significant that so much should have changed in such a short space of time. It leads on to the thought that Wellingtonians have come to care a great deal more about their region and about the "green approach". I believe that this has made the task of the local authorities that much easier. I sense that there is massive consumer demand throughout New Zealand for the establishment of a mature landscape and we should not underestimate it.

Then I turn to the national context and I have to ask a few questions: is this consumer preference part of a more significant trend? Do New Zealanders of this generation place a higher value on the "greening" of their environment than their forefathers? More basically, do we underrate the emotional and other attachments felt throughout the community for growing trees, shrubs and forest vistas? Should one argue that the retention of indigenous bush remnants is now a matter of high national priority because of this?

In considering these questions you will come across some significant pieces of evidence. There is no doubt that interest in native vegetation is on the increase. Sales of indigenous species by nurserymen have risen dramatically. The excellent Manual on Revegetation produced by the Q.E. II National Trust has sold over 3,400 copies.

There is no doubt that at the Government level policies on indigenous bush are a matter of great concern. Nearly 30% of the current flow of correspondence to the Minister for the Environment is on this theme. Again and again we see a forest in one corner of New Zealand becoming a matter of nationwide concern, often without due consideration for the people most directly affected by what happens to their environment. There is also little doubt that as more and more New Zealanders return from overseas after seeing the damage which is being done to temperate and tropical forests elsewhere, they develop a far greater attachment to New Zealand's unique botanical heritage.

The "green approach" may represent a more fundamental change in New Zealand's society. In the Commission we can see very clearly that this country has come to the end of the period of wholesale clearance to bring the land into farming. Dr Shearer has described this as the "Philishave" era, and it is over. Development now has to be very selective; you cannot shave the vegetation from the land and expect an economic return to the nation.

As we see it therefore, investment in the type of land development that was appropriate for a colonial economy during most of the last hundred years is by and large questionable. It will moreover generate conflicts of all types. From now on we have to tread more gently on the land and become more adaptable in our management ethic. In particular we have to give greater weight to the environmental values and ecological consequences. This, as any catchment board struggling to enforce the protection clauses in our legislation can tell you, is simple economic sense.

The change is also in my view evidence of a change in culture. No longer does the New Zealander simply think in terms of dominating nature. We are finding a new identity as part of our environment and we have come to see (and sometimes understand) ecological systems as something that we must work in harmony with. This harmony will in turn reinforce our identity. Surely this is what one sees in the home gardener's planting programme, in the explosion of crafting activity using indigenous resources and in the rebirth of a much deeper philosophy within the Maori community, for example in relation to a resource such as flax.

One could give a whole speech about flax alone. Is it not ironic that the strategic decisions by the British Government to establish settlements in this part of the world flowed from the desire to secure alternative sources of flax which was then an essential item for sail making? Is it not ironic that this same flax, which is endemic to such large areas of New Zealand, now holds the prospect of processing into high quality products (with the possibility of methane as a by-product) and is it not intriguing to hear someone like Tungia Baker talk to us about the significance of her own experience in working with flax?

In Aotearoa it is sometimes more appropriate to talk about "flaxroots" opinion rather than use the term "grassroots". At the flaxroots level I see a clear trend, with all New Zealanders moving to a new maturity and using the "green approach" as part of that process. The ideas which are part of this process are of great importance. We can quote key concepts like sustainability, provision for both material and non-material needs, ecological diversity and dynamic equilibrium. But a tree can of course say it all much more simply.

The theme of your conference is on urban spaces. All these concepts can be reflected in our cities. Compared to urban settlements elsewhere in the world they are of course already remarkably "green". Let us look at the urban ecosystem therefore as something which contains vegetation, wildlife and a pattern of competition among species. The fact that humans are the main factor need not blind us to the underlying reality, which is one of ecological balance. Who in Wellington could forget that a factor such as wind, for example, is virtually outside human influence and yet it has a dominant influence on our lives, on our buildings and of course our gardens?

We can take a more deliberate approach to this ecosystem if we map it and decide how to distribute certain species; where to have gaps, where to have corridors, where to bring the birds back and where to try to get rid of the birds. Future New Zealanders may see this approach to the urban ecosystem as indespensible and wonder why we took so long to come to it. It could become just as important as the understanding of marine or mountain ecosystems. After all, most of us live in cities and it is this environment which is of first concern to most of us. Let us therefore look at this interaction between our society and our environment.

From all these current trends I conclude as a general principle that this sense of maturity as New Zealanders and the assertion of an identity with the environment are strongly interactive. To use the jargon, there are feedback loops. We feel more mature as individuals when we look more and do more about the New Zealand environment. These very actions strengthen the sense of national identity, even in the heart of our cities. There is no doubt in my mind that this trend amounts to a quiet revolution which has been significantly underestimated. And if my conclusion is correct, it could reflect one of the most dynamic areas of growth for New Zealand society towards the end of this century.

Ten years ago the environment was by and large an afterthought. Now it is quite apparent that it is the starting point and the end point of many individual judgements and many individual decisions. This surely is most significant for you and for me as citizens. It is also significant for the Institute. It is certainly important for all groups who are actively involved in the environmental movement and it is significant for New Zealand society.

I would like therefore to put this pattern into a wider context. My own work over the last ten years has made me aware of an important interrelationship between three areas of conflict in New Zealand society.

- The battle over the environment is one, and I say, it has shifted ground dramatically in our time. Ever since Manapouri it has moved closer to the heart of economic decisions about resource use and the planning of society's priorities - to which I would add, in the nuclear context, its very survival.
- Then there has been growing friction in the race relations area which has taken us from an assumed state of harmony in the late 1950's and early 1960's to much more open prejudice on the one hand and a quite dynamic trend towards multiculturalism on the other.
- The third area concerns the unresolved agenda of the sexual revolution and the changes in sex roles within society. The increasing hostility between males who expect to dominate and exercise power and the assertive message coming from New Zealand women in the 1970's and 1980's is belatedly being recognised as central to the quality of our human environment.

None of these areas of conflict are within coo-ee of resolution. We are going to have to work very hard on them. I would however like to leave you with one thought. Sensitivity to the environment and the development of an environmental ethic is indistinguishable from growth and compromise in all three areas.

It is no coincidence that the same people who have been concerned about the environment have been active in the area of multiculturalism. It is no coincidence that in relating to the indigenous environment many pakehas find themselves thinking and feeling in terms which are very close to those reflected in Maori culture in the 1980's. It is no coincidence that the people who are out to ignore the environment or destroy it tend to play down the crucial contribution which the Maori renaissance is now making in many areas of New Zealand life and that they tend to be more aggressive, more violent and less considerate to the feelings of others. It is finally no coincidence that most of the damage to the environment is done by males. I think there is a message there if we want to listen to it.

It follows that if environmental maturity can facilitate our approach to problems in other areas, New Zealanders will individually and collectively be able to achieve a much better quality of life. This is not the wilderness aspect of environment, neither is it ecological purity, pure and simple. The environment is not a museum piece, it is the place where we live. I am therefore offering a highly pragmatic answer to the question why we should "give up something" in order to protect the environment.

It is in our cities that this particular drama has to be played out and we come therefore to the practical steps which can be taken to support this approach. Your conference is focussed right in this area. In a few weeks time on Arbor Day the Year of the Urban Tree will be officially inaugurated. It will coincide with a number of activities designed to re-establish the tree as a multiple asset in our urban areas. I might say that we in the Commission are keen to act as an "ideas exchange" during this twelve month period.

Please write to us if you have a particular project or a particular concept which you think is worth pursuing. We intend to prepare a regular newsletter to keep everyone informed about what is going on throughout New Zealand. I look to this conference and to your Institute as a logical starting point for this flow of ideas.

I have talked this morning in abstract terms. I have done so because I think it is time we recognise that the environment and what it has to offer has been little understood. Often we have devoted energy to a particular aspect of the problem without getting to the heart of the matter. We rush to an area of conflict with our fire extinguishers at the ready. We need to think more about the causes of the fire.

As far as the human environment in New Zealand is concerned I am absolutely convinced that the theme I have covered will prove to be central to the way in which New Zealand develops in the period ahead. Our obsession with economic issues and economic problems has undoubtedly diverted attention from what will turn out historically to be much more important issues. They are moreover issues over which we have some degree of control as a society.

URBAN SPACES - THE "GREEN APPROACH"

Finally therefore we come to the implementation of these new ideas in the urban context. What are the guidelines we should follow? These are the Commission's suggestions and I have had them copied for distribution to you.

(1) Protect what green spaces exist

(2) Enhance greenness on a valid ecological basis

(3) "Validity" will in turn depend on:

- (i) appropriate technology to achieve -
  energy preservation;
  noise abatement;
  wind protection;
  structural protection.
  (Note that research is needed on the role of plants in engineering.)
- (ii) choices appropriate to New Zealand - e.g. the plants that suit New Zealand biological species and environmental conditions. (When a pollution resistant, deciduous exotic is planted on Lambton Quay it may not be a native but it is very well suited to the micro-environment.)
- (iii) a planting pattern which reflects ecological principles in its design - e.g. continuity, compact shape, diversity and others.
- (iv) use of buildings as surfaces for plant growth - treat them as buffs, plateaux, canyons, caves. (Would the Institute like to hold a national competition for building/garden design?)

(4) Arrange for involvement of all groups in the community. (Would the young

people in Manners Mall continually destroy the vegetation if they had planted and identified with it themselves?)

(5) Recognise that the needs of people and ecological needs are not mutually exclusive. In the area of overlap we can find the fundamental rationale on which "greening" must be based.

The Banks Lecture 1984
A Survey of N.Z. Trees and Shrubs of Horticultural Value

by

R. Mole

Otari Plant Museum, Wilton, Wellington.

The man after whom this series of memorial lectures is named took part, along with botanist Daniel Solander, in the first botanising expeditions known in this country - the year 1769.

The plant collecting was mainly confined to eastern coastal areas of the North Island and around Queen Charlotte Sound and Admiralty Bay in the South Island.

However, despite such limited forays, some 360 new species were collected which, for botanists would be (to quote David McGill of Wellington's Evening Post) "like winning the Golden Kiwi every day for a year".

Sir Joseph's name is commemorated in 12 species of New Zealand plants which are included in such well known genera as *Coprosma*, *Senecio*, *Astelia* and *Cordyline*.

The sp. name 'banksii' is also featured in a genus endemic to New Zealand called *Alseuosmia*. *A. banksii* is referred to in more detail a little later on in my talk this evening which is entitled "A Survey of New Zealand Trees and Shrubs of Horticultural Value".

Out of a grand total of about 2,200 species, New Zealand has just over 500 species of trees and shrubs - so about ¼ of New Zealand's flora is made up of woody plants. In an analysis of this group carried out some years ago, I arrived at a total of about 200 which, in my opinion, warranted special consideration for garden use. I hasten to assure you it is not my intention to deal specifically with each of my selections this evening.

Instead, I would like to deal with the larger groups and discuss briefly their main characteristics, selecting a few of the more horticulturally important species from these groups. Then to move on to comment about other trees and shrubs which belong to smaller groups of the flora and finally I wish to discuss more general matters related to the woody plants of New Zealand and those from overseas.

But first, a few words about the

GARDEN ASSETS OF TREES AND SHRUBS

- Although, of course, not confined to trees and shrubs, we often appreciate their beauty because of their colourful flowers.
- We appreciate, on occasions, their colourful fruits.
- We may appreciate the colouring and the design of their bark.
- Sometimes it is their form and foliage that appeals to us.
- Foliage and/or flowers may be scented.
- Trees add depth and interest to areas viewed from a distance.
- They create visual unity of different areas.
- They direct the eye to a focal point by creating a vista.
- Conversely, they can screen out undesirable features, e.g. industrial sites.
- They can reduce wind velocity.
- Reduce temperature by their shading effect.
- They enrich the air with oxygen.
- Filter dust particles.
- Reduce the intensity of noise.
- Their extensive root systems can prevent erosion on hillsides and along river banks.
- Trees provide a haven as well as food for bird life.

Actually, the list is not exhaustive, but I think ample for us to realise that trees and shrubs are indeed the grand masters of the plant kingdom. They play a very important role in the urban environment whilst, as we shall see later, their role in the rural landscape is also important.

Only about 13 species of native woody plants are deciduous and even some of these have a reluctance to shed their leaves in the warmer parts of the country. For example, some years ago I recall giving a lady a dwarf kowhai which was to be grown in Waikanae (about 55 km north of Wellington). In Wellington the dwarf kowhai will lose its leaves regularly in August (not a conventional deciduous plant), but this was not the case in Waikanae since the recipient said she went around cutting them off so that the flowers could be seen more readily.

Since the majority of the flowers produced by the evergreen subjects are small and not brightly coloured, there is a tendency for the leaves to mask any floral attributes. For example, New Zealand has a sizeable group of brooms, technically species of *Carmichaelia*, but they include one species of *Corallospartium* (Coral Broom), one species of *Chordospartium* (Weeping Broom), this is *C. stevensonii*, plus three species of *Notospartium*. With regard to Carmichaelias themselves, there are 38 species listed in Volume 1, Flora of New Zealand, 1961, but this figure may be reduced to 17.

The majority of New Zealand brooms are easy to grow. In the 21 years that the carmichaelia border has been maintained at Otari, there has been little trouble from pests or diseases. Carmichaelias are drought tolerant; they love the sunshine; take pruning well; some have a graceful, pendulous habit; nearly all are long lived, yet, perhaps because of their small flowers they are given sparse attention in the horticultural world. The only species I have seen listed in the trade are *C. aligera*, *C. flagelliformis*, *C. odorata*, plus the one with the largest flowers *C. williamsii*. I have no doubt that if the New Zealand brooms had flowers as showy as Scots Broom or as conspicuous as the Spanish Broom (*Spartium junceum*), their sale to the public and their use by parks departments would improve rapidly.

COPROSMA

Another large group made up of mainly shrubs is contained within the genus *Coprosma* - about 40 species. All flowers in this group are horticulturally insignificant, but their fruits can be quite colourful as can be seen in *C. pumila*.

Many years ago there were moves afoot to utilise fruits for a coffee industry (coprosmas belong to the same family as true coffee), but it did not eventuate. Like the kiwifruit, male and female plants are required for fruit production, but unlike trade in kiwifruit, I have not heard of nurserymen grafting male corposmas onto females for this purpose.

Because of their below average overall appeal, there are comparatively few species offered in the trade. *C. repens* is perhaps the most prevalent and this species in coastal areas is used for hedging and shelter. *C. acerosa* is a wiry interlaced species of unusual colouring, useful for covering banks in very exposed sites or, grown as a specimen in a large rock garden.

A much wider range of coprosmas is available as cultivars. For example, 'Prostrata', very useful indeed for tumbling over high retaining walls, as is its near relative 'Kirkii' or 'Kirkii Variegata', both widely grown in parks departments for ground cover. More erect coprosmas for open sites and preferably frost free ones are often forms of *C. repens* such as 'Picturata' and 'Marble Queen'. Self coloured leaves are found in the swarm of *Coprosma* hybrids which had their beginning at Otari whilst Walter Brockie was curator. I refer to the likes of 'Greensleaves', 'Copper Shine' and 'Brunette'.

A more recent cultivar with good garden potential is 'Beatsons Gold' - compact in full sun, but reasonably tolerant of some shade. Finally, brief reference to 'Williamsii Variegata' - attractive, but not so tough as many of its colleagues, preferring some shelter from wind and protection from hard frosts.

DRACOPHYLLUMS

Visitors to Otari in recent years have certainly shown interest in New Zealand Grass Trees - the dracophyllums. The H.Q. of this genus is in New Zealand though the exact number of species has ebbed and flowed over the years. In 1925 it was 20, in 1961 it was 35, reduced by one botanist in 1983 to 23. All species are evergreen and range in size from prostrate forms, through erect shrubs often 1-2 m tall, to trees 10-12 m tall, though it is most unlikely that garden specimens would exceed even half this maximum height.

Long, thin, needle shaped leaves (present in *Dracophyllum longifolium*) are responsible for the common name 'Grass Tree'. The tallest species have larger leaves which are tufted at the terminals in the manner of pineapples, as seen in *D. traversii* and in the all year round red coloured leaves of *D. latifolium*. I consider that several species have high garden potential, yet among the home gardening fraternity and in many parks departments, I would say they are practically unknown. I suppose their paucity in these quarters is due to their absence in nurseries, wherein I have yet to see more than one species offered for sale.

I am aware that dracophyllums are notoriously difficult to raise from cuttings taken in the conventional manner, though I wonder if any have been tried by tissue culture, which may provide the answer to their vegetative propagation. Layering works, though it is hardly a method to be practiced in the trade. On the other hand, seed is easy to germinate, though growth is certainly slow in the early years.

The majority of dracophyllums prefer cool, rather sheltered, damp situations, but once established some of the narrow leaved forms seem tolerant of rather dry areas and are able to withstand strong winds. I have never seen frost damage on dracophyllums in Wellington and most seem very long lived.

Whilst form and foliage is their main aesthetic appeal, the flowers of some, for example, *Dracophyllum strictum* and *Dracophyllum pyramidale* should not go unnoticed.

BRACHYGLOTTIS

There was a time when, with confidence, one could inform people that New Zealand had but one species of *Brachyglottis* and such plants we called Rangiora. Now, seemingly, woody species of *Senecio* have been transferred to *Brachyglottis* which now has (I think) 14 species. This figure represents a loss of about 10 species of *Senecio* (through amalgamation) compared to their total in 1961. However, since the change over is not fully endorsed in all botanical circles I, as a grower, will tonight refer to them as senecios.

In my opinion, most New Zealand woody senecios are of horticultural value, though the subalpine to alpine species I have found difficult to maintain at lowland levels, and so have other growers I know. Thus, you are unlikely to find such species as *S. adamsii* and *S. bidwillii* available in nurseries. Of the lowland species *S. greyi* (which now includes *S. laxifolius*) would, I think be the most widely grown grey leaved species. Less commonly grown are *S. compactus* (Castle Point only), *S. hectori* (Takaka Hill) and *S. huntii* found only in the Chatham Islands. This plant is, I feel, deserving of much wider use in gardens. It grows into a shrub or small tree; leaves are pleasantly aromatic, whilst its rich, golden yellow flowers are produced in abundance through December to February.

At least two grey leaved *Senecio* hybrids enjoy garden popularity. They are the Mutton Bird shrub (*S. reinoldii* crossed with *greyi*), and a hybrid which materialised at Otari which I have called 'Otari Cloud'.

HEBE

Hebes, the largest group of woody plants in the New Zealand flora, need no introduction to this gathering. 79 species were described in the flora of 1961 and as a change contemplated in other genera, the number of species could go up to over 90.

We can divide the hebe tribe up into at least two main groups for horticultural purposes - what I call broad leaved hebes and the whipcord group. The broad leaved ones have been popular plants with gardeners for a long time. They are easy to propagate,

Figure 1: *Hebe albicans* from the mountains of Nelson. An excellent garden plant.

Figure 2: *Hebe ochracea* growing in the Christchurch Botanic Gardens. Also from mountains of Nelson.

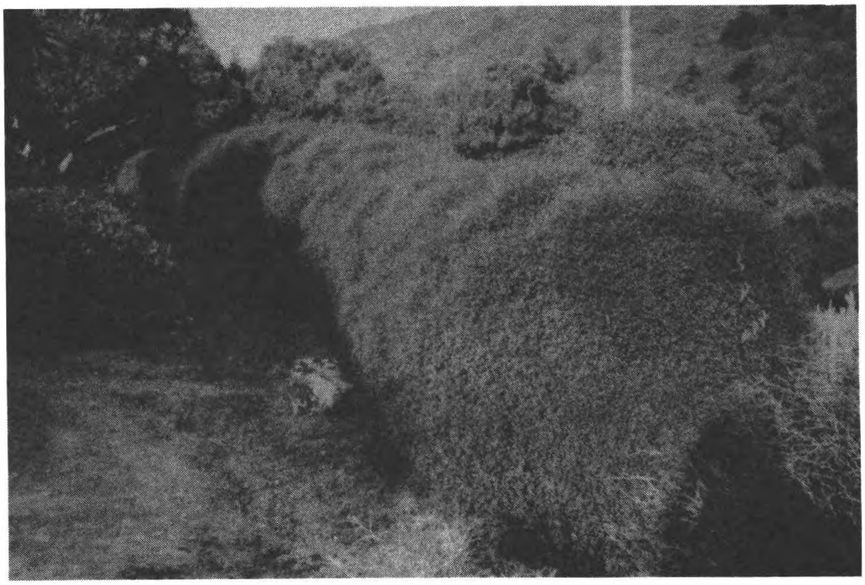

Figure 3: *Muehlenbeckia astonii* clipped to maintain its natural form makes an attractive hedge. This one is in the Otari Plant Museum.

quick to grow and flower, easy to transplant, hardy, compact, not too big, adaptable to varying soils and so on. Some of the best are: *H. albicans* (Mts of Nelson), *H. decumbens* (Mts Marlborough and adjacent parts of Nelson and Canterbury), *H. hulkeana* (Mts Marlborough and North Canterbury), *H. diosmifolia* (lowland North Island, Whangarei North), *H. traversii* (Mts Marlborough/mid Canterbury), and *H. speciosa* (lowland and now very rare in nature). In the whipcord group the three I would place at the top for garden use are: *H. armstrongii* (a very rare plant in the wild), the well known *H. cupressoides* and my favourite *H. ochracea* (from mts of West Nelson).

Not unexpectedly, scores of garden cultivars of *Hebe* have come into being and still they come. They are too well known to warrant comment here, but before leaving hebes, I think it would be appropriate to say that despite them having many attributes for garden use, they can also be tempramental and one of their main defects is 'dieback'. Unfortunately, the majority of hebes seem prone to this trouble and although there are some that are less affected than others in a given period of time, generally speaking the useful garden life of hebes is often shortened by what gardeners call 'dieback'.

OLEARIAS

About 30 species of *Olearia* appear in New Zealand, but in nature three grow readily into small trees and another eleven tend to do so with time. Under garden conditions, the majority are likely to be small to large shrubs. Like the senecios, olearias are members of the Compositae and so have daisy type flowers, the majority being white. Their production is, I think, best seen in *Olearia cheesemanii*, which often covers itself in flowers and can be conspicuously attractive. The same species may flower when only a few inches high, say 4-6" (10-15 cm) tall. Three species I know of produce purplish disc florets (as opposed to the more common yellow ones) though this slight improvement in floral appeal is offset, from my experience, with greater difficulty in keeping this trio of *O. augustifolia*, *O. semidentata* and *O. chathamica* healthy under garden conditions.

A garden asset possessed by many New Zealand plants is a pleasant scent. A few species of *Olearia* are in this category, including *O. paniculata*, used a lot in the past for hedging. Longevity, plus an ability to withstand tough growing conditions is a 'credit card' of many olearias, for example, *O. albida* and *O. traversii*, both used for shelter purposes near the coast.

Time does not permit further examination of this group in depth, but other species suitable for parks and large gardens would include - *O. avicenniaefolia*, *O. furfuracea*, *O. macrodonta*, *O. pachyphylla* and for smaller areas *O. nummulariifolia*.

PITTOSPORUM

Formerly of some 26 species, now possibly being reduced to 18, the pittosporums grow into trees more readily than the olearias. For example, the well known and often used Kohuhu (*P. tenuifolium*) and Lemonwood (*P. eugenioides*), probably the most popular species for garden use. Both these species I have found ideal to supplement secondary growth in bush areas. Where conditions are not too exposed 20-30 cm of growth per season is obtained in their early years, which isn't bad going for Wellington. Although the flowers of Lemonwood are reasonably conspicuous, the flowers of many pittosporums are often less noticeable than those of *Olearia*, due to their often darker colouring. Like the olearias, several species have pleasantly scented flowers, whilst their tough constitution and ability to take pruning and produce compact growth, gives us the opportunity to use some for hedging or for informal windbreaks using say, *P. ralphii*, *P. umbellatum* or *P. crassifolium* (Karo).

There are several popular cultivars of *Pittosporum* - older ones such as the variegated form of *P. tenuifolium* *P. ralphii* and *P. crassifolium* as well as a few newer ones, including front of the border placement for 'Tom Thumb'.

I have endeavoured, albeit briefly, to bring out the salient points, good and bad, within the largest groups of New Zealand's woody plants relative to their use and horticultural potential.

Before proceeding to say a few words about more general matters, there are three more species I would like to mention since having observed their performance over the last 21 years, as well as their absence from many nurseries, I feel they should be more readily available to the gardening public in those areas for which they are suited. First on the list is -

ALSEUOSMIA BANKSII

This plant grows wild in lowland forest from about Whangarei northwards - thus, I doubt very much if it would be hardy enough to grow outside say in Christchurch.

It is a slender, leafy shrub growing no more than 1.5-2 m tall, often less. Thus, it will fit easily into a small garden, preferably in semi-shade. I recommend this little known species for garden use primarily because of its delightfully scented flowers - a scent reminiscent to me of gardenias. (Two weeks ago a professional photographer had just entered the Wild Garden at Otari when he suddenly stopped and asked where the scent was coming from - it was a still, damp day, ideal seemingly for sensing the aroma.) Under trees *A. banksii* is quite hardy in Wellington and the original plant introduced to Otari is still there, being at least 30 years old. Another asset of this shrub is that its 12 mm long tubular flowers are produced plentifully right through the winter from May to August.

All propagation of this plant at Otari has been by seed, which is easy and I've witnessed seedlings begin flowering when no more than 15-20 cm tall. At no time has spraying for pests and diseases been necessary. But ... I have yet to see this plant offered for sale in the trade.

Figure 4: *Pachystegia insignis* showing the flower buds which have given rise to its common name of the 'Drumstick plant'.

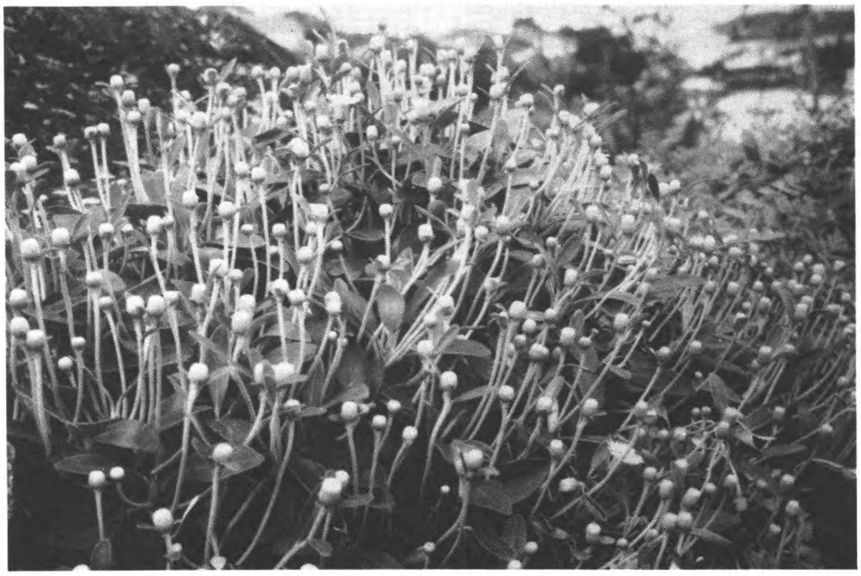

Figure 5: Plants of *Pachystegia insignis* growing in a steep, north-facing clay bank at Otari.

MUEHLENBECKIA ASTONII

The second specimen I suggest to you as a good garden plant I call the Zig Zag bush, botanists call it *M. astonii*. It is a species suited to the plant connoisseur because of its distinctive features but, at the same time, it is ideally suited to perform a certain task in the park or garden.

The stock at Otari was obtained by me as cuttings from an isolated specimen growing about 1 km inland from Baring Head, Wellington. Thus, there is little doubt that the plant is hardy to both wind and low temperature and I would think reasonably salt tolerant too.

Under garden conditions, it grows naturally into a very twiggy bush to about 2 m tall and wide, with small, heart shaped leaves and insignificant flowers and fruits.

Its claim for use in parks and gardens, stems from its ability to grow easily in average soil; its medium to fast growth rate; its dense, compact habit with branchlets to ground level. Thus it is, I feel, very well suited for hedging purposes.

But its form is not its only claim to recognition as a garden plant. In the winter particularly (I think the colder the better), when devoid of leaves, the young branchlets colour up to give a mound of coppery/bronze colouring quite distinct among New Zealand woody plants.

For any of you interested in the origin of plant forms, I would add, but briefly, that *M. astonii* belongs to a group comprising about 10% of the woody plants of this country, having branchlets which arise at 90° angles to each other. This type of growth is called divaricating.

Since the H.Q. for this type of growth is in New Zealand the reasons for its presence has puzzled scientists for some time. One theory is that it originated as a defence against frosts, likely to occur at most times of the year in certain lowland and montane areas. The second theory is that it may have arisen as part of the plant's defence against the eating habits of the Moa.

Time will permit reference to only one more plant in this section, which although better known than the previous two, is still unobtainable from many nurseries judging from enquiries I receive from members of the public. I refer to:

PACHYSTEGIA INSIGNIS (Marlborough Rock Daisy)

This is another plant of accommodating proportions, growing no more than 1 m high and wide. It has bold leaves, glossy above, felted below when old and on both surfaces when young. From December to February it puts on a bright display of flowers held well above the foliage on very stout stems. In fact, with regard to these stout stems topped by sizeable flower buds, I suggest a good common name for this plant would be the 'Drumstick Plant'.

Two specimens of *Pachystegia* at Otari lived for over 30 years and when grown in rather poor, stony soil, topped with a stone mulch, natural reproduction is plentiful.

However, a good performance of *Pachystegia* is not necessarily confined to a gritty soil. Some years ago young plants were put into a steep, north-facing clay bank at Otari. Quite oblivious to dry periods in the ensuing summers, this planting has progressed in five years to the stage shown in Fig. 5.

Unlike *Alseuosmia* which I said would be doubtfully hardy in Christchurch, *Pachystegia* I think appreciates a more continental climate. Conversely, this plant is not so content in the Auckland area where, I understand, it fails to set viable seed.

Last year I heard a whisper that four or five species of *Pachystegia* may be classified in New Zealand. One of these with its reddish flower stalks and fawny red undersurface of the leaves was thought distinctive enough for the accomplished artist Audrey Eagle to feature on the dust cover of her 2nd Volume of Eagles Trees and Shrubs.

There are other species I would like to mention relative to their potential for garden use, but time precludes further discussion on these lines. For now I would say that in the past few years especially, many people have extolled the virtues of New Zealand plants, either verbally or by the written word. This is good, but no matter how much one exalts the horticultural potential of New Zealand plants, the gardening public at large will, I think, always tend to favour the more colourful subjects, the field in which the credentials of New Zealand plants are lacking.

I should add here that when it comes to choosing plants for my home garden that colourful exotics take precedence. Similarly, local body parks departments and the Ministry of Works use a majority of exotics in urban areas to provide impact and colour.

Occasionally though, even in inner city areas, a planting may consist entirely of natives. In semi-rural areas we may find plantings in harmony with the surroundings, where roadside planted natives blend in with the backdrop of natures plantings. Unfortunately, the same statement cannot be applied to the bulk of plantings in the New Zealand countryside itself.

On this matter, I would like to draw your attention to this Bulletin of the R.N.Z.I.H. It was published in June 1939 (a fateful year as we all know) and features an article originally submitted as a Thesis for the Institute's Diploma in Horticulture.

The Thesis was compiled by Mr M.R. Skipworth B.Sc. (Forestry) and was entitled 'Roadside Beautification in New Zealand'.

I would like to read you two or three exerpts from this work, starting with the opening paragraph which reads as follows (quote) 'There is at present, widespread interest throughout New Zealand, in the subject of roadside beautification. For the greatest benefit to the country it is essential that all this effort and enthusiasm should be directed along the most fruitful course. Although it at first appears simple, the subject is a particularly complex and difficult one, owing to the numerous factors which have to be taken into consideration ... This study has been written with the hope that it will prove useful to the many enthusiasts who desire to see their country made more beautiful. By wise preservation and carefully planned planting, we may hand down to posterity a land of tree garlanded beauty, instead of a countryside of treeless landscapes, bush denuded slopes and rotting stumps'.

A little later on a main heading reads: 'NATIVE VERSUS EXOTIC'. (quote) 'Whenever the subject of roadside planting is discussed, argument usually arises as to the relative values of natives and exotics. The "native" supporters state that we should plant our own New Zealand trees and shrubs and that anything else is not in keeping with this country's landscape, exotics creating an unnatural effect. Those in favour of exotics argue that we should not confine our choice to natives but choose the best that is suitable from all over the world, thus greatly widening the range of beautiful subjects available ... They also add that much of our landscape, especially in the environs of the main towns, has already lost its New Zealand character and that the planting of exotics, therefore, is not out of place.

To the qualified, but unprejudiced person and also to the average intelligent member of the community, there is an obvious place for both types, but with a strong bias in favour of natives, wherever suitable'.

Finally, in the conclusion, Mr Skipworth said (quote) 'Up to the present in this country, little consideration has been given to the preservation of natural beauty or its extension, especially as it affects our roads. Is this indifference to the lack of natural beauty in our surroundings going to continue, or are we going to make some concerted effort to restore and extend the beauty of our countryside? The time is now opportune for some official action to show that we have some civic self-respect. Let us hand down to posterity a heritage of beautiful roads and earn everlasting thanks for our foresight' (unquote).

Well, as I said, that was written in 1939. 42 years later on the 28th September 1981 Cabinet supported in principle the roadside planting scheme called 'Beautiful New Zealand'. Prior to this date there was seemingly no concerted national effort to enrich the quality of the New Zealand landscape and it is ironic that a countryside with so much potential for beauty should have so many long and unattractive stretches of highway.

Mr Skipworth stated there should be a strong bias in favour of natives, <u>wherever suitable</u>. Such roadside planting that has occurred in the intervening years (up to 1981) would seemingly indicate that the majority of sites are not suitable. If this is true, is the trouble due to deficiencies in the various planting sites, or is it related to deficiencies in the native plant material itself. To a large extent, I think the trouble lies in the plants themselves.

For example, a major deterrent to more widespread use of N.Z. trees is their inability to grow well as isolated planted specimens, or even as a planted group in really exposed sites. I must hasten to add that the Pohutukawa is as tough as most trees around coastal areas, though there is a limit to what even this tree can stand. Also, its performance is limited to mainly frost free sites. The incidence of forest would rule out quite a few other species of trees, native to the warmer parts of New Zealand, being used in the colder parts of the country.

The Cabbage Tree can be planted in a wide range of habitats, but because of its lack of height and lack of branches lower down, its use as a shelter tree is somewhat limited.

In near coastal sites Ngaio (*Myoporum laetum*) grows as readily as Pohutukawa and is more frost tolerant, but planted specimens in even moderately exposed areas are unlikely to exceed say 6-7 m in height, thus the range of shelter is also limited.

Southern Beech trees are hardy in most areas where horticulturists are likely to plant them, but even Black Beech in conditions of moderate exposure is shaped by the wind and dieback occurs at the tips of branchlets.

From my rather limited observations, I feel we have to accept the fact that no New Zealand tree can grow as fast; need no staking, nor attain a height of say 10-15 m or more with a well developed crown in most situations (including very exposed ones), as *Pinus radiata*. There are a few other exotics in the same category, but for comparison purposes *P. radiata* will do. In addition to being the backbone of commercial forestry plantations in this country, it has been used for shelter purposes liberally throughout most parts of New Zealand.

Planting *P. radiata* to control gorse is another use made of this versatile tree - seemingly, not a new exercise in New Zealand since I was informed recently that David Tannock, ex Director of Dunedin Parks, organised the planting of pines on gorse clad hills around Dunedin in the 1930's and there may be other examples of similar land management that took place a long time ago.

From about 1912 onwards *P. radiata*, eucalypts and macrocarpas were planted on Tinakori Hill, Wellington, as part of the town belt. I doubt if the city fathers had them planted knowing that New Zealand natives would regenerate within them. But, this is what is taking place within the shade of the conifers. In more open areas (still on Tinakori Hill) the exotic conifers regenerate.

Three years ago about 5,000 pines were planted on an old fire break on Wellington's Outer Town Belt. Gorse is regenerating there too, but the pines have a head start. Coversely, regeneration of the pines is unlikely in the nearby reserve because of the shade provided by the closed canopy of natives which, in turn, will act as a large seed source for the natives to regenerate within the pines as time goes by. Subsequent growth results in pine laterals touching each other, cutting down light intensity and thus begins the gradual decline of the gorse.

Such schemes are not foolproof, but they do reduce the time span during which gorse, by itself, would be highly inflammable, plus inducing more quickly the establishment of New Zealand plants. At Otari Native Plant Museum I am aware of a stand of gorse, 30 years old, which only now is beginning to be overtaken by regenerating natives (mainly Mahoe) and this is on a South-facing slope where one expects more rapid native plant establishment.

Whilst then the use of exotic pines does, with time, induce the native plants to get established, I feel it is a pity there is not a native tree that could be used in the first place. Did the woody plants of this country evolve during a time when the land was not subjected to the onsloughts of winds we call the roaring 40's?

Last year nearly 500,000 tourists

Figure 6: The gums shown here planted alongside Lake Taupo give the countryside an Australian look.

Figure 7: Exotic pines on the Rotorua-Taupo highway. Scenes such as this are repeated throughout New Zealand's pastoral areas.

visited New Zealand. 'More tourists' said the 1983 Tourist and Publicity's Annual Report 'more tourists want an authentic New Zealand experience. They should see things of a distinctive national flavour', said the Report. In no way does the bulk of trees and shrubs seen in the New Zealand countryside, outside of reserves, have a distinct national flavour. Instead it has a distinct international flavour, with the New Zealand element often excluded.

The early settlers and many people since then in rural areas have, understandably had to use exotic material for shelter, screening and so on because where tall shelter is concerned, natives have not been available. Conversely, in some cases nothing has been planted at all as a result we get a moonscape. Where planting has taken place we may see a countryside looking more like Australia with its gums. The exotic mixture continues with some parks being symbolic of Italy with the Lombardy Poplar (riddled with rust I might add throughout most parts of the North Island - and finally the most common trees of all, the exotic pines scattered extensively over most parts of the New Zealand countryside, especially in the North Island.

I have little doubt that the form of *P. radiata* here is far different from the small distribution of the species in its native habitat of Monterey County, California. Seed and clonal selections over the years are likely to have been responsible for this change. Conversely, as far as I'm aware, little or no research has been done to raise strains of New Zealand trees that might fulfil the same functions as *P. radiata*. I am not thinking of one tree for such use, but several different ones produced to grow in areas that suit them best.

Although the number of New Zealand trees we can use in exposed sites is currently limited, I believe it a fallacy to classify most New Zealand trees as slow growers. Given the right conditions there are many that grow quite fast, particularly in more sheltered sites. At Otari this current season several young and not so young trees were observed and marked in this regard. In only the six month period September 1983 to the end of February 1984 some 30 species were measured for terminal and lateral growth. A selection of terminal growth rates were: Kauri - 23 cm; Kowhai - 27 cm; Kamahi - 24 cm; *Olearia traversii* - 28 cm and a Tree Fuchsia - 45 cm. These were all young specimens. In the Auckland area I was told of a young Kauri that put on over 1 m in one season at the nursery of Graeme Platt, Albany.

Graeme Platt goes plant hunting to find forms of New Zealand plants that stand out from their associates. He is not interested in the easy to obtain variegated cultivars, but in species that offer good form, are robust and relatively quick growing. Thus we have the efforts of one New Zealand nurseryman to produce plants for qualities other than those primarily associated with beauty. Hopefully, there are other growers with similar objectives - after all, quicker growth can mean a quicker turnover and a bigger profit margin.

The New Zealand Forest Service would, seemingly, be the best institution to carry out trials with the objective of producing native trees with the growth rate and exposure tolerance approaching the ubiquitous *P. radiata*.

I realise that the prospects of success are not high. In fact, one leading botanist told me recently that 'you cannot expect to get blood out of stone'. Genetically, he said, New Zealand trees are just not programmed to develop in the same manner as *P. radiata* and certain other exotics growing here.

Thus my suggestion of research and trials is based more on intuition for possible success, rather than on current scientific data. Plant provenance would obviously be 'the name of the game' - the selection of propagating material from specimens of good form already existing in an exposed site; the observance of saplings (considered to be the same age) to single out any of more robust habit than their neighbours; the propagation of such material vegetatively as well as by seed from which promising material would again be selected and grown in areas of varied exposure. I feel that knowing the great adaptability of plants surely out of this country's approximate 130 species of trees, there should be a few capable of

Figure 8: Stand of cabbage trees, south of Dannevirke. These cabbage trees, probably remnants of the original vegetation, give the area a definite New Zealand flavour.

Figure 9: Pohutakawas mirrored in the Waitemata Harbour. A truly New Zealand landscape.

further adaptation, plus the possibility of finding mutant seed forms that may after years of selection and reselection of the most robust types, be able to withstand isolation, grow quickly and be of good stature in the country which gave them their birth.

In the context of the exotic planted tree versus the native planted tree we have a parallel in the exotic adventive plant versus native plants in the wild, perhaps nowhere better seen in the urban landscape than along the thoroughfares of Wellington.

Some years ago along a 3 km stretch of road in Wellington I listed over 50 species of exotic plants growing by the roadside. A sizeable proportion of this total were weeds, others we could well do without such as gorse, barbary and old man's beard. On the other hand, in recent years certain exotics have multiplied so much, that a person writing in Wellington's Evening Post last year suggested Wellington should have a 'Wild Flower Week', with guided tours.

Plants growing include: Nasturtium (originally ex South America), *Senecio glastifolius* (South Africa), Marguerite *Kentranthus ruber* native to Europe.

Like the pines, most of these exotics seem to thrive in the most difficult situations, where I am sure even the greenest fingered members of a parks department would fail with planted specimens. Truly the adventive flora of New Zealand makes a sizeable contribution to the number of plants growing wild and to many visitors would make them think that the New Zealand flora is indeed quite colourful at certain times of the year.

As I said a moment or two ago, we could well do without some wild exotics, but their presence, overall, does indicate a climate conducive to the well-being of a very wide range of plant material for such a comparatively small country. The time may come, if it has not arrived already, when the number of exotic adventive species exceeds that of the truly indigenous flora.

At this point, I must add that a short time after the 1970 publication of Volume 2 of the Flora of New Zealand, two 'exotic' botanists, Messrs Raven and Englehorn, wrote in the New Zealand Journal of Botany (quote) 'One of the most fascinating and controversial themes that runs through the literature of New Zealand botany concerns the interplay between the native flora, essentially that of an oceanic island, with the alien flora. In our opinion, there is <u>no</u> scientific justification for continuing to treat the alien flora of New Zealand as something apart from the native flora. There is <u>no</u> other country in the world in which all plants that reproduce themselves by natural means are not regarded as part of the flora' (unquote).

If this line of thinking is accepted, would what I said previously with respect to researching native trees to replace *P. radiata* fall away, since radiata itself becomes, or is part of the New Zealand flora - it certainly fits the category of reproducing itself naturally!!

In 1981 was published Dr David Given's eye opening book on 'Rare and Endangered Plants of New Zealand'. In it he said that 10-15% of the flowering plants and ferns in New Zealand are currently at risk. The maximum per cent quoted would represent over 300 species. These are mostly the plants that evolved before man set foot on these islands - these are what we regard as the primaeval species and are therefore an irreplaceable segment of our national heritage.

When environmentalists and wildlife enthusiasts argue for the preservation of wild plants, they sometimes overlook a most compelling fact that would help them in their campaigns - that is the survival of wild species directly benefits man. In 1960, says Dr Norman Myers (author of 'A Wealth of Wild Species') a child suffering from leukemia had only <u>one</u> chance in <u>five</u> of remission. Today, thanks to a drug developed from an obscure tropical forest plant, the odds are reversed and that child has an 80% chance of recovery. In fact, each time we take a doctor's prescription to a pharmacy, there is a <u>one</u> in <u>two</u> chance that the medication we collect originated in the unique properties of a wild plant or animal!

Fortunately, there is a great awareness

today of the continuing hazards to sections of the New Zealand flora, such as from noxious animals, noxious weeds, overuse or careless use of herbicides, from fire; land use for farming, homes and industry, to say little of plants pulled out for planting in the home garden.

With the Nature Conservation Council as the co-ordinating body, moves are afoot to list endangered plants currently growing in parks and gardens and to further ask local authorities if they would be prepared to grow other native plants in the threatened category, with a view to returning to the wild, perhaps, the propagated specimens.

Whilst I feel one should treat the cause and not the symptoms on an issue like this (i.e. try to prevent further losses in the field), the situation is one where horticulture has helped to retain species already lost in the wild; it retains many species currently at risk and with time may provide further plants to supplement those growing wild.

I prefer the truly wild plants of New Zealand (i.e. the species). Nevertheless, I do have a high regard for many of the native cultivars, the group most used in parks departments and home gardens.

Coloured foliage is the main asset of the majority of these garden forms - for example *Pseudopanax* 'Gold Splash', the purple leaved Akeake and *Cordyline* 'Prince Albert' (an expensive one to buy). Plants in which aesthetic qualities are found primarily in their coloured flowers are few, even among the cultivars. Examples are: *H.* 'Youngii', cultivar s of Leptospermum such 'Gaiety Girl' and 'Martini', the Kakabeak and in the dwark kowhai *Sophora* 'Gnome'. A conifer with high aesthetic value is the yellow leaved totara, whilst, for mainly indoor use, the variegated foliage of Parapara (*Pisonia brunonianum*) is quite attractive.

We have then, on the one hand, the native cultivars found in gardens, but very rarely in the wild; secondly, we have the many introduced species to gardens which have escaped to become naturalised and thirdly, we have the indigenous, indeed over 80% endemic element of the truly wild plants of New Zealand. The presence of this group under cultivation is of small repute compared to their informality and grandeur when seen growing naturally with their companion species in nature. A sizeable proportion of this group evolved whilst this country was in a very long period of geological and anthropocentric isolation.

Geological isolation remains, but not so isolation from mankind which has made devastating inroads into the natural plant cover of this country. But, thanks mainly to the establishment of our national parks and numerous reserves, large areas of virgin and regenerating forests, plus wetland and alpine areas, are still present and hopefully will be maintained.

There is today a greater public and official awareness of the need for effective plant conservation, plant regeneration and seemingly native plant propagation. If successful, these measures will hopefully ensure that future generations of New Zealanders and visitors tothis fertile country will be able to enjoy this rich plant heritage, not merely because many of the plant associations are old and have a link with the past, but because to be within such areas one is enriched with qualities that are of permanent value to humanity itself.

Transplanting of Vegetable Crops

by

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Transplanting is the transfer of young plants from a propagation area to the field, where they are to grow to maturity. The advantages claimed (Anon 1981) for this technique over direct seeding are:

- more intensive use of land, from the greater annual turnover of crops
- earlier production
- improved consistency of yield and evenness of maturity
- less cultivation of the field required
- more economic use of seed
- easier and cheaper weed control
- opportunity to reduce the effects of some diseases such as clubroot of brassicas.

The major disadvantage is the large amount of labour required, at least with "traditional" transplanting methods. Plants also suffer transplanting shock, the severity depending on the conditions experienced before and after transplanting.

Transplanting Shock

Transplanting shock is the term used for the check to growth suffered by plants on being planted in the field. This check is primarily due to a reduction in plant water potential, but there may also be temperature shock if the plants have been raised under warmer conditions than they experience in the field.

• The water status of the plant depends on the balance between water uptake by the roots and water loss through transpiration. The management of transplants before, during and immediately after transfer to the field must be aimed at disturbing this balance as little as possible.

Water Uptake

This is dependant upon the water potential of the soil, the area of root surface through which water can be taken up, and the hydraulic conductivity of the soil-root system. The water potential of the bulk of the soil can be optimised by irrigating the field before transplanting, or by transplanting after rain. The root system area is at a maximum when root damage is minimised. This can be achieved with bare-rooted seedlings by sowing seedbeds at low densities, and by transplanting when plants are small (McKee 1981a). Many "cell transplant" systems have been developed (see below) to minimise root disturbance.

The movement of water from the soil to the plant can be enhanced by compacting the soil around the plant, and by watering-in. Both operations reduce the volume of large soil pores around the plant roots, thus increasing the hydraulic conductivity of the soil at water potentials found in the field. Watering-in also supplies a small quantity of readily available water immediately the seedling is transplanted. Where extensive areas of crop are transplanted under conditions of strong evaporative demand, application of water in the same operation as transplanting may be important in permitting plants to survive until the transplanting operation is completed and the field can be irrigated.

Water Loss

Water loss from the plant is controlled by the leaf area, the resistance to water vapour movement through stomata and cuticle, and the atmospheric demand. It can be reduced by the conventional wisdom of planting on overcast days, or in the early morning or evening. This is not always practicable, however, where larger areas have to be planted or time of establishment is critical. Losses can also be reduced by reducing leaf area, and by drought-hardening which increases stomatal resistance to the flow of water vapour.

Pruning or Topping

It has been common practice with some crops to remove part of the leaf area of plants at transplanting to reduce evaporative water losses during the period that water uptake may be reduced by root damage. Research into this practice reviewed by McKee (1981b) suggests that it is of little advantage. The removal of leaf or stem material prior to transplanting results in decreased root growth until the plant restores its original root/shoot ratio.

Nieuwhof (1969) pointed out that leaf removal decreases the photosynthetic area of the plant, and as a result most of the photosynthates produced are used by foliage. In non-topped plants, he claimed, although foliage may wilt temporarily, more photosynthates will eventually be translocated, resulting in a stronger root system.

Jones and Mann (1963) reviewed the evidence available on the effects of leaf and root pruning on the growth of onion transplants. They concluded that root pruning was less damaging than leaf pruning, and that the most severe effects were on plants with both tops and roots pruned. They reported, however, that onion transplants were usually pruned to facilitate handling.

The only situation in which pruning or topping plants seems to be advantageous is in crops such as tomatoes where delayed transplanting results in plants growing excessively large in the seed bed. Even in these cases yields will be reduced if the plants are not given time to recover from topping before being transplanted.

Hardening of Seedlings

The literature reviewed by McKee (1981b) suggests that loss of water vapour through plant leaves can be reduced by "hardening" practices in the seedbed. Hardening consists of applying a non-lethal drought stress to the plant, then re-watering to allow plants to recover turgor prior to transplanting. This treatment may be combined with temperature hardening, in which the temperature of the seedling-raising environment is reduced to near field temperature.

Drought hardened seedlings are reported (McKee 1981b) to have lower transpiration rates than unhardened seedlings, and to return to pre-transplanting transpiration rates sooner after being placed in the field. Stomata of hardened plants do not reopen fully, even when full turgor is attained. This is ascribed to high levels of abscisic acid which develop in the plant during stressing and which decline only slowly.

If the effects of hardening are mediated through abscisic acid levels, it may be possible to achieve the same effect by application of this growth regulator. McKee (1981b) could find no reports of such experiments. Results obtained with other growth regulators and anti-transpirants have been too inconsistent to be commercially applicable.

Drought stressing during hardening reduces photosynthesis and therefore growth. Hardened plants will therefore be smaller than unhardened plants of the same age, and this may be reflected in early crop yields.

As well as its effect on transpiration, drought hardening is reported to increase root growth. Thus the practice may increase the "drought avoidance" as well as the "drought tolerance" of the seedlings.

Transplanting Methods

A number of systems have been developed to improve on "traditional" bare-rooted transplanting. These improved systems usually lead to less root damage to the plants. Bussell (1982) however, from a review of the limited literature available, concluded that there was no consistent advantage in crop growth and yield from the use of cell grown transplants as compared with bare-rooted plants. The major advantage of the newer systems lies in their compatability with mechanised methods of production, transport and planting.

Bare-rooted Transplants

Bare-rooted transplants can be produced under protection or in the field. The choice will depend on the crop, the local climate, the degree of earliness required, and the facilities available. Transplants can be grown under glass for early spring planting, however the facilities required will usually mean that this operation is done by a specialist nurseryman. If transplants are not required until later in the season, growers can produce their own outdoors in a sheltered area. While bare-rooted transplants are usually cheaper to produce than cell-transplants, they probably suffer more root damage. The method is not suitable for plants such as cucurbits which are sensitive to root disturbance (Whitaker and Davis, 1962).

Compressed Blocks

Planting in blocks of compressed peat or soil is a widely used method. These blocks are produced by machine, and the block size, shape and composition can be adjusted to suit the crop type and the size to which seedlings are to be grown. Fungicides and pesticides can be incorporated. Where high populations are required, a number of plants can be grown in each block. This method is used for onions and leeks, where up to six seeds are sown per block (e.g. Norman 1980, Wood 1983).

Good husbandry, particularly maintaining high moisture levels in the blocks, is needed when growing compressed block transplants (Cox 1984). Root growth is limited if outside surfaces of the block dry out during propagation or during transportation prior to transplanting. Block shape has some effect on the rate at which roots grow into the surrounding soil under marginally dry conditions but irrigation at transplanting leads to better root outgrowth irrespective of block shape (Cox 1984). Plants should not be held too long prior to transplanting since roots are able to grow into neighbouring blocks and root damage occurs at transplanting time, checking growth. Root growth into neighbouring blocks also presents problems with a semi-automatic transplanting system.

The choice of block type is not likely to be critical for certain crops, e.g. lettuce, where differences in growth evident at transplanting time do not persist to maturity (Cox 1984). In other crops such as leeks, where differences at transplanting time persist to maturity, the choice of raising system is more critical.

The difference between these species reflects variation in growth pattern. Growth of lettuce is asymptotic, with growth rate decreasing as the plant matures. Early differences do not persist to maturity. In leeks however, growth rate remains relatively constant, and early growth differences are maintained until harvest (Cox 1984).

Compressed blocks are more easily handled during transport and planting than are bare-rooted transplants. Semi-automatic transplanting equipment has been developed which can be operated with only two people, a tractor drive and a person on the planter.

Container-grown Transplants

When plants are grown in containers, roots are able to grow freely through unconsolidated compost, but are prevented from spreading into the root zone of adjacent plants. Nieuwhof (1969) stated that early cauliflowers are often pricked out of the seedbed into 8-12 cm clay pots. These containers would be very cumbersome to transport to the field and to individual planting sites. Such systems are rarely used today.

The most commonly used system for producing container grown transplants comprises a polystyrene tray with cells of an inverted pyramidal shape. The "speedling" system was the first of these systems and was developed many years ago in U.S.A. It is now used widely there and in Europe. In Europe, particularly Britain, similar "Hassy" and "Veg-Wedge" systems are also used (Anon 1981, Royle 1981, Clayton 1983). Some of these systems use a cell of cylindrical rather than pyramidal shape, e.g. the "Super seedling" system in the U.K. (Rixson 1983), and the "Techniculture" system in the U.S.A. (Rogers 1982). All systems now use smaller cells than the earliest "Speedling" trays so that there is more economic use of compost (e.g. Long 1983).

All of the polystyrene trays have an opening at the base of each cell to allow drainage and to permit air pruning of roots emerging from the bottoms of the cells. This is claimed to increase the growth of fibrous roots which bind the compost rooting medium together. At planting time trays are easily transported to the field,and plants with the bound compost around the root system are easily removed from the cells. These, like compressed blocks, are able to be transplanted by semi-automatic planting machinery (e.g. Rogers 1982, 1983).

There is considerable debate as to whether the compressed block or container grown system is the best for transplanting annual vegetables. There are advocates for both; for example, Clayton (1983) favour containers, whereas Norman (1984) favours blocks.

Crops which develop larger and deeper rooting systems than most annual vegetables, e.g. asparagus, can be grown in root-training cells. These cells are made of plastic, are deep and narrow, filled with unconsolidated compost, and designed to encourage downward growth of roots. At planting, the two sides of the cell can be separated, allowing the plant to be removed with minimal root damage. Because of the shape of the root mass produced by these cells, mechanical transplanting is difficult. However, mechanical transplanting of "root-trainer" grown cell transplants of asparagus has been achieved in New Zealand using suitably modified machinery.

'Chain-paper Pot' Systems

These systems, developed in both Europe and Japan, have been designed for use with fully automatic planters (Lawson 1981). Pots are made of appropriate grades of paper and are connected in chains. There are two main systems:

(a) The pots are joined together in a honeycomb pattern. The honeycomb is extended on a tray and then filled with compost prior to sowing seed in each pot. This system was first developed in Japan, where it is now used for establishing most of the sugarbeet crop. The pots are also made under licence in Finland.

(b) Cylindrical compressed blocks are made in a machine and then wrapped between two paper tapes, with the distance between blocks arranged so that they can nestle into one another when laid out on a tray. This "bandolier" system was developed by the National Institute of Agricultural Engineering in England.

At transplanting, the chains are fed automatically into the planter, which separates the individual pots and places the plant, together with its paper pot, into the soil. This system is claimed to plant 15,000 plants per operator hour, compared with a rate of 1,500 plants per operator hour achieved by manually fed semi-automatic plants (Anon 1981).

Vegetable Transplanting in New Zealand

Most transplanting of vegetables in New Zealand is done using bare-rooted transplants. Proprietary compressed peat blocks, e.g. 'Jiffy 7's', are used occasionally in annual vegetables, but they are very expensive. Root-trainer grown asparagus seedlings are being used to establish new hybrid cultivars in particular, rather than the traditional "bare-rooted" crowns.

The use of bare-rooted transplants is justified at present as they are less expensive than the various types of cell transplants described above. However, Cox (1984) has stated that raising and transplanting costs for cell transplants can be cheaper than for bare-rooted transplants. The situation should therefore be kept under review.

The advantages of transplanting listed in the opening of this paper can only be achieved when vigorous plants are transplanted with minimum disturbance under favourable environmental conditions. Both bare-rooted and cell-grown transplants can be used successfully if appropriate care is taken. The future choices between bare-rooted and cell transplants, and between the various cell methods will be based on the costs of production of the plants, and of placing them in the field. With increasing automation in both areas, the cost advantages may well be with cell transplants.

The importance of transplanting as an establishment method for vegetable crops may increase in future years. The technique assists growers to achieve the high product quality and accurate scheduling of production essential for fresh vegetable exports.

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The Aalsmeer Flower Auction in Holland

by

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During the summer of 1980 I was able to spend several months working for a flower exporter in the United Flower Markets in Aalsmeer. During this time I was able to learn something about the flower auction system in Holland and why it's so successful. It was also a chance for me to look at the horticultural industry in Holland.

The flower auction in Aalsmeer is one of a number of flower auctions spread throughout Holland, where cut flowers, foliage and pot plants are auctioned on behalf of growers. Most of this produce is exported to other countries in Europe, but some is airfreighted to as far away as Japan and the United States. The Aalsmeer auction is the largest of its kind in the world and presently handles in excess of two billion flowers a year. A new auction recently completed in West Holland at Rijnsburg will almost have the capacity of Aalsmeer. To give an idea of the size of the operation, 840 million roses, 174 million tulips and 160 million carnations pass through in a year. On a busy day, 3 million roses can be sold!

The auction is ideally situated, being only 15 minutes from Amsterdam's Schipol airport and two hours drive from the nearest north sea ports. The building itself looks like an enormous aircraft hanger. It's three storeys high and covers more than 25 hectares. The front of the building comprises an office block on which is displayed a giant logo, see Figure 1. The building itself can be divided into two main areas. The right hand side is taken up with six auction rooms arranged in pairs along its length. Each auction specialises in certain things, one for instance, sells nothing but roses, whilst another sells only houseplants. Running away from the auction rooms are eight streets or straats where flowers are sent after sale. Along these streets 250 of the largest dealers and exporters have their own packing facilities. Small dealers will buy produce here and take it elsewhere for packing. Some of the largest dealers, including Zurel, the company I worked for, cover whole blocks, complete with drive-in coolstores, cafeteria and fleet of trucks.

The auction is actually a growers' co-operative of more than 4,000 members. Each grower is charged a commission of 5.1% on their sales to pay for the system. Buyers are also charged a surcharge of 0.2% of the price of each purchase. One of the strengths of the system is that buyers must pay for their purchase immediately. This amount can be credited by computer to the grower's account (after deduction of commission) which means the grower can collect his money from the day's sale that morning if needed.

The Auction System

The marketing chain starts on the grower's property where the flowers are cut, ready for their trip to market. Many of these growers are local, Aalsmeer having one of the largest concentrations of glasshouses in Europe (Figure 2). Growers throughout the rest of Holland and even parts of West Germany supply the auction as well.

During the night vans and trucks arrive at auction from growers' properties laden with cut flowers and pot plants. They enter the auction through special 'climate lock'

Figure 1: Entrance to the United Flower Markets, Aalsmeer, showing the floral symbol.

doors that keep the climate inside the buliding constant all year round. Each grower will drive his truck into an area designated for a different type of flower. The flowers are taken from the trucks and loaded onto carts where a delivery note is attached. This is a computerised form listing the grower's name, the type and quantity of flowers and the quality grade. The grower can set the quanlity grade from a set of standardised criteria used throughout the flower industry in Holland. A team of auction inspectors are free to walk around the newly arrived produce and inspect samples to ensure standards are adhered to. It is very important that these standards are maintained as most flowers are sold on their quality grade without being personally inspected by the buyer.

Because of the vast number of trolleys used inside the auction building, an electrically driven underfloor transport system was developed. The system is made up of submerged moving chains, into which are clipped the trailers. One loop passes through each auction room, another makes a circuit of the building's floor, and a third moves the sold flowers to the packing and shipping areas. Figure 3 shows the size of the auction and the number of trolleys which are passed through in a matter of hours.

Each of the six auction rooms has facilities for about 300 buyers. In total there are 2,600 registered buyers at the auction, most are exporters or local wholesalers, but there are also some shopkeepers and florists. Large exporters are likely to have at least one buyer in each auction room because of the volume and variety of orders they handle. The auction rooms operate from 7:00 a.m. until 11:00 a.m. Monday to Friday but this varies depending on the time of year.

Bidding

The trolley loads of flowers enter the auction room and are checked by inspectors who put any comments on quality onto the delivery note. As each cart enters the room, this information is handed to the auctioneer.

The buyers are seated in full view of the flowers (Figure 4), and each one has

Figure 2: Aalsmeer from the air, showing one of the largest glasshouse complexes in Europe.

a microphone and a push button for bidding. Some buyers also have an outside telephone. Every registered buyer has a personal plastic card which has to be inserted into a slot in the desk before he can bid. This card unlocks his bidding button and also connects him to the main computer.

At 7:00 a.m. the flowers start to move into the auction rooms. The computer has processed the grower's delivery notes so that each buyer has a print out of items for sale that morning. This gives the buyers time to go down to the auction floor and look at the flowers and also ring up their packing areas to discuss the sale and what last minute buys are required.

Each auction room has two clocks (three in the houseplant rooms) which means two auctions are going on in each room at the same time. The buyer in that room can purchase from either of the clocks. On each clock there is a digital read out that gives the lot number, the number of flowers in each unit and the minimum number of units in the lot that a trader is allowed to buy. While the goods are moving slowly in front of the clocks (pulled by the underground transport system) a floor worker removes a sample from the cart. to show the buyers what is being auctioned at that time.

The auctioning is controlled by an auctioneer who sits below the clock. Bidding is done in reverse from the normal auction procedure. The clock starts at the 100 guilder mark (12 o'clock) and moves quickly anti-clockwise towards the 1 guilder mark. The first buyer to push his button stops the clock and purchases the flowers at that price.

The bidding system works in favour of the growers as it forces the buyers to bid high. A skilful buyer must know the market and be aware of the lowest price he can get away with. I remember during my time there, one of our firm's buyers was away and a new person took his place. He came back the first day most disappointed as he'd only managed to buy a couple of dozen buckets of flowers. He hadn't been quick enough on the

Figure 3: Inside the auction market. The auction rooms are to the right of the picture. Note the custom built trolleys in the foreground.

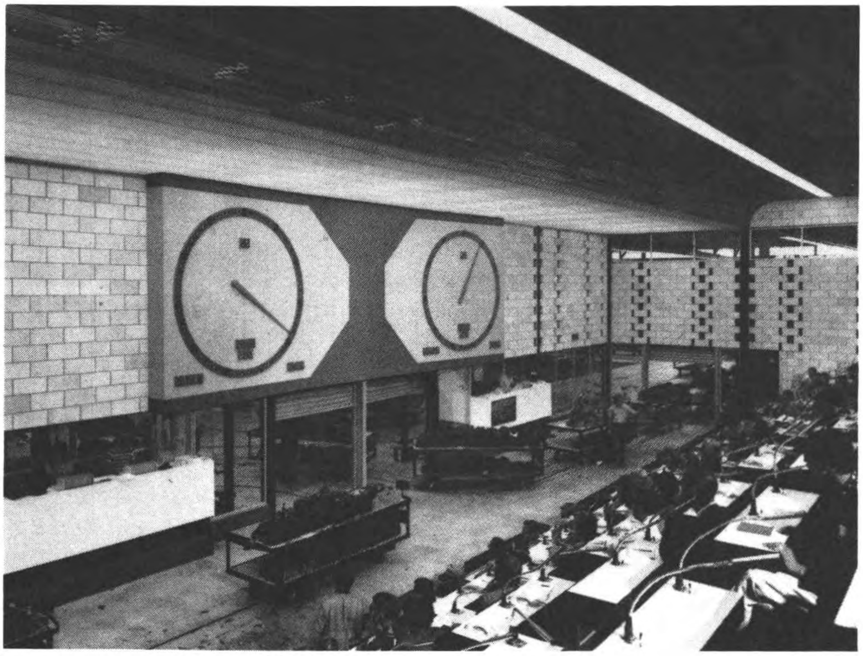


Figure 4: A typical auction rooms with both clocks operating simultaneously. Note the underground transport system pulling the trolleys at bottom left of picture.

button!! Another advantage of the system is that each transaction only takes from five to twenty seconds, which means the auction can push through an average of 18,000 transactions each day during the four hour business period.

Once the buyer has purchased a lot he notifies the auctioneer if he wants to purchase the entire lot or only part of it. The sale is completed and all the data is fed into the central computer. A transaction ticket is also produced listing the buyer's number, price of the sale, and any other important information. The ticket is then fixed to the sold lot. A buyer can if necessary claim his flowers fifteen minutes after they were sold.

The Dealer/Exporter

On the streets leading away from the auction rooms is a part of Aalsmeer that the public don't see. In these streets are the dealers who buy flowers and plants from the auction and then sell them to customers in different parts of the world. The dealers ensure that they offer their customers a wide variety of produce of top quality at competitive prices. To do this, the dealers often have to go further afield than Aalsmeer to buy their flowers. They buy flowers from other auctions in Holland and import out of season or exotic flowers from all parts of the world. While I was there, the dealer I worked for was importing gypsophila from Israel, dendrobiums from the Far East, carnations from Ecuador and orchids and dried flowers from Australia.

The work of the dealer, starts with their flower brokers whose job is to communicate with customers regularly by telephone or telex. They give the customer up to date information on prices and quality, and any apparent market trends. To illustrate the buying systems from start to finish I will use as an example the dealer I worked for, and their dealings with customers in England.

Deliveries to English customers are made twice weekly on Wednesday and Saturday.

This fits in well with customers as flowers are ready for sale on Monday and Thursday mornings. For the Saturday delivery the broker and his customer will converse on Thursday afternoon to discuss prices at that day's auction, what was available and so on. The customer will then place an order. By the next morning the dealer will have a fairly good idea about what they need to buy. The flowers are bought at the Friday auction and by Friday evening will be packed in trucks complete with cool store facilities, ready for the short drive to the ports, and England. These flowers will be delivered from Saturday afternoon to early Sunday morning in Scotland and Northern England, much sooner to the South of England. Assuming the flowers were picked late Thursday, they are on sale just over three days later. If these are delivered during the week this would be much less. Many flowers are also air-freighted to the U.S.A. and Canada and can be on sale there about 48 hours after auction.

Packing and Dispatch

Once the order has been received from the customer and bought from the auction it is important that the flowers are dispatched as quickly as possible without any loss in quality.

Once flowers arrive at the dealer's packing area, they are put into cool storage until they are packed. Different species have different requirements, so larger dealers have several cool stores all at different temperatures. Some species are also stored in water and some without. Some flowers, for instance tulips, are often packed inside the cool stores. This is to maintain them in peak condition. The packers wear warm woollen clothing and spend all day in the large cool stores coming out occasionally to warm up their hands!

The dealer I worked for had about 30 packing tables with two pairs of packers on each. About 20 of the tables were used for packing single species such as roses, carnations and chrysanthemums. The rest, including the table I worked on, packed mixed boxes of the lower volume species. Packing, especially at the speed the Dutch work, is a skilled job, and I was always amazed at the few breakages that occurred. The methods of packing varied so much that I could not begin to describe them here. The guiding principle was to have the heaviest flowers at the bottom of the box for instance iris and lilies. These are then secured in place with wooden battens nailed to the box sides, which were made of reinforced cardboard. The more fragile flowers were then placed on top and secured with packing material. Some of the cartons I packed looked like small coffins and could hold 6-700 roses. From here on automation took over, and the boxes were automatically tied and directed along a conveyer belt to the correct bay for that order.

The day's work was dictated by the number of flowers to pack. Some days we would finish by 2:00 p.m., whereas others we'd finish at 7:00 p.m. You would arrive at work in the morning and never know exactly when you would finish. Apparently around Christmas 12-hour days are the norm. The packers work very hard, and are well rewarded, and all seemed to appreciate the importance of a fast smooth operation.

In concluding, I was very impressed with the whole operation. I learnt a lot about the system as well as new flower cultivars. I think its success can be best summed up by giving the example of a large floristry business in England which buys flowers from both England and Holland. The manager told me that he could order whatever flowers he wanted from Holland on Sunday afternoon, and have the order on Sunday morning. "It is the right quality, and if it itsn't a credit is immediately given or a replacement sent. This is at a price at which British growers cannot usually compete and with a service they cannot match."

An Investigation to Establish the Optimum Time of Propagating castanea sativa

by

A. Petheram

Extracts from a thesis for the National Diploma in Horticulture (N.Z.), submitted by A. Petheram in 1983.

As the diversification of horticulture in New Zealand increases, interest in previously untapped commercial resources arises. One such crop currently gaining interest in the Waikato region is the sweet chestnut, Castanea sativa, family Fagaceae.

The basis for this paper is not founded on long term confidence in the export market for New Zealand sweet chestnuts but rather on current short term demand for trees of specified clones.

It would appear that the prospects for New Zealand sweet chestnuts on the European and North American markets are likely to be very limited. Traditionally, chestnuts are eaten either hot and roasted in winter, for which the New Zealand harvest is out of season, or as a cheap source of food. As such they would not command the high prices which would be essential for an economically viable export crop.

The long term market in Australia is diminishing as large scale plantings are implemented there and the Japanese market is questionable owing to the rigid emphasis placed on quality.

Irrespective of established or potential markets, the local demand for chestnut plants persists. The traditional method of propagation has been from seed. However, seedlings are too variable in quality and quantity for consideration in commercial orchards. There is great variation also in the age at which sweet chestnuts begin to bear fruit and reach their ultimate cropping yield. Seedlings grown in New Zealand could take 15 to 20 years before they bear a sizeable crop (3). Budded or grafted trees have been recorded as producing fruit in their first year of growth, with a steady increase in production in subsequent years.

It is essential, therefore, that known clones be perpetuated to protect investment rather than rely on chance.

RECORDED TREES

The New Zealand Tree Crops Association has been recording Castanea sativa for trial evaluation purposes since 1977. To be of commercial value, a tree must bear large quantities of sweet tasting sizeable nuts. The 'Marron' type is favoured as opposed to the 'Chataigne'. The 'Chataigne' has the common divided nut (cloison) and is said to be polyembryonic. This makes them difficult to peel and could mean that they are undesirable for cooking. To be regarded as a 'Marron' a tree must have at least 90% of single celled nuts.

In Europe, trees bearing 100 kg of nuts per year are regarded as exceptional, the norm being around 50 kg for a French orchard producing tree. In the Waikato, the New Zealand Tree Crops Association has recorded a tree (Te R/1005) which was planted as a seedling in 1959. It first bore nuts at 15 years old in 1974. In 1977, its third year of production, its weighed yield was 160 kg. Another tree (Te R/1001) has an annual estimated yield of 300 kg.

Nut size is measured in numbers of nuts per kilogram. Large nuts are regarded as numbering 60 to 70 per kilogram. Several Waikato trees have exceptionally large nuts. One particular specimen in Cambridge (Cb/1017) averages 51 per kilogram.

It is these desirable, large fruiting trees that should be perpetuated as clones.

CLIMATE

"The climate of Hamilton City and surrounding districts is characterised by warm humid summers and mild winters. The mean annual temperature at Ruakura Agricultural Research Centre, approximately 3 kms north of the trial site, is 13°C.

February and July are the warmest and coldest months, with mean temperatures of 17.8°C and 8.1°C and mean daily ranges of 12°C and 10.3°C respectively. Ground frosts occur on an average of 49 days a year and have been recorded in all months, but the greatest evidence is between May and September, with an average of 39 ground frosts for the five month period.

Average annual rainfall at Ruakura is 1197 mm, which is evenly distributed throughout the year, with a winter maximum and summer minimum. Average number of days with rain (1.0 mm or more) is 131, ranging from seven days in February to 14 days in June.

Bright sunshine recorded at Ruakura amounts to 2003 hours annually, or about 47% of the possible.

Fogs may occur in any month but are more common in autumn and early winter. The average occurrence is about 60 fogs a year. Winds of all speeds are most frequent from a westerly and north-westerly direction. Stronger winds, however, are more common from directions between south and west. Periods of calm or with wind speeds of less than 1.8 metres per second occupy about one third of the time."

The most suitable chestnut growing areas in New Zealand appear to be the Waikato, and Bay of Plenty. In general the best producing districts overseas are rather humid, warm temperate zones, e.g. south-western France, coastal central California, southern Japan and coastal China. Although chestsnuts are grown outside these areas, e.g. England, Germany, Spain, Italy, Korea, India, etc., the quality and yield is much reduced. The Waikato climate appears ideally suited to *Castanea sativa* (8).

TRIAL ONE

OBJECTIVES

The commercial method of propagation locally was by side grafting in late September. The success rate was high, usually in excess of 95%. However, with a limited number of superior trees, scion wood was in short supply.

Budding methods, when practised by a skilled budder, are faster than grafting (5). Under favourable conditions the percentage of successful unions is very high - 90% to 100%. As mentioned, where there is a shortage of available scion wood, or where the scion is being transported for propagation, then budding is favoured over grafting as many more unions can be obtained from the available scion wood.

However, inquiries into local budding trials proved daunting. Experienced propagators and enthusiastic amateurs alike had returned inconsistent results, enough to indicate that budding using current practices was not a satisfactory method of propagating *Castanea sativa*.

The objectives of this experiment therefore were to determine an efficient, economic method of propagating, by budding methods, a specified clone of Castanea sativa and to establish the optimum time of year in which to carry out such work.

INTENTIONS

It was intended to compare the success of three budding methods:

(i) Slice budding
(ii) T-budding
(iii) Inverted T-budding.

against time.

Throughout the season, every two weeks, or as close as suitable weather permitted to that timing, ten stock plants were to be budded by each of the three methods, making thirty stock plants per session.

It was intended that budding should begin as soon as suitable sap flow permitted and as soon as suitable buds were available. If budding were to begin the first week of November and continue through until the end of March, then ten trials would have taken place, involving a total of three hundred buds.

General Methods

It was decided that the position of budding was to be at 100 mm from ground level. As no relationship between the height at which the rootstocks were budded and the percentage of successful unions has been established (10), it was felt that 100 mm afforded the budder adequate ground clearance and comfort while still producing an aesthetically desirable plant.

There were arguments for and against the side of the bud position, north facing, south facing, etc. (10). Some recommend away from the prevailing wind for bud support, other recommend away from the afternoon sun. In this case, the northeast side of the stock was chosen, not directly facing the afternoon sun and protected from the strong north-westerly winds.

SITE AND SOIL TYPE

The trial was conducted at the Hamilton City Council's nursery in Cobham Drive, Hamilton, an area known geologically as the Waikato Plain.

The original soil type is of the Horotiu sandy loam to Horotiu sandy clay loam type. It is well drained, easily worked soil, brown, friable sandy loam topsoil to 15 cm on 20 cm of yellowish brown friable sandy loam overlying bedded sands, silts and gravels (2).

After 30 years as a Municipal Nursery, and 50 years before that as a private nursery, the natural profiles have been altered and additional topsoil and humus brought in.

The nursery rows lie to the sun, running north to south. The nursery is relatively exposed to the prevailing westerly and north-westerly winds and also to the stronger winds from the south.

SCION MATERIAL

All scion material was gathered from a Castanea sativa known by the New Zealand Tree Crops Association as C/10 Hn/1007. This tree is reknowned for its large marron type nuts and good flavour. The nut weight average is approximately 52 per kilogram. A mature tree, planted around 1930 of unknown providence, it is in good health with no obvious signs of disease, stress or deficiencies. It is a reasonably balanced tree, well proportioned. The soil type in which it grows is a Te Kowhai silt and clay loam.

All scion material was gathered from the east side of the tree for the reason that it was slightly lower to the ground on that side and was easily cut by standing on the roof of a car. All material was cut early in the morning, before 7:30 a.m., and budding completed before 9:30 a.m. Leaves were removed by severing the petiole 15 mm from its base, and the material was placed immediately between wet newspapers and placed in the boot of the car.

At the nursery the budstocks remained between the wet newspapers until needed and were withdrawn individually. Care was taken to complete the budding operation as quickly as possible without allowing the bud to dry out.

ROOTSTOCK

All stock were one year old seedlings grown from Castanea sativa C/10 Hn/1007. This was the same tree from which all scion wood was obtained. It was felt that by using stock and scion from the same tree, possible problems arising from incompatability would be reduced.

Seed was collected in the second week in April 1981, and after checking viability by flotation, was sown immediately, individually in 500 ml plastic containers and set out in cold frames.

Small nuts were discarded, as it has been found that a positive correlation exists between nut weight and seedling height.

Germination began in the first week in August and continued until the end of October. The germination percentage was approximately 72% of nuts planted.

It was observed that nuts collected from the same tree and stored under refrigeration at 2°C resulted in 60.8% germination from 120 nuts planted. Those planted had also been selected by submerging in a tub of water and discarding those that floated.

The seedlings were planted out into nursery rows in the first week of November 1981. The spacings were 450 mm along the row and 800 mm between the rows. There were twelve rows of 50 plants, making a total of 600.

One fertiliser application of 'Gro Plus' N.P.K. 10.7.7 was applied as a side dressing on 6th November 1981 at a rate of 50 g per plant. It was lightly hoed in.

On November 9 1981, a pre-emergent herbicide was applied by knapsack application. The chemical used was Simazine at a rate of 12 gm a.i. per 14 litre knapsack per 100 m². The 'chemical' was sealed by irrigation.

By autumn of 1982 the plants ranged in size from 50 cm to 60 cm and averaged 10 mm in diameter at a height of 15 cm.

In August 1982, owing to unforeseen nursery development the stock was required to be moved, so the opportunity to grade the plants according to size was taken. The method was to grade in groups of ten along the rows so that each group contained an approximately even number of small, medium and large plants. The new layout resulted in ten rows of fifty, making a total of 500 plants.

Simazine was applied as a pre-emergent herbicide at a rate of 12 g a.i. per 100 m².

OBSERVATIONS

Pests and Diseases

Rabbits caused the most serious threat to the trial. They were a particular problem before spring growth in August 1981 and again in August 1982. Because the trial area was situated within the city boundary in a built-up residential zone, police permission was required to eradicate them by shooting. On the first night, 50 were shot within the nursery and surrounding 58 hectare reserve. The following week a further 35 were destroyed. Severe ring-barking of trees occurred, which had to be discarded for trial purposes. It was felt that had they been allowed to go unchecked for a further week, the trial could have been in jeopardy.

In February 1983, two fungal infections became apparent on the stock plants. Analysis by the Ministry of Agriculture and Fisheries determined them to be *Phytophthora cinnamomi* and a *Phoma* sp.

The *Phytophthora cinnamomi* showed as a discolouration in the leaves and eventual death in the plants. The extent of the infection was insignificant. (1% of the total crop.)

The *Phoma* sp. showed as a bronze discolouration in the stem above budding, gradual dieback and death of the plant. This fungus was also insignificant. (1% of the plants budded.)

By the time the diagnosis was returned, no additional incidence of either fungus had occurred. No chemical control was applied. It is interesting that *Phoma* sp. often occurs if plants are under stress either from overwatering, underwatering, lack of nutrients, excessive shading, exposure to wind, etc.

In my opinion, these conditions did not prevail. However, compared to the growth of the rootstocks in Trial 2, those of Trial 1 were less vigorous.

Weather

Throughout the period of the trial recordings and observations were kept.

Of particular relevance are the conditions on the day of the trial, the day after, and the week following in general. Unless the weather was excessively wet, rainfall is probably irrelevant as dry spells were compensated by overhead irrigation.

Apart from the rainfall, which was well below the average monthly totals, the weather did not vary greatly from the norm.

RESULTS TRIAL ONE

RESULTS

The number of successful unions was assessed eight weeks after the date of budding and determined by the number of living buds at that date.

TABLE 1: Successful Unions

Date	Method						Total	
	Slice		T		Inverted T			
	No.	%	No.	%	No.	%	No.	%
November 11th 1982	3	30	1	10	0	0	4	13.3
November 25th 1982	2	20	0	0	0	0	2	6.6
December 9th 1982	0	0	1	10	1	10	2	6.6
December 24th 1982	0	0	1	10	0	0	1	3.3
January 12th 1983	0	0	0	0	0	0	0	0
January 27th 1983	0	0	1	10	1	10	2	6.6
February 10th 1983	1	10	2	20	2	20	5	16.6
February 24th 1983	3	30	3	30	4	40	10	33.3
March 10th 1983	4	40	8	80	6	60	18	60.0
March 24th 1983	3	30	4	40	3	30	10	33.3
Total	16	16%	21	21%	17	17%	54	18%

COMMENT

Method

Looking at the total results over the whole season, the figures appear disappointing. However, this is an unrealistic perspective as budding success is only relevant around the optimum period, i.e. the period when the highest success rate is recorded. Of the total results shown, none of the methods used is significantly superior to the others. Over the whole trial the results were:

T-Budding - 21% success from 100 unions
Inverted T Budding - 17% success from 100 unions
Slice Budding - 16% success from 100 unions.

Although T-budding rated highly (80%) on March 10, the results on February 24 and March 24 were only 30% and 40% respectively.

If one looks at the trial as if it were 10 separate experiments, then again the T method is the most successful.

Number of times method is most successful:

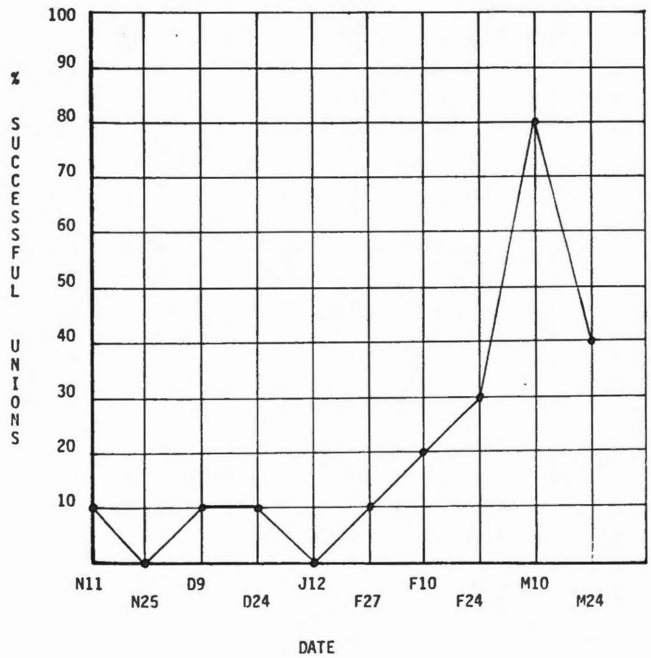
T - 6*
Inverted T - 4*
Slice - 2

* Includes two first equals. Excludes January 12 when there were no successful unions.

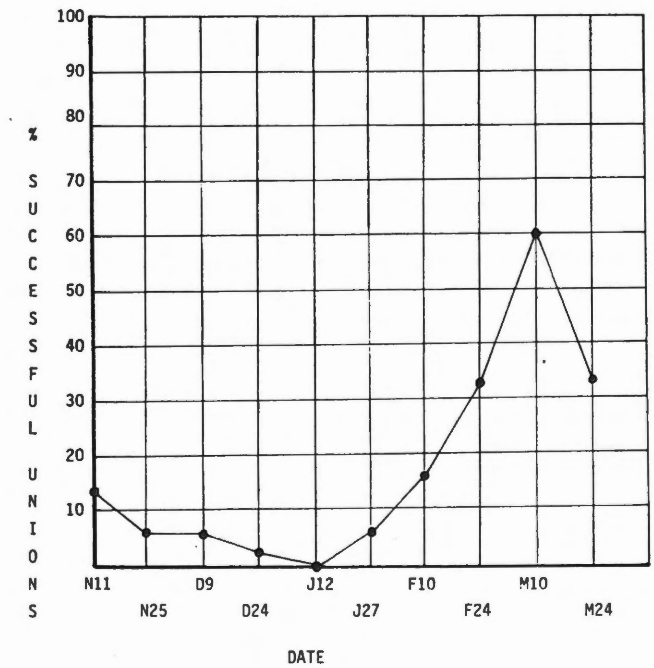
Looking at the critical point, that is, the period in which most successful unions occurred - February 24, March 10 and March 24, the results were:

T - 50% success from 30 unions
Inverted T - 43.3% success from 30 unions
Slice - 33.3% success from 30 unions

These results, budding over the critical period, are not as low as the overall total results appeared to indicate. It could therefore be said that, under the conditions of the trial, T-budding was the most successful of the three methods.



Graph 1: Successful Union (T method) Per Time of Operation.



Graph 2: Successful Unions (Slice, Inverted T) Per Time of Operation.

Time of Operation

Plotting on a graph;

(i) the number of successful unions using the T method against time of operation.

(ii) the total number of successful unions of the three methods against time of operation

gives the results shown in Graph 1 and Graph 2.

As previously mentioned, the critical period of greatest success for all methods was within four weeks from February 24 to March 24. The optimum date was March 10. Unfortunately the gradient of the successful unions over time of operation curve before and after the peak was very steep, especially for the T method. The maximum of 80% on March 10 fell sharply to 30% on February 24 and 40% on March 24. A slight variation in the time of operation could result in a large decrease in success.

More information is required between these three dates, which were chosen arbitrarily at the planning stage of the trial. It is unlikely that the true optimum date would be March 10. It is also unlikely that the optimum period is so short.

I would recommend, therefore, that a further trial be implemented, budding on a daily basis throughout this period to give more detailed information on and around the optimum date.

DISCUSSION

Weather

It is a quirk of human nature to blame the weather and at the time the current weather is always far hotter, far colder, far windier, drier, wetter, and the frosts are more severe than can ever be remembered. It is the fault of the weather, and a valuable psychological scapegoat at that.

However, in this case the weather cannot be held responsible. Although, as previously stated, rainfall was well below the norm for the previous years, this factor was not relevant as overhead sprinkler irrigation was used.

All other weather features, including humidity, were typical of those that could be expected in the Waikato at that time of year and could not be said to have had an undue bearing on budding success.

If there is any cause of bud failure, then I do not believe it was the weather.

Technique

(a) Budding

The budding technique used was closely scrutinised by an experienced propagator. When it became apparent that the success rate was low, he was asked on February 10 to conduct a comparative experiment of 10 slice buds and 10 T buds. His results were almost identical to my own.

In a separate trial using first year rootstocks, i.e. budding on to rootstocks in March that were germinated the previous September, my percentage of successful unions for T-budding was 70% from 100 plants.

Throughout the trial care was taken to observe good budding hygiene and practice. Emphasis was placed on preventing deterioration of the scion wood by minimising exposure to wind and sun. The budding knife was sharpened at the beginning of each season and touched up at the change of each method.

(b) Tying

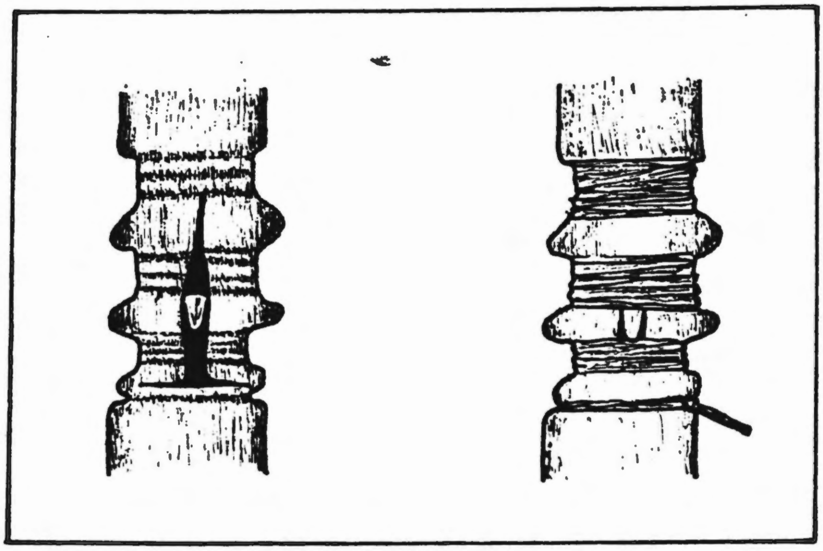
On reflection, the tying of buds and lack of follow-up adjustment could have contributed to a reduction in bud takes.

The materials used were rubber budding strips known by the manufacturer as No. 1.

On December 9 when the trial of November 11 was inspected, it was found that massive growth of the roostock was causing severe constriction around the rubber budding tie. Although the rubber was stretching, the growth was such that it was beyond the elastic limit of the tie (Figure 1 (a)).

The ties were removed and the roostocks appeared as shown in Figure 1 (b). Some of the buds (60%) appeared to have been successful. It was noted that the petioles had fallen off. The ties were not replaced.

On December 16 it was necessary to remove the ties of the November 25 experiment, and thereafter ties were removed four weeks after budding. On reflection, I feel this was a mistake. The ties should only have been loosened but still been left to hold the bud firmly. I feel that several buds, especially of the slice method, were lost by excessive



(a) (b)

Figure 1: Constriction of Budding Ties.

callus growth dislodging them, particularly during the spring flush.

Vigorous callus tissue appeared to have either moved the bud shields sideways and dislodged them (in the case of the slice budding) or moved the top of the shield out from the camium (in T and inverted T budding).

NUTRITION

Izaki, Hiyama, Ishizuka and Hoshino (1973) (9) established a positive relationship between rootstock nutrition and successful bud union. Rootstock grown in plots with heavy applications of N, P_2O_5 and K_2O gave a higher percentage of successful unions then did those in unfertilised plots. The leaves of those from the highly fertilised plots were found to contain an exceptionally high nitrogen level just after budding. A positive co-relation was found between the nitrogen content and the percentage of successful unions.

No obvious sign of deficiency was noted in this trial, although it became apparent later that rootstock similarly grown for Trial 2 on different land was more vigorous.

A laboratory test was done on a soil sample, which showed the nutrients to be adequate. The pH was 5.8, a figure considered suitable for _Castanea sativa_ (12).

CONCLUSIONS TRIAL ONE

Within the given conditions and circumstances of Trial 1, my conclusions are:

1. That of the three budding methods tested, Slice, T, and Inverted T, T-budding was the most successful on _Castanea sativa_.
2. That the most successful period in which to bud _Castanea sativa_ is between February 24 and March 24.

TRIAL TWO

OBJECTIVES

In view of the possibility of inconclusive results in determining a method of budding giving a high percentage of successful unions a second trial was devised.

The objective of this trial was to

determine whether Castanea sativa seedlings germinated and planted out in the year of collection could be successfully budded late summer and presented as a saleable article at the same time as a plant similarly grown, but grafted the following spring.

The advantages of this method would:

(a) minimise propagation costs - budding is faster to perform;
(b) reduce the quantity of scion wood required;
(c) allow any unsuccessful unions to be grafted in spring.

INTENTIONS

It was intended to T-bud 100 seven-month old rootstocks at the end of March. The exact date was to be determined by experience gained in Trial 1, with Trial 2 to be left as late as possible to allow maximum growth of the rootstocks.

METHOD

T-budding was chosen for its simplicity and common usage.

SITE AND SOIL TYPE

Trial 2 was conducted on a one acre residential lot surrounded by dairy farm land in the north east sector of Hamilton City.

The soil type is a Kainui silt loam which is developed on moderately weathered tephric silts overlying strongly weathered tephra.

Kainui silt loam has a very dark greyish-brown friable silt loam topsoil with moderately developed granular structure on yellowish-brown friable silt loam to silty clay loam with soft granular structure. The soil is well drained (2).

The trial area was brought in from farm land in autumn 1981 and, apart from pasture grass, has never carried a horticultural crop.

The nursery rows lie east to west. The site is similarly open to the prevailing westerly and north-westerly winds but protected from the stronger winds from the south.

SCION MATERIAL

All scion material was gathered from Castanea sativa C/10 Hn/1007 as was that for Trial 1.

The method and technique for gathering and preparing material was the same except that the scion material was gathered later in the morning at 9:30 a.m. and budding began at 10:30 a.m.

ROOTSTOCK

All stock were seven month old seedlings grown from Castanea sativa C/10 Hn/1007.

Seed was collected in the second week in April 1982, and after checking viability by flotation was sown immediately individually into 500 ml plastic containers and set out in cold frames. As for Trial 1, small nuts were discarded.

Germination began in the first week in August and continued until the end of October. The germination percentage was approximately 70% of nuts planted.

The seedlings were planted out into nursery rows under black polythene film mulch in the first week of September. Mag Amp (coarse ground) was applied at a rate of 50 g per plant at the root zone. Herbicides were not used apart from the initial application of glyphosate followed by rotary hoeing.

250 plants were planted in two rows at a spacing of 20 cm along the rows and 40 cm between.

By March 28, 1983, at seven months, 80% of seedlings ranged in height from 40 cm to 150 cm and averaged approximately 15 mm at 15 cm from the base.

OBSERVATIONS

On September 3, a grass minimum temperature of -3.9°C was recorded. This had been anticipated and scrim was used to cover the plants. However, during the night of October 2, a section of the plants (20) were exposed to the frost and were severely damaged.

It was noted that these plants quickly recovered, sending up multiple shoots from the nut. These were later pruned to one.

It quickly became apparent that even without irrigation these plants were more vigorous than those of Trial 1. By the end of March 1983, at seven months they had reached a maximum of 1.5 metres in height with 80% of plants greater than 0.4 metres. Those of Trial 1 at a similar age ranged from 0.4 metres to 0.6 metres.

Although Trial 2 was conducted late in the season (March 26) the roostocks were still slipping easily. They were vigorous and free of pests and diseases. The scion wood was firm and easy to prepare.

RESULTS TRIAL TWO

RESULTS

The results were assessed on 21st May 1983. Of the 100 stock budded, 79 resulted in successful unions. 15 of the failures appeared to have been caused by excessive callus tissue sloughing off the shield. The remainder appeared to have united well but the buds were dead.

COMMENT

The significant of this result is that when the result of the previous trial is taken into account, under the conditions of that trial March 26 is not the optimum date for budding.

Therefore, had Trial 2 been carried out on March 10, one could possibly have expected a higher percentage of successful unions than the 79% achieved on March 26.

DISCUSSION

Weather

The weather at the time and following the trial was ideal for budding - drizzling, overcast skies. Although a mild to moderate south to south-west wind prevailing during the following week, the trial site was well sheletered.

Technique

Rubber budding strips were used as for Trial 1. Because the growth rate of the rootstock was no longer vigorous, constriction as occurred in the previous trial was not a problem and the buds were held firmly without any adjustment of the tie.

Nutrition

A soil sample from Trial 2 was laboratory tested and the nutrient availability was found to be adequate with the pH at 6.1.

Generally chestnuts prefer a well drained acid (pH 5.5-6.0) soil (12). Trials by Bailey and Woodroff (1932) showed that pecan seedlings in their first year grew best at pH 7 and markedly less in soils below pH 6.4 or above 8.6. Possibly a higher pH than that suited to the mature chestnut if favourable to seedling rootstocks. Certainly the plants of Trial 2 were more vigorous than those of Trial 1.

CONCLUSIONS TRIAL TWO

Under the given conditions and circumstances of Trial 2, it can be concluded that successful budding by the T method can be achieved on rootstock of _Castanea sativa_ germinated in the previous spring.

FINAL CONCLUSIONS

With the given conditions and circumstances of Trial 1 and Trial 2, my conclusions are:

1. That of the three budding methods tested, Slice, T, and Inverted T, T-budding was the most successful on _Castanea sativa_.
2. That the most successful period in which to bud _Castanea sativa_ is between February 24 and March 24.
3. That successful T-budding can be achieved on rootstock of _Castanea_ sativa germinated in the previous spring.

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Botanic Gardens and the Conservation of Threatened Plants

by

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"The six hundred or so botanic gardens of the world are the conservationists' best ally in the fight to save plants."

Synge, 1982.

INTRODUCTION AND BACKGROUND

For most people a botanic garden is an attractive collection of plants, a place to go for lunches and picnics, or a sanctuary from the busy pace of life where one can draw aside and contemplate nature. Botanic gardens play a crucial role in the world-wide attempt to stem the accelerating loss of plant species and their habitats. They have great potential for gene-bank conservation, maintenance of plant materials for restocking into the wild, public education, and last resort "fire-brigade" actions. Not all species can be cultivated, most gardens do not have the space or resources to maintain large numbers of threatened species, and it is frequently difficult to recreate habitats for species outside their natural range.

There is little doubt that worldwide many plant species face an uncertain future. Present day clearing of tropical forests is estimated at about 32,000 ha per day (Rao, 1984) which suggests that the world's richest biome is likely to be reduced to mere fragments of its former extent by the end of this century. Norman Myers (1984) notes that,

> "Informed scientific opinion suggests that we may be losing one plant species every week right now. If we accept that this rate of extinction is likely to accelerate (say, two species a week by the early 1990's and three by the late 1990's), we can expect that - unless we expand our conservation efforts - we may witness the elimination of 2,500 species by the end of the present century. Indeed we may well count ourselves fortunate if we lose only one in 10 of today's 25,000 threatened plant species by the year 2000. After that, if predictions of human population pressures in the tropics are fulfilled, we may have to reconcile ourselves to the prospect of losing one quarter, possibly more, of existing plant species by the time that human communities (let us hope) eventually make ecological peace with Nature a century hence."

Some plants have always been rare. Examples are provided by species endemic to small islands, whose geographic range is small because of limited available land. Island-like situations include mountain tops, lakes, and areas of specialised habitat (e.g. calcium- or magnesium-rich soils) which are surrounded by dissimilar habitat. Nevertheless, the rarity of many native plants in New Zealand can be attributed to the influence of man, both Polynesian and European. Generally this has been by loss or deterioration of habitat rather than by direct threat to species themselves. One of the tragedies of nineteenth century settlement in much of New Zealand is that the transformation of the landscape was so complete, particularly in the lowlands. It is not surprising that recent estimates indicate that less than 10% of this country's wetlands remain in good conservable condition (Thompson, 1984). Other habitats actively under threat include scrublands (often seen in terms of potential for conversion to farmland and plantations), coastalsand communities, and low- to mid-altitude grasslands. It is not necessary to completely eliminate the habitat to lose species. Habitat degradation including the introduction of weeds, can lead to progressive elimination of component species.

Curiously, although horticulture can be a valuable aid to conservation of threatened plants, the attractiveness or ornamental value of some species can lead to their loss. In Australia, the cut flower trade is a significant factor with 42 species considered threatened by exploitation from wild sources for this use (Good and Leigh, 1974). Western Australia has the largest wildflower industry where 587 species are being exploited in the wild, providing some 14 million flowering stems and 2613 kg of seed (Burgmann and Hopper, 1982). Huxley (1974) quotes the instance of a rare *Cyclamen* in Turkey being greatly depleted by suppliers to the horticultural trade because its corms were confused with those of a more common species. In New Zealand the less spectacular nature of our flora means that a cut-flower industry or supply of plants for horticulture does not generally have to be based on plants in the wild. Demands are chiefly met from cultivated sources. Nevertheless there is concern that wild populations of plant groups such as orchids, mistletoes, tree ferns, and biological curiosities such as *Dactylanthus taylori* (Flower of Hades or Wood Rose) could be affected by trade (e.g. Nature Conservation Council, 1984).

Many people accumulate objects simply because they are rare, and some plant species acquire value simply on account of their rarity in the wild. Recently, plants of the Three Kings Islands endemic *Elingamita johnsonii* were reported as disappearing from gardens in Auckland, and it seems reasonable to assume that this species had acquired value in the eyes of unscrupulous plant fanciers. A curious example of depletion concerns *Himantoglossum hircinum* (Lizard Orchid). This plant has an extremely restricted distribution in Britain and people travel long distances to photograph it in its natural habitat. However, at one of the best known sites some plants are surrounded by circles of trampled grass about 2 m radius, caused by photographs walking close to the individual plants and lying down to photograph them close-up. This not only modifies the habitat adjacent to the orchid but makes it easy for people to locate plants and dig them up at the end of the flowering season. In New Zealand similar damage to the surroundings of photogenic species, and the risk of loss of plants or their seeds, must be a consideration as the precise locations of rare plants become known.

CONSERVATION STRATEGIES FOR BOTANIC GARDENS

In conserving species, inventory is the first step, followed by investigation of distribution and habitat, and *in situ* conservation in the wild habitat where at all possible. Species ought to be saved within the natural fabric of their ecosystems. But alongside reservation in the wild and as a second line of defence, *ex situ* has an important role.

The primary form of *ex situ* conservation is cultivation of species on the brink of extinction. There have been some spectacular instances of this. The perennial Teosinte of Mexico is one of the few wild relatives of maize. It is probably extinct in the wild but survives in cultivation from a single plant gathered in 1910. Plants propagated by the U.S. Department of Agriculture have been distributed to botanic gardens, ensuring that this agriculturally important species will survive at least in cultivation.

It is not enough to just rescue a species from the wild. There must be deliberate programmes to propagate it and distribute it to those other gardens best able to grow and make use of it. Not only should part of the gene pool of the species be preserved but also material should be available for replanting in the wild, and for research into the systematics, biology and ecology of the species. This requires adequate documentation of the provenance and propagation history of individual plants and systematic maintenance of species in cultivation. A tragic nineteenth century example illustrates the dangers of a *laissez faire* approach to threatened plant horticulture. The first botanists to visit Philip Island in the Norfolk Islands group were enchanted with the magnificent vines of *Streblorrhiza speciosa* (Philip Island Glory Pea) festooning the forests, and within a few years it was growing in European conservatories. Denudation of the island by feral animals led to the total loss of this species on Philip Island. But what of the plants in cultivation? Problems in propagation and unwillingness to flower had led to its disfavour and today the Philip Island Glory Pea is not known in the wild or in cultivation. To prevent similar recurrences an international register of threatened plants in cultivation is being compiled by the Species Survival Commission of the International Union for Nature and Natural Resources (IUCN), and the Nature Conservation Council has initiated a similar project for New Zealand.

An important link between *ex situ* and *in situ* conservation is the propagation of plants for reintroduction into the wild. A New Zealand example is provided by *Hebe armstrongii* which is now known in the wild only from inland Canterbury. Over a period of several years, Dr Brian Molloy (Botany Division, DSIR) and staff of the Department of Lands and Survey have taken propagating material from wild plants and raised vigorous young individuals which have been planted back into the wild alongside their parents. A similar technique has been suggested for endemic plants of the Three Kings Islands. However, when this strategy is applied to plants of isolated islands, plant hygiene and quarantine become of utmost importance, in order to prevent unwittingly the introduction of predators and diseases not formerly on the islands. Geographic isolation may lead to problems in follow-up; visits usually are at infrequent and irregular intervals. Thus, to gather adequate propagating material, determine critical environmental factors, and monitor recovery, programmes may be costly and well beyond the resources of many botanic gardens.

It is important that living material of threatened species be available for scientific research. Frequently natural populations of such plants are too small, few in number, or remote to allow experimental manipulation. Cultivated stocks must be used. The results of research may be critical to understanding the dynamics of a species and its long term management. This aspect of horticulture - the maintenance of plant collections for research - has perhaps tended to be neglected in New Zealand. Collections have tended to be somewhat ephemeral, frequently not outliving the period of activity of the individual scientist. At least one overseas university justifies its growing of threatened species by the need to provide material for research and teaching, using the rationalisation that students and scientists can as well experiment with rare as with common plants.

Botanic gardens enable the public to see plants with little effort. Education and public awareness are crucial to conservation but people are more likely to support conservation when they can actually see and even tough endangered species. It is one thing to read about a highly threatened species or even see a photograph of it but this is not substitute for the real, living plant. The late Marius Jacobs suggested that in the tropics, gardens should protect a piece of natural forest, walkways should be put through it at different levels and the plants labelled so that people could see and learn about the tropical flora in its natural habitat (Synge, 1984). Some excellent samples of indigenous vegetation still survive in urban centres, e.g. Wiltons Bush (Wellington) and Riccarton Bush (Christchurch). Where gardens are adjacent to areas of natural habitat there is considerable potential to set up small reserves to teach about ecosystems and their component species, both common and rare. In Europe, in particular, some gardens have set aside display beds of notable threatened species native to that country, using simple means such as display boards and pamphlets to outline the reasons for rarity and depletion, the strategies used to conserve plants, and the considerable dependence of mankind on natural products from plants.

THE NEW ZEALAND OUTLOOK

In 1983 the Nature Conservation Council

sponsored a meeting to look at ways of co-ordinating and encouraging responsible horticulture in relation to conservation. As a result, the Council is acting as a co-ordinating body to establish a national liaison between agencies and individuals working in the field of rare and endangered native plant conservation. One of the first steps is to determine which threatened species are being grown so that a national register of plants can be established. Already this is indicating that a surprising number of threatened species are in cultivation, but that many are of uncertain provenance. As might be expected, attractive species tend to be grown more frequently than those which are relatively inconspicuous. Paterson (1984) in a review of the role of horticulture and botanic gardens in conservation points out that because the sale of plants is generally dependent on visual appeal, commercial nurseries cannot be relied on to propagate and cultivate a wide range of threatened species. A few are interested in producing endangered plants for sale provided there is some demand, but he also records that one commercial nursery composted 200 plants of *Parahebe trifida* (currently regarded as threatened) when sales were not forthcoming.

Having established which species are in cultivation, their source, and their location in gardens, attention must be drawn to those species not adequately represented. The Chatham Islands have approximately 35 endemic plant taxa and many such as the Chatham Island forget-me-not (*Myosotidium hortensia*), are widely grown. Nevertheless, there are some outstanding gaps in conservation. *Myrsine coxii* is a little known shrub almost confined to the southern part of Chatham Island, yet it is represented by very few plants in cultivation. Two endangered plants of the southern tablelands of Chatham Island (*Aciphylla traversii* and an undescribed *Cortaderia*) are virtually unknown to horticulture, even though wild populations are under considerable threat. There is a need for a more systematic transfer of the Chatham Island endemic flora into horticulture. Similar case histories from elsewhere suggest that the Chatham Islands are a microcosm of New Zealand as a whole in this regard.

It is impractical for <u>all</u> gardens to grow <u>all</u> threatened species. There needs to be developed a botanic gardens network in which individual gardens take responsibility for those species appropriate to their particular climate and soil conditions, resources, and historical interests. Some plant groups require special facilities for propagation and it is squandering scarce resources to replicate these at numerous sites throughout New Zealand. Seed banks need to be established for long-term storage under a range of temperature/humidity conditions. However, such facilities can be expensive to set up and maintain and are probably better attempted by a few institutions and gardens than by all botanic gardens.

New Zealand lacks a national botanic garden funded by central government. Restricted local authority funding may have long been one of the inhibiting factors in development of botanic gardens for science and conservation. Local authorities may be more sympathetic to the conservation role of botanic gardens if they appreciate the regional value of gardens in their care, and can be persuaded that resources are being used wisely nationwide. Some of the approaches used by the Timaru Botanic Gardens are described by Paterson (1984). They include the sale of surplus plants and one aim has been to build up stocks of endangered spcies and make these available to those interested in growing them. This, "involves the public in part of something that is essentially a public relations exercise".

The availability of plants through botanic gardens, may be a powerful weapon in combating illegal trade in endangered plants. The Convention on International Trade in Endangered Species of Fauna and Flora (CITES) has been ratified by 85 countries (but not New Zealand). The rarity value of some species has led to illegal trade despite CITES, and there may be need where possible, to reduce rarity value by propagation and dispersal of specimens. In the case of *Elingamita johnsonii*, one of the rarest of the Three Kings Islands endemics, loss of plants and suspected smuggling has been countered by dispersal of seed to over 40 botanic gardens worldwide and the raising of many hundreds of plants which are now becoming available to the private grower. It is hoped that this will reduce the black-market demand for *Elingamita*. Ratification of CITES by New Zealand and adequate revision of the Native Plant Protection Act are urgent requirements in the regulatory and legal sphere.

The World Wildlife Fund (WWF) and International Union for Conservation of Nature and Natural Resources (IUCN) have declared plants to be the subject of their attention during 1984-1985. The New Zealand sector of the programme was launched by Sir William Gilbert (WWF-NZ) in March this year. It is highly appropriate that during 1984-85 attention is focused on threatened plant species and the whole array of strategies available to conserve these. Among these strategies, horticulture has a vital role to play.

D. Given is a member of the IUCN Species Survival Commission and author of various conservation publications including the N.Z. Red Data Book (co-authored with the late Professor Gordon Williams).

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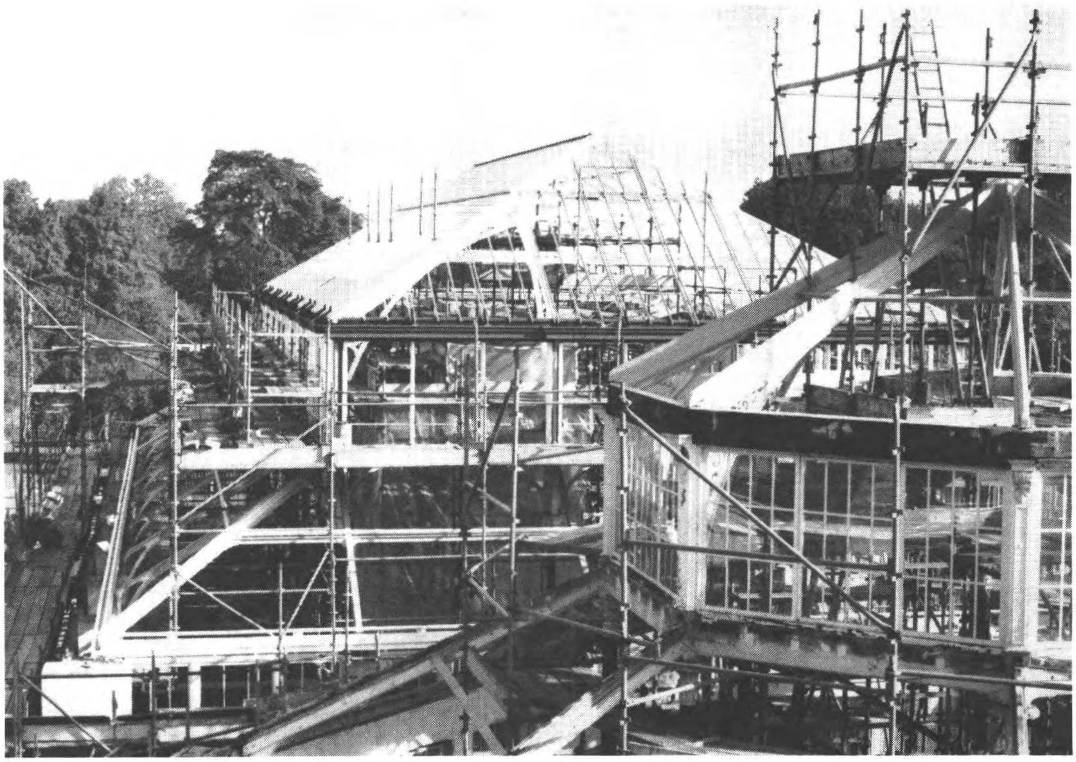
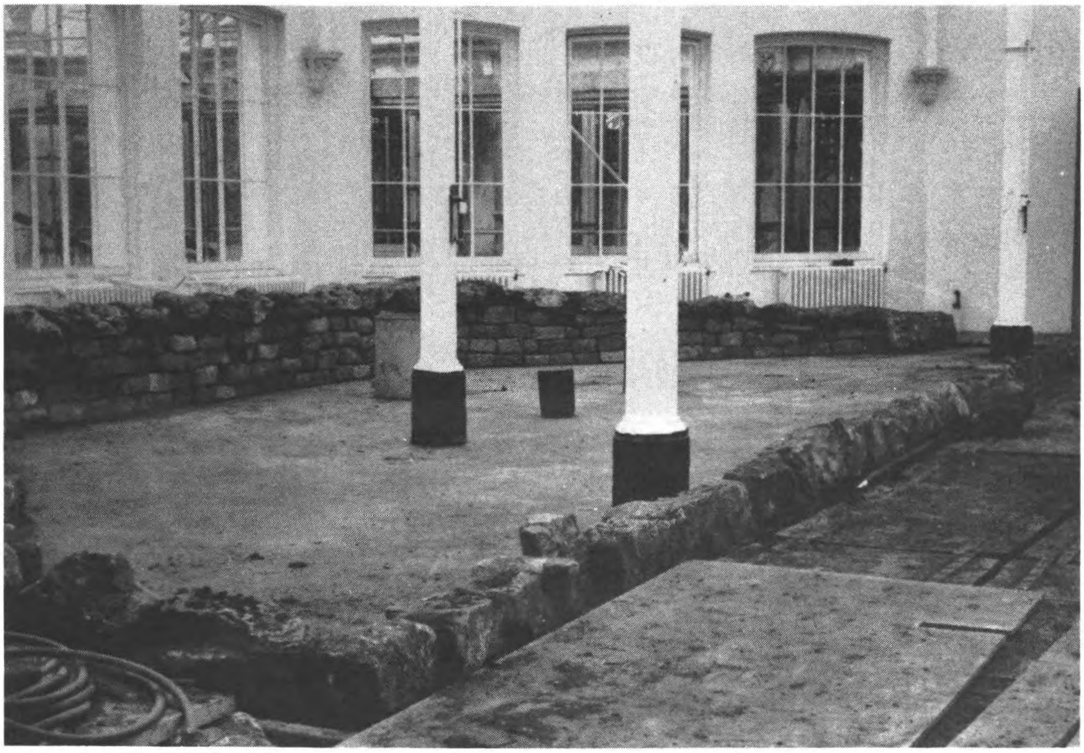
Royal Botanic Gardens, Kew the Temperate House-Restoration and the New Zealand Collection



Temperate House - Restoration of the North Wing and North Octagon.

Without any doubt the Palm House, which was constructed between 1844 and 1848, is the most well-known glasshouse at Kew. Soon after it was completed it became obvious that another large structure was also needed to accommodate not tropical plants, but temperate species which would not survive our cold dull, wet winters without protection. Sir William Hooker, who was Director of Kew between 1841 and 1856, first mentioned the need for a new Conservatory in his annual report for 1856. Soon after, the architect Decimus Burton, was asked to design a Conservatory large enough to accommodate tall-growing tender woody plants. Construction of this building, which is made up of five sections, started in 1860. Although the two Octagons were finished in 1861 and the large Centre Block in 1862, financial problems did not allow completion of the two wings before 1889, in fact eighteen years after Decimus Burton's death.

The Temperate House, which is 628 feet long and in the centre 137½ feet wide and 62 feet high, covers an area



North Octagon - Dry stone walls outlining the planting area. Photo - H.J. Fliegner.

North Octagon - Preparations for planting. Photo - H.J. Fliegner.

North Octagon - Spacing-out and planting the New Zealand collection. Photo - H.J. Fliegner.

of 48,312 sq. ft. This makes it Kew's largest 19th Century glasshouse, indeed one of the largest display glasshouses in the world.

Unfortunately high maintenance cost, together with some damage towards the end of the second World War, led to serious deterioration. Finally the building became unsafe and all parts had to be closed to the public in the early 1970's.

In January 1977 restoration began and the project took 3½ years to complete. As a result of this, growing conditions for the plant collection from many parts of the world have been greatly improved. A specially designed glazing bar for this house and new glass are mainly responsible for higher light transmission. The old heating system, which was inefficient and rather intrusive, had to be renewed and new cast-iron radiators are fitted below the low level windows on the perimeter walls. In addition to these, high level radiant panels are situated underneath the gallery floor in the Centre Block. The heating maintains maximum temperatures between 5°C and 10°C.

All the rainwater from the roof is collected in six underground storage tanks which have a total storage capacity of 120,000 gallons. A new deionising unit helps to provide suitable water for irrigation during prolonged drought periods as chlorinated mains water with a high pH is unsuitable not only for ericaceous plants, but also for a number of other alkaline-sensitive groups. The ventilators at ridge level and intermediate level have been motorised and the low level windows fitted with a much improved opening gear.

The two basements of the Octagons, which once accommodated the old boilers, have been transformed into calorifier rooms, leaving ample space for staff facilities in one, and an area for short-term exhibitions in the other. Both are now connected with the interior of the house by spiral staircases.

Re-landscapi-g started in March 1979 and it was completed in July 1981. In close co-operation with architects and builders, it was possible to commence work as soon as the restoration of a section was completed. With the exception of the two Octagons, which have concrete floors, the soil was cultivated to a depth of three feet to ensure free drainage and organic materials added for soil improvement. Finally the entire area was steam sterilised to reduce pest and disease problems.

The layout for the planting area was determined by a cruciform path connecting the four main doors. Semi-formal sidepaths had to be constructed to reduce the planting areas to a manageable size and facilitate circulation for visitors. Different kinds of rock were used for the construction of sunken paths in the dry environment of the South Wing and raised paths for the more humid montane flora of the North Wing. In the latter as well as the Centre Block, waterfalls and small pools are new features which pleasingly add to the landscape effect.

The five sections of the Temperate House provide physical partitions for geographical planting areas. With the emphasis on mainly woody plants, the North Wing contains the Asian Collections, i.e. S.E. Asia, Himalayas, China, Japan, and a collection of Rhododendrons from New Guinea.

A small cross-section of plants from New Zealand and Tasmania, Norfolk and Lord Howe Islands can be found in the North Octagon. Some of the New Zealand plants overspill into the Centre Block which is otherwise devoted mainly to the flora of the Americas together with a section of temperate economic plants.

The South Octagon is now our "Cape House" containing the main collection of Cape Heaths, Proteas and Leucadendrons. Three quarters of the South Wing is planted up with African woody plants, the rest with Mediterranean species. Some of these plants from the different geographical regions are displayed outside in a 3 feet wide border surrounding the outer walls, providing semi-tender plants with extra protection. This is also an ideal testing ground for winter hardiness.

The planting area for the collection of New Zealand plants in the North Octagon had to be created on a concrete surface as mentioned before. This section, together with the South Octagon, are the only areas at Kew which are landscaped like a roof garden. The beds are bordered by Westmoreland limestone, raising from 15" near the centre path to three feet at the back. Before soil was introduced, the concrete floor was covered with about 3" of coarse gravel. Over the top nylon netting was spread out and covered with a coarse layer of peat to prevent the soil from being washed into the lower drainage layer, as only one drain, fitted with a special filter, is situated in the centre of each planting area.

Planting commenced in March 1980. Tall growing species such as Pseudopanax lessonii, Metrosideros excelsa, Pittosporum cornifolium, Nothopanax arboreus, Meryta sinclairii, Pittosporum fairchildii and others form a background for some smaller plants. Dacrydium cupressinum can be described as an architectural plant and its graceful pendulous habit is set off by the white walls of the Octagon. Freycinettia banksii is underplanted with Fuschia procumbens, two very different plants, but botanically highly interesting. One corner is devoted to a wide range of Carmichaelia spp. surrounded by some Olearia spp. which prove to be most floriferous and certainly more showy. On two columns Clianthus puniceus and its white form are grown, which unfortunately are always severely attacked by red spider mite when cultivated under glass. Three clumps of the rare Xeronema callistemon produced the first two inflorescences after 15 years of cultivation. Up to recently it was grown in containers, but there are clear indications that this plant seems to prefer shallow soil. Close to Plagianthus divaricatus, a most unusual member of Malvaceae, grows the prostrate Metrosideros perforata with its shoots clinging to the Westmoreland limestone, annually producing most attractive carmine flowers.

Two educational labels explain, with the help of diagrams, the most important characteristics of the New Zealand flora and its diversity.

Even in the largest glasshouse the display of species from various parts of the world is limited. It is therefore important to make a selection to show a good cross-section of the flora valuable to students and botanists as well as being of interest to the visitor.

In July 1981 planting of all sections in the Temperate House was completed, leaving nine months before the re-opening for establishment, labelling, recording, and putting the 'final touch' to everything.

Since the official re-opening by Her Majesty the Queen on the 13th May 1982, many thousands of visitors have come to admire this splendidly restored Victorian Glasshouse with its extensive collections of tender woody plants.

by

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The Effect of Shade and Nitrogen on Production of Container Grown Ornamental Peppers *Capsicum annuum*

by

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ABSTRACT

A 3 x 6 split-plot experiment examined the production of ornamental peppers cv. Fips grown in a glasshouse under 3 shade and 6 N levels in 12.5 cm pots. Both factors strongly promoted foliage growth and fruiting but levels above 40% shade (maximum light level of 30 klx) and 600 g N m^{-3} proved excessive. Plant quality was increased by N application but was reduced by shading. There were marked interactions between these two factors on most aspects of foliage and fruit development. High quality plants could be produced at 50 klx light level (0% shade) and 600 g N m^{-3}.

INTRODUCTION

Capsicum spp. occur in the wild in the American tropics as weedy species under the shade of large canopy trees or in disturbed environments (Pickersgill, 1971; Wiggins and Porter, 1971). With such a background, *C. annuum* is generally thought of as a shade plant. Recent studies in the Caribbean confirmed that shading benefited production of peppers in the tropics by increasing yields and plant growth (Schoch, 1972). However, in temperate regions, shading was considered either unnecessary or detrimental to *Capsicum* production (Colegrave Grower Information Bulletin C5, 1977; Rylski and Halevy, 1974).

The influence of shade and fertilizer levels on several ornamental plants of tropical origin was studied by many workers (Conover and Poole, 1974a; 1975; 1980; Taylor, et al., 1959). Most of these plants were container-grown tropical foliage plants. However, temperate species such as *Pittosporum* grown in containers as indoor plants were also shown to be affected by light and fertilizer levels (Poole and Conover, 1980). An interaction between light intensity and fertilizer concentration was examined by Bunt (1963) on growth of tomato, a solanaceous relative of *Capsicum*. Research, however, is lacking on the influence of shade and nutrition on the production of container-grown ornamental peppers. The objectives of this study were to evaluate growth and quality of ornamental peppers under various production light and nitrogen levels.

MATERIALS AND METHODS

Experimental Design

A split-plot 3 x 6 experiment in randomised blocks was established to study the effects of 3 shade or production light levels and 6 nitrogen rates on ornamental peppers. Shade was assigned to the main plots which were divided into sub-plots to which the different levels of N were applied. Treatments were replicated 7 times, commencing on 6/13/79 and terminated on 14/3/80.

Plant Material and Growing Conditions

Capsicum annuum L. cv. Fips plants were raised from seeds and pricked out directly into 12.5 cm pots at the commencement of the experiment. The seedlings were at the 4-5 leaf stage (about 5 cm high) when pricked out. The experiment was carried out in a thermostatically-controlled glasshouse with a minimum temperature of 15°C.

Automatic fan ventilation in the glasshouse kept the maximum temperature at approximately 5°C above ambient outside temperature. The plants were hand-watered when required.

As the experiment was run through the summer months, the glasshouse was shaded by a 50% polypropylene shade cloth (Sarlon) at the ceiling as well as whitewashed with lime on the glass roof and walls. This was designated the 0% shade level. The other two production light levels under 40 and 80% shade were achieved by growing the plants under wooden frames (0.8 m x 0.5 m x 0.3 m) with one or two layers of the 50% Sarlon cloth respectively. The maximum light levels under the 0, 40 and 80% shade were 50, 30 and 10 klx respectively. The temperatures under the three shade levels were all similar (31°C maximum and 15°C minimum). The plants were pinched at the terminals when they were about 7.5 cm high, allowing for 4-5 shoots to develop per plant. Spraying for *Botrytis*, aphids, mites and white flies was done when required.

Media and Fertilizer

The medium used was a mixture of equal parts (1:1 v/v) Southland Springhill peat and coarse sand. The physical and chemical properties of the peat and sand used were described by Goh and Haynes (1977).

The fertilizer sources used in this experiment for N, P and K were Osmocote (26%N), superphosphate (9% P) and sulphate of potash (39% K) respectively. The six N levels applied were 0, 150, 300, 450, 600 and 750 g N m^{-3}. Each treatment received a standard base dressing of 200 g P m^{-3}, 250 g K m^{-3} and 6 kg m^{-3} of lime, applied as a mixture of 3 parts dolomite lime and 1 part of agricultural lime as recommended by Bjerkestrand (1969). In addition, each treatment got a base dressing of 360 g m^{-3} Fetrilon (35% EDTA chelate with 5% Fe) and 150 g m^{-3} 'Sporumix A' (containing 1.14% Zn, 1.20% Cu, 5.46% Mo, 0.05% Co and 9,78% Mg).

Data Collection and Analysis

Plant growth was assessed before the tops were harvested and oven dried. This was carried out 4 months after the commencement of the experiment. Plant height was measured from the soil surface to the highest point; plant width at the widest point and stem diameter at the base of the plant adjacent to the soil surface. Visual rating was obtained using a score of 0 for dead to 5 for compact, high quality plants with a good display of colourful fruits. A leaf sample from each plant was randomly selected for the determination of mean leaf area and leaf chlorophyll content. The mean leaf area was measured by a planimeter or area meter while the chlorophyll content was determined by the method used by Khoo (1979). Growth index was calculated from the sum of plant height and width divided by two (Collard, et al., 1977). Height growth index was calculated from the product of height and the square of the stem diameter (Thomas, 1980). The data so collected was statistically analysed for analysis variance and F test. Foliage samples from the best and worst treatments were randomly selected from each replicate, aggregated together and ground to give composite samples for analysis of foliar N concentration as determined by the method described by Parkinson and Allen (1975).

RESULTS

Shade and N treatments significantly affected the growth and quality of ornamental peppers cv. Fips (Table 1). Plates I, II and III illustrate the reponses to the three shade and six N levels. The main effects of the two factors were given in Table 1.

Increasing shade levels reduced the appearance of symptoms of transplant stress at the beginning of the experiment. Plants under 0% shade showed typical symptoms of yellowing defoliation while those under 40 and 80% shade displayed no such symptoms. Consequently, 3-4 weeks after the commencement of the experiment, plants under the higher shade levels had grown more strongly and had lush foliage. This trend was carried through to the end of the experiment.

Plants under 0% shade were compact, with good fruit yields that stood out better among the relatively sparse foliage and smaller leaves than plants under higher shade levels (Plate I) giving rise to the higher visual rating than plants under the other shade levels. Plants under 40% shade were tallest with greater spread, big leaves and abundant foliage that were inclined to conceal rather than accentuate the good yield of fruits (Plate II) resulting in the lower visual rating than plants under no shade. Plants under 80% shade were of poor quality, tall, straggly with abundant foliage, big leaves and poor fruit yield (Plate III). Therefore, increasing shade levels diminished plant quality though increasing all aspects of foliage and fruit growth with the optimum generally at 40% shade (Table 1).

Nitrogen levels strongly influenced foliage growth and fruit development (Table 1). The optimum was generally close to 600 g N m^{-3} with deficiency symptoms (chlorotic or lighter green foliage) observed at the lower rates.

Interactions occurred between shade and N levels in all cases except plant height, stem diameter and height growth index (Table 1). Nitrogen deficiency symptoms were observed at 0 and 150 g N m^{-3} under 40% shade (Plate II). Such symptoms were seen even at 300 g N m^{-3} under 0% shade (Plate I), but were only obvious with plants receiving no N under 80% shade (Plate III, Fig. 6). Optimum plant width and growth index were obtained at 600 g N m^{-3} under 80% shade (Figs 1 and 2). Highest mean leaf area and leaf chlorophyll content were obtained at the highest N rate but under 80 and 40% shade respsectively (Figs 5 and 6). Foliar dry weight, the number of fruits and total fruit fresh weight were highest at 600 g N m^{-3} under 40% shade (Figs 4, 7 and 8). Optimum plant quality was obtained at 600 g N m^{-3} grown under no shade (Fig. 3).

DISCUSSION

Results of this study showed clearly the influence of shade and N levels on ornamental pepper production. Studies of several tropical foliage plants had revealed similar effects from these two factors (Collard et al., 1977; Conover and Poole, 1974a; 1980; Taylor, et al., 1959). The maximum light level under no shade in the present study was 50 klx and this was responsible for the highest quality ornamental peppers. Optimum plant quality of several foliage plants was obtained at

Table 1: The influence of shade and N levels on growth of *Capsicum annuum* 'Fips' (*, $P<0.001$; **, $P<0.01$; *, $P<0.05$; #, $P<0.10$).**

	Height (cm)	Width (cm)	Stem diameter (mm)	Growth index	Height growth index	Visual ratings	Leaf area (cm^2)	Number Of fruits per plant	Total Fruit fresh weight per plant (g)	Foliar dry weight (g)	Leaf chlorophyll content (mg/g F.W.)
Shade %/light levels (klx):											
0 50	15.1	12.6	3.27	13.8	1.8	3.3	5.7	13.9	8.9	3.8	2.7
40 30	21.3	17.3	3.87	19.5	3.3	2.8	17.0	17.5	12.4	5.6	3.7
80 10	22.3	19.2	3.60	20.8	3.0	2.0	24.0	6.1	3.7	2.7	3.6
Level of significance:	***	***	*	***	**	**	***	***	***	***	***
LSD (5%)	2.0	1.7	0.45	1.7	0.8	0.4	2.5	3.9	3.0	1.2	0.02
CV (%)	21	22	26	20	60	27	34	66	75	61	0.44
N levels (g N m^{-3}):											
0	16.6	11.2	3.02	13.9	1.6	0.9	9.7	2.3	1.4	1.0	0.5
150	20.2	16.9	3.72	18.6	3.0	2.0	14.8	13.1	8.8	3.9	2.3
300	19.7	17.3	3.60	18.5	2.8	2.6	14.3	13.3	9.1	4.2	3.3
450	19.8	17.7	3.67	18.8	3.0	3.2	17.5	14.4	9.3	4.7	4.1
600	20.9	18.2	3.74	19.6	3.1	3.6	18.3	17.1	11.8	5.5	4.6
750	20.1	17.0	3.71	18.9	2.9	3.6	18.9	14.8	9.8	4.9	5.3
Level of significance:	***	***	***	***	***	***	***	***	***	***	***
LSD (5%)	1.3	1.3	0.29	1.1	0.6	0.3	2.3	3.6	2.6	0.8	0.4
CV (%)	11	13	13	10	34	16	24	47	50	34	0.39
Significant Interaction:											
Shade x N levels	-	*	-	#	-	***	**	**	**	**	***
LSD (5%) : shade means	-	2.2	-	2.0	-	0.5	4.0	6.2	4.5	1.5	-
N means	-	2.6	-	2.4	-	0.5	4.3	6.7	4.9	1.7	-
CV (%)	13	14	15	12	38	18	26	50	54	38	0.39

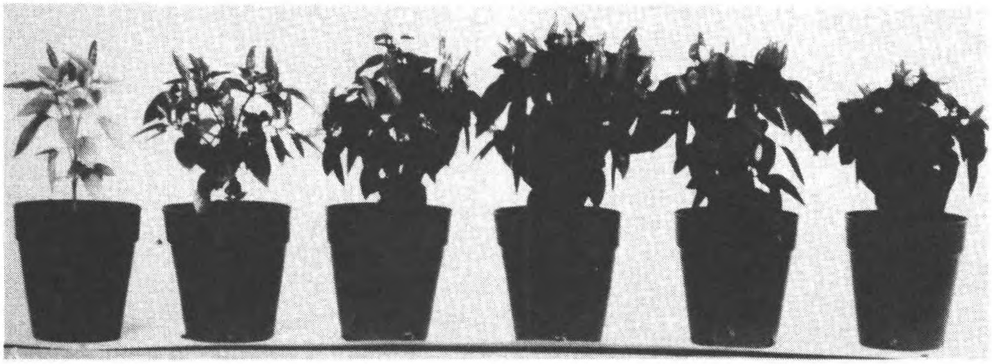

Plate I: Effect of increasing N levels (left to right) on growth of *Capsicum annuum* 'Fips' at 0% shade.

Plate II: Effect of increasing N levels (left to right) on growth of *Capsicum annuum* 'Fips' at 40% shade.

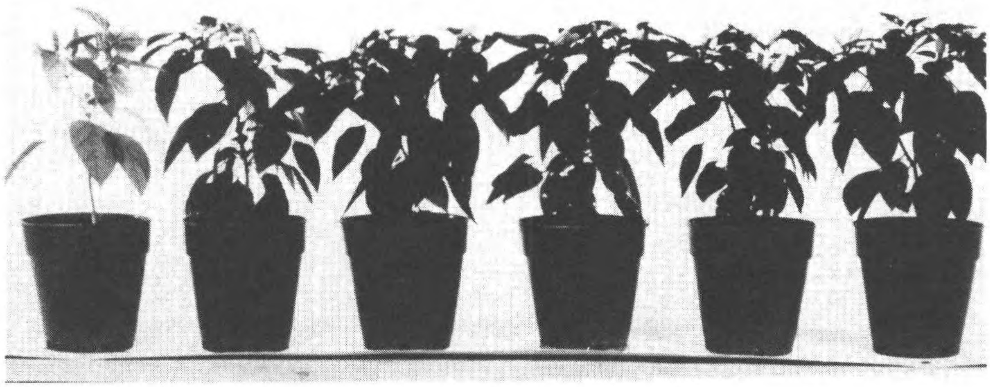

Plate III: Effect of increasing N levels (left to right) on growth of *Capsicum annuum* 'Fips' at 80% shade.

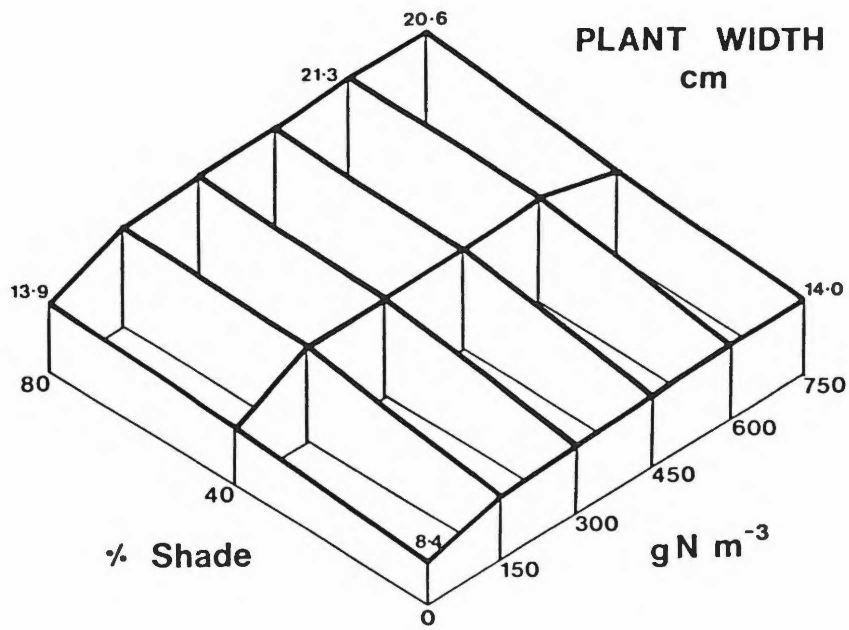

Fig. 1: Interaction of shade and N levels on plant width of ornamental pepper 'Fips'.

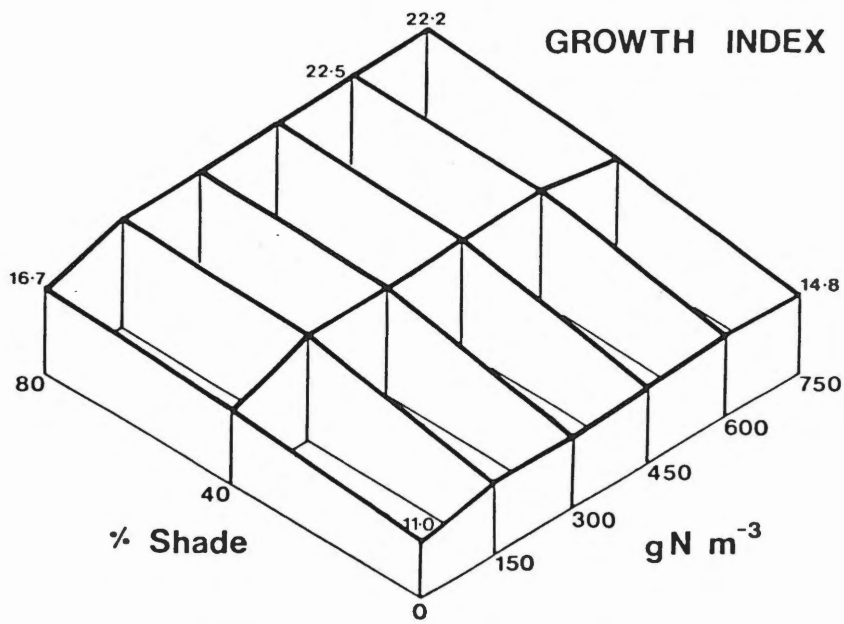

Fig. 2: Interaction of shade and N levels on growth index of ornamental pepper 'Fips'.

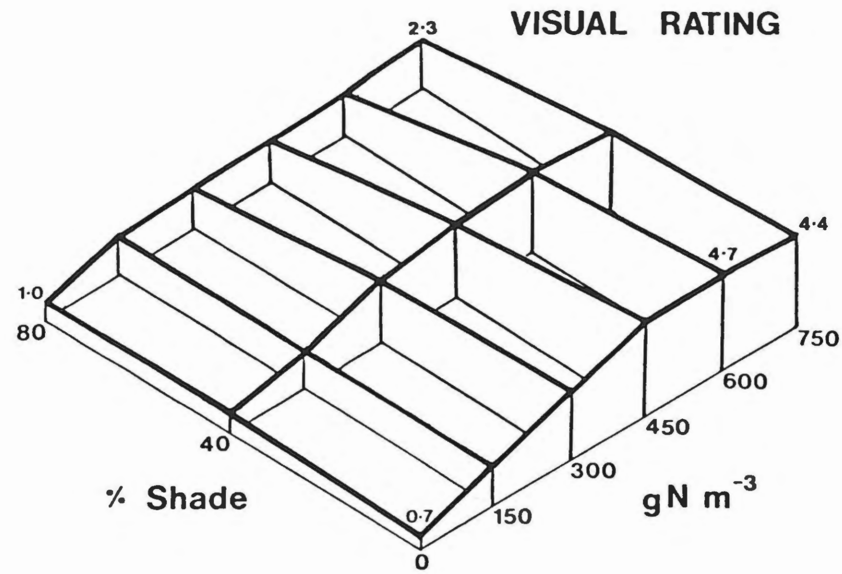

Fig. 3: Interaction of shade and N levels on visual rating of ornamental pepper 'Fips'.

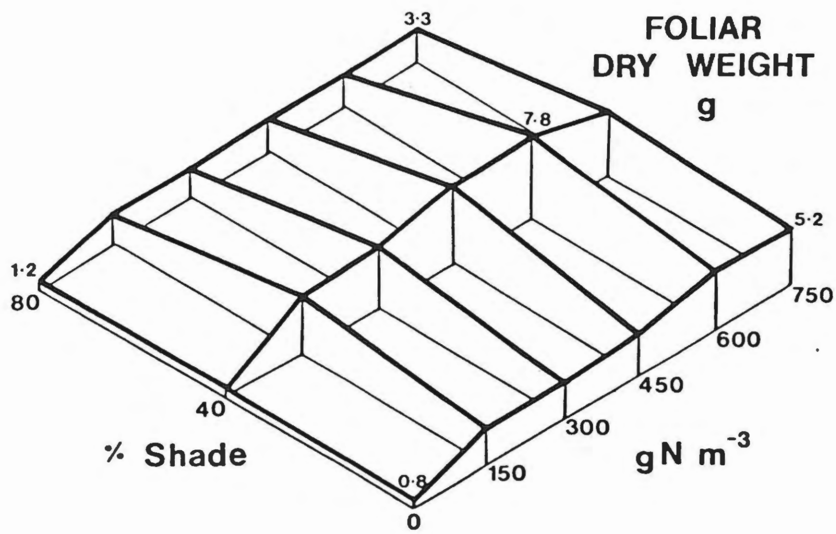

Fig. 4: Interaction of shade and N levels on foliar dry weight of ornamental pepper 'Fips'.

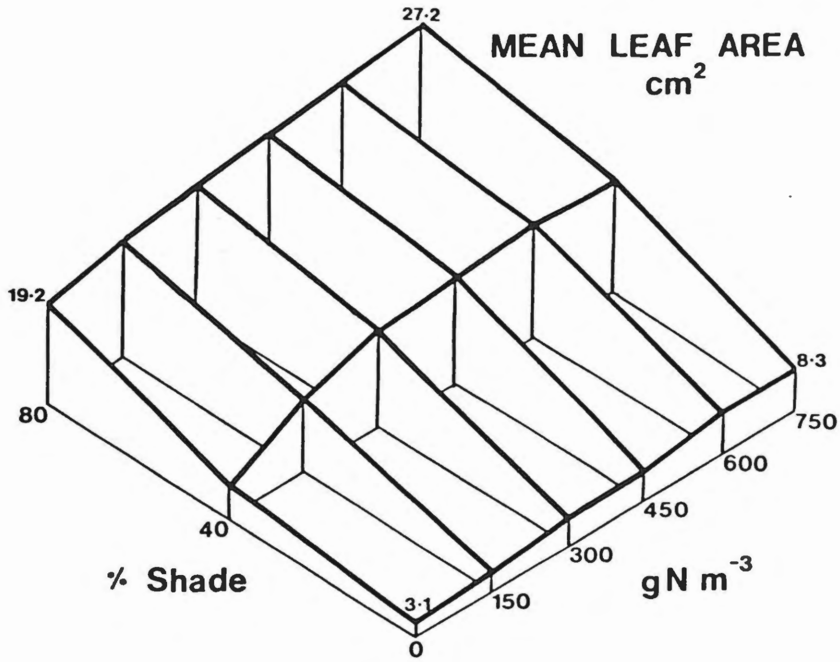

Fig. 5: Interaction of shade and N levels on mean leaf area of ornamental pepper 'Fips'.

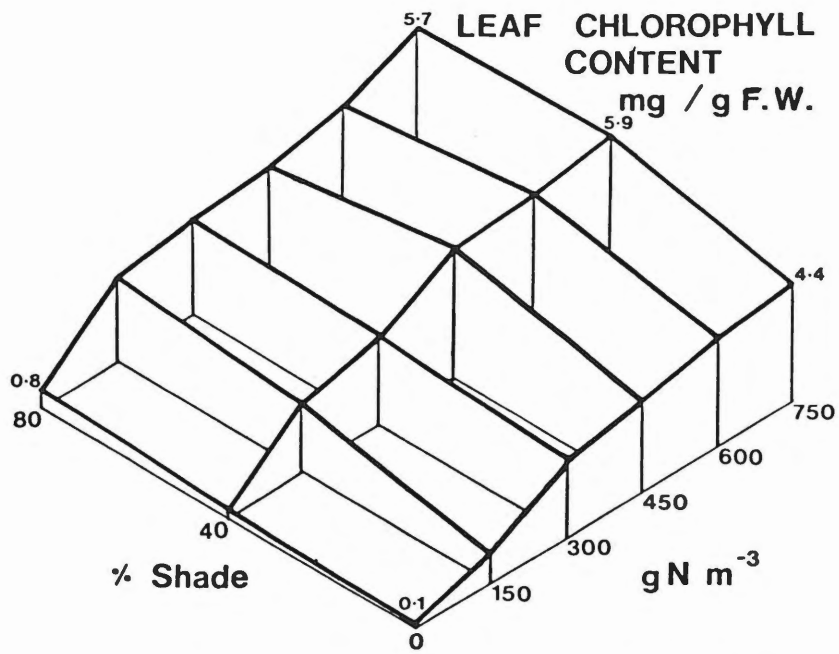

Fig. 6: Interaction of shade and N levels on leaf chlorophyll content of ornamental pepper 'Fips'.

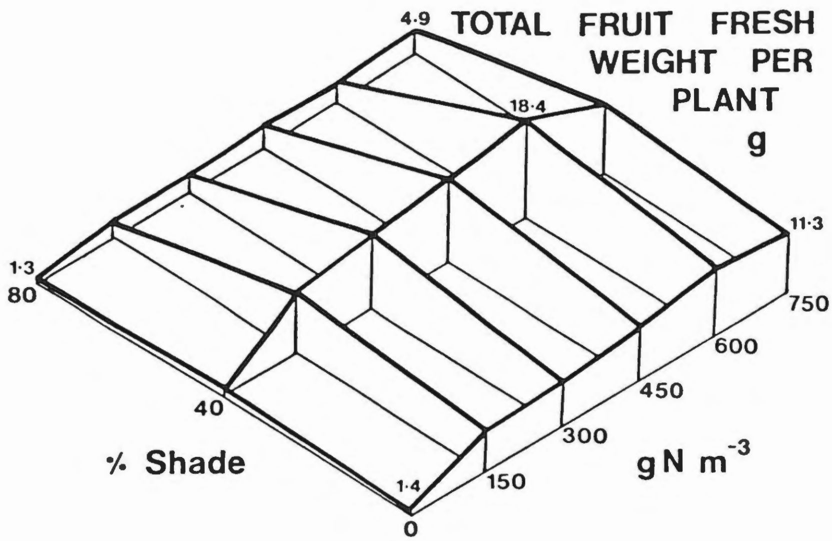

Fig. 7: Interaction of shade and N levels on total fresh weight of fruits per plant of ornamental pepper 'Fips'.

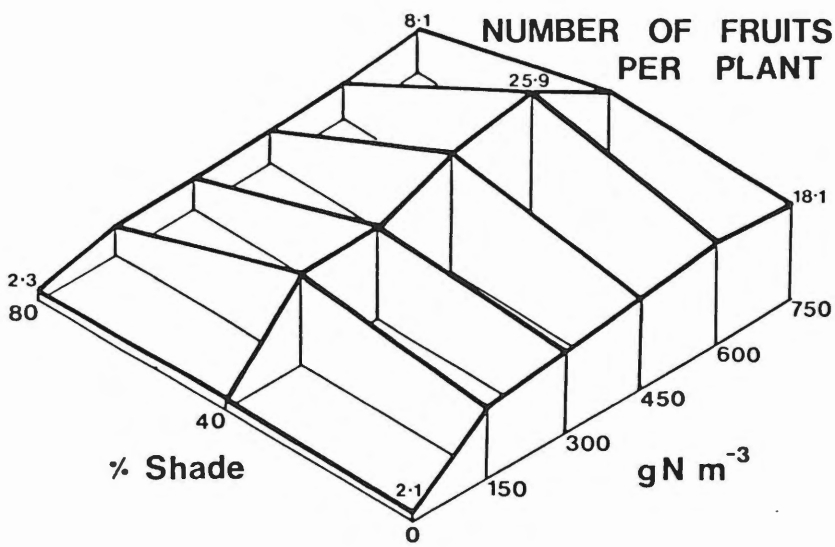

Fig. 8: Interaction of shade and N levels on total number of fruits per plant of ornamental pepper 'Fips'.

light levels between 50 and 70 klx (Conover and Poole, 1974a; 1980; Poole and Conover, 1975; 1980). Study of *Ficus macrophylla* grown under similar media, fertilizers and environment indicated a similar response to 50 klx with no shade provided (Teoh, 1979). However, shading improved foliage growth and fruiting of the ornamental peppers in the present study. Experiments in the tropics indicated a beneficial effect of shading on dry matter, leaf area and fruit yield (Schoch, 1972). The greater growth and fruit yield at 40% shade (30 klx) in the present study, however, did not improve the quality of an ornamental plant. The abundant foliage and bigger sized plants were not as well rated commercially as smaller and compact ones. Increasing shade level further to 80% when the light level was only 10 klx was definitely detrimental to the quality of the ornamental peppers in the present study. Similar observations were made on *Chrysalidocarpus lutescens*, *Ficus macrophylla* and *Philodendron oxycardium* (Conover and Poole, 1974a; Poole and Conover, 1975; Teoh, 1979).

The effects of the three shade levels in the present study could be attributed to their influence on photosynthesis. The rate of photosynthesis was subjected to changes in light intensity. The maximum light level under 0% shade (50 klx) could be high enough to reduce photosynthesis as a result of stomatal closure, accelerated respiration or photo-oxidation of chlorophyll (Devlin and Barker, 1971). Strong light increased transpiration, and could lead to turgor loss and stomatal closure. The relatively low chlorophyll content in 0% shade plants in the present study or as indicated by poor foliar colour in studies by other workers suggested the likelihood of photo-oxidation of chlorophyll (Collar et al., 1977; Conover and Poole, 1975; Poole and Conover, 1980). However, the negative effect of 50 klx on photosynthesis was beneficial in producing high quality, compact plants in the present study. Improved photosynthetic activity was apparent in plants grown at 30 klx under 40% shade in this study. This could be attributed to greater light interception by well-formed grana in chloroplasts along the greater leaf surfaces of larger leaves, increased contents of chlorophyll, decreased amounts of carboxylating enzyme, reduced photochemical capacity and lower respiration and transpiration rates as a result of reduced stomatal openings leading to a better hydrous condition of leaves (Collard et al., 1977; Johnson, et al., 1979; Schoch, 1972). Under 80% shade conditions (10 klx), light intensity probably fell below that of the light-compensation point frequently, so that photosynthesis was severely reduced and respiration exceeded it (Devlin and Barker, 1971). In the present study, fruit yields were drastically reduced under these conditions while excessive light allowed sufficient photosynthesis for fruit growth.

The influence of N levels in this study paralleled previous research on areca palms and *Dracaena angustifolia* (Conover and Poole, 1980; Poole and Conover, 1975). High quality plants of both species were produced when about 600 g N m^{-3} was supplied every 4 months from 8-9 month Osmocote. The requirement for about 120-150 g N m^{-3} per month in the present study agreed with the recommendations of the previous study on nutrition of ornamental peppers. The tomato which is closely related to *Capsicum* (Solanaceae) had a high N requirement when grown with similar media, fertilizers and environment (Thomas, 1979).

Interactions between shade and N levels in the present study support the findings of Bunt (1963) and Conover and Poole (1974a; 1975; 1980). Bunt (1963) found that tomato plant fresh weights were increased as light and fertilizer levels were increased. A lack of fertilizer response at high shade level (80%) indicated an interaction between N and shade levels in the production of *Maranta* and *Philodendron* plants (Conover and Poole, 1974a; 1974b). Increasing fertilizer levels applied under 80% shade reduced yield while the same additions under 60% shade gave beneficial results. This was attributed to the plants' inability to utilize the excess fertilizer resulting in a high accumulation of soluble salts. This would explain the poor performance of *Capsicum* plants in the present study under 80% shade. Interactions between shade and fertilizer levels on foliage quality and growth of *Dracaena angustifolia* and *D. marginata* were also noted (Conover and Poole, 1975; 1980).

Interaction between shade and N levels on growth and quality of *Ficus macrophylla* was observed by Teoh (1979) where plants were only able to respond to N at the optimum light level of 50 klx.

Acknowledgements

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Horticultural Education in the Waikato Technical Institute

by

R. Henderson

Agriculture/Horticulture Department, Waikato Technical Institute, Private Bag, Hamilton.

The Agricultural/Horticultural Department of the Waikato Technical Institute offers a range of Horticultural Courses and occasional seminars.

SHORT COURSES

Short courses of 30 to 100 hours duration (or one day a week for 5 to 20 weeks) to cater for adults: wishing to enter The Industry; to broaden their understanding of Crop Husbandry practices; to re-enter the Industry and up-date their crop knowledge; to gain a grounding in the business and production management side of Horticulture.

Essentially, all courses fit together in a tiered or staged concept beginning with the fundamentals, leading into in-depth studies on specific aspects of Husbandry, going on to specific crop production and ending with business management.

This is best represented diagramatically as shown on the next page.

BASIC HORTICULTURE

A sixty hour course, and specifically catering for those who have no formal education or training in Horticulture and who need a grounding in the fundamentals.

It begins with "Morphology" - plant parts and their importance and "Physiology" - how a plant functions, what makes it tick, what are its needs and how do we supply them.

The next step covers "Purchase to Pre-Planting" - this means Site Selection; Modification and Preparation and includes, Irrigation and Drainage, Soils and Shelter. "Planting and Maintenance" comes next and includes; Plant Selection, Planting, Training and Pruning, Weed Control and Nutrition. Pest, diseases and physiological disorders are also touched on as are chemicals, safety, legislation and use.

Where possible we get out of the class rom and into the field to actually prune plants, dig holes or clean filters. We aim to make sure that theory is applied, and the emphasis is on practicality.

CROP HUSBANDRY

This is a modular course which gives an in-depth coverage of several topics. It is geared towards growers needing knowledge in specific areas. For example, a person with an Accounting background could omit the module on Finances.

Modules currently dealt with are:

Factors affecting Crop Production

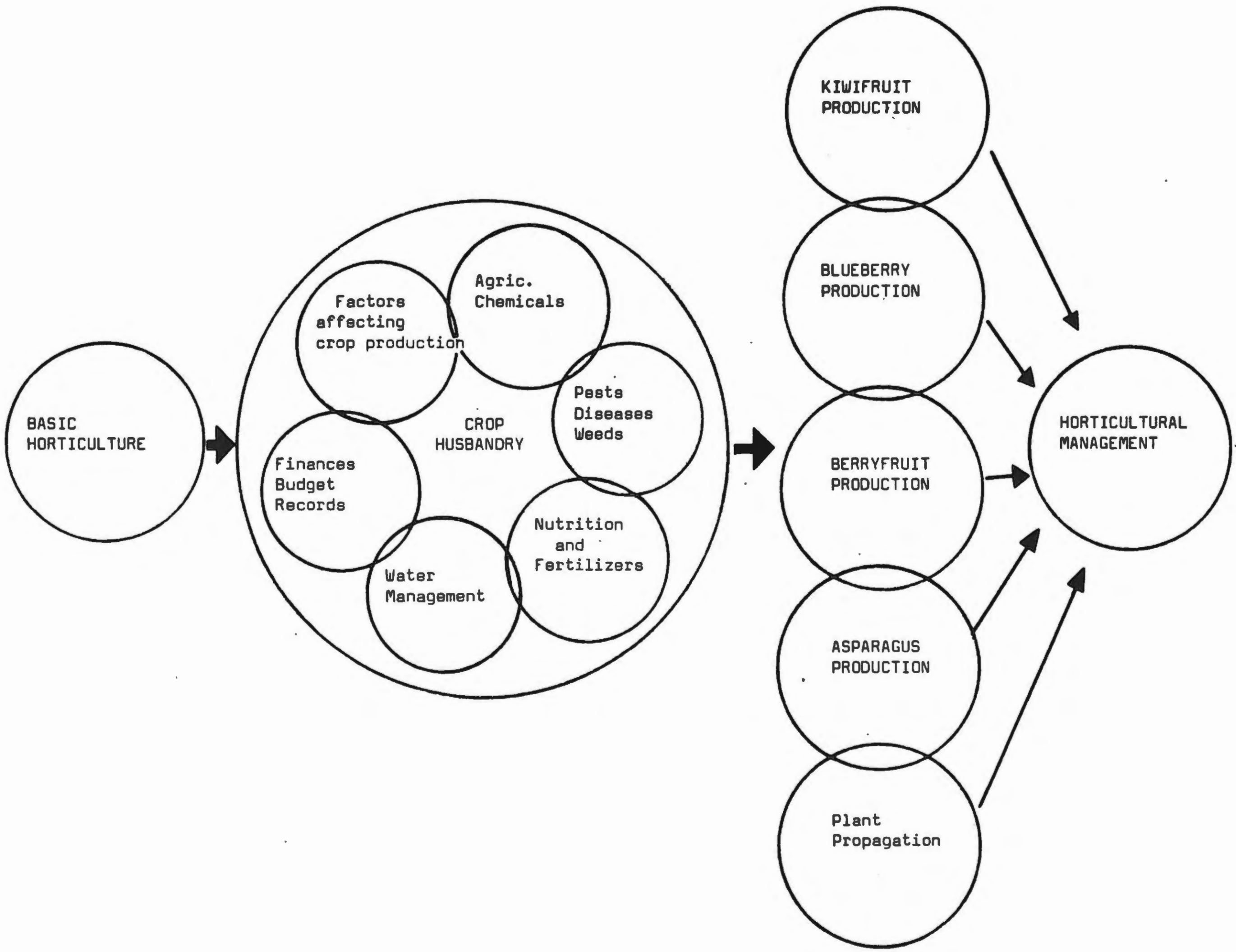
This covers the influence of the climate, shelter, palnting regimes, and pruning.

Pests, Disease and Weed Control

This includes Pest and Disease Morphology and life cycles, damage and control measures, Weed Control methods and identification, and Physiological disorders.

Agricultural Chemicals

Legislation, Safety, Toxicities, Formulations, Chemical groups and modes of


BASIC HORTICULTURE
CROP HUSBANDRY
Factors affecting crop production
Agric. Chemicals
Pests Diseases Weeds
Nutrition and Fertilizers
Water Management
Finances Budget Records
KIWIFRUIT PRODUCTION
BLUEBERRY PRODUCTION
BERRYFRUIT PRODUCTION
ASPARAGUS PRODUCTION
Plant Propagation
HORTICULTURAL MANAGEMENT

action for Insecticides, Fungicides, Herbicides are covered in this module. Spray equipment, decontamination and calibration are also included.

Nutrition and Fertilizers

This topic covers chemical elements, plant requirements, fertilizers and their application.

Water Management

Irrigation (Systems, Water Rights, Evapotranspiration and Water Budgets and Equipment) plus Drainage will be covered in this module.

Finances, Budgets, Records

Elementary Book-keeping, budgets, sources of finance, loan application, financial and production record keeping will be in this unit.

Crop Husbandry is a part-time two-year course, one day a week for 20 weeks in a year. It is very popular and fills the gap between Basic Horticulture and Horticultural Management with time for detail being allowed.
Property visits are an integral part of this course not only to reiterate theory taught in the class room, but to look at new crops and technology, e.g. Hydroponics and Whitlof.

SPECIFIC CROP PRODUCTION

Kiwi Fruit, Asparagus, Blueberries, Berryfruit

These are 30 and 60 hour courses designed for the person either investigating a crop as a tentative grower, those establishing crops or existing growers who find their knowledge lacking.
The course content obviously depends on the specific crop. E.g. Pruning is not covered under Asparagus. Topics usually covered include:

Crop Requirements

- Botany, Site Selection, Climatic requirements, Cultivars.

Orchard Lay-out and Design

- Shelter, Plant Selection and Populations, Irrigation and Drainage.

Propagation

- Cuttings, Grafting (lots of practice), and Growing Facilities.

Planting and Post Planting Care

- Nutrition, Weed Control, Soil Preparation, Planting Procedure, Pruning.

Agriculture Chemicals

- Spray Schedules, Safety, Specific Pest Disease or Physiological problems.

Cost of Establishment

- Long term budgets and planning plus evaluation of current systems.

Harvesting and Post Harvest Facilities

- Picking and packing procedures and systems, cool storage.

The emphasis is very much on property visits; seeing different training systems, layouts, facilities. All very much aided by the co-operation of growers.

PLANT PROPAGATION

This is a specialist 60 hour course for those wishing to 'grow-their-own' rather than purchase nursery plants.
Botanical nomenclature, morphology and physiology are covered as they relate to plant breeding and being able to provide the correct growing environment.
Propagation structures, aids, media and general facilities and equipment are covered before specific techniques.
Sexual and Asexual (Vegetative) propagation then covers principles and techniques.
Cuttings, layering, grafting, micropropagation, rootstocks are dealt with in theory from the initial propagation through to potting up or planting out.
This course also has a strong emphasis on the practical side of things. Seed is sown, cuttings are potted up, bench grafting is carried out.

HORTICULTURAL MANAGEMENT

This is a two-year part-time course

held weekly for 20 weeks each year.
It is specifically designed for Managers, Owners, Operators and Workers, and concentrates on the business and production management side of Horticulture. Course content includes:

Source of Finance, Budget, Cash Flows, Taxation, Balance Sheets, Management Problem Solving, Labour Management, Timing of Operations, Alternative Enterprises, Systems of Land Tenure.

FULL TIME COURSE

TRAINING IN HORTICULTURE

This course is specifically designed for school leavers or young adults with a keen interest in plants and plant production. It runs for twenty weeks, five days and one evening a week.

The aim is to give the 16-20 year old student a good grounding in theoretical and practical work enabling them to be more employable.

Results to date indicate that this is indeed the case, as many local orchardists, market gardeners, nurserymen request that propsective employees take this course prior to commencing work and come to the W.T.I. seeking keen enthusiastic students to recruit as new staff.

Students study plant botany, morphology, physiology, nomenclature and plant families in the class room and have to produce a 75 specimen pressed and labelled plant collection.

They also study Horticultural Practice and Production and deal with; machinery and tools - care, maintenance and use; Pests, diseases and weeds; irrigation and drainage, shelter.

Crop Production and Husbandry is also covered with Fruit, Vegetables, Nursery and Plant Propagation topics.

Included in the course, the area of Personal Development covers such subjects as Fire Arm Safety, First Aid, Interview Techniques.

These classes are taught both in the class and in the field. Again, with field trips reliance is upon goodwill of growers.

Four of the twenty weeks is spent in the field at work experience. Students gain an insight into the real work-scene and get the opportunity to work in a variety of operations for one week at a time.

At the end of the course they can all operate a chainsaw, drive a tractor, make cuttings, pot up plants, identify a range of ornamentals, shelter trees, pests and diseases and refurbish a spade to name just a few of the skills gained.

In all cases for both Short Courses and our Full Time "Training in Horticulture" course, we rely heavily on the co-operation of growers. Without their willingness to be invaded and poked and prodded by twenty students at a time and their helpfulness in assisting us with property visits the realistic and practical element to Horticultural Education within the W.T.I. would be lost.

One Day Seminars

Seminars and workshops are also held. Sometimes in junction with the Ministry of Agriculture and Fisheries.

Chestnuts, Shelter, Tatura Trellis's Blueberries are some of the recent subjects covered.

"Horticultural Education" - a broad and encompassing term that could mean Turf Culture, Amenity Horticulture, Herbs, Landscaping, Organic Gardening, Ornamentals, Tree Surgery, Asian Pears, Loquats, Peanuts, Reclamation, Hydroponics, Micropropagation, Indoor or House Plants.

We endeavour to cover it all, do it all or rather would like to, but cannot on present staffing levels. Currently the Horticultural sector of the Agricultural Department of the Waikato Technical Institute is small with only two full time tutors, one part-time tutor and part-time technician.

We would like to do more courses, for instance, there is the demand for Nursery Production, Cut Flower Production, and Plant Retailing to be covered, BUT we are restricted in our wish to expand by Government Department restraints. New courses have to have approval firstly from the Horticultural Sector Committee of the Regional Training Committee. If then this is granted we approach the Education Department for their endorsement. A very often frustrating and time consuming exercise, as the demand and need for new courses is NOW when new crops are emerging and getting publicity, not two years hence.

Bedding Plant Production — Changing with Technology

by

T.E. Welsh

Instructor in Nursery Crops, Horticulture Department, Massey University, Palmerston North.

"A wooden box is filled with compost and carefully levelled. Seed is evenly broadcast over the surface and a fine covering is applied with a sieve. The seed box is placed into a warm greenhouse and watered in. Once germinated, seedlings are graded to size and pricked out into similar type boxes. Transplanted seedlings are placed back into the greenhouse to become estbalished. A few weeks later they are shifted out into a cold frame to harden off. The finished plants are then transported to garden shops and sold in bunches of ten or twelve."

This procedure for bedding plant production has gone unchanged for centuries. In contrast, our life styles have changed dramatically and so too have our industries. Now at long last the bedding plant industry is stepping into an age of "high technology".

Traditional bedding plant production is being confronted by many technical developments. Most of these have originated overseas and gradually filter through to New Zealand nurseries. Some of the more prominent technological developments, of recent times, have been:

Soil-less Media The advent of the "U.C. Type" mixes have virtually replaced loam based compost as a growing medium.

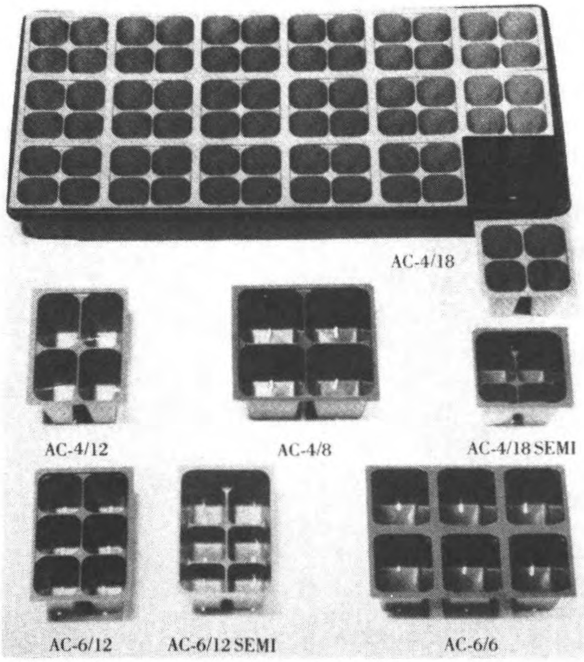
Plastics have offered an inexpensive replacement to the clay pot for container culture and an alternative to glass as a greenhouse cladding material.

Seed-breeding Programmes have improved the range and performance of varieties. While F_1 hybridising programmes continue to produce new superior lines of high quality plants.

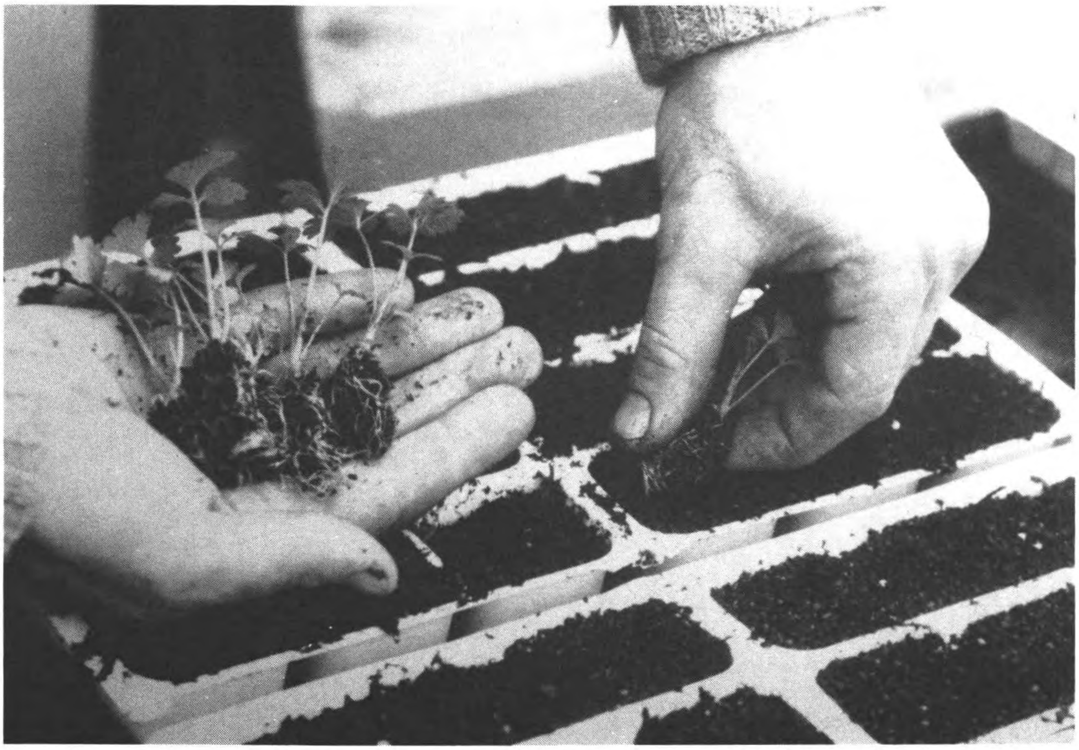
Other factors have applied pressure for further improvements in the way we produce and market bedding plants. Two oil based recessions have made growers aware of the need to increase efficiency, instead of just increasing prices to combat rising cost. Changes in retailing have created a consumer oriented market place. The selling of bedding plants in chain stores has given rise to a new self-service approach to presentation. In response to these changing demands growers have turned to technology to provide a solution. Some new approaches to production and marketing have evolved but with various degrees of success.

Direct Seeding has been tried world wide with many mechanical seeders coming onto the market, including one model designed and produced in New Zealand. The process of mechanical direct seeding saves on labour by eliminating the laborious task of handsowing and pricking out. However, more space is required in the germination stage and a poor strike can mean that time-consuming patching up is required.

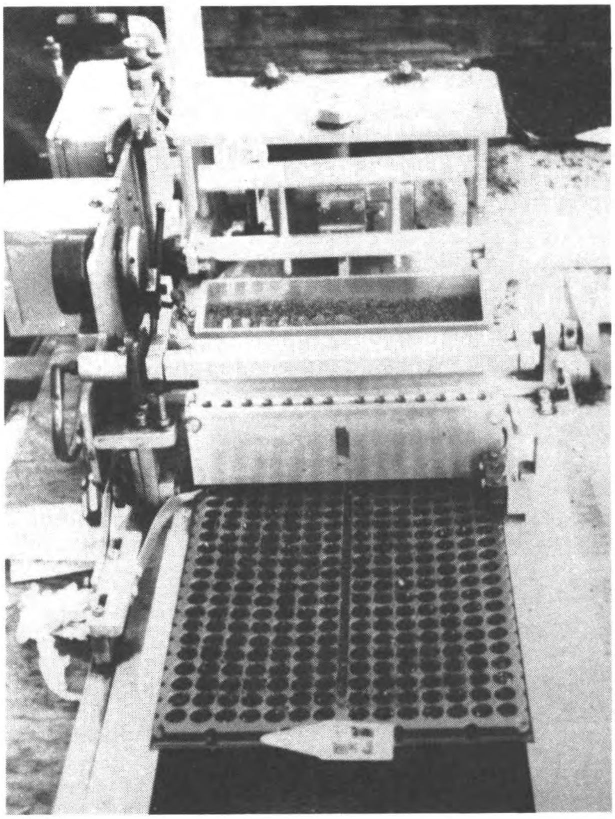
Unit Packs have come into use as a result of the self-service marketing trend. When seedlings are grown in packs of six or twelve plants, customers can simply help themselves to their desired amount of purchase. More recently, individually unitised cell packs have been developed for greater customer convenience in handling the seedlings when they are transplanted. Growing seedlings in the cell packs takes more care in watering and fertilizing during production, but the



Cell-Packs (Ball Seed Catalogue 1984) (Ball Seed Co. West Chicago Il. U.S.A.)



Transplanting Celery Plugs into Cell-Packs.



Blackmore Seeder sowing into plug tray (Knox's Nursery Orlando Fla, U.S.A.).

end result of a high-quality transplant for the customer has paid off in countries where they are being used.

In New Zealand only a few nurseries have been able to apply direct seeding as a viable production system. Most growers are holding back in anticipation of a more feasible way to apply direct seedling to their situation. The trend toward growing in self-service open-packs has now been widely accepted in most commercial nurseries throughout the country. There is, however, great diversity in the size and type of packs available and this causes prices of packs to be somewhat expensive compared to other countries. Attempts to introduce cell-packs have met a cautious reaction mainly because of price and continuity of supply. Vegetable seedling growers have seen the value of using cell containers to produce a high quality transplant. Perhaps commercial bedding plant producers will follow this pattern. While discussions on direct seeding and cell culture continue in New Zealand, a new system, combining the two, has been sweeping through other countries particularly the United States.

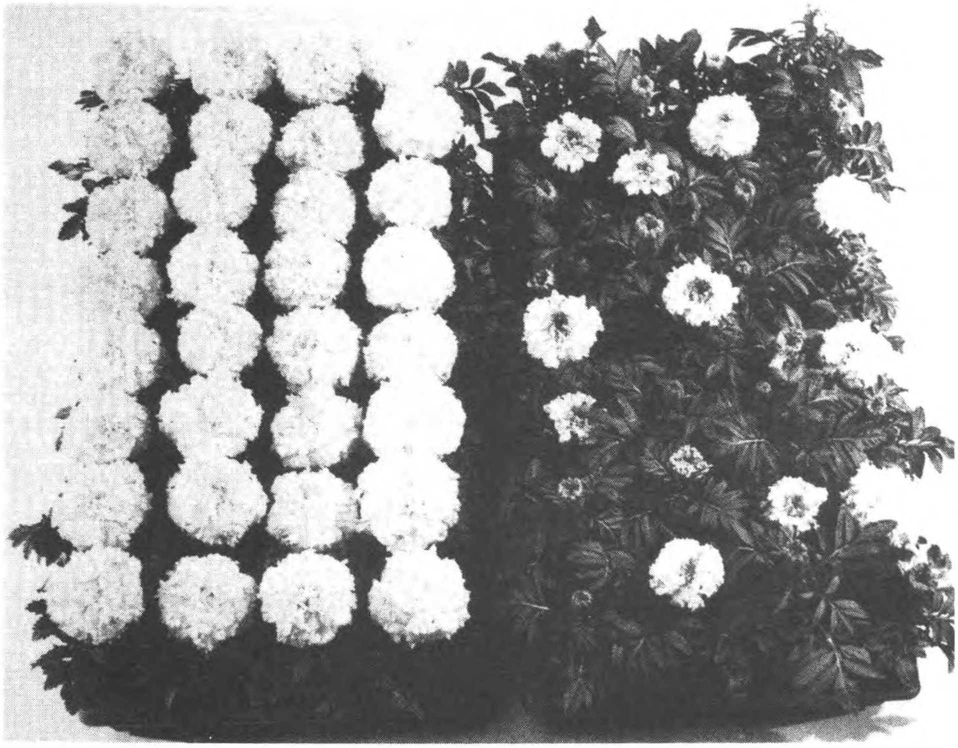
Plugs

The plug system of producing bedding plants has been around for some years. However in the past two growing seasons its acceptance has really taken off. The plug system offers the savings of labour achieved by direct seeding while economising on space by sowing into trays containing many small cells. After seed is mechanically sown into the plug trays, it is placed in a controlled environment either in a greenhouse or germination chamber. When seeds have germinated, they are placed in a warm greenhouse and grown on for 3 to 4 weeks. In the same manner as newly transplanted trays, grown by conventional methods. The different is the amount of space occupied at this stage. The plug tray requires only one-third the space normally required. When the plugs begin to fill out the cell with roots and start to crowd on the surface, they are transplanted to their final containers. The transplanting is made easy by having each seedling unitised with its own root ball. Transplanters simply lift out the plugs and place them in pre-dibbled holes. It takes half the time required for conventional transplanting. Once in their final containers, the plugs are finished off in a cooler less protected environment. Here are some of the advantages of plug growing which have convinced growers world wide.

- no transplant shock
- transplanting time cut by 50%
- eliminate repairs (patching up)
- save space in warm greenhouse
- hold longer, giving more flexibility in management
- reduces incidence of damping off
- saves on seed cost

Mechanication of Production

Plug growing is a precise and skilled operation that requires more careful cultural habits. New innovations in production techniques have coincided with



Left: Marigold Pineapple Crush (Improved)
Right: Marigold Pineapple Crush (Old)
(Ball Seed Catalogue 1984)

plug production. They include:

Pack-fillers which not only fill plug trays and finishing packs but some of the more advanced models mix the media, fill packs, pre-dibble holes and extrude plugs onto a conveyor belt ready for planting. This can all be done in one operation with one piece of equipment.

Movable Benches are being employed to economise on both the shifting of trays and the use of greenhouse space. Less aisle space is necessary so there is better utilisation of the greenhouse area.

Overhead Booms are being used to irrigate and fertilise crops with a greater degree of accuracy. This becomes very important with cell culture - especially with plugs. These booms can also be used to apply growth regulators and pesticides, they can be automated and they provide a much greater degree of accuracy than circular pattern irrigation.

Improvements to the Product

As production techniques improve so too must the quality of the product. Bedding plants like other ornamentals are a luxury item and the market place is very competitive in this area. Continuing technological advances are being made on the quality of the product.

Growth Regulators such as Alar® and Cycocel® have been in use for some time as dwarfing agents to control the height of plants and in some cases their shelf life. Growers are making more use of growth regulators now than ever before and their use will continue. They are important not only in dwarfing plants but in many other ways. Examples are: 1) use of silver-thiosulphate to reduce petal shatter in geraniums; 2) artificial shortdays to initiate early flowers on African Marigolds; 3) high Intensity Discharge lamps to increase growth development especially when growing in winter; 4) gibberellins to shorten time to flowering with Cyclamen; 5) artificial long days to bring crops into flower early such as tuberous Begonias and more recently Mimulus.

High-Tech Seed has been developed to obtain high-germination and extra performance. There is some secrecy about how this is done, but it can be best described as superclean seed. Only the best performing seeds are selected out of an original batch. Of course these special seed lines are obtained at a higher price. The higher price paid may certainly be worthwhile when seeding plug trays as it is important to have as many plug cells full as possible.

Marketing in Flower seems to be a trend to match our changing life styles. The demand for quick instant colours seems prevalent amongst the new generation of gardeners. Some may question whether this improves the quality of the product. If bcdding plants are grown correctly with the use of suitable varieties, growth regulators and adequate nutrition, a high quality product can be achieved to meet this demand.

Conclusion

The technoloqy necessary to increase productivity in the industry is available and being applied. It is only in recent years that this technology has been channelled towards the Bedding Plant Industry. It is now up to bedding plant growers, whether they grow flower plants for retail, vegetable plants for market gardeners or bedding plants for city councils, to decide if their operation warrants investigation into some of these new techniques. If they are to take up the challenge, it will be a formidable task to adapt these new ideas into workable solutions under our growing conditions. However, taking such measures may decide whether it is profitable for a grower to continue growing bedding plants in the future.

Nutrient Deficiency Symptoms in Asparagus

by

J.M. Follett; J.A. Douglas and G.S. Smith

Ruakura Soil & Plant Research Station, Private Bag, Hamilton, New Zealand

Asparagus production is increasing rapidly in the Waikato region, and with it, there is increasing demand for information related to efficiency of production and crop quality. At present there is little information on nutrient requirements of the crop in New Zealand, and overseas results tend to be site specific and not particularly applicable to our conditions. Recently, we began a detailed programme to investigate nutrient requirements. Critical levels of the essential major and minor elements will be defined and related to levels in field-grown asparagus. Our first experiment has been to induce deficiency symptoms in asparagus to obtain a visual expression of the effect each essential element has on plant growth. These results are presented here.

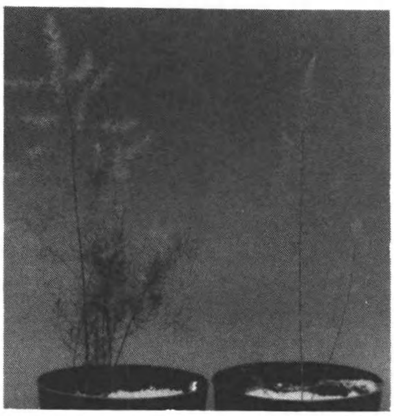
METHOD

Asparagus seed was sown in silica sand and when approximately 5 cm high the seedlings were transplanted into pots containing acid washed silica sand and fed a nutrient solution containing all essential elements. When approximately 30 cm high, these seedlings were again transplanted into fresh acid washed silica sand and fed a nutrient solution developed at Rukuara (Smith et al., 1983) containing all essential elements except the element for which deficiency symptoms were required. The elements assessed were nitrogen, phosphorus, potassium, sulphur, magnesium, calcium, iron, copper, manganese, molybdenum, zinc and boron. After one month the plants had developed few deficiency symptoms, so they were trimmed down to the level of the sand to induce new growth. Plants were then grown on for another two months, when the following observations on the symptoms induced for each element were made.

RESULTS

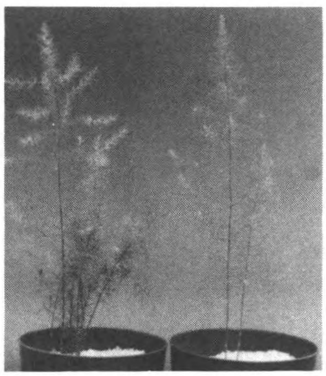
Nitrogen

Symptoms of nitrogen deficiency were not specific with no morphological changes being detected in individual parts of the plant. However, growth was reduced, giving a spindly appearance to the plant.



Phosphorus

Early symptoms of phosphorus deficiency include the colour of the stems changing from green to blue-green. This was slowly followed by some needles turning yellow and dying. However, needle length and spear height were normal. The plants displayed no noticeable morphological changes



(In all the photographs in this article the control plant is on the left and the deficient plant is on the right.)

Potassium

Potassium deficiency appeared first in the older needles which died back. Growth was adversely affected with spear height, lateral shoot length, and needle length all being reduced. This was followed by spear and lateral shoot tip dieback

Magnesium

Chlorosis was the main symptom of magnesium deficiency. Firstly, the needles on the older stems, and then the older stems themselves, became chlorotic. This symptom was rapidly followed by general chlorosis, and in all cases rapid senescence and death

Sulphur

Sulphur deficiency caused severe malformation of the plant with significant morphological changes taking place. There was little growth with the spears being few in number and shorter than the control. Needles and lateral shoots were stunted and compacted together in a rosette form and the foliage went rapidly from green to light green, then yellow with some needle fall. Plants grew poorly and quickly became chlorotic and spindly

Calcium

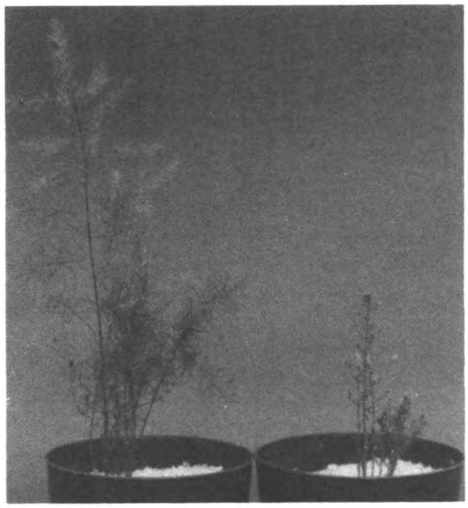
Calcium deficiency resulted in rapid senescence and death of the plant. Initially, spear height and lateral shoot length were reduced, and this was followed by the plant becoming chlorotic and eventually dying. Although most growing points were sensitive to calcium deficiency, those of the roots were affected most severely. Asparagus roots without a supply of calcium produce a multitude of small, short lateral roots before they ceased growth and became discoloured and died. Death of the whole plant may be due to dehydration following death of the root system

Iron

Iron deficiency gave yellowing and general chlorosis of the plant. The chlorosis began at the spear, lateral shoot and needle tips, progressively working down the plant. This was followed by the foliage turning white with some needle death. Height and spear numbers were reduced along with a general reduction in plant vigour.

Copper

Copper deficiency resulted in severe morphological malformation of the plant. The spears were short, thicker than normal, woody in appearance, and blue-green in colour. Branches off the main spear were severely reduced in length, with needles also being reduced both in number and length. These symptoms were followed by spear and lateral branch tip die-back and eventual death of the plant.



Manganese

No morphological changes were detected with manganese deficiency. The symptoms were very similar to those produced by iron deficiency, except that they were not nearly as intense. The needles at the spear and lateral branch tips were first to turn yellow, then white. Spear height and numbers were greater than for iron, although less than for the control.

Molybdenum

The deficiency symptom to molybdenum was expressed by the older spear tips dying back with this senescence moving gradually down the spear. Young spears, lateral shoots and needles were unaffected.

Zinc

No morphological changes were detected with zinc deficiency. There was a slight reduction in the number of spears produced, with the spears becoming slightly chlorotic at the tips.

Boron

The main symptom of boron deficiency was severe tip dieback on all spears. Tip die-back was also observed on the lateral shoots, although this was not as severe as the main spears. New spears were shorter in height and appeared blue-green in colour. Lateral shoots and needles were shorter than the control and slightly compacted.

A summary of the deficiency symptoms is given in Table 1.

Table 1: Guide to Asparagus Deficiency Symptoms.

Symptom	Nutrient Responsible
Slight chlorosis	Boron, Zinc, Manganese
General Chlorosis	Sulphur, Magnesium, Iron, Calcium
White foliage	Iron, Manganese
Tip die-back	Copper, Molybdenum, Potassium, Boron
Severe malformation	Sulphur, Copper
Blue-green appearance	Phosphorus, Copper, Boron
Rapid senescence and death	Magnesium, Calcium
Needle length reduced	Iron, Sulphur, Copper, Boron

CONCLUSIONS

This work has shown that asparagus is much more sensitive to the deficiency of some elements than others. In particular, magnesium, calcium, copper and sulphur gave marked effects on plant growth, and with the exception of sulphur, their deficiency led quickly to plant death. On the other hand, most of the other elements showed varying degrees of chlorosis and tip dieback but the plants did not die. The similarity between the visual deficiency symptoms of many of the nutrients means that they cannot be used alone to diagnose nutritional disorders in asparagus. Plant and soil analyses will be needed to provide more precise guidelines. This can only come about once the critical plant levels for each individual element have been determined. To date, we have completed the experiments to define the asparagus requirements for each major element, and at the present time, we are defining the minor element requirements. This glasshouse research will be supported by field studies to obtain further information on soil and plant relationships. When the results are drawn together we should be in a better position to define the nutrient requirements of asparagus.

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Protection of a Living Heritage — the notable and Historic Trees Scheme

by

R. Flook

Notable and Historic Trees Sub-Committee, P.O. Box 11-379, Wellington.

Conservation issues of one sort or another are constantly in the news at the moment with various groups trying to save and preserve parts of New Zealand's "past". The public, faced with a lack of clear information on the issues involved often becomes negative and ignores the issues at hand. It is very important that those with their own particular conservation interest should not ignore this. A well prepared and reasoned case is an entitlement the public deserves. This will enable them to make an enlightened judgement on an issue.

There is an understanding amongst all New Zealanders that trees are a valuable asset from an economic point of view. However, what is often overlooked is that trees form part of New Zealand's heritage and that they, in some instances, pre-date man's arrival in this country by hundreds of years. There are many significant trees that contribute to our history, or by their stature are of great beauty or of scientific interest. While these trees are not 'economic' in the normal sense, they make a tremendous contribution to the urban and rural scene. This contribution is often more widely recognised by visitors to New Zealand, for instance the recent comments by Dr David Bellamy about the importance of Whirinaki forest.

This article will describe the reasons for protecting significant trees and how you as members of the public can help.

The Notable and Historic Trees Committee

This sub-committee was formed by the R.N.Z.I.H. in 1977 to locate and identify significant trees in New Zealand. The committee's first task was to set out clear definitions for Notable and Historic trees. Before a tree can be considered for either of these categories it must be at least fifty years old.

A Notable Tree: is one which is recognised as rare, or of scientific interest or of exceptional stature. The term notable exotic tree describes an imported species and the term a notable native tree is self explanatory.

An Historic Tree: describes a tree that has a link to our history, legend or an important event. An historic tree can be either native or exotic. Very often trees can be both notable and historic.

Notable or Historic Tree Groups: Under this category a stand of trees can be registered as a notable or historic group. An example of this group registration would be Isel Park, Nelson.

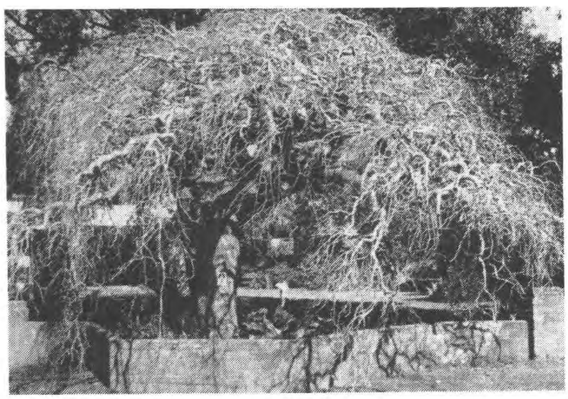
Examples of the above categories are described at the end of this article.

At present the committee has nine voluntary members, who meet in Wellington and have an interest and knowledge of trees. The members respond to all enquiries from the public regarding the possibility of registering particular trees or tree groups. It is essential that only suitable trees are registered and to do this the following investigative procedures are followed.

An investigation begins when information on a tree is supplied by a member of the public. The information is then forwarded to a tree registration officer, who is nearest to the location of the tree. These Voluntary Tree Registration Officers (T.R.O.) are appointed by the committee to assist in the assessment of the nominated tree. The tree is evaluated by means of a standard

Pohutakawa - Historic native tree of national interest. Atributed as planted on Arbor Day 1915 (2½ months after the Gallipoli landing) by the Mayor of Eastbourne, the late J.P. Kelly. Probably the first Anzac Memorial in New Zealand.
- Burstall Report No. 20, p. 33.

Weeping Ash - Notable exotic of national interest. Avalon Crescent, Lower Hutt. The thickest and widest spreading tree of this species recorded in New Zealand. This is part of Mason's planting 1840-50 on the estate known as the 'Gums'.
- Burstall Report No. 20, p. 41.



Weeping pagoda tree - Notable exotic tree of national interest. The only tree of this species known in New Zealand.
- Burstall Report No. 20, p. 41.

Cupressus macrocarpa, Monterey Cypress, Monterey Peninsula. Florio Zande, Boscobel, Takapu Road, Tawa. Girth at 1 ft, 24 ft, height 42 ft, spread 50 ft, in 1972. Known for over 100 years as the "Earp Macrocarpa" or "Bucket Tree", the latter because for over 100 years it has been trimmed to the shape of an upturned round bucket. Arthur H. Carman, in "Tawa Flat and the Old Porirua Road 1840-1910", states that in 1956 Mrs Annie E. Hewer wrote that her late father Frederick Westburn, when 17 years old (1897) worked for William Earp and trimmed the tree to the shape it is now from a very rough macrocarpa. Earp took up the property in 1855 and built a fine house in 1860, when it is thought that he planted the tree. Mrs Zande is a granddaughter of William Earp. (Other old trees recorded on the property are being listed as notable of local interest.)
- Burstall Report No. 20, p. 39.

method set out in a manual of guidelines produced by the committee. The details of the tree are recorded on a registration form, which requires an owner's signature and has descriptive notes with dimensions. This information together with a recommendation and photographs is sent back to the committee for final approval before being included on the National Tree Register for N.Z. Following approval by the committee an enamelled label of the tree's designation is sent to the owner or Tree Registration Officer for fixing to the tree. This label identifies the tree as significant to the public, thereby giving some recognition and small measure of protection for the tree.

Legal Protection

At present there is very little legal protection for significant trees. Many trees are listed on District Schemes but this is only a very limited form of protection. The committee has been actively lobbying for legislation. So far legal opinion is not certain as to whether new legislation is needed or whether protection can be afforded by Historic Places Trust, Q.E. II Trust or the Nature Conservation Act. We feel that it is important that any legislation must be specific and not be an overall blanket of protection. This blanket protection can only antagonise a 'public' very conscious of interference in the individuals' rights to act in their own interests. The protection of significant trees depends on public awareness and goodwill. Many examples exist on our records of the loss of trees through ignorance or the will to flout the public interest.

For example: i. A splendid pohutukawa was cut down by mistake due to an inaccurate location on the District Scheme.

ii. The removal of some magnificent Norfolk Island Pines at Eastbourne. This was carried out by the Eastbourne Borough Council in spite of public opposition and expert advice that their removal was not warranted. It has now been established that the trees cut down were not in fact causing the problem attributed to them. The gap left is irreplaceable to the community.

The many recorded examples we have of 'mishaps', etc., show that public support and interest should be given some legitimacy enabling action to be taken to prevent these irreparable losses. We can no longer deal irresponsibly with our national heritage of significant trees. We are custodians of this heritage to be handed on to future generations of New Zealanders.

For legislation to work, we believe that the R.N.Z.I.H. should govern the scheme. The following information sets out a possible structure which could be used to administrate the scheme. This will be necessary soon, as the workload is now almost unmanageable for the voluntary committee.

We would recommend the appointment of a RNZIH Administration Officer, say two-three days per week, Government funded (refer note at end) to carry out its present work, but to link in with Tree Registration Officers and improved legislation.

It is envisaged that such an Administration Officer would be stationed at Lincoln or preferably Wellington and be responsible to a Board such as the present Notable and Historic Trees Committee.

It is expected that the surplus time of the Administration Office two-three days per week, could be used by a local body such as Wellington City Parks Department, the Historic Places Trust or the Q.E. II Trust.

Note: Government Acts suitable for providing funds for the employment of an Administration Officer:

Q.E. II Trust	1 day
Historic Places Trust	1 day
RNZIH Direct from Govt	1 day
Total initially	3 days (reducing to 2)

Reality is necessary when considering protection for our national trees. Other very important aspects for deliberation are noted as follows:

1. Maintenance
2. Insurance following damage caused by, e.g. a tree shedding a branch.
3. Arbitration in the case of disputes. An evaluating method will be needed.
4. Processing and updating information on the National Tree Register.
5. Research and an accurate legal recording system.
6. Site visits and periodic inspections.
7. Publicity.

Current Investigation

An important avenue of information on significant trees is the work done by Mr S.W. Burstall, a foremost authority on trees in this country. Mr Burstall compiled a series of Forest Mensuration Reports in 1974 under the auspices of the Forest Research Institute. The committee have been researching these fascinating reports in order to update the reports and register the listed trees of national significance. These reports describe trees and the reasons for their being notable or historic and clearly arranges the subjects as being of national or local interest. The following extracts from the seven reports covering New Zealand demonstrate the wealth of information available and also the great heritage of trees this country has:

Northland Auckland Report No. 16

1. *Metrosideros excelsa*, Pohutukawa. Butlers Bay, Mangonui, 1968. Diameter at breast height 125 ins. Height 60 ft. Spread 120 ft in 1968. The largest pohutukawa yet recorded. Age possibly between 500 and 800 years old.

2. *Quercus robur* (syn. *Q. pedunculata*) Common English Oak. Waimate North. The oldest oak in New Zealand, the acorn being brought from Goat Hill, Dorset England, by Richard Davis one of the early Church Missionary Society missionaries who arrived at the Bay of Islands in the brig "Governor Macquarie" on the 15th August 1824. The acorn was planted at the mission station at Paihi. In 1831 Davis moved to the new mission station at Waimate, taking the tree with him. It was seen there by Fitzroy, in

1835, who had this to say "A thriving young English oak, near Mr Davis's house, augurs well: for where English oaks succeed, many other useful trees will certainly grow ... Englishmen one now meets everywhere; but a living healthy English oak was a sight too rare near the Antipodes to fail in exciting emotion". (Voyages of Her Majesty's Ships, Adventure and Beagle Vol. 2, by Robt Fitzroy, p. 604, London, 1839.) Although ranking low in size for trees of this species in New Zealand, when inspected and measured in 1971 the tree was very healthy, diameter at breast height 60 ins, height 60 ft, spread 85 ft. Hort List (1941) No. 2.

3. *Vitex lucens* Puriri. Marist Brothers Marcellin Hall, Pah Road, Royal Oak, Auckland. Diameter at breast height 54 ins. Height 52 ft. Spread 90 ft in 1970. A magnificent tree in a group of exotics probably planted by William Hart about the time he built his house nearby in 1846. The largest and best planted puriri recorded anywhere. There are many other good puriris planted on the area formerly called "Pah Farm", part of which is now Marcellin Hall. The most noteworthy is a splendid avenue of trees running up from Pah Road to the entrance of what is now Monte Cecilia Convent. This avenue was probably planted by Thos Russell soon after 1870 along the driveway to his house.

Waikato Thames Valley Coromandel Bay of Plenty Report No. 17.

p18 *Eucalyptus regnans* Tasmania and Victoria Marshmeadows Newstead. Girth at breast height 37 ft. Height 225 ft in 1969. Planted by Captain Runciman c. 1878. The late Mr Gudex measured its height by theodolite in 1957 as 219 ft. In 1964 Forest Service Officer's measured the height also with a theodolite as 234 ft. However, some of the top was blown off during the Wahine gale 1968. The tallest tree of any species recorded in N.Z.

Taranaki Wanganui Rangitikei C. North Island Report No. 19.

p24 *Magnolia campbellii*, Pink Tulip, Tree, E. Himalaya, Hamlet Street, Stratford. Diameter at 1 ft, 52 ins. Height 51 ft. Spread 69 ft in 1969. Planted by the late Percy Thompson c. 1918. Believed to be the largest of this species in the world. It has been estimated to have carried about 3,000 blooms in one season.

Corynocarpus laevigatus, Karaka. Te Poronui Pa, near Waitotara. Te Porornui was a pa of the Nga Wairiki hapu of the Nga-Raunui tribe, at Papatupu, near Moumahaki, about four miles from the hotel at Waitotara. The earthworks lie at the junction of the Moumahaki River with the Waitotara.
The warriors of the Ngati Hine hapu of the Ngati Ruanui tribe (from Takiruahine and other Ngati Hine pas) went down to storm Te Poronui Pa some 120 years ago. The noted Nga Rauru chief, Tahupotiki, stood on the main rampart of the pa, and spoke to the invaders. His mana was such that the attacking party departed without striking a blow, on finding that he was there in person. A karaka tree was planted by the tribesmen to mark the spot where Tahupotiki stood on the ramparts of the Te Poronui Pa and harangued the invaders. The incident is recorded in a waiata which commences thus:

"Tena te toko neghengehe
Kei a Tahupotiki;
Hei tutetute i a koe,
Ka takaia to rakau,
Ka tangi haere ra"

(The above is taken from a list of historic trees compiled by John Houston on 10th December 1934 and given to George Fuller by Rigby Allan from the Taranaki Museum files.)

Marlborough Nelson Westland Report No. 21.

p41 *Podocarpus spicatus*, Matai Lake Ianthe on the main road south. Diameter at breast height 91 ins. Height 89 ft. Spread 90 ft and height to first branch 17 ft in November 1966. Age about 1,000 years. Signposted by A.A. A very large tree.

North Canterbury South Canterbury Catham Islands Report No. 22.

p35 *Podocarpus totara* 'Pendula', Weeping Totara. Sundrum near Woodbury Geraldine. Diameter at 3 ft, 33 ins. Height 28 ft.

This is the only known natural specimen of this type. It is the progenitor of several historic trees planted in different parts of New Zealand. A very attractive offspring has been planted in the spacious garden. The property was a country home of A.C.D. Spencer.

p38 *Quercus robur* (syn. *Q. pendunculata*) Timaru Boys High School. Diameter at breast height 18 ins. Height 26 ft. Spread 40 ft in 1970. Known as the 'Lovelock Oak' this tree was presented to Jack Lovelock by Adolf Hitler when Lovelock set a 3 min 47.8 second world record for the 1500 m at the 1936 Olympic Games in Berlin.

p45 *Tilia* x *europaea* (syn. *T. vulgaris*) (*T. cordata* x *platyphyllos*). Common lime. Raincliff Station. Diameter at breast height 26 ins. Height 60 ft in 1970. An average tree sampled from a 200 yd avenue in which trees are 15 ft apart in rows 35 ft apart. The planting was done c. 1885; today this is probably the finest lime avenue in New Zealand.

Otago Southland Report No. 23.

p11 *Quercus petraea*, Durmast or Sessile Oak. East Aurum Street overlooking Oamaru Harbour. Diameter at breast height. Height 25 ft. Spread 35 ft in 1968. Planted in 1913 'in memory of the Antarctic Heroes, Capt R.F. Scott and his companions - Wilson, Bowers, Oates and Evans, who reached the South Pole on 18th January 1912, and perished on the return journey'. Known as the Scott Memorial Oak.

The Task Ahead

The committee needs help from the public and especially from RNZIH members to assist in the work. Do you know of any remarkable trees in your street or district? Although the committee is sorely pressed, we are sure there are members who are qualified and could help with the investigation of trees. We only have 24 Tree Registration Officers throughout New Zealand, which shows how thinly spread our investigative resources are. A comprehensive national register of trees compiled by RNZIH members will be our best argument for the protection of New Zealand's significant trees.

We can be contacted for pamphlets and information by writing to:

The Secretary,
RNZIH Notable and Historic Trees Scheme,
P.O. Box 11-379,
WELLINGTON.

Achimenes — the Hot Water Plants

by

K.J. Townsend

During recent years the great upsurge of interest in greenhouse and house plants has resulted in the commercial propagation and distribution of many pot-plants which for years past have been known and grown only by a small number of keen gardeners. One such plant is *Achimenes*, an herbaceous perennial, the tiny dormant rhizomes of which are gradually becoming more widely available; these develop into bushy plants bearing attractive petunia-like blooms in a great variety of colours. Achimenes are gesneriads, i.e. members of the family Gesneriaceae, and are therefore related to several better-known plants such as the 'gloxinia' (*Sinningia*), *Saintpaulia* and *Streptocarpus*. Originating in central America, they require some warmth when starting into growth in spring, but will grow and flower freely in summer and early autumn in an unheated greenhouse or on an indoor windowsill.

ACHIMENES - PAST AND PRESENT

The name *Achimenes* is first found in the *History of Jamaica* by Patrick Browne, published in 1756. Several possible derivations of the name have been put forward; the one usually quoted originated with Dr John Lindley, who suggested in 1841 that Browne derived it from two Greek word forms meaning 'not tempestuous', referring to a supposed dislike of bad weather. *Webster's International Dictionary*, however, says 'New Latin from Latin Achaemenis, a magic plant (Pliny) from Greek Achaimenis', which sounds plausible, as Browne was a physician by profession and would no doubt have been familiar with the writings of Pliny.

The first species to be cultivated was *A. erecta* from Jamaica, the type species, which was brought home to England by William Forsyth in 1778. It bears small flowers of brilliant scarlet, and has also been known as *A. coccinea*. Much later, in 1841, Theodore Hartweg introduced into England two new species from Guatemala, *A. pedunculata* (orange-red) and *A. longiflora* (blue) followed in 1846 by another, *A. patens*, with purple flowers, which he collected in Mexico. Others such as *A. antirrhina* (orange-yellow) and *A. longiflora* var. *alba* (white) had been introduced on the continent of Europe in the 1840s; and with these species available in a range of colours the hybridists wasted no time, and nurserymen were soon offering named varieties. By 1850, Bass and Brown of Sudbury were selling 36 different *Achimenes*, and within the space of a few years the plant was a firm favourite all over Europe. Louis van Houtte of Gent offered 67 varieties in his catalogue for 1858, and William Bull of Chelsea listed 61 in 1876. Some of these old cultivars have astonishingly good constitutions and are still with us after a century and more; worthy of note are 'Ambroise Verschaffelt', given a First Class Certificate in 1860, and 'Violacea Semi-Plena', raised in 1858.

Achimenes seem to have remained widely known and grown in greenhouses and conservatories during the rest of the nineteenth century, but together with other favourites of Queen Victoria's era such as the fuchsia and the pelargonium, they fell from favour during the early part of the twentieth century in the fashionable revolt against everything considered 'Victorian'. This, combined with the fuel and labour

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Achimenes dulcis. Drawing by Charles Stitt.

shortages of two wars, resulted in many varieties of these and other ornamental greenhouse plants being lost forever.

Miraculously, however, some *Achimenes* - notably the one now known as 'Purple King' (its original name, if any, having been lost) - survived through it all. It was grown as a cottage-window plant, the rhizomes being handed on from generation to generation, and from neighbour to neighbour, with the instructions 'always water them with hot water'. I know of cases where the plant has been handed down in the same family since before 1900, and of others where the 'hot-water plant', as it came to be known, had been taken abroad by emigrants. (I understand it is now circulating in Australia). Just how the 'hot-water' tradition started is a matter of conjecture; my own theory is that many years ago, 'somewhere in England', one of the gardeners up at 'the Big House' gave a few of the tiny rhizomes to a lady friend down in the village, and being a good gardener he told her never to give them cold water straight from the tap (or pump) but to use water 'with the chill off'. In common with many messages passed on by word of mouth, in time this became exaggerated, firstly no doubt to 'water them with warm water', and eventually 'water them with hot water'. Believe it or not, I have even heard of recipients being told to water them with boiling water - poured into the saucer in which the pot is standing - and some people apparently do manage to do this regularly without killing the plants! It is a fact however that achimenes dislike water which is colder than air temperature, especially if it remains on the leaves overnight; this can cause damage to the leaf tissue.

A noticeable trend in horticulture following the 1939-45 war has been the gradual return to popularity of several of the Victorian favourites; for example, the fuchsia and the pelargonium and more recently ivy, all of which now have horticultural societies devoted to them. In the United Kingdom, interest in achimenes and other gesneriads is growing rapidly; perhaps it will soon reach the level at which a society specifically for gesneriad growers will be a practical possibility. Our Saintpaulia and Houseplant Society, although covering a much wider range of plants, does cater for growers of gesneriads in their literature and show classes, and has done much to foster interest in achimenes. In the United States, the American Gloxinia and Gesneriad Society Inc., has been flourishing for many years and has the status of International Registration Authority for all gesneriads except saintpaulia. A complete and authoritative Achimenes Register has been compiled, detailing the first published references to names in this genus, and the society has several nurserymen among its members, who are currently raising and marketing new cultivars. Most of the new introductions on offer in the United Kingdom in recent years, however, have come from Europe, notably from Konrad Michelssen of Hanover, West Germany, who since the 1960s has carried on an extensive breeding programme and markets achimenes in very large numbers. In this country I have been successful (operating on a very much smaller commercial scale) in raising a few new ones which have proved acceptable.

In 1979, the Royal Horticultural Society invited entries for a trial of *Achimenes* as plants for hanging baskets, and in that and succeeding years the display in the glasshouses at Wisley has been greatly admired by visitors. After the trial, three cultivars received the Award of Merit, two were Highly Commended and four were Commended.

THE PLANT - ITS STRUCTURE AND GROWTH

Achimenes are sold by nurserymen during the planting season (late winter to early spring) as dormant rhizomes, sometimes referred to as tubercles. These vary widely in size, shape and colour; most sorts are small, round and nut-like, less than 1 cm long (½ in), although those of other varieties resemble catkins and can be several times as long. In structure, these storage organs are composed of numerous fleshy scales, which are modified leaves, tightly packed on the central axis which is the modified tip of an underground stem. Each scale has an axillary bud at its base and the rhizome, *Achimenes* 'Ambroise Verschaffelt'.

Achimenes 'Violacea Semi-Plena'.

Drawing by Charles Stitt.

if the terminal growing point is damaged, can produce shoots from any of these dormants buds. Broken fragments of the rhizomes, if otherwise healthy, will cheerfully produce one or more shoots (although growth will be a little slower than from whole rhizomes). However, even tiny fragments or the smallest of the whole rhizomes are capable of producing flowering plants in a few months if grown well and by late summer there is little difference between such plants and other ones grown from larger rhizomes.

The rhizomes of many varieties, although small, are capable of staying alive in the right storage conditions for a long time. When kept as they should be in a dry storage medium, they will start to shoot at the usual time in early spring: the thin shoots will grow to a few centimetres long (1-2 in) and then stop, many remaining alive in that state, if undisburbed, for a full year. They can be planted at any time during the season (I have had flowers in autumn from rhizomes planted in July) but the plants may not flower until the following season if planted later in the year, and they will of course need heat during the winter.

Some species and cultivars are of sturdy, self-supporting growth, but the stems of many are slender and require some support if an upright plant is required; these are very effective however as basket plants, when the pendulous stems show the flowers to advantage. Stopping is not usually required, as side-shoots will develop naturally from the main stems, and also sometimes from below ground, these adding their quota of blooms to those already being produced. Cutlivars and species are available with widely varying habits of growth, from dwarf bushy plants of 15 to 20 cm (6-8 in) to strong upright growers up to 80 cm tall (2½ ft); the majority have stems between 30 and 40 cm (12-16 in) in length.

Once flowering has started, each node usually produces at least as many flowers as leaves; many cultivars will in fact produce several buds from each leaf axil, which open in succession. This freedom of flowering, combined with the wide range of attractive colours now available, adds up to a pot-plant which sells on sight when in flower and whose future is assured. With adequate feeding, flowering will continue for three or four months, the plants then gradually dying down with the onset of dormancy. The new rhizomes, which begin to form underground about midsummer, will by now be fully grown and ripened. Some achimenes produce their rhizomes close to the surface, clustered at the base of the plant, or within a few centimetres of it: others send them further afield on long underground shoots, and they will be found pressed tightly against the base of the pot. Some of the species and hybrids will produce from the upper stem nodes, at the end of the growing season, miniature rhizome-like structures which are known as propagules, and which afford an additional means of propagation, if required. It is also possible to propagate by shoot tip cuttings, which root readily with bottom heat; however with most achimenes this is academic knowledge, as the rhizomes increase to such an extent each year that other means of propagation are unnecessary. Other gesneriads having similar, but larger rhizomes are *Smithiantha* (*Naegelia*), *Kohleria*, and *Gloxinia* (the true genus, not the well-known gloxinia which is correctly *Sinningia*).

CULTIVATION

Achimenes are relatively easy to grow, their main enemies being low temperatures and too much water (especially a combination of the two). They may be attacked by insect pests when grown in a mixed collection of plants, but when grown by themselves pests seldom become troublesome. If they do appear, fumigation with a suitable aerosol is better than using a liquid spray. Soil pests are best prevented by incorporating in the compost an insecticide powder recommended for this purpose such as diazinon.

The compost used should be of a porous and sponge-like texture, providing perfect drainage; if mixing your own potting compost avoid using fine, dusty materials which would give a muddy and sodden texture when watered. One of the proprietary all-peat composts may be used if mixed half-and-half with Vermiculite or Perlite. The rhizomes may be started into growth between February and April, depending on when it is possible to provide the steady warmth necessary. Single rhizomes may be planted in small pots - say 6 cm plastic or 3 in clay - and potted on into a larger size when they outgrow their pots. If planting several rhizomes per pot, to produce a bushier effect, as is often done, either plant them in a small pot and pot-on as above, or plant direct into the final size pot; if this is done, take care not to overwater, as a large pot retains moisture longer. Plant about 5 to 7 rhizomes in a 12 cm plastic or 5 in clay pot, or more in proportion for a larger pot, pan or hanging basket. Fill the container to within a few centimetres of the top with gently-firmed compost - do not press down too hard - space the rhizomes out, cover with another 2 to 3 cm of compost (1 in) and again firm down lightly. Water thoroughly with warm water and place the container in a temperature of 15°C or more to start the rhizomes into growth. Water again only when necessary: aim to keep the compost moist but not soaked. Full light is required as soon as the shoots start coming through. Keep warm until the plants are a few centimetres high, when they will tolerate slightly cooler night minimum temperature, but preferably never less than 12°C. A capillary watering system suits achimenes very well, and caters for their dislike of overhead watering.

If an upright plant is required, supply thin canes and ties as necessary. During growth and flowering, practise the usual hygiene of removing dead flowers and leaves, or botrytis may cause trouble. No artificial heat is required during the summer months; the plants do best with plenty of light but should be shaded from direct sunlight. When in full growth, never allow the pots to dry out completely. When the plants have been in their final pots for about a month, start feeding with a general liquid fertilizer at the recommended dilution and rates, changing to a high-potash (tomato) fertilizer in August to ensure that well-ripened rhizomes are formed.

When flowering tapers off in early autumn, feeding should be stopped and watering be reduced, allowing the pots to dry out completely as the foliage and stems start to discolour and die down. When dead, cut off the stems at ground level and store the pots in a dry place at about 10° to 12°C - never lower - for the winter. When harvesting, tip the soil ball from the pot and carefully crumble the soil away to expose and remove the rhizomes. If these are harvested before the planting season, they should be stored in clean, dry sand, peat or vermiculite to avoid dehydration; do not keep them in sealed airtight containers - they require a little air. Cardboard boxes with lids are ideal.

Growing achimenes from seed is not difficult providing a few basic conditions are met. The seed itself is extremely fine, so should be sown on the surface of the compost and not covered. It requires light for germination, but the containers should be kept out of direct sunlight; a high temperature around 25° to 28°C is necessary. Maintain humidity by covering the pot with polythene or glass so that the soil surface does not become dry, but take care that condensation does not build up and drip on to the compost. Pricking out the minute seedlings is difficult - it is probably best to plant a group of them in each small pot and allow these to grow together. Some will flower the first season if sown early, but all will form small rhizomes before winter sets in, and these can be replanted the following spring and grown on so that the best can be selected.

RECOMMENDED SPECIES AND CULTIVARS

At the present time, about 70 or 80 sorts of *Achimenes* are commercially available in the United Kingdom; if all those available in the U.S.A. and West Germany were added to these, the total would probably be more than twice that number. The following is a representative selection of those currently available here, illustrating the wide range of flower-colours and habits of growth. It is worth noting that every colour in the spectrum is represented - this is unusual in a single genus of plants.

<u>Species</u>

A. antirrhina. Tall and upright growing with large light green leaves, the blooms being of bright orange, shading to yellow in the tube.

A. bella. An almost stemless, rosette-forming species with long, hairy leaves and pale violet flowers. Collected in Mexico in 1961 by Professor H.E. Moore.

A. dulcis. Very beautiful, curved trumpet-shaped blooms of pure white against grey-green foliage on an upright plant. Collected in Mexico in 1961.

A. erecta. Bushy grower, small green leaves, covered in small yellow-eyed blooms of vivid scarlet.

A. flava. An attractive dwarf species with thin wiry stems, bearing small flowers of rich ochre yellow. Another species collected in Mexico in 1961.

A. longiflora. The long trailing stems of this species bear large, long-tubed blooms of a delicate shade of blue.

A. mexicana. Long blooms of deep violet-purple against pale green foliage.

A. virginata. A recently introduced species with glossy-surfaced foliage and trumpet-shaped blooms of bright canary yellow.

Cultivars

'Ambroise Verschaffelt' (Regel*, 1855) FCC** 1860. A unique variety, quite unlike any other. The white flowers are heavily marked with a network of deep purple veins.

'Brilliant' (Wm. Bull, 1891). Longish stems, with small yellow-eyed scarlet-orange blooms.

'Cameo Triumph' (Townsend, 1977). Large pink blooms, deckled edges, the limb of the flower embossed like a cameo.

'Cascade Evening Glow' (Michelssen) HC 1979. Small bushy plant with attractive flowers; the colour is in effect a warm salmon.

'Cascade Fashionable Pink' (Michelssen) HC 1979. Light salmon-pink, flushed with yellow at the centre.

'Cascade Rosy Red' (Michelssen). A very bushy plant with large, well-displayed flowers of vivid deep rose.

'Cascade Violet Night' (Michelssen). Rich, deep violet blooms with a velvety texture.

'Clouded Yellow' (Townsend 1975). Upright plant, light green foliage, open-throated flowers of soft yellow and dusky shadings.

'Harveyi' (Sutton 1927). Also known as 'Shirley Fireglow', under which name it received an AM in 1961 (when shown in London), this unusual narrow-leaved plant flowers in autumn bearing small orange-scarlet blooms with a few dark spots at the centre.

'India' (Michelssen). A delightful dwarf bushy plant with large dark-eyed violet-purple flowers borne in profusion.

'Jubilee Gem' (Townsend 1980). Sturdy and vigorous upright grower, with attractive dark foliage and a long succession of rich, glowing red-purple trumpets.

'Longiflora Major' (Turner, 1856). This is, and always has been, the largest flowered *Achimenes*. The beautifully-shaped pale blue flowers can reach 8 cm in diameter (3 in), and are borne on tall slender upright stems with small rounded leaves.

'Margarita' (1856). A trailing plant with light green stems and leaves, the long-tubed flowers being of pure snow-white without any markings.

'Opal' (Townsend 1979). The large blooms open a pale lemon yellow, maturing to creamy white, delicately flushed and finely picotee-edged with purple. Short and bushy.

'Paul Arnold' (Van Tubergen, 1956). An excellent and easy upright variety with large rounded upward-facing purple blooms. 'Early Arnold' is almost identical.

'Peach Blossom' (Borges, USA, 1954). The name describes the shade of pink exactly; the large dark-eyed flowers are freely borne.

'Pearly Queen' (Townsend 1982). Sturdy branching habit. Large flowers, freely produced, exhibiting a blend of pink, lilac and cream with a mother-of-pearl effect.

'Pendant Purple' (Townsend 1978). AM 1979. Very vigorous trailer, producing many side-shoots, bearing a profusion of blooms in a warm, rich shade of purple.

'Prima Donna' (Benary, W. Germany). A really outstanding cultivar, introduced a few years ago as hybrid seed. Vigorous,

* Raiser/introducer. ** Awards from RHS after trial in the Garden: FCC = First Class Certificate, AM = Award of Merit, HC = Highly Commended.

sturdy, bushy and free-flowering, with dark stems and leaves against which the dazzling coral-scarlet flowers show up to great effect.

'Purple King' AM 1979. The best-known and original 'hot water plant'. Extra vigorous, tough and easy, with incredible numbers of large ruffled blooms.

'Purple Triumph' (Lyon, USA 1967). Forms a remarkably dense bush with small leaves, set with freckled light purple blooms. Good easy grower.

'Red Admiral' (Townsend 1974). A very unusual upright plant with large grass-green leaves against which the rich scarlet trumpet-shaped flowers show up in striking contrast.

'Ruby' (Townsend 1976). A miniature bushy plant, about 15 cm high (6 in.), covered with small bright ruby-crimson flowers, a unique colour among *Achimenes*.

'Tarantella' (Michelssen). A short, compact and extremely free-flowering plant with slightly cupped blooms of rich salmon.

'Violacea Semi-Plena' (Van Houtte 1858). Unique old variety with good constitution. The freely carried purple blooms have their centres filled with a rosette of petaloid stamens. I suspect that this is the cultivar given an Award of Merit on 15th August 1933, as 'Minnie Rich', as the description matches.

'Vivid' (Plantsmith, USA, 1949). Long trailing stems bearing small leaves and medium-sized blooms of unique colouring; the tube of each flower is orange, and bears a face of vivid light magenta.

'White Giant' (Borges, USA, 1963). An excellent white-flowered variety. The blooms are large, and have purple markings at the centre.

What prospects does the future hold for *Achimenes*? It seems likely that, as happened with the fuchsia and pelargonium, as soon as the average gardener discovers what an attractive and rewarding range of plants is available, and starts growing them, there will be a sudden explosion in popularity. That point has not yet been reached - many gardeners have still not even heard of them; but I feel that it may not be far distant.

The article is written for English conditions. Remember when months are given for various practices to be carried out, approximately six months should be added on to correspond with the same season here.

Ed.

The Potential of Native Shrubs for Riparian Revegetation in South Island Mountain Catchments

by

J.M. Follett* and G.A. Dunbar

Centre of Resource Management, Lincoln College, Canterbury.

The riparian zone is an important part of a river system and the reasons for, and benefit from, a high input into maintenance or revegetation of the zone have been well documented (Marshall 1972; Hathaway 1973; Van Kraayenoord 1968, 1976; Sheppard 1978; Evans 1979). Until comparatively recently, however, the benefits from revegetation have been obtained by using a range of exotic species, with little attempt being made towards an evaluation of native plants.

In 1976, the Department of Lands and Survey agreed to contribute to investigations by the then Tussock Grasslands and Mountain Lands Institute into the use of native plants for riparian revegetation, particularly in mountain catchments. A pilot study began in 1977. In undertaking such work, the Institute was conscious that historically, most New Zealand riverbeds would have supported a mixed vegetation of scrub, forest and grassland. Many riverbeds would have had just a few narrow channels winding through a dense mat of tree and shrub roots. With the removal of native trees for timber, and destruction of shrubs to provide access for grazing in the riparian zone, many river beds would have altered from a system of several narrow meandering channels, consisting of a broad 'braided' stream course with many interconnecting channels.

The job of containing the spread of these braided channels and protecting the riparian zone has been largely the concern of the Catchment Authorities. They have provided engineering structures, and plantings of fast growing exotic species, principally willows and poplars, to stabilise the river banks and lessen the damage to adjoining pasture and crop land, or buildings. There is much scope, however, for the use of native plant species in riparian planting programmes, particularly where the public has access through proposed picnic areas or walkways, or in visually important areas near highways, and where screening of engineering structures is necessary. Native planting would provide greater vegetative diversity to the riparian zone, which in turn is important for long term stability and effectiveness in coping with environmental factors such as extremes in temperature and moisture supply. Many of these effects of native plantings were acknowledged by the Manawatu Catchment Board in a report produced in 1978. (Brougham 1978)

The investigations begun by the Tussock Grasslands and Mountain Lands Institute in 1977 along three main lines.

1. Propagation techniques for some native shrub species were studied in the glasshouse and nursery beds at Lincoln College.
2. Field trials were established to compare the growth rates and survivals of native plants with those of selected exotic species.
3. The growth rates and forms of root systems of several native and one introduced species were studied at Lincoln in large bins containing gravel and soil.

1. <u>Propagation techniques</u>

To be readily available for use in erosion control, plant materials need to

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be easily propagated. For native shrubs, cuttings offer the most reliable source of propagation material.

Technicians at the Institute have had success in propagation of many natives. Cutting material collected from late summer through till winter has given good results. Experiments have shown that survival and subsequent root growth can be significantly increased by making a vertical wound 2-3 cm long at the base of the cutting before lining out. Root promoting hormones and bottom heat in propagation beds gave little additional benefits (Follett & Foggo 1981).

Cuttings were generally lined out under mist in the glasshouse and once good root initials had been formed the cuttings were either lined out in a nursery bed or potted up into propagation tubes. Trials have shown that good survivals could be obtained by simply lining out the cuttings in a nursery bed, without the initial glasshouse stage, but precautions had to be taken to ensure that adequate watering and shade was given until winter. Plants lined out in the nursery were latterly root-pruned, and undercut with a spade several times during the growing season in order to produce good compact root systems, which in turn allowed for easy transplanting reduced the transplanting shock and encouraged rapid, establishment after planting.

Problems have been encountered with *Dracophyllum acerosum* cuttings which appear very difficult to propagate. Another major problem has been in a very low survival rate in the transplanting of rooted cuttings and seedlings of matagouri (*Discaria toumatu*).

Seed may be used for raising stock for revegetation, although this entails a longer time period in the nursery for the seedlings between sowing and planting out, than for cuttings. Apart from the time factor, there may be poor seed viability, especially in wind pollinated species such as *Olearia avicenniaefolia*, and problems such as the very long stratification period required for matagouri seed.

Cortaderia richardii (toe-toe) a member of the grass family, was propagated by division of the plants and lining out in a nursery.

For most native species a period of one year in a nursery bed proved sufficient to produce healthy vigorous plants between 10 cm to 30 cm tall, depending on species, with well developed fibrous root systems resulting from good conditioning in the nursery. A notable exception in terms of time, was for cuttings of *Podocarpus nivalis* (mountain totara) which grew very slowly.

2. Field Plantings

Pilot plantings of native species were made in the Kowhai River headwaters in late spring of 1977, and showed early on the need for well grown and well conditioned plants. Rooted cuttings of four native shrubby species gave very poor survivals on the gravelly site. Best one year survivals were from *Hebe odora* (6%) and *Coprosma rugosa* (2%). The other two species planted were *Olearia avicenniaefolia* and *Griselinia littoralis*.

There were further plantings in spring 1978, autumn 1979, autumn 1981 and spring 1981. Assessment of the results in autumn 1982 showed that only *Hebe odora* and *Cassinia fulvida* of the native species gave reasonable survival rates, and *Hebe* had in fact, higher percentage survival than *Salix purpurea*, the poorest of the two willow species planted for comparison. (Table 1) Even in the surviving plants, however, height growth has been negligible.

At another site on Craigieburn yellow-brown earth subsoils in the Porter River headwaters, plantings in 1978 gave poor results. The only species to survive have been the two willow species and well conditioned nursery stock of *Hebe odora* and *Cassinia fulvida*. Most other stock was lost through frost heave.

It appears that autumn is the better time to plant on these sites, providing the plants have enough time to establish before winter. Spring establishment is difficult because of the strong heating which occurs at the surface of river gravels and the strong, dry, winds which commonly occur in summer. Plants are also in a state of moisture stress for a

Fig. 1: *Hebe odora* ready for planting out. These plants were lined out in the nursery as cuttings. Conditioning in the form of undercutting and wrenching producing these compact plants with strong fibrous root systems ideal for transplanting.

Fig. 2: The trial site near the Kowhai River, Mt Torlesse. This species evaluation trial has had fertilizer applied to the left hand plot. The result being a big response to the applied nitrogen and phosphate by Browntop and Haresfoot clover.

TABLE 1: Survival of Species Planted at Kowhai Site.

Species	Percentage Survival Rate in Autumn 1982			
	Planted Spring 1978	Planted Autumn 1979	Planted Autumn 1981	Planted Spring 1981
Cassina fulvida	0	62	100	71
Coprosma rugosa	0	0	25	0
Griselinia littoralis	0	0	83	82
Hebe odora	38	62	100	100
Olearia avicenniaefolia	0	0	100	36
Cortaderia richardii	0	12	-	-
Salix glacophylloides	59	-	-	-
Salix purpurea	18	-	-	-

large part of the year because of the porous nature of the substrate.

Fertilizer in the form of molybdic, 20 percent sulphur, reverted superphosphate at 400 kg/ha, and urea at 100 kg/ha applied at time of planting in the field, had no apparent effect on growth rate or survivals of planted stock. There was however, a marked response by surface herbaceous cover, particularly from browntop and haresfoot trefoil at the Kowhai site.

3. Root Growth Study

Studies of willows and poplars by Hathaway (1973) has shown that they are well suited for riparian revegetation because of their root morphology, root tensile strength and soil binding capacity. The soil bin study carried out by the Institute at Lincoln compared five native plant species with one willow species, *Salix purpurea*. The native species *Olearia avicenniaefolia*, *Cassinia fulvida*, *Hebe odora*, *Griselinia littoralis* and *Cortaderia richardii*, and the willow were grown in soil bins with two different "soil" substrates. Root morphology and total root development were compared in these two substrates, a yellow-brown earth subsoil, and a very recent stream-gravel. The effect of nitrogen (urea) on growth was also studied.

Plants were excavated from the bins between the sixth and ninth month after planting. The willow species *Salix purpurea* produced by far the highest weight of roots and shoots (Table 2) and the root systems showed a good balance of strong laterals and fibrous roots.

TABLE 2: Dry Matter Yields of Plants in Root Growth Study (Mean oven dry weight in grams, for all treatments.)

Species	Shoot	Root	Total
Salix purpurea	96.5	64.7	161.2
Cortaderia richardii	57.6	13.1	70.7
Olearia avicenniaefolia	8.6	4.7	13.3
Cassinia fulvida	8.0	3.2	11.2
Hebe odora	4.4	2.8	7.2
Griselinia littoralis	1.6	1.4	3.0

Although *Cortaderia* had the highest root weights of the native species grown, the root system consisted mainly of "fleshy" roots with few fibrous roots which would hold easily eroded material in a riparian site. The *Olearia*, *Cassinia* and *Hebe* species although producing less total biomass than the *Cortaderia*, had adequate fibrous root systems with good soil holding capacities. The *Griselinia* gave both low plant weight and a root system with no fibrous roots.

All species except the *Cortaderia* produced higher plant weights when grown on the subsoil than in the gravel, probably because of the higher moisture holding capacity and the more constant moisture content of the finer textured subsoil.

In response to nitrogen application, *Olearia*, *Cassinia* and *Hebe* showed the greatest response over the trial as a whole, the mean total dry weights being increased by 41%, 76% and 68% respectively. There were very small increases only, in yield from *Griselinia* and *Salix* and a decrease in yield by *Cortaderia*.

Discussion and Conclusions

The root growth characteristics demonstrated by the native species and their total rate of growth make it apparent that relative to *Salix purpurea* they are not as suitable for a primary role in stabilisation of an actively eroding or highly vulnerable stream bed. Primary stabilisation would need to be achieved by the more aggressive introduced species, through the use of mechanical structures or frequently by a combination of these methods.

Many of the native shrub species have proved relatively easy to propagate from cuttings in nursery beds, and providing plants are well conditioned in the beds they would transplant readily into a secondary stage of stabilisation, or could be used at the same time as engineering structures are put in. The study showed that several of the shrub species have desirable attributes for riparian areas, such as the high soil holding capacity of the fibrous rooted *Olearia*, *Cassinia* and *Hebe*, and the ability of several species, particularly *Hebe* to layer and form new roots from stems which have been partially buried by silt or debris. Additionally the virtually evergreen nature of the natives adds year-round variety in greenness and form to the stream bed vegetation.

Many of these native plants are unfortunately very palatable to livestock, and their slower growth rate means that the stream bed must be fenced for a long period. However, fencing of vulnerable riparian areas should be accepted as a common precaution. In hill and mountain areas there would normally be much regeneration of native species in fenced riparian zones and this has been well illustrated in a tributary catchment of Firewood Stream in South Canterbury where the Catchment Board first began stabilisation work about 1958.

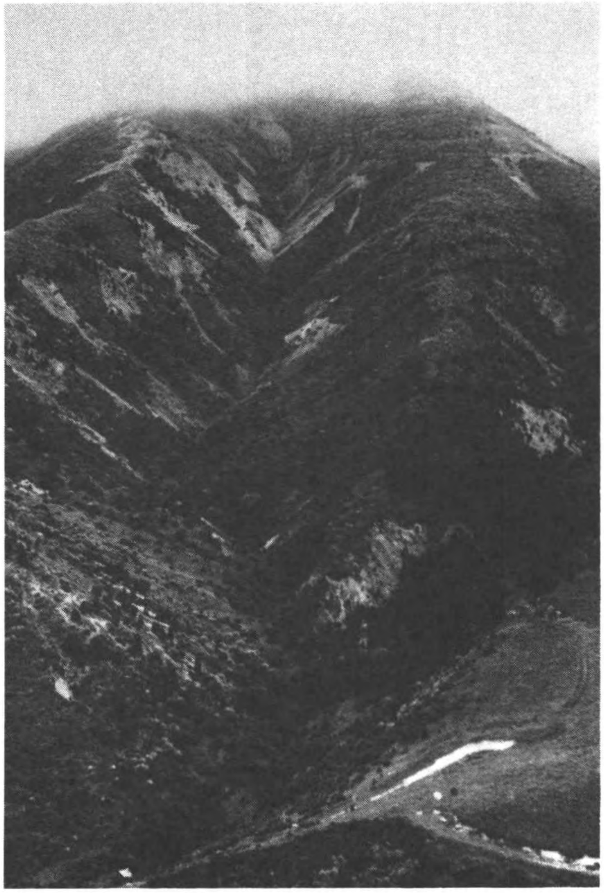

Fig. 3: A tributary catchment of Firewood Stream in South Canterbury which was initially stabilised by rock groynes and the planting of exotic species. This area which was also fenced to remove pressure is now being rapidly invaded by many New Zealand natives.

Two native species, matagouri which is generally not grazed, and tutu (*Coriaria* sp.) which should not generally be grazed because of its toxic properties, occur commonly along stream courses. Both fix nitrogen, and their growth and the subsequent growth of associated plants may be encouraged in these zones by topdressing with superphosphate fertilizer.

In conclusion then, whilst it is unlikely that native shrub species will play a primary role in revegetation of riparian areas in the mountains, the studies show that they could be useful and attractive in a second phase revegetation programme.

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Citations for the Award of Associate of Honour A.H.R.I.H. (N.Z.) 1984

GERALD PILKINGTON WARD, CBE

Gerald Ward was born at Manchester, England, on 16 May, 1923. His father was an Electrical and Mechanical Engineer and lectured at Loughborough College, Leistershire.

Gerald was educated at Clifton College and Cambridge University where he graduated Master of Arts in the field of Mechanical Science. He served as an officer in the RNVR for a period during the war years.

Gerald taught in secondary shcools in England for four years and in South Africa for one and a half years. In 1952 he emigrated to New Zealand and is now a New Zealand citizen. He taught at Christ's College for a period of four and a half years.

Gerald has been connected with the Fruit Growing Industry in New Zealand for 27 years and during this period he successfully established a new orchard at Loburn incorporating up-to-date methods and was well recognized as a meticulous and knowledgeable orchardist.

In Her Majesty the Queen's New Year's Honours List, 1984, Gerald Ward received the CBE - Commander of the Most Excellent Order of the British Empire in recognition of his outstanding contribution to the Fruit Growing Industry both at the local and national levels. He has served on a number of important bodies and organisations including the following:

- Dominion President, N.Z. Fruit Growers' Federation, 1978-1982.
- Canterbury Director, N.Z. Fruit Growers' Federation, 1973-1982.
  Proposing, promoting and implementing the integration of the N.Z. Fruit Industry which came to fruition in the amalgamation of the Citrus and Sub-tropical Council with the N.Z. Fruit Growers' Federation, and the restructuring of the Industry into Fruit Sectors.
- Member of Apple and Pear Price Authority, 1980-1983.
- Horticultural Export Development Committee, 1978-1982.
- Chairman, Fruit Tree Co-ordinating Committee, 1980-1983.
- Member of Fruit Research Committee, 1973-1979.
- Chairman, Canterbury Fruit Advisory Committee, nine years.
- Canterbury delegate to New Zealand Fruit Growers' Federation Dominion Conference, 17 years.
- Secretary, Loburn Fruit Growers' Association, eight years.
- Chairman, Loburn Irrigation Committee, six years.
- Member of University Council, University of Canterbury, 1983, continuing.
- Member of Lincoln College Council, 1980, continuing.

- Chairman, Management Committee, NZAEI, continuing.
- Member of Canterbury Development Corporation, 1983, continuing.
- Member of Canterbury Regional Development Council (ministerial appointment), 1983, continuing.
- Chairman, Rangiora District Adult Education Committee, 12 years.
- Member of Rangiora High School Board, six years.

Gerald Ward has given an outstanding service to the New Zealand Fruit Growing Industry and also in other fields of horticulture.

ERIC J. GODLEY

Dr. Eric Godley's deep love of plants and in particular our New Zealand native plants, can be traced back to the mid 1930's and to his boy scout days. After a life-time of service to botany and to horticulture he retired in 1980 from the position of Director, Botany Division, D.S.I.R., Lincoln.

He joined the Department in 1951 and was first a senior geneticist and later Director (1952-58) of the Crop Research Division. He was appointed Director Botany Division in 1958 and held this position until his retirement.

Dr. Godley served overseas in the army during World War II and upon his return to New Zealand, after gaining his Ph.D. at Cambridge, lectured in Botany at Auckland University College from 1948-50.

At University Dr. Godley had a natural and close rapport with students enhanced by his dedication to botany and studies on our native plants. In later years, both in season and out of season, Dr. Godley has been a staunch defender of our indigenous flora, not in an overt way, but rather through considered argument and enthusiastic promotion at every opportunity, especially in research circles. However, when native forests were threatened he was prepared to take more direct action if it was likely to yield beneficial results. His major contribution to horticulture has been by his unceasing promotion of our native plants.

Always mindful of our history, he has directly promoted knowledge of our plants by editing new editions of Laing & Blackwell's "Plants of New Zealand" (7th edition, 1964) and Leonard Cockayne's "New Zealand Plants and Their Story" (4th edition, 1967), both classic books in our biology literature. More than anyone else Dr. Godley re-awakened interest in the work of Leonard Cockayne, New Zealand's greatest plant researcher and gave the fourth Cockayne Memorial Lecture in 1974 (N.Z. Journal of Botany 17: 197-215, 1979). In all this work he has shown a scholarly approach which is sometimes lacking in New Zealand. Perhaps his most important direct contribution to horticulture in recent years has been his monthly articles from September 1978 in the N.Z. Gardener on a variety of subjects. These articles are written with interest and authority for the lay horticultural readership.

In science great significance is placed on the published word and a scientists's publication list reflects the achievements and the fields of endeavour of the scientists. Dr. Godley has published no less than 75 papers the titles of which indicate that his early interest in genetics broadened to a more general interest in flower bilogy and botanical history especially botanical exploration. He still retains a great interest in some indigenous genera such as *Sophora*.

Dr. Godley is recommended for the Award of the Associate of Honour of the R.N.Z.I.H. by the Canterbury District Council.

ERIC EDWIN TOLEMAN

Eric Toleman began his horticultural career in England in 1932. His early studies and work in horticulture were gained at the University Botanic Gardens, Cambridge and for a period he studied at the Norwegian State College of Agriculture in Norway.

In the Royal Horticultural Society's General Examinations he gained a First Class Certificate in Horticulture. Before emigrating to New Zealand he passed the final N.D.H. examination in England, and also gained a Diploma in Teaching. His interest in amenity horticulture is based on his studies in this field in England where he only required to pass the examination to qualify as an Associate Member of the Institute of Park & Recreation Administration (U.K.). War interrupted his further studies and from 1939 to 1945 he served in the Royal Air Force.

In 1961 Eric Toleman took up the position as Instructor in Horticulture with the N.Z. Department of Agriculture in Hamilton. This was the first appointment of a Government Advisor in Horticulture in the Waikato area. He became actively involved with the Royal N.Z. Institute of Horticulture and was for many years a member of the Committee of the Waikato District Council. In 1965 he was elected a Fellow of the Institute.

Mr Toleman published a very successful booklet on vegetable growing for the home gardener and he was also a noted authority on mushroom growing. His booklet published by the Government Printer on "Mushroom Growing in New Zealand" became a best seller.

Over the many years of his horticultural career he has lectured extensively on horticultural topics at seminars, growers meetings, University extension courses, Technical Institute's and to innumerable Horticultural Society and Institute meetings.

He gave the Banks Lecture of the Royal New Zealand Institute of Horticulture in 1980 on the subject "The Potential For New Zealand To Become A Major Producer Of Horticultural Crops".

Also he has been a regular contributor of articles for the Department of Agriculture publications, the New Zealand Gardener and the New Zealand Journal of Agriculture. He is a noted judge of vegetables and flowers at shows, and has recently completed the revision of the authoritate "Flowers For Shows" handbook of the Institute. He is also a much respected examiner in horticulture for the Institute in its N.C.H. and N.D.H. examinations.

In retirement Eric Toleman continues with his love of horticulture and is unstinting in imparting his knowledge for the benefit of the horticultural fraternity.

Great Trees of N.Z.
A Review

by

R. Flook & R.W. Shepherd

R.N.Z.I.H. Notable and Historic Trees Committee

At last a book on New Zealand's significant trees. Although much of our history for art, literature and some aspects of our environment have been documented, seldom has attention been directed towards the rich heritage of trees in this country. To select from such wealth is difficult but Mr. Burstall's knowledge of his subject has obviously helped the authors choose a satisfactory balance of native trees and those introduced as a result of European settlement.

When the book is opened at random an appreciation of the majesty of trees of great age and stature is aroused. The photographs and descriptions lead on from one to another as an excursion into time. The text grips the reader. It is completely absorbing. Some of the trees remind us of our colonial past, others such as the 'Peacocke' rimu near Pureora question the wisdom of selective logging, a practice which removes such examples of forest giants from the future. This book evokes the spirit of 'Aotearoa' yet reminds us of our commercial dependence on that introduction from California 'Pinus radiata'. Not all trees are large or noble - thus the inclusion of aged Kanuka belies the denigration of the word 'scrub'.

'Great Trees of New Zealand' is an easily read book, well presented, comfortably handled, and with excellent photographs. The price is affordable. Minor lapses in proof reading as well as a few historical inaccuracies occur, such as Arthur instead of Alfred for Ludlam's name. Neither is it safe to simply assume that the planting of exotics on a property began immediately on settlement. In many cases the land had first to be cleared. Thus the majority of Mason's plantings took place after his return from Tasmania in 1850 and the Maori troubles in this area had subsided. Conversely Ormand at Karamu raised conifer seedlings as early as 1871. Our historic knowledge is continually expanding and this book enlarges our understanding of our colonial past. It confirms a relationship between conifers grown at Karamu and Albury Park with those grown in the Botanic Garden of Wellington.

Through its Notable and Historic Trees Committee the R.N.Z.I.H. seeks to promote greater appreciation of our significant trees, to locate and identify them and list on its National Register. By stimulating public interest and awareness "Great Trees of N.Z." should bring further support for these efforts to protect a valuable part of our heritage for both present and future generations. The book is recommended to all R.N.Z.I.H. members and to all those who value the contribution that trees make to the natural beauty of our country - they will find it both informative and entertaining reading as well as an important reference source.

"Great Trees of N.Z." Written by S.W. Burstall and E.V. Sale in association with the N.Z. Forest Service. Published by A.H. & A.W. Reed.

Myoga, a Possible Ginger Crop for New Zealand

by

J.A. Palmer, Crop Research Division, D.S.I.R., Lincoln.

Introduction:-

The gingers, members of the genus *Zingiber*, are native to areas of south and east Asia together with the adjacent islands extending from Japan to New Guinea. Most, including the common ginger of commerce *Zingiber officinale* Rosc. are tropical plants.

Large quantities of ginger are imported into New Zealand annually both in the form of fresh (green) ginger roots from Fiji and as dried ginger (about 20% of fresh weight) mostly from India. New Zealand imports for the five year period 1976 to 1980 were around 175 to 200 tons of fresh roots plus an average of a further 91 tons of dry ginger (ITC 1982). Other major ginger producing countries include Queensland, China, Taiwan and Jamaica.

Several other *Zingiber* species are used locally in Southeast Asia both for flavouring and as folk medicine. The two most important being cassumar, *Z. purpureum* a common adulterant of Indian ginger (Roy & Roy, 1982) and the broad leaved ginger *Z. zerumbet* of which the shoots are more frequently used than the roots. This last species is probably best known in temperate areas as the variegated ornamental cultivar 'Darceyi'.

The most cold tolerant species is Myoga, *Z. mioga* (Thumb.) Rosc. cultivated widely in Japan and to a limited extent in Hawaii.

Description of Myoga:

This is a typical ginger plant with a thick rhizomatous but inedible rootstock (Fig. 1). Young shoots in spring and flower buds in summer are eaten.

Pseudostems are formed from tubular leaf bases. Each new leaf grows up through the sheathing base of the preceeding ones. The growing point remains close to ground level. The leaf blades are shorter and broader than those of common ginger, frequently 30 cm long and up to 8 cm broad at Lincoln. This is appreciably greater than the figures quoted by Ohwi (1965) in his Flora of Japan. Plants seldom exceed 60 cm in height with 7 or 8 leaf blades per pseudostem.

When leaves senesce the entire pseudostem breaks off at the junction with the root leaving a prominent circular leaf scar (see Fig. 1).

Flowers occur on separate shoots in mid summer (Fig. 2). The bracts enveloping the unopened buds are thick and fleshy and perhaps more valued for edible purposes than the shoots. The flavour of both is similar and nowhere near as pungent as the common root ginger. They may be eaten cooked, especially with fish, or raw in salads.

Environmental requirements:

Myoga plants need shelter from wind, adequate moisture and partial shade none of which are particularly common on the Canterbury plains. It can only be grown successfully at Lincoln in a shade house or in a shaded sheltered site in a home garden.

Wind rapidly tears and dessicates the leaves and is particularly damaging to the emerging shoots. If water stress is sufficient in late summer the pseudostems abscis and plants normally remain dormant till the following spring.

Dormant plants have proved quite winter hardy when stood outside glasshouses in pots or when planted in home gardens in Christchurch.

Fig. 1 Two year old myoga root photographed 29 September 1984. Note large circular leaf scars from previous year's foliage in centre.

Fig. 2 *Zingiber mioga* (Thumb) Rosc. plant, late January. Pot height 14 cms.

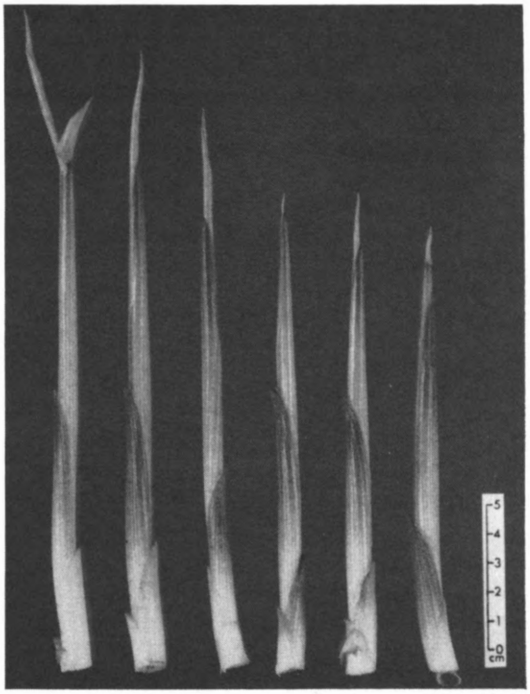

Fig. 3 Shoots of myoga from shaded plot. 17 October 1984.

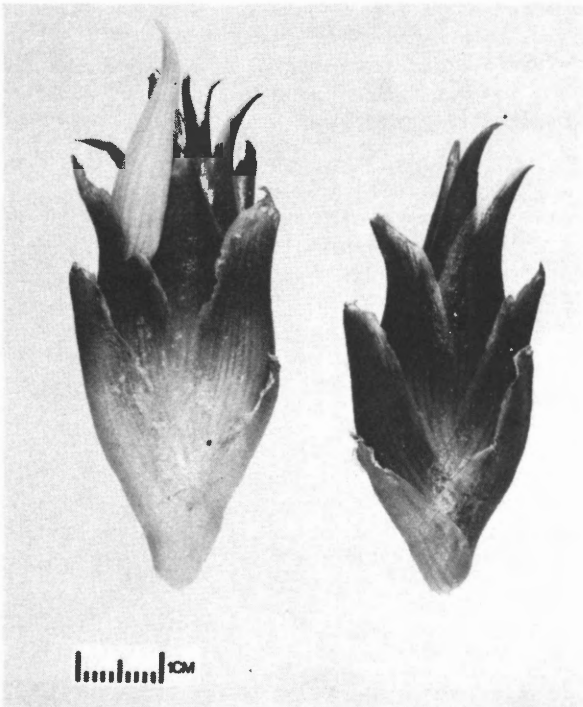

Fig. 4 Flower buds of myoga. January 1983.

Agronomy:

Myoga is a sterile pentaploid (n = 5x = 55) and seed is unknown. All propagation is by root division. This is best done in early spring when new developing shoots are visible. Single shoots may be detached with some 30 cm of rhizome and grow away readily in any sterile medium at this time. When roots are divided in autumn many failures result.

Trial plantings have recently occurred on the West Coast and in the Waitakeres but it is too soon to comment on these. The results quoted below are derived from plants grown in boxes in a shade house at Lincoln and should be interpreted with caution.

Shoots appear above ground in late September about the same time as asparagus. Blanching with black polythene may improve quality and shoot length but is not essential. Harvesting at Lincoln occurred from mid October to the beginning of November. Cutting does not stimulate new shoot formation in the same way as asparagus. If all shoots are removed at one time it may take up to six weeks before fresh shoots arise. Leaving one or two shoots per plant, two year old plants yielded an average of 3.8 shoots weighing 5.5 grams (Fig. 3). The planting density in this trial was about 26 plants/m^2.

Only about half the plants produced flowers in the first season after propagation and demand for propagating material has so far precluded more prolonged testing. Flower buds harvested (Fig. 4) weighed between 16 and 24 grams.

Because of the relatively high value to weight ratio of Myoga there is a potential for out of season air freight of shoots and flowers to Japan, Hawaii and ethnic Japanese districts on the West Coast of North America. One Auckland company is investigating this potential. Some use might be expected from gourmet cooks also within New Zealand.

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The Wellington Botanic Garden: an Important Historic Garden

by

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It may come as a surprise to learn that the Wellington Botanic Garden is one of New Zealand's most significant historic gardens. For too long these Gardens have been known only by their attractive Rose Garden and Begonia House as well as a pleasant walk in from the main gate to the lawn and Swan Pond. Pines in the Gardens have been considered ugly and expendable while the bush in the valleys is referred to in current maps as 'wooded area'. Our eyes, mine included, have not been discerning, or our minds enquiring.

This pleasant domain comes alive with the recent discovery of the archives of the Reserve. They reveal a fascinating story of this Garden from when in 1869 the Botanic Garden Act gave the care of the Reserve to the Governors of the New Zealand Institute, forerunner of the Royal Society. For twenty two years the Botanic Garden Board as it was constituted, developed the raw wind swept area into a functional public Garden. As well as this the Board carried out a number of economic trials on plants brought in by Government. For example sorghum and sugar beet were grown, harvested and tested for their sugar content, mulberries were grown for possible use in sericulture, flax was trialed for the New Zealand Commission while cork oak and olive trees were planted too. Attention, however, was directed mainly towards growing trees, especially conifers, to test their suitability for timber and use as shelter.

Conifer trees were planted in the Gardens between 1870 - 1873. A few of these came from New Zealand sources, but the majority came from three Australian Nurseries and surviving invoices show what these were.

However, most of the confiers grown came from Government imported seed which was distributed through the Geological Survey to Domains, Acclimatisation Societies, and settlers throughout New Zealand. The Botanic Garden in Wellington received its share but often, due to James Hector's positions as Director of the Survey and Manager of the Gardens, the Botanic Gardens did much of the distribution of the seed. The Gardens were also highly successful in raising this seed and distributed plants throughout the Wellington region, the Wairarapa, and the Northern part of the South Island. Requests came from other areas and plants were sent as far away as Kaipara Heads, the Patea Church and Domain, Reefton Hospital, and Invercargill to name a few examples.

Most of the conifer seed brought in by Government came in between 1870 - 1884. Musoori in India supplied the Indian confier seed, European conifers came from Kew whil large quantities of the Californian conifer seed came from one source in Los Angeles. The source of the Californian seed seems to be related to an order placed in 1868 by the Hon. Mr. Richardson, owner of Albury Park in Canterbury. James Hector, in touch with Richardson, used this same source for Government's first order for seeds and subsequently for the next ten years all Californian seed came from this address. The seed was collected from the same area each year and therefore it can be presumed that it contained some genetic similarity.

The importance of this period of conifer introduction into New Zealand cannot be overemphasised and because of the wide distribution of these plants throughout the country, many of which are still alive today, we now have a new understanding on the relationship of these trees to each other. For example the earliest *Pinus radiata* growing at Albury Park are related to those in the Wellington Botanic Garden and to those which grow at Mauriceville West. Many of the beautiful confiers in the Masterton park were raised in Wellington Botanic Garden around 1878 and sent to Masterton either as a direct donation or through Mr. McCardle the Nurseryman who laid out the Park. Mr. McCardle also obtained many of his conifers from the Wellington Botanic Garden.

The pines on the skyline of Wellington's Botanic Garden have been growing there for over one hundred years and form a historic skyline which can be associated with the beginning of the forestry industry in New Zealand. By 1875, 127 species representing 12 genera were established in the Gardens and even as early as this *Pinus radiata* and *Cupressus macrocarpa* showed promise. There are many beautiful stands of pines in Wellington's Garden, the Stone Pine, Lodgepole Pine, Corsican Pine, Roxburgh Pine and many others. Other species feature as single specimens but not all of the original 127 species have survived. Recent additions of dwarf confiers complement the earlier confier plantings.

There is another area in Wellington's Botanic Garden which has great historic importance and that is the 'Wooded Area'. What an English description for the indigenous vegetation which grows in the steep valleys. The trees growing in these valleys are remnants of the coastal broadleaf forest which once covered the area before European settlement began. The archives for the Botanic Garden include an unpublished paper by the early Botanist and Draughtsman J. Buchanan. Entitled 'Notes On The Colonial Botanic Garden, Wellington And Its Flora', this paper was read to the Wellington Philosophical Society in 1875. Using Buchanan's list of indigenous plants endemic to the Reserve, a comparison can be made with plants growing in the Reserve today. The result is surprising, since collectively over all the remaining areas in bush most of the species are still represented today except for the podocarps and their associated epiphytes. The bush contains beautiful trees of hinau, titoke, kohe kohe, ngai, tarata, rewa rewa, and northern rata. Also present are specimens of *Cyathea medularis* with trunks 20' - 30' high. Large Kanuka trees are present and all these, including the pungas and kanuka could be over 100 years of age.

Although Buchanan said that the number of species was less than in the surrounding areas this statement is somewhat misleading since there was considerable variation in the natural vegetation depending on altitude. Forest at Wilton and Karori had a greater density of podocarps per acre than that in the broadleaf cover nearer the coast. Another unpublished paper of Buchanan's written in 1870 does not distinguish between the areas and puts all the identified plants in one list. Did he use this list for his comparison?

Some podocarps did originally grow on the Reserve and some old ones were still there in the 1880's. Today, none grow naturally in the bush. Some species are represented by only one or two specimens. The composition of each valley is different so that it is necessary to retain them all if the original vegetation is to be preserved. The areas are fragile and management procedures to increase humidity, prevent wind exposure and remove adventive's are highly desirable if the areas are to retain their present value and be handed to the future. Dr. E.J. Godley has drawn attention to the importance of this remnant of lowland native bush. He suggests that limited restocking, based on Buchanan's list and taken from genetically related material is possible. This would seem appropriate since some species are represented by one or two specimens only. Some totara is coming back naturally, the source being a planted row of totara on Hill Path.

The historic significance of this Garden is still visible today but both the conifers and the native bush are delicate and of course ultimately, as the pines pass maturity and need to be removed the visible link with the past will disappear.

The Gardens were handed to the Wellington City Council in 1891 so that in 1991 the Council celebrates a hundred years of management. A history of the Reserve from 1840 to 1991 is at present being undertaken. As the centenary approaches it is time to consider the skyline for the future. It is time for horticulturists and botanists to consider the potential of the Reserve and give support to the Council as it enters the second century of its administration. The Garden is an important one which can turn in two directions. One is towards just a pleasant Domain for public enjoyment, the other is toward a Botanic Garden retaining visible links with its historic past while continuing to serve those in the community who have a specialised interest in horticulture and botany. This would be a Garden worthy of the Capital City.

In conclusion I wish to acknowledge the resources of the National Museum which have provided much information contained in this brief article on the History of the Colonial Botanic Garden, and the help of our Vice President Dr. E.J. Godley in confirming my assessment of the bush im the Wellington Botanic Garden.

Theses Presented by Candidates Completing the National Diploma in Horticulture in 1983

N.D.H. THESES

PETHERAM A.K.	*Castanea sativa*, propagation by budding methods.
PETHERAM J.A.	Planting in Road Reserve