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ORCHIDS IN NEW ZEALAND

July-August, 1978

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ORCHIDS IN NEW ZEALAND

Official publication of the Orchid Council of New Zealand

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EDITORIAL

The Waikato Orchid Society has been working for many months to present to the orchid public a one day seminar. This issue brings to readers the papers presented at Hamilton on 22 July, 1978. The five papers are produced in full and our thanks must go to the authors concerned as it is apparent that a lot of time and effort has gone into their preparation.

Our regular features will appear as usual in the next issue of the magazine.

Thank you Bay of Plenty Orchid Society for the donation of $150. After a considerable journey the cheque reached the Council Treasurer just one week prior to expiry date.

Our congratulations to Mr. Frank Askin, President, Wellington Orchid Society, on his recent award of the C.M.G. in the Queen's Birthday Honours List.

It is with pleasure we welcome the Wairarapa Orchid Society as an affiliate member to the Orchid Council of New Zealand. Societies please note: Club Secretary is Mrs. Iris Booth, 112 Essex Street, Masterton.

Judging News Correction

In the last issue of the magazine we published a list of succesful judges; the Registrar General advises that in No. 4 Regional Panel the name, Graham Robertson is to be included and R. Wilkins deleted.

Generally the fungus absorbs starch from the cells of the host and uses it in the synthesis of nitrogenous substances which are reabsorbed in turn by the host cells. Gastrodia sesamoides is unique in having a secondary association with nitrogen — fixing bacteria which swarm within the cells of the rhizome and stem.

Gastrodias are difficult plants to find because of their colour, or rather lack of it. All have a dull brownish green stem with dirty white flowers. The flowers are bell shaped and are pendant. I've found them growing from the Bay of Plenty to Southland although obviously they are not now as common as they once were.

Usually I look for them in the bush under fairly dense canopy with not too much growing on the floor. As they have quite tall stems with practice you can spot them.

I've not tried cultivating Gastrodias and think they are better left where they are.

G. sesamoides grow up to 60cm high and have about a dozen flowers in spring and summer.

G. cunninghamii is a much larger plant often a metre or more tall. Usually there are many more flowers and I've counted over 40 on some spikes.

G. minor is apparently similar to G. cunninghamii and probably derived from it. I've not seen a living specimen of this species.

Pterostylis barbata

I find the genus Pterostylis a fascinating one, and P. barbata is among the most interesting and usual of them. It is not very common in New Zealand and my own plants were obtained in Australia.

In many ways it is similar to most Australian Pterostylis in that it grows from a rosette of leaves about 3cms long and 5mm wide. The stem bears two or three bracts and ends in a solitary flower. This has the usual features but with some important differences. Firstly, there are no feelers (sepals) which we associate with this genus. Secondly, the labellum is pendulous and covered with long golden hairs. The tip has a large variously lobed purple callus. A group of these plants in flower is something to behold. What pollinates P. barbata is not known, and the part the unusual labellum plays in this would be an interesting study.

P. nutans. This is another uncommon species in this country. In Australia it would be one of the most frequently encountered species and easy to cultivate. It gets its name from the nodding single flower.

A large rosette of half a dozen leaves up to 5cms long and 3cms broad, sends up a spike in spring. The flower has the usual features but is distinctly drooping.

I love P. nutans because it can be relied upon to produce a pot of flowers every year and multiply quite quickly.

Calochilus

Calochilus are usually called "beardies" from the hairs found on the labellum.

The tuber and single leaf are almost impossible to distinguish from those of a Thelymitra. It's probably for this reason that not many are found. It is only when in flower, that what they are is easily apparent. After flowering the dried flower remains for a long time and makes identification possible.

C. robertsonii grows in similar places to Thelymitra ixioides and often with it. In the Bay of Plenty, it seems to flower in November which is the best time to look. The stems are strong and up to 50cms tall in some cases, with from 1-8 large green purple flowers and a mass of red purple hairs on the labellum.

Calochilus are difficult plants to keep in captivity for any length of time. They seem to flower the first year, throw a small stem the second year with one or two flowers and then fail to reappear in the third year.

I've tried lifting them carefully with a large amount of soil, but they always seem to finish up the same way. Currently, I'm trying to raise them from seed in the hope that such plants might be able to survive.

Two other species are also found, C. campestris with greenish yellow flowers, and C. paludosus, a very large species growing up to a metre or more in height.

These are just a few of the not so common native terrestials which I hope will whet your appetites and perhaps encourage some of you to grow our lovely New Zealand orchids.

INTRODUCING THE WAIKATO SEMINAR

by Tom French, New Plymouth

Mr. Bell, members of the Waikato Orchid Soc., fellow orchid enthusiasts, I feel that all orchid growers will want to join with me in congratulating the Waikato Orchid Society in organising and hosting this seminar, which by the theme chosen, and the speakers listed to speak to this theme, promises to be a very important orchid event in this orchid year.

The theme for this seminar, "Orchids today: Where are we? What does the future hold?" is very applicable at this time. Many orchid growers and enthusiasts feel that although great progress in the popularity of orchids has occurred in the past decade, as evidenced by the rapid growth of Orchid Society membership, but, that in the development of a culture most suitable to the climatic conditions of this country, and in the development of strains of the more popular genera which will be typically New Zealand we seem to have reached a cross roads in progress. Where are we today? What does the future hold?

To know where we stand with orchids today, it is necessary to look at the past in some degree. My own knowledge of the past is somewhat limited, but research through some of my father's papers enabled me to gain a little idea of orchid growing from the early 1920's. Although no orchid societies existed, and orchid growers were few and far between, some interchange of orchid experience did take place, and among others, the names of Mr. Fred Powell, now of Auckland, and Mr. Jim Gardener of Matamata, occur frequently in his letters. The culture of orchids in those early days was based mainly on that of England and the Continent, and although this presented some difficulties in our climate, a good deal of success was attained. The main genera grown seem to have been Cattleya, Paphiopedilum and Dendrobium, with a few Cymbidium, mainly species.

With the importation of many Cymbidium hybrids in the 1930's, and a break from the more traditional methods of growing this genus, an increase in the popularity took place, particularly with the realisation that for Cymbidiums a glasshouse was not an essential in many parts of the country.

World War 2 saw the export of many fine seedlings and clones of Cymbidium from England to Australia and a number of these found their way to New Zealand. The ease of culture and beauty of form of these Cymbidiums aroused great interest and an upsurge in the number of Orchid enthusiasts leading to the formation of the New Zealand Orchid Society, based in Auckland in 1948. This body provided a means of communication between growers throughout the country and played a vital part in the rapid development of the orchid cult at this stage.

The difficulties of attending meetings in Auckland led to the formation of district Societies in various centres, the first I believe being the Waikato Orchid Society, and the Canterbury Society, followed latterly by many others. A series of meetings between these Societies during 1973-74 led to the establishment of the Orchid Council of New Zealand, with the object of the furtherance of orchid culture in New Zealand by the mutual cooperation of Member Societies.

The membership of The Council now stands at fifteen Societies, and many proposed projects have been put into operation.

We must not overlook the important part played in orchid progress by the commercial cut flower growers, more especially in the realm of exports of Cymbidium blooms to the American and European markets, a most valuable contribution to our National economy, and further bringing to the notice of amateur growers breeding trends of other countries. Pioneers in this section of orchid growing were Mr. Hepburn of Whakatane and Mrs. K. Black of Levin, proving that New Zealand growers can compete successfully on world markets with quality blooms. The business of growing and exporting blooms has expanded rapidly, and we now see the development of the co-operative, which caters for the smaller grower who wishes to add to the export potential.

Today, although the bulk of orchid collections consist of Cymbidiums, there is a growing awareness of the beauty and interest of what is known as other genera, providing a display of blooms throughout the year. So this is one of the crossroads at which we stand today; will the grower of tomorrow tend to specialise in one genus; or shall we see once again the mixed collections of 50 years ago?

Over the past few years orchid hybridising has been carried out on a small scale by some of our more progressive or enthusiastic growers. Some hybridising has been on the hit or miss system, but others have instituted planned breeding programmes, and it is to these persons we must look for the future progress in the production of plants suited to our needs, both for the amateur grower and in the field of commercial cut flowers, and surely we have now in New Zealand the breeding stock for this to be accomplished.

Associated with a breeding programme is the necessity of improving our methods of seed raising and clonal propagation. A study of results from some overseas laboratories, shows that sturdy large size seedlings and mericlones are being produced in a relatively short time, but those doing this work are naturally reluctant to reveal details of flasking media used. Surely New Zealanders with their record of initiative, can by freely exchanging experience and knowledge, raise the standard of flasking in this country, to the ultimate benefit of the orchid cult generally. Having established progressive breeding programmes and attained improved methods of propagation; what can we do with all these orchids? I am informed that there is still room in the Northern hemisphere markets for more of our orchid products, although other Southern hemisphere countries are rapidly planning to take advantage of this demand. Traditionally New Zealand has made use of the co-operative system to aid in the production and marketing of the products of our land, thus enabling the employment of large scale and more economic methods, and leaving the producer free to concentrate on the provision of high quality basic products. I am sure that a paper on this subject is of interest to a number of those attending here today.

Orchid growers in this country are fortunate that many of the more serious pests and diseases of orchids are not present here, although I understand that many are intercepted through our quarantine system for imported plants. It is to be hoped that all importers of orchid plants adhere strictly to the quarantine requirements and so keep to a minimum the reliance on chemical sprays in the maintenance of pest and disease free plants.

It should be noted that many sprays classified as relatively safe for in the garden or orchards present a much greater danger to the operator when used in the confined space of the glasshouse or shadehouse, as some growers recently discovered to their cost. I am sure that all those present here do wear approved protective equipment when using insecticides and fungicides. The reason for spraying with chemicals is to kill the bugs: not yourself.

Our New Zealand native orchids are now receiving more attention from a number of enthusiasts, and there is room in this area of orchid culture for more research into growing conditions, propagation and eventually hybridisation. One of the highlights of the recent Australian Orchid Conference in Perth was the massed display of native terrestrial orchids, mainly raised from seed.

Ladies and Gentlemen, at the conclusion of this seminar we must all have gained a better understanding of the place of orchids today; and more than a glimpse of what the future holds for orchids and orchid growing in New Zealand.

From January onwards I inspect the pots daily and as soon as any shoots appear the pot is returned to the shade house and treated normally.

In early April, all pots are returned to the shade house, whether in growth or not.

3. Fertilising — No manures are used although I'm tempted to try a little 'Blood and Bone' to see what happens. Very dilute foliar feeding is used once the orchids are in full growth at regular intervals. Most species seem to respond well and I've not observed any ill-effects so far.

4. Watering — It takes time but I like to put the pots out in the rain periodically, but of necessity must use supplementary watering. It is better not to water from above unless the plants are dry by night. This is particularly important during humid spells in the Bay of Plenty.

5. Pots — To begin with I used only clay pots but am now moving more to plastic. Of course watering has to be done more carefully and an even more free draining mix is vital. The big advantage lies in the fact that there is much less moisture fluctuation. Clay pots can dry out very quickly and terrestrials, when in growth, do not like to be so treated.

6. **Pests and diseases** — My biggest pests are thrips and greenfly. At times leafroller can be troublesome. For small infestations of thrips I use methylated spirits. Recently I've tried using systemics but it is too early to say whether this has had adverse results on the plants.

Leaf rot can be very troublesome with some genera, particularly Thelymitras. Good ventilation and care in watering are the best preventative. Affected plants, I treat by cutting off the rotted leaves and spray with a copper spray or some fungicide.

7. **Reproduction** — Most genera reproduce vegetatively, quite quickly. A few however refuse to make more than one or at most, two tubers per year. I've tried both methods that have been suggested in other journals with some success. These are:

(a) As soon as the plant has finished flowering, remove it from the pot. The new tuber will be found to be almost fully developed. Take off the new tuber carefully and replant the orchid. Usually it will now produce a second somewhat smaller tuber.

(b) With a sterile blade cut the tuber exactly in half, being careful to divide the new shoot. Seal the fresh cut surfaces. (I use sulphur/copper or wax) and plant. As a rule two new plants will develop.

8. **Seed raising** — Growing terrestrials from seed has been and is still a difficult job. Some success can be expected using agar and the flask method, but as a rule, the young seedlings refuse to develop chlorophyll.

Of recent years, I've noticed seedlings growing in my hanging baskets and sphagnum moss in the pots of carnivorous plants. As these are grown in the shadehouse with the terrestrials, the seed must have blown in. Under such conditions Thelymitras have flowered in two years.

At present I'm concentrating on using a method introduced very successfully in South Australia. This involves using the parent pots. The top of the pot is surfaced with a small quantity of powdered rotted wood from the bush and this covered with a layer of chopped pine needles. The seed is sown on here and kept moist. It is too early yet to say how successful this method has been, but if it's anything like what I saw in Adelaide, I'll be very pleased.

9. **Growing in the open ground** — I've not done much of this but it worked quite well with Pterostylis and Thelymitras on the banks at the back of the section. The big problem is to keep weeds etc. from choking out the orchids. Only one orchid has succeeded in the garden to date. This is the lovely Thelymitra venosa. which I grow in rows with my other bulbs.

Gastrodia

We have three species of this very interesting genera in New Zealand, one also found in Australia, the two others endemic.

Gastrodias are leafless saprophytes with large tuberous rhizomes. The power possessed by fungi to absorb soluble salts from the soil has been used by many plants for nutritive purposes. It is with the orchid family that this partnership has reached its greatest complexity.

The underground parts — In most cases these are tubers. These tubers vary enormously in shape and size and can not be used as a method of identification except very roughly. Mature tubers of Corybas may be only 2-3mm in diameter while Thelymitras and Orthoceras can grow up to 8cm long and 14mm in width. Usually the growing point can be seen quite easily by inspection but in the case of very small tubers or very dry ones, it's not always easy to do so. I don't think it matters too much if they're planted upside down, but if you're worried, wait until the autumn when they start into growth and you'll soon see which is the right way up.

When the tuber begins to grow, particularly in large species like Thelymitras, the shoot will reach a considerable height before it starts to send out roots which grow from the stem a short distance above the tuber and not from the tuber itself. Until roots are produced the plant lives off the tuber so be careful with the water. Many good tubers have been lost through soaking pots and keeping them wet because a leaf is visible.

A new tuber or tubers are produced every growing season. In some species these will be right beside the old tuber, in others at distances up to ten or more centimetres away. Usually species which only make one or two tubers grow close to the parent, while the more prolific like Pterostylis grow at some distance. The roots are quite large in relation to the plant, particularly for example in Corybas. Occasionally in pots the roots will come out of the mix for a number of reasons (too small a pot, too firm a mix) but these turn green and act like leaves. Some orchids have a rhizome or thickened rootstock in place of the tuber: e.g. Spiranthes.

The leaves — With the exception of the saprophytes, all our terrestrials have a leaf(s) at some stage. When the plant is in full growth the leaves are a help in identification, in at least you can place the genera, or group of genera. Juvenile plants can complicate the issue as in some species they are quite distinct from the adult.

1. Those having a single onion-like leaf — Microtis, Prasophyllum.
2. Those with more or less heart shaped leaves, close to the ground — Corybas, Acianthus.
3. Plants with long strap-like leaves which may be ridged or grooved. There can be considerable variation within a single species, but they are always relatively narrow in proportion to length — Thelymitra, Calochilus.
4. Species with usually two leaves opposite and close to the ground. Leaves thin and relatively wide in relation to length — Aporostylis, Chiloglottis. Some young Pterostylis are easily mistaken for this group.
5. Pterostylis — a few species have rosettes in juvenile forms and these flower before the leaves appear. Others flower from rosettes, but most species are easily identified as Pterostylis by the stem with its alternate long thinnish leaves.
6. Hairy leaves — Lyperanthus, Caladenia.
7. Orthoceras — has several long narrow leaves.

Growing Native Orchids

Most people have their own methods and if yours works for you, then stick to it. I observe carefully the habitats and conditions in which I find orchids growing and try to provide something similar: i.e. whether they grow in full sun, filtered light, full shade etc.

Potting mixtures — Ideally, I suppose, there should be different mixes for different genera, but I don't have the time, so make up a basic mix and vary this by adding for example, leaf mould to suit.

1. Mix must always be free draining. To obtain this, I use about 10% sharp sand. To this I add half rotted leaf mould and or very old untreated sawdust. For Corybas and Acianthus, I use at least 30% of leafmould, and plants like Thelymitras, Calochilus and Orthoceras only 10%.
2. Rest period. Most terrestrials have a dormant period and this is summer in our area. When the plants have died down store them in a cool airy place. Don't dry them out rock hard. I store mine in the basement of the house.

Rest period may be as short as 2-3 weeks or several months, it is important to know your plants.

WHERE ARE WE WITH CYMBIDIUM BREEDING TODAY?

by I. D. James, Hamilton

The answer to the question posed above is, to a large extent, evident from an observation of present day hybrids. What is not always so evident is where we have been in the past. Unfortunately much important information gained by both past and present hybridizers has not been published and often not recorded. Yet a knowledge of what has gone before is essential to a full understanding of what present day hybrids represent and to the planning of a future breeding programme.

Notwithstanding what we have said above probably no breeder of other horticultural plants has as much specialised genetic and geneological information available to him as the hybridizer of the more popular Orchid genera. We do not however, seem to have as much of this kind of knowledge of Cymbidiums as we do of say Cattleyas. Prior to World War I, Cymbidiums were regarded as "botanicals". Liking cooler conditions and being easy to grow, they graced the conservatories of the homes of wealthy Englishmen but seldom appeared before the R.H.S. as candidates for awards. A new era emerged in the 1920's with the appearance of Cymbidium Alexanderi 'Westonbirt'. This clone had flowers of much superior quality to any known at that time and more importantly proved to be a superior parent. When crossed with almost any other Cymbidium it produced progeny which were of almost uniformly high quality. These progeny were known then as "Westonbirts" and commanded high prices. Unfortunately the progeny were themselves largely sterile and seldom produced viable seed.

Most or all of the inherited characteristics of progeny are determined by a genetic code contained in the chromosomes within the nucleus of each cell. With higher plants and animals the normal state is for the cell to have 2 sets of chromosomes, one set contributed by each parent. Cymbidium species have 2 sets of 20 chromosomes usually expressed as 2N = 40. We now know that Alexanderi 'Westonbirt' has 4 sets of chromosomse (4N = 80) and that its floral superiority was due to this. Such 4N plants are known as tetraploids. When crossed with diploid (2N) they produce triploid (3N) plants with 60 chromosomes. The good qualities of Alexanderi 'Westonbirt' were predominant in its offspring because it contributed 2 sets, or 40 chromosomes, and the diploid parents with which it was mated only one set, or 20.

Following Alexanderi 'Westonbirt' other chance tetraploids came to light. These included Pauwelsii 'Comte d'Hemptinne', Rosanna 'Pinkie' and Early Bird 'Pacific'. The four clones mentioned established blood lines which have dominated the breeding of whites and pastel colours for the last 30 years. Yet by 1956 there were published authenticated reports of only 10 tetraploids, some of these being the progeny of the other known 4N plants. In that year Dr. Earl Wells of California published the results of a prodigious undertaking involving the counting of the chromosome numbers of 110 choice Cymbidium clones from Europe, Australia and the U.S.A. His list brought to light many new tetraploids and a feverish rush on the part of some of us at that time to try and get our hands on them. The Cymbidium breeder now has within a limited range of types, innumerable tetraploid stud plants at his disposal. Most have arisen by crossing existing tetraploids. However some have emerged during meristematic tissue culture or seed germination, either by chance or treatment with the drug colchicine.

4N plants crossed with 4N plants give 4N progeny. 2N plants crossed with 2N plants give 2N progeny. 4N plants crossed with 2N plants result in 3N progeny. 3N pollen is sterile. A 3N plant may occasionally produce a seed pod and a little seed which will germinate in the flask but subsequently grow poorly, few if any, seedlings reaching flowering size. Exceptions have however been recorded to all the above rules. If we take a 2N

clone and convert it to a 4N with colchicine, the 4N plant, compared with the 2N, is likely to have:-

Fewer flowers per spike.
Flowers with wider lips and wider columns.
Darker and stiffer leaves.
Shorter flower spikes.
Flowers with broader sepals and petals and slightly larger size.
Flowers with thicker sepals and petals — i.e. more substance.
Later blooming characteristics.
Slower growth — sometimes more than one season to make up a new bulb.
Less vigour — although this is controversial.
Uneven growth in a population of seedlings — many more "runts" which will not grow satisfactorily compared with a 3N or 2N cross.

3N plants have, in general, characteristics intermediate between 4N and 2N plants. However, often 3N seedlings tend to have the even growth rate and vigour of 2N plants. The round, heavy flowers we now expect of modern recently awarded hybrids often owe much of their quality to polyploidy. However many of our best Cymbidiums are still diploids and it is important that the hybridizer understands the undesirable traits that can come with polyploidy as a package deal. Further, the continued use of diploid parents may be essential to progress with some breeding lines.

It is also important that the hybridizer has a knowledge of the basic laws of inheritance. If we consider an inherited character such as dwarfness, it may be dominant or recessive. If we cross a dwarf or miniature species with the dwarf character dominant, with a large species all the progeny will be miniatures even although only one of the set of 2 chromosomes (the set contributed by the miniature parent) carries the miniature factor. However if we self pollinate one of the progeny 75% of the second generation will be miniatures and 25% larger plants. If we consider two independent characters, say colour and flower shape, with white dominant over red and poor shape dominant over good shape, then crossing a good shape white with a poor shape red will result in first generation seedlings which are all whites of poor shape. However if we self pollinate one of these, one in every sixteen of the second generation seedlings will be a red with good shape. Although the latter example illustrates the principle, it will not necessarily be exactly that way in practice — for reasons discussed later.

The classic Mendellian ratios described in the preceding paragraph may not appear if the plants are other than diploids. To take the first example above, if the letter M is taken to represent one chromosome set (referred to as a genome) of the miniature species, the diploid plant, with its pairs of chromosomes can be described as MM. Crossed with the large species LL, all the first generation seedlings are ML and as already described they will all be miniatures due to the dominant dwarfing character carried by the M genome. Now suppose we culture the meristematic tissue of each species and convert them to tetraploids with colchicine treatment. The converted plants with their now 4 sets of chromosomes will have the genome constitution MMMM and LLLL respectively. Cross the two and all the progeny will be MMLL and as expected, all dwarf plants. However if we self pollinate the MMLL plant we do not, as was the case with the second generation diploids, find one large plant in every four. In fact there will be no large plants — all will be miniatures or exhibit some miniature characteristics.

The reason segregated second generation hybrids do not appear using tetraploid parents in the above manner is that there is no "crossing over" or exchange of genetic material between the pair of MM chromosomes and the pair LL chromosomes during meiosis. The egg cells and sperm cells produced by the MMLL plant all have the constitution ML, and their fusion can only produce MMLL plants. If miniatures are what we wish to breed this is a desirable state of affairs. However if we turn now to the other example and convert the good shape white and the poor shape red to tetraploids, repeating the breeding programme will not result in one in sixteen of the second generation being good shape reds. There may be some reddish flowers of fairly good shape but because all the second generation must carry the white factor in at least one of the

NEW ZEALAND ORCHIDS

by W. J. Forrest, Te Puke

Why do I grow New Zealand orchids? It's not because of their size or their flamboyant colours. It can't be because they are unique as most genera are found in even greater variety in Australia. Indeed most of our genera and species are believed to have arrived here as wind borne seed from Australia. Does there have to be a reason? Yes, I guess there does, and in my case it's because they are a unique part of our flora which if we're not too careful will go the way of the Huia and the Moa. Orchids as you are all well aware, are not the easiest of plants to cultivate and terrestrial orchids are usually more difficult than epiphytes. All except half a dozen of our reputed species are terrestrials.

According to the Flora of New Zealand, Vol. II, there are twenty-one genera represented out of a world total of 500-800. Only three genera, (Aporostylis, Earina and Yoania) are not also recorded in Australia.

List of genera:

Tribe Neottieae

1. Acianthus, 2. Adenochilus, 3. Caladenia, 4. Aporostylis, 5. Chiloglottis, 6. Lyperanthus, 7. Corybas, 8. Calochilus, 9. Thelymitra, 10. Caleana, 11. Pterostylis, 12. Orthoceras, 13. Prasophyllum, 14. Microtis, 15. Spiranthes.

Tribe Epidendreae

16. Gastrodia, 17. Earina, 18. Dendrobium, 19. Bulbophyllum, 20. Yoania, 21. Drymoanthus.

The Orchidaceae is one of the largest families of flowering plants in the world numbering some 30,000 species and varieties. The orchid family, is considered to have originated from the Liliaceae and is perhaps the most advanced in the Monocotyledoneae. Although the family is thought to be rather ancient in respect to geologic time, no fossil remains have been found. This could possibly explain the connection with the Australian orchids.

Distribution of our Native Orchids

Although New Zealand extends for over 1600 kilometres from north to south, its narrow width and insular location means the climatic variations are much less than one would expect. Indeed, altitude and aspect are more important in producing climatic differences.

Although soil and topography have a definite influence upon terrestrial species, there is little doubt that temperature and moisture are the most essential factors which control the distribution and survival of all orchids both terrestrial and epiphtic. In temperate regions like New Zealand, orchids may be roughly divided into those which occur in open bogs, meadows, fields and similar habitats, and those which grow in wooded areas.

Two important factors affect our present knowledge of the distribution of orchids. Firstly, a great percentage of the country has been converted into farmland in the last century and secondly, knowledge of the distribution and abundance of any species of plant is relative to the amount of botanical collecting which has been carried on in a given area. An illustration of the first, can be seen today in the swamp reclamations in Southland. Here vast numbers of the beautiful Thelymitra venosa, Prasophyllums, Chiloglottis, Aporostylis, Caladenia, and Aelenochilus can be found but I venture to say that in a few years they'll be no more, or at least, very limited.

Man's activities are not all adverse however and orchids are tough customers when it comes to survival. One such habitat provided by man is the roadside and roadside cuttings. This is particularly true now that stock droving is virtually a thing of the past. When out searching for orchids I always make a careful study of road verges, not only in New Zealand but also in Australia.

Some orchids occur throughout the country and the outlying islands as well, while others are more restricted in area. Another feature is that as they move southwards, orchids like Aporostylis, found only at altitude in the North Island, are found at sea level in the far south.

General characteristics of New Zealand Terrestrial Orchids

While there may be considerable variation, nearly all our orchids have the same basic characteristics.

Recently introduced materials of interest to commercial growers, or larger hobby growers for use when resistance has developed to older compounds. Propagite gives good two-spotted mite control under high temperature conditions and seldom causes injury. Limited experience with these compounds so test plants for safety before widespread use.

7. **Tin Acaricides**

cyhexatin (Pictran®). A very effective but slow acting acaricide generally of lower activity, against two spotted mite, than propagite. Does not affect mite predators. Of interest to commercial and larger hobby growers.

Other members. A range of tin compounds, including fenbutatin-oxide (Torque®), tricyclotin and azocyclotin have recently been introduced. Little experience on orchids but very similar properties to cyhexatin is evident from their use on other crops.

8. **Petroleum Oils**

Orchids are seldom treated with oils. Changes in nomenclature have been made and the following is a brief summary of oils available in New Zealand.

Winter Oils: Seldom used oils designed for winter use on deciduous trees.

Intermediate Oils: Oils designed for spring use on deciduous fruit trees.

Narrow Range Intermediate Oils: Not at present available, but designed for late spring use on deciduous trees and winter use on citrus.

All-Purpose Oils: A highly refined oil suitable for use at any time of the year on tolerant plants. Supersedes summer oils. This would be the oil to select for use on the few orchids tolerant to spraying oils. Rates of use vary depending on the time of use, higher rates being required when the pests are most tolerant in winter.

Note: Most orchids will not tolerate oil sprays of any type.

Used for control of mite and scale insects and with the addition of a suitable organophosphate for mealy bug control.

9. **Miscellaneous Compounds**

9.1 **Chloromethane sulfonamide**

'KumitoxR'. A systemic acaricide, safe on orchids, which can be applied as a high volume spray, included in water applied by the trickle irrigation system or drenched into the media.

Gives control for several weeks and one of the most effective acaricides used on orchids. Suitable for both commercial use and home gardens. Not cleared for use on food crops due to inadequate toxicological information on residues. Slightly hazardous but avoid excessive contact, washing off material contacting the skin.

9.2 *Metaldehyde*

Various types of baits containing 'Meta' or metaldehyde are marketed for slug and snail control. The life of these baits is short and under wet conditions repeat applications will be desirable, if slugs or snails are present, at 5-7 day intervals. These baits are suitable for home garden and commercial use. Problem infestations in commercial production can be better controlled with sprays of aminocarb or methiocarb followed by the use of the metaldehyde baits. In non-commercial situations repeated use of baits and hygiene gives adequate control.

10. **Soil and Media Disinfection**

Commercial growers have available chlorpicrin and methylbromide for media disinfection.

All growers can use formalin and metam (Basamid) for disinfection and may test safety of treated media by germinating cress seeds in treated and untreated media samples. The media is safe to use when no differences occur in germination time. Further details of media disinfection will be discussed if requested, during the question time.

Discussion Period

It will be assumed that all participants will have read these background notes. Further details and explanations will be given and it is hoped that there will be an exchange of notes on experiences, particularly in regard to safety or injury observed following the use of many of the new compounds on the more sensitive species of orchids.

Any commercial growers who wish to have details on the safe handling of commercially available pesticides, may request this information at the conference.

4 sets of chromosomes and must carry the poor shape factor in at least one of the remaining ones, we do not find perfect colour and perfect shape combined in any one plant.

The examples given above, particularly the second one, may, in practice, be an over simplification. Good shape may be controlled by many, not a single, genetic factor. The good shape characters may not be entirely dominant over the ones for poor shape, or the poor shaped red may in fact have carried some unsuspected characters for good shape. What we are emphasising is that polyploidy can be a double edged sword for the hybridizer with long range goals. It may be possible to breed out an unwanted character by raising successive diploid generations but if it has not been done before we convert a plant to tetraploidy, subsequent attempts may fail and if the character happens to be of a dominant nature, the breeder will have entered a one way street.

Some Cymbidium hybrids currently cultivated have only 3 species in their ancestry. Few have more than 8. Hybridists have thus had a relatively small gene pool to draw on and this has restricted progress in developing or improving desirable traits. Following is a brief history of the development of the main colour categories.

REDS

These possibly present the greatest challenge as the reds we have lag behind the other colours in quality and the road to improvement is not at all clear. Even their origin is somewhat obscure. A study of "Sanders' List of Orchid Hybrids" will show that our present day reds are largely founded on 3 clones. These are C. Ruby (parentage uncertain but attributed to C. giganteum), C. Cooperi (said to be a natural hybrid, but from what?) and C. Ceres. C. Ceres is recorded as a hybrid between C. i'ansonii and C. insigne, (and the important clone is variety 'F.J.Hanbury' FCC-RHS) and for this reason there are references in the literature to C. i'ansonii being the species in which present day reds have their origin. Yet this species is not described as a red flower. It is interesting to read the comments of Sir Jeremiah Coleman who crossed C. tracyanum and C. lowianum prior to World War I and distributed many of the hybrids under the label of C. i'ansonii (under protest) because the experts of the day had pronounced that C. i'ansonii was a natural hybrid between those two species. When the seedlings bloomed, the experts were proved to have been wrong. However in the meantime Sir Jeremiah's hybrids had been used to make further crosses with the possibility that many present day reds with a recorded ancestry back to C. i'ansonii have no C. i'ansonii blood in them at all.

C. Ceres 'F.J.Hanbury' was awarded by the R.H.S. in 1931 and its exhibition showed that the introduction of solid red colouring into Cymbidiums had been achieved. Thirty years of hybridising followed before the standard of the reds was raised to a new plateau in 1961 when Wondabah Orchids of Sydney registered their cross of C. Sensation (C. Spartan Queen x C. Fascination). C. Sensation is largely founded on the C. Ceres bloodline but C. tracyanum and the mysterious C. Cooperi are also recorded in its ancestry. C. Sensation and its subsequent remakes is proving difficult to surpass. Many of the best reds we currently have bear this label. Unfortunately it is sometimes a reluctant breeder and it is often difficult to get viable seed from some of the better clones.

In California Stewarts produced, in the mid 1950's the cross of C. Khyber Pass (C. Profita x C. Carisona) also with bloodlines going back to C. Ceres but with C. Ruby and C. Cooperi also in its ancestry. C. Khyber Pass has proved a prolific parent (although often passing on to its progeny its column deformity), its progeny including such well known clones as C. Tethys, C. Sabre Dance, C. Tapestry. Stewarts also produced a number of other reds with the same basic bloodlines we have been describing and these, with C. Khyber Pass have been hybridised to produce many reds of similar quality.

The salient feature of current breeding for reds throughout the world is that we are getting new hybrids but few clones which are showing anything but a marginal improvement in floral quality over their parents. In the short term we can expect some good things to come from the conversion of existing clones including seedlings, to 4N plants by colchicine treatment. However there will also be disappointments here as polyploidy will accentuate some

poor characteristics already inherent in many red plants.

Red is an elusive colour in Cymbidiums. Cross a red with some other colour and the red is diluted to, at the best, pink, or at the most, an assortment of muddy colours. To preserve the red colour in the first generation a red flower must be crossed with a red flower. This has been known to hybridizers for many years and has resulted in their work in this colour being restricted to the narrow breeding lines discussed, preserving the red colour but also preserving some deficiencies in shape, flower size and spike habit. The only obvious way to produce really "new" reds would be to cross our best diploid reds with suitable diploids in other colours, self fertilise some of the progeny and look for improved reds in the second generation crosses — and perhaps taking a short cut by treating this second generation with colchicine while in the flask.

WHITES

The early tetraploids were mostly whites and largely for this reason we had flowers in this or the white with pink flushing category of reasonably good shape long before equivalent standards were approached by other colours. The years immediately prior to World War II were dominated by the triploids produced by C. Alexanderi 'Westonbirt'. Following World War II this type of breeding was dominated, and perhaps still is, by tetraploids founded upon C. Alexanderi and C. Rosanna 'Pinkie'. Typical of these are the large, round, cupped flowers in crosses of C. Balkis, C. Etta Barlow, C. Joan of Arc and C. Pearl-Balkis. The whiteness in these crosses comes from C. eburneum and one or two allied species which have only 2 or 3 flowers on shortish upright spikes. The short spikes and low flower count are difficult to eliminate. Further, C. Rosanna tends to transmit the damnable habit of flowers which open when turned inwards to the spike. Some very good modern whites have been raised by crossing a tetraploid from the breeding lines discussed above, with one of the better shaped diploids, usually a green, which have emerged in recent years. C. Via Real (C. Sussex Dawn x C. Etta Barlow), Dr. Lloyd Hawkinson (C. Joan of Arc x C. Blue Smoke) and C. Highland Mist (C. Mary Ann x C. Miretta) are typical of this type of breeding. They often have arching or semi arching spikes (a white with an arching spike was a rarity 30 years ago) with a good flower count. However being triploids they do not breed and are the end of a line.

Interest in breeding whites seems to have fallen. Yet there is much to be done. The goal is a plant with a tall upright spike carrying at least 14 well spaced outward facing flowers of good size, flat shape and with a sparkling white crystalline texture with no purple staining whatsoever on the dorsel sepal. Such a plant will attract the judges like a magnet. Throughout the world at Cymbidium exhibitions the best on show, or grand champion, is more often than not, a white.

GREENS

If one who had left the Cymbidium scene as recently as 15 years ago, came back to review the advances made in the intervening period, the improvements achieved in this colour category would impress him the most. In the early post war years interest in breeding greens seems to have fallen away, particularly in California, where most of the breeding was based upon the new tetraploids which did not include any available greens. Not impressed by the absence of suitable tetraploids some hybridizers, with McBeens of England in the forefront, continued patiently with diploid breeding to produce generations of greens using the simple formula of crossing the best flowers available. Progress was slow but about 10 years ago some very superior diploids started to appear on the exhibition benches. These included C. Fort William (C. Pearlbel x C. Baltic), C. Loch Lomond (C. Miretta x C. Sussex Dawn) both from McBeans. From Australia came C. Joyce Duncan (C. York Meredith x C. Micky) and in New Zealand John Young's cross of C. Baltic Knight (C. Baltic x C. Green Knight) produced some clones ranking in merit with the best of those mentioned.

Some of the good diploids mentioned now have tetraploid forms and with other promising green tetraploids appearing, such as C. St. Patrick 'Shamrock' (C. Sussex Dawn x C. Mandarin) from the U.S.A., the future is promising. Many have some less desirable traits, including weak spikes, but some of the 4N forms seen impress as good breeding material. The first

4.2.2 **Short Life**				
maldison 'Malathion^{R}'	½-2	General Insecticide	Slightly hazardous	Hobby use. Wettable powders least phytotoxic. Test varieties first. Often injures especially as emulsifiable concentrate.
4.2.3 **Medium Life**				
pirimiphos-methyl 'Actellic^{R}'	7-10	Aphis, white fly mite, scale mealy bug, caterpillars	Slightly hazardous	Experimental use on orchids suggested. A promising material on many ornamentals.
diazinon	7-10	General Insecticide	Moderately hazardous	Commercial & home garden use. As for maldison above.
azinphos-methyl 'Gusathion^{R}'	21	Caterpillars scale etc. General insecticide	Very highly hazardous	Standard commercial insecticide. Test for safety.

5. Carbamates

Common Name	Active Life (days)	Pests Controlled	Toxicity	Availability & Comments
carbaryl	3-5	Caterpillars, scale crawlers, mealy bug, earwigs, earthworms etc.	Slightly hazardous	Home garden and commercial. Short life material of useful but low activity usually not phytotoxic at recommended rates. Do not overspray.
aminocarb 'Matacil^{R}'	10-14	As above plus slugs & snails	Very highly hazardous	Commercial users only.
methiocarb 'Mesurol^{R}'		(Methiocarb repels birds)		
methomyl 'Lannate^{R}'	3-7	General Insecticide (systemic)	Very highly hazardous	Commercial use only. Widely used on ornamentals and vegetables.
oxamyl 'Vydate^{R}'	10	Systemic for mite and nematodes	Very highly hazardous	Commercial use only for mite and nematode control.

6. Bridged diphenyl and related acaricides

Generally slightly hazardous slow acting effective acaricides. Most require careful timing in relation to stages of development if mite present. Follow label directions. Mite will develop resistance to these compounds following repeated use over a period of several years.

tetradifon

'Tedion^{R}' An ovicidal type material acting on eggs or adults to prevent fertile eggs being produced. Not effective on high populations where it can be combined with a knockdown type compound to extend control. Wettable powders cause less phytoxicity but are also slightly less active, and leave more residue. Avoid treating flowers.

dicofol

'Kelthane^{R}' controls all stages except eggs. Useful. Can be combined with tetradifon.

bromopropylate Neoron^{R}
benzoximate Citrazon^{R}
propagite Omite^{R}

3.4 **Endosulfan.** A slightly less toxic pesticide slightly more active than lindane, with similar uses.

Note: Except for small quantities of DDT and lindane and for certain uses with endosulfan, permits from the M.A.F. are required to apply (and purchase) these compounds.

4. Organophosphates

EXAMPLES OF ORGANOPHOSPHATES

Type	Active Life (days)	Pests Controlled	Toxicity	Availability & Comments
4.1 **SYSTEMICS**				
4.1.1. **Short Life**				
mevinphos Phosdrin[R]	½	all	Very highly hazardous	Commercial users only. Very useful but highly toxic. Seldom phytotoxic.
4.1.2 **Medium Life** menazon	14-21	aphis	Slightly hazardous	Hobby and commercial. Generally useful in home gardens.
acephate Orthene[R]	14-21	whitefly, aphis caterpillar, suppreses mite & mealy bug	Slightly hazardous	Commercial growers (availability to home gardens expected). Very useful compound.
demeton-S-methyl Metasystox-i	21	ditto	Very highly hazardous	Commercial users only. Very useful. Check for safety. Injurious to **Calanthe, Phragmopedilum** or **Stanhopea.**
omethoate Folimat[R]	21	mite, mealy bug, midges, scale and many other pests	Very highly hazardous	Commercial users only. Highly active. Check for phytotoxicity first. It does occur on some types
4.1.3 **Longer Life**				
phorate Thimet[R]	23-42	aphis (soil use)	Very highly harzardous	Commercial users only. Effective when incorporated in media or granules applied to media in containers and watered in.
disulfoton Disyston[R]	35-42			
4.2 **NON-SYSTEMICS**				
4.2.1. Fumigants *dichlorvos* 'Vapona[R]'	½	All insects & most pests except slugs & snails	Very highly hazardous	Commercial use only. Very useful. Use 1.8g active to 1000 cu ft. Test for phytotoxicity first. If flowers present, fumigate only while they are dry.
dichlorvos aerosol	Immediate only	ditto	ditto	For use in the home according to direction. Very low concentration but highly effective if vapours contained in small draught free area.
naled 'Dibrom[R]'	½	ditto	moderately hazardous	Commercial use only. May be slightly more phytotoxic in some situations.

results from these will come from a race of new vigorous triploids achieved by breeding back to choice 2N clones. And can we hope for greens that do not fade to yellow in strong light?

YELLOWS

None of the species used in hybridization had the strong clear yellow colour we see in some of the modern hybrids. Yet there are records and pictures of strong yellow clones appearing from the earliest times. But there were not too many of them and remarkably none of the early clones seemed to have established any breeding dynasties. Typical is C. Apollo which produced many progeny which were intensely coloured but reluctant breeders. Then came in 1951, C. Hawtescens which was possibly the best yellow seen in a flower of such stature (C. Apollo was incidentally a grandparent) and was, rumour had it, a tetraploid. Only one or two clones seemed to have been produced, or survived, of this cross. However it disappointed by not producing much viable seed.

There always has been one sure fire way of producing yellows, and that has been by crossing a white flower with a green flower, when a few yellows emerge in the progeny. Many were produced in the 'Westonbirt' era by crossing Alexanderi 'Westonbirt' with a green diploid to produce many clear yellows. Many were pale and faded to cream but there were exceptions — Swallow 'Daffodil' which is still popular, is a very early example. A later example is C. Valya Craig which produced a few good quality yellows of glorious colour. C. Shiraz (C. Alexanderi x C. Shirley) appeared in a number of yellow forms which were all tetraploid (both parents being tetraploids) but although there are some fine individual yellow clones among its progeny, it has not yet been mated with anything that has resulted in the production of good yellows in quantity.

A breakthrough may have come with the emergence of some tetraploid forms of C. Wallara (C. Balkis x C. Auriga) in Australia. C. Wallara 'Gold Nugget' is probably the best yellow Cymbidium yet seen, although the flower spike is a little short. It yields good seed. Some C. Wallara progeny have already flowered with a good yellow colour but it is too early to pass judgment on its future as a stud plant. What it needs as a mate is a diploid yellow with a long (not pendulant) spike with many large flowers. Does anyone have such a plant?

POLYCHROMES

This term is often used to describe flowers which are so muddy that they defy classification in to any other colour group. However a combination of two bright, clear colours can produce striking results. A good example is C. Clarisse Carlton (C. Cambria x C. Babylon) where many of the clones exhibit a unique smokey colour, basically red over green, which is appealing but hard to describe. The formula for producing such colours is not clear. However some other progeny from that famous 4N parent, C. Babylon 'Castle Hill', have similar intense colour combinations — along with the tremendously powerful spike habit with which C. Babylon endows its offspring.

Space and time do not permit a review of other current breeding lines such as miniatures, "pure colours" and breeding for early or late flowering habit. However there is one factor common to them all — they can all be improved. Raising seedlings can be a fascinating hobby for the amateur who may have a bigger part to play in Cymbidium development than he has in the past. Due to a shift in interest to mericlones and other reasons, some commercial growers find that unflowered seedlings do not now command prices sufficiently high to enable them to be raised and sold economically and offer them only in flasks. Most seedlings are disappointing but the occasional good one compels us to keep trying.

There is a necessity to keep accurate records and for older hybridizers to record or pass on the knowledge they have gained. There is a necessity for records to be kept of failures as well as successes. There are many mysteries unsolved. Why is it that there are so many accounts of repeat crosses using identical pod and pollen parents producing different results from the original cross? Why is it that a high proportion of the really great crosses appear to have been made where one parent was infected with virus? Is it true that triploids which have yielded viable seed have done so because they were virus infected.

Continued on Page 13

ORCHID PROPAGATION

by Phillip Wyatt, Cambridge.

Propagating orchids is possibly the second most important aspect in growing orchids. The first is obviously to get them to grow and flower. The propagation of orchids, in all aspects, is constantly being reported in serial publications, books and monthly orchid society meetings. To cover everything fully would require rather a substantial book, so in this article I shall dwell briefly on each method leaving out much information which can be gathered through a wide reading programme.

Orchid growing was initially the preserve of the English gentry. Indeed very high prices were paid for some very rare plants, and this of course put the growing of orchids out of the reach of all but the wealthy. To increase their collections, the growers would finance collecting trips to South America and India, and while these provided very significant botanical finds they were expensive. Often only a few plants out of thousands would survive the voyage back to Europe. As with any plants it was not long before commercial nurseries tried to propagate them and provide large numbers for resale at a reasonable price, and names that come to mind are Vietch & Sons, and Sanders. During these early days when the bush was plundered for its flora there was not much consideration given to preserving plants in their wild habitat, but over the past five to ten years, much emphasis has been placed on limiting bush collections and forcing people to obtain their plants by self perpetuation of plants already in 'captivity'.

Initially orchids were propagated by divisions and back bulbs. This method is very slow and it takes many years to build up a small stock of any particular variety. Keiki formation in Dendrobiums, Vandas, Phaleanopsis and others, is another vegetative method commonly used, often unintentionally, for small scale production. How many times have you watered your soft cane dendrobium too early only to find the flower buds turning into plants?; or have you had the top of your Vanda knocked off suddenly and discovered what should have been flower nodes. initiating into new plantlets?

This is all right for the amateur growers, but those involved in the retailing of plants want large numbers quickly.

Attempts to grow orchids from seed were filled with frustrating failures. The dust like seed is an embryo without a food reserve so it needs to obtain an outside source of nutrition. This is provided by the complex relationship orchids have with the fungi, mycorrhiza, but until the mid 1900's these mycorrhiza were not recognised as being of any importance. Still, in some cases, the seeds were found to germinate if they were scattered on top of the potting mix of an established plant, and some even grew into plants, but as the survival rate was extremely low this method could not have a major impact on producing plants for distribution. Other methods were searched for to raise seed, and the first major innovation was the use of ground ophyrus tubers which was called Salep. This did not provide a completely reliable seeding medium as its chemical composition varied. The next step was to analyse this Salep and devise a chemically defined nutrient solution to replace it. The two most prominent figures in this work were Burgeff and Knudsen.

Orchid seeding gained its greatest boost in 1922 when Lewis Knudsen published his formula for a nutrient solution for the aseptic culture of orchid seed. This was certainly a great advancement over 'Salep', the concoction used up until then. For some plants seeding still remains the main method of propagation, e.g. the Cypripedium alliance and other terrestials, but it has as its main drawback the inability to reproduce the parent plant true to type. Rather than consider seed sowing as a method for producing replicate plants, it is best left to be considered in the realm of hybridisation, but the basic techniques and media developed for seeding are all important

1.8 **Thiadiazoles**

The soil fungicides *etridiazole* **(Terrazole®)** and fenaminosulf (Dexon®) are active against **Pythium** and **Phytophthora** organisms causing damping off of orchid seedlings etc. Fenaminosulf is highly hazardous and a S3 Part II poison. Etridiazole is frequently incorporated in soiless media. These materials may be applied as dusts or drenches, pre or post planting. Repeat at 1-12 week intervals as specified on the label directions. To avoid injury do not exceed recommended rates.

1.9 **Quinone Group and related materials**

Dichlone (Phygon XL) is seldom used on orchids but may be a useful disinfectant on cut surfaces, if tolerated, and is effective against algae on benches. Choranil is a seed fungicide used on vegetable seeds.

Chinosol (8-hydroxyquinoline sulphate or oxyquinoline sulphate) and 8-hydroxyquinoline have been recommended as general disinfectants to protect cut surfaces and eradicate bacterial and fungal infections on orchids. Chinosol is marketed by Hoechst (New Zealand) Ltd., P.O. Box 67, Auckland, who could advise local suppliers and both compounds are sometimes available from chemists as pharmaceutical grade products. Use at low dilutions according to directions, frequently originating from U.S.A. recommendations.

1.10 **Oxazolidine and Hydantoin compounds**

A very recently developed group of compounds undergoing development in New Zealand. **Vinclozolin (Ronilan®)** is effective against botrytis and Sclerotinia type organisms and iprodione (previously glycophene) is in addition active against Alternaria and Rhizopus. Both are long life compounds that may be effective on difficult to control wet weather fungi on orchids.

1.11 **Fluanid group**

Dichlofluanid is active against botrytis, but is inclined to be damaging to some plants and leaves a heavy spray deposit.

1.12 **Triazines**

Anilazine (Dyrene®), a mild acting fungicide for wet conditions controls botrytis and alternaria problems.

2. **Insecticides and Acaricides**

2.1 **Naturally Occurring and Related Compounds**

2.1.1 **Pyrethins.** Naturally occurring pyrethins from the pyrethrum daisy are very good knockdown materials, but have too short a life to be useful in horticulture. Solvents of some formulations can be very damaging.

2.1.2 **Synthetic Pyrethrins.** A number of synthetic compounds are now coming onto the market, including *permethrin* (Ambush®). These compounds give excellent control of many insects and are effective at very low rates, leaving no visible residues. All control caterpillars while control of mealy bug and scale is achieved by some of the group. Ideal for orchids. Watch for commercial developments.

2.1.3 **Nicotine Sulphate.** An S3 Part II Restricted poison useful as a fumigant for aphis control. Seldom causes injury providing plants are dry but some plants are sensitive to it. Very highly hazardous and superseded by inorganic compounds.

2.1.4 **Others.** Rotenone (Derris) and ryania have few uses on orchids. They are short lived and leave heavy residues. If on hand, derris dust is active on caterpillars and spider mite. Better materials are available.

3. **Organochlorine Pesticides**

3.1 **DDT, TDE Group.** Very stable compounds giving control of most large insects such as caterpillars and beetles. Emulsifiable concentrate formulations will cause injury so use wettable powders. TDE is no longer available.

DDT may be used as a treatment for media to control soil insects and as a residual spray for slater control. In media use ½ oz active material to every cubic yard of media. May damage petals so use before flowering. A toxicologically safe but persistent compound active on foliage for three weeks and in the soil or media for at least three years.

3.2 **Lindane.** Effective for control of aphis with a shorter life for beetles and caterpillars. Do not use emulsifiable forms because of risk of injury. Active for up to 10 days.

3.3 **Cyclodiene Group.** *Aldrin* and dieldrin are available for use as soil or media insecticides but should only be used by commercial growers following detailed instructions on their safe use. These materials are very dangerous and must be used so that no contact occurs with the skin and body (inhalation etc.). Life at least 3-4 years in the media.

Bisdithiocarbamates

Common Name	Examples®	Spectrum
zineb	Dithane Z78	Wet weather fungi, rusts,
maneb	Dithane M22	Wet weather fungi
mancozeb	Dithane M45	Wet weather fungi, rusts, spider mite
	Manzate 2000	
metiram	Polyram 2000	Wet weather fungi, spider mite

of efficiency. They are active against many wet weather disorders, captafol being outstanding against Glomerella and other wet weather fungi, persisting for 10 weeks or more on treated foliage. Test sensitive plants first and avoid skin contact since it is an irritant. Recommended, when tolerated, during periods of high humidity and lower temperatures to prevent continuing spread of fungi affecting the leaves or plants.

1.5 The dinitrophenyl group containing **dinocap** (Karathane®) are used against powdery mildews and mite. They have no uses on orchids.

1.6 A wide range of so-called systemic fungicides are now available. Many of these are not true systemics but at least penetrate into the plant and move locally in leaves. Related materials are discussed together.

1.6.1 Benzimidazoles

Common names	Trade Examples	Fungi controlled
benomyl	Benlate®)	botrytis, sclerotinia type fungi, many leaf spot fungi
thiophanate-methyl	Topsin®)	
carbendazim	Bavistin®)	

Unfortunately, many fungi are developing resistance to these materials, and once resistance to one occurs, all are ineffective. Useful for controlling outbreaks of the listed fungi, but avoid regular use and reserve them for special problems. Can be added to potting mixtures but will not control Pythium, Phytophthora and other related damping off fungi.

1.6.2 **Pyrimidines**

Includes dimethirimol (Milcurb®), pyrazophos (Afugan®) and others effective against powdery mildews which orchids don't get and are therefore of no interest.

1.6.3 **Oxathins**

Oxycarboxin (Plantvax®) is very effective against rusts and could be tried for safety, if rust is a problem on indigenous orchids. Spraying three times at 21 day intervals is effective on most rusts.

1.6.4 **Piperazines**

Triforine (Saprol®) is active against a wide range of fungi including rusts and many wet weather disorders. Worth evaluating on problem diseases. (Outstanding on most rose diseases when applied at 21 day intervals.)

1.7 **Nitrated Benzenes and Related Compounds**

Quintozene (PCNB) is effective against a wide range of soil fungi including **Rhizoctinia, Sclerotinia, Sclerotinium** and **Rosellinea.** (It is not effective against **Fusarium, Pythium, Verticillium, Phythphora, Thielaviopsis** or **Aphanomyces).** When possible identify the fungi causing soil problems and disinfect the media. Quintozene may be effective in controlling losses in many cases. Use is now restricted to horticultural type applications but it is still obtainable as Brassicol®.

Chlorothalonil (Daconil® Bravo®) is frequently used on ornamentals to control botrytis and fungi affecting flowers. It may be of interest on orchids for similar problems.

Dicloran (Botran®) is effectvie against Rhizopus, a fungus active under high temperatures on foliage and sometimes in media.

in the more modern art of tissue culture, and the formula of the two most important nutrient solutions are reproduced here:

Knudsen Formula 'C'		
Calcium Nitrate	Ca(N03)2 4H20	1.000gm
Ammonium Sulphate	(NH4)2S04	0.500gm
Magnesium Sulphate	MgS04 7H20	0.250gm
Potassium diHydrogen Orthophosphate	KH2PO4	0.250gm
Ferrous Sulphate	FeS04 7H20	0.024gm
Manganese Sulphate	MnS04 4H20	0.0075gm
Sucrose		20.00gm
Agar (N.Z.)		9.00gm
Water (Distilled)		1.0 litre

Vacin and Went 'Soln. 5'		
Tricalcium Phosphate	Ca3(P04)2	0.200gm
Potassium Nitrate	KNO3	0.525gm
Potassium diHydrogen Orthophosphate	KH2PO4	0.250gm
Magnesium Sulphate	MgS04 7H20	0.250gm
Ammonium Sulphate	(NH4)2S04	0.500gm
Ferric Tartrate	Fe(C4H4O6)3 2H2O	0.028gm
Manganese Sulphate	MnS04 4H20	0.0075gm
Sucrose		20.00gm
Agar (N.Z.)		9.00gm
Water (Distilled)		1.0 litre

In both cases the pH of the media should be adjusted to around 5.5 prior to sterilising. The solutions are then dispensed into 250 ml flasks to a depth of around 2cm. These flasks are then plugged using a rubber bung which has a hole packed with cotton wool and sterilised in an autoclave or pressure cooker at 15lbs per square inch for fifteen minutes. After sterilising, the flasks are left to cool and the media solidifies. They are then ready for use. Numerous additives can be included in this media, depending upon the end use to which they are to be put, i.e. micro nutrients, phyto hormones, complex organic homogenates and vitamin complexes to name a few. Those that are important do not lose their activity with sterilising.

To be able to successfully sow seed, and carry out tissue culture you require a sterile working area and a quite well lit room to care for your flasks. All this requires time and can be a lot of expense, but for those who are successful there is a sense of achievement in raising your own hybrids from seed.

Plant tissue culture has revolutionised orchid growing in all aspects. Now, within a very short space of time thousands of plants can be prepared from a single mother clone and usualy come true to type. Admittedly the chance of mutation increases with the propagation of very large numbers, but often these are advantageous such as conversion from the diploid to tetraploid state as with C. Cariga 'Canary' 4n. Over the past eighteen years since George Morel first introduced the orchid world to tissue culture, the variety of genera produced in this manner has greatly increased to include most of those of commercial importance, including Cymbidium, Cattleya, Odontoglossum, Vanda, Phalaenopsis and Dendrobium.

One genera that still successfully appears to evade the knife is the Cypridpediaceae, but this seems due to contamination problems of the apices rather than the sheer cussedness of the plants. Nevertheless there are some reports cropping up of success in this direction, and who knows, we may soon be culturing Paphiopedilum Winston Churchill 'Indomitable' in its thousands.

The main source of initial material for tissue culture remains the apical or lateral meristematic areas, but other parts of the plant have been investigated as a tissue source, such as the leaf edge or base of Cattleyas, or the roots of Vandas. One source however, that seems to be of increasing importance is the use of the dormant eyes on a Cymbidium backbulb. This saves destroying a new shoot or waiting for the bulb to strike. When Morel first started tissue culturing orchids it was in a bid to produce virus free plants, and in order to achieve this the smallest possible amount of starter material is necessary. So only the first pair of leaf primordia along with the apical meristematic area of the plant was used. To do this a good stereo microscope and very fine tool, along with a steady pair of hands are required. It did not take long to find that by using a much larger explant it was still possible to successfully culture the tissue. The major disadvantages of using such a large explant is that the tissue around the meristematic area dies and the explant may not survive, and that virus is not eliminated. Each plant, hybrid or species, has its own proliferation rate, even different varieties of the same hybrid shows this phenomenon. Thus it takes no time at all to whip up

several hundred plants of **Cymbidium** Bethlehem 'Magi', whereas Cleo Sherman 'Flamingo' or Alexanderi 'Westonbirt takes a little longer giving only two or three growths from each corm. To overcome this reluctance to proliferate the use of cytokinins in the media has been increasingly practised. Once there are enough corms to give the desired number of plants, phytohormones are again invaluable to speed up the process. The addition of auxins induces apical dominance and promotes rapid root growth, sometimes to the extent there are more roots than leaves!

Over the past seven years or so, not much has been published on tissue culture, except perhaps to report on the progress in the continuing saga of the Paphiopedilums. Attention has now been focused onto other aspects of propagation such as the use of phytohormones, or more recently, the use of morphactins to increase vegetative growth without using special aseptic techniques. Now with increasing knowledge on phytohormones, it is no longer necessary to lamage your plant or lose your flowers. The use of these chemicals is especially invaluable to the grower who only wants two or three extra plants from one of his favourite. A mixture of auxins (Indole acetic acid, Naphthalene acetic acid) mixed into a paste to be applied to the nodes of the plant is now available in the U.S.A. These pastes are especially recommended for Phalaenopsis, where the flowers are broken off from the spike, and the paste applied to this area. Another phytohormone, 6 Benzyl aminopurine, a member of the cytokinin group, can be used in a similar manner, the method of which shall be reproduced here:

1. Weigh 10 milligrams of 6 Benzyl amino purine.
2. Add to 200 millilitres of water, being careful not to splash any of the powder onto the side of the container.
3. Place into a pressure cooker and cook at 15lbs for fifteen minutes 'Benzyl-aminopurine is not soluble in water and if you do not have access to a pressure cooker a drop or two of detergent such as Tween 80 will suffice.
4. Make the total volume up to 1 litre with water.

Now we are ready to tackle the plant, with an eye dropper; place a few millilitres of the preparation into the axils of the plant. Those plants which lend themselves best to this sort of treatment would be Vandas and Paphiopedilums.

The culture and care of the plants may continue as usual after about four or five days. The range of plants that this may be used on is only limited by your natural curiosity. To date there have been no reports of gross flower deformities from the use of phytohormones, but watch carefully, and adjust the rate and time of application accordingly.

Morphactins were 'discovered' in Germany in 1964 where they were originally developed and marketed as weedicides. During the ensuing years as more become known about their mode of action on the plants, the possibilities of other uses became evident. They are commonly known as anti-auxins as they act by preventing auxins from binding to the active sites in the apices, allowing the lateral apices to develop. The effect is the same as decapitating a Vanda, as it is the apical meristematic area, which by binding the auxins promotes its own growth at the expense of the lateral meristematic areas. Other effects of morphactins are; the disproportionate production of female flowers in relation to male flowers, and a greater amount of fruit set. This should not affect orchids too much which are mostly unisexual, except if used when in flower, could induce pod setting. It has also been known to induce flowering, and this brings to mind an interesting exercise, combining gibberellic acid with the morphactin in an attempt to control flowering times of plants to suit the flower markets.

The member of the group of morphactins most commonly used is Methyl-2-chloro-9-hydroxyfluorene-9-carboxylic acid, or Chlorfluorene, or Maintain CF125 (the commercial preparation). One note of caution before I go further: the full effects of chlorfluorenol on orchid plants and their flowers has not yet been fully investigated. So far it appears that

PESTICIDES AND THE ORCHID GROWER

by D. A. Slade, Senior Lecturer in Horticulture, Massey University

This paper will make brief mention of the more important fungicides, insecticides and acaricides used in horticulture with comments on their usefulness on orchids. Since there are some commercial producers attending, mention has also been made of S3 Part II Restricted Poisons available only to commercial growers. These materials are generally too toxic for home garden and hobby use since the general public do not have either the knowledge or protective clothing to enable them to be used safely. And a note of caution to everyone: **Read the Label** before you open the container. Follow the instructions. The most toxic pesticides will cause fatal poisonings if one drop is splashed in the eye! This type of 'accident' need not occur.

Pesticides will be discussed in related chemical and biological groups. There are more than 2500 registered trade products in New Zealand. I will use common names which are on all labels. Any mention of trade named products (indicated by ᴿ) is to assist indentification.. No endorsement of the named product or criticism of similar un-named products is implied.

A wide range of pesticides are mentioned for background information. Those which are in *italics* are my recommendations of materials suitable for use in orchid production. The remaining details are for those who may require more specific information. In the discussion further aspects will be described and questions answered.

Orchids suffer from infections resulting in leaf spots and rots caused by a number of wet weather fungi, including Glomerella, Cercospora and Botrytis. Often superficial sooty moulds may be associated with insect infections.

Important insects include aphis, mealy bug, scale, caterpillars, while other pests include spider mites, slaters (wood lice), slugs and snails.

Diseases are encouraged by humid conditions and may be avoided or reduced by reducing the humidity about the plants. Don't forget to use other similar approaches to control — chemicals are not the only answer to diseases and pests.

The Materials available for pest and disease control

1. **Fungicides and Bactericides**

1.1 Sulphur is available in many forms, depending on particle size. It controls dry weather disorders such as rusts and powdery mildews but is also phytotoxic (plant injurious) so has no place in orchid spraying. Lime-sulphur is even more phytotoxic, controlling similar fungi and, only on deciduous plants, scale insects.

1.2 Copper is also phytotoxic to most plants but can be applied as insoluble bordeaux, copper oxychloride and oxides. It supresses bacteria. Copper is often used for the control of wet weather disorders on a wide range of plants but is too phytotoxic and leaves excessive residues for general use on orchids.

Many of the other older inorganic fungicides occasionally used on orchids, such as mercury, cadmium, lead and arsenical based materials are no longer available, having been replaced by more desirable synthetic organic pesticides.

1.3 The dithiocarbamate fungicides contain **ferbam,** now superseded and *metam* a soil disinfectant (see later).

1.3.1 The bisdithiocarbamates include several products summarised below. In general they are mild acting fungicides active against wet weather disorders, leaving visible deposits on plants.

My preference in this group for control of fungi such as Glomerella and Cercospora on orchids, is for mancozeb and metiram because they have possibly more persistence and a good spectrum, including when used regularly, a marked effect reducing spider-mites.

1.3.2 **Thiram** is closely related to this group controlling in addition botrytis. It is however, very short lived and superseded by the above compounds and benomyl.

1.4 Phthalic acid derivatives include *captan*, **folpet** (Phaltanᴿ, Flit 407ᴿ) and *captafol* (Difolatan)ᴿ. These are arranged in increasing order

* Rotylenchus reniformis. The reniform nematode. A tropical and sub-tropical plant pest, common overseas in house plants. Found on a ginger plant ex Hong Kong.
* Radopholus similis
* The burrowing nematode which has 244 known hosts. The cause of citrus decline in Florida, banana decline in Fiji - Australia. A pest of palms, pepper, avocado, tobacco, kumara, ginger and many tropical, subtropical and glasshouse crops. Intercepted on ginger from India.

Other major pests and diseases which have not been recorded or intercepted in N.Z.

Pseudomonas cattleyi. Bacterial brown spot — causing leaf spot and leaf rot of cattleya, Phalaenopsis.

Several rust diseases, especially in Cattleyas. Rusts are host-specific. Cattleya rust is in some commercial nurseries in U.S.A.

Parralelopsis Cattleya. Cattleya gall midge — causes galls on the roots and severe reduction in growth of cattleyas.

Conclusion.

New Zealand is relatively free of serious pest and disease.

Every importation of plant material carries the risk of introducing disease.

Diseases can be difficult and costly to control. Some also affect economic crops.

Regulations, permits, quarantine and inspection are all part of the system to prevent entry of unwanted pests, diseases and weeds.

The price of freedom is eternal vigilance.

Freedom from serious pests and diseases of orchids is no exception.

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any ill effects are only transitional, and may be dependent on the time of application in relation to flowering.

Possibly the best method of application would be as a paste painted around the base of the plant. Spraying could be considered but as chlorfluorenol is quickly metabolised by the plant it may not persist long enough with a single application to be totally effective. Chlorfluorenol is one of the most active members of the group, and as we do not wish to destroy the plant fairly low concentrations are used. So the method to follow is to mix up a paste using Maintain CF 125, a 12.5% solution of chlorfluorenol, in unscented lanoline:

1. 1.0gms lanoline is weighed into a wide mouth container.
2. Measure 0.25 mls Maintain CF 125 and add to the lanoline.
3. Mix thoroughly!
4. Add to this a further 9gms lanoline.
5. Mix thoroughly.

This gives a paste ready to use. Using a small water-colour paint brush apply the paste to the base of the plant. Orchids to which this has been applied with apparent success include Paphiopedilums, Cymbidiums, Asocendas and Sophronitis. Still there are many other genera which may respond favourably to this treatment. Chlorfluorenol has a low animal toxicity rating, but it would still pay to observe all the precaution afforded a highly toxic chemical.

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If we have made mistakes in the past it has probably been to concentrate too much on individual flower quality at the expense of spike habit. Too many modern hybrids have short spikes and a low flower count. Perhaps we should try and find out what happened to those long spiking many flowered diploids we threw out years ago because the flower quality was inferior to the polyploids. It may be that some could be usefully incorporated in to modern breeding programmes.

1980 CONFERENCE

The broad outline of what we proposed for the 1980 Conference is now decided and the various committees are making detailed plans.

In mid-May, members spent some hours at our venue (Ellerslie Racecourse) taking exact measurements of the floor areas. Particulars of the space available to Societies wishing to take part in the 4-day Show are our immediate concern as you will all require this information before designing your entries. The Show Schedule, together with Conditions of Entry, is drawn up and in its final form will be sent out as soon as possible. At the moment it is proposed that Society exhibits will be in two classes, those to a maximum of 7.5 sq. metres and another class to a maximum of 3.75 sq. metres. The prize list is yet to be decided but we are already promised trophies from Societies and individuals. Please advise the Secretary, Box 33-493, Takapuna, Auckland 9, if you intend donating a trophy.

Publicity is going into more detailed planning too. Top quality slies of orchids are needed—we have been invited to submit a selection to the N.Z. Govt. Tourist Bureau for possible use by them. A Conference Calendar featuring orchids is another possibility for 1980, and such slides for either of these projects can be of any genera. The greatest care will be taken of them.

We are greatly encourged by the offers of support for the Show and Conference received from N.Z. Societies and even before our official letter of invitation was sent overseas, we had enquiries from other countries. All promises well for 1980.

IMPORTED PLANT DISEASES

Joy Amos, Horticultural Advisory Officer, Ministry of Agriculture & Fisheries, Auckland

Orchids in New Zealand

* New Zealand has several indigenous species of orchids.
* Cymbidium cut flowers are produced for export earning about $300,000 per year at present.
* Several orchid nurseries sell plants and cut flowers on the home market.
* Thousands of home gardeners grow orchids for pleasure.

The Disease Situation

* Three diseases have been recorded on our native orchids.
* Tomato mosaic, Cymbidium mosaic and mixtures of these two viruses are very common in cultivated orchids. Most of the named viruses are known to be present. Although there are many of these, in fact only about five viruses are involved, the common disease names being synonyms or names for mixed virus infections.
* About thirty pests and diseases have been found on cultivated orchids in New Zealand.
* A large number of pests and diseases are known to be present world-wide.
* A few of these are of greater economic importance on alternative hosts than on orchids.
* Every orchid import carries the risk of bringing in more pests and diseases.
* The risk is such that orchid plants (except those imported in flasks) are now subject to Post Entry Quarantine.

What is imported?

Cut flower orchids from Singapore arrive each week in Auckland, Wellington and Christchurch. They are inspected on arrival prior to distribution to florists throughout the country.

Orchid plants are flown in from many parts of the world. In the year ending June 1976 about 20,000 plants were imported plus an unknown number of seedlings and mericlones in flasks.

Those in flasks are raised in aseptic conditions in laboratories and for this reason are allowed in without restriction.

Some orchid plants are collected from their natural habitats or grown in natural conditions in the open in Singapore, Thailand, South America, S.E. Asia, Pacific Islands and other countries. These represent a much greater risk.

Plants from reputable nurseries in countries with strict plant health regulations similar to our own are relatively free of pest and disease. Some, such as cultivars of Cymbidiums, are the highly cultivated progeny resulting from decades of hybridising under glass in Europe, U.S.A. and in Australia.

How are orchids imported?

Modern methods of propagation have had a dramatic effect on the quantity, price and availability of orchid plants. Modern methods of transport (airfreight) ensure that plants from most parts of the world arrive in good condition within three or four days of being packed at the export nursery.

Commercial growers and orchid fanciers are therefore able to import plants with relative ease.

Pests and diseases can arrive with the plants, in or on the plants or in the packing material. Very few of them are likely to die in transit as the time is short and conditions favourable. Some even develop and multiply en route.

This is why there are regulations — to try to prevent the importation and establishment of more pests and diseaess in New Zealand.

Plants and cut flowers of orchids must have an International Phytosanitary Certificate accompanying them, issued after inspection by Plant Health authorities in the country of origin. On arrival they are inspected again.

Plants are put into post-entry quarantine, as the visual inspection on arrival is not sufficient to ensure that the plants are free of pest and disease. The number is limited to 2,000 plants per importer per year to allow for adequate inspection and supervision. The risk of importing pest and disease also increases with the size of import.

The procedure for importing plants is as follows:-

1. Application form is filled in and returned to the local Horticultural Inspector, Ministry of Agriculture & Fisheries.
2. Proposed plant quarantine area is inspected by Horticulutral Inspector.
3. Permit to import is issued by Plant Health and Diagnostic Station, Levin.
4. Permit is sent overseas with order for plants.
5. Plants are inspected before export. International Phytosanitary Certificate is issued and accompanies the plant consignment.
6. Plants arrive and are inspected by Port Agriculture Officers.
7. Plants are treated, if necessary, then go into Post Entry Quarantine.
8. Plants are inspected by Horticultural Inspector in Post Entry Quarantine.
9. If healthy, plants are released.
10. A charge is made, at present $2.25 for each 50 plants or part thereof, with a maximum of $70.

About 300 permits are issued every year for orchids. This is 25% of all plant import permits.

In 1975/76 approximately 20,000 orchids were imported plus an unknown number of mericlones and seedlings in flasks.

Interceptions of pests and diseases on orchids

The following list for the year ending June 1976 is typical of interceptions.

Country	Proportion of Total Imports	Pest Interceptions
Australia	28%	26
U.S.A.	16%	—
Thailand	10%	8
S.E. Asia/Pacific	15%	20
India	10%	11
S. America	8%	6
Europe	10%	—
Singapore	1.5%	50
Others	2%	—

Disease interceptions on arrival

Botryosphaeria dothidia, Cercospora, Glomerella cingulata (many times), Guignardia citricarpa, Phytophthora, Physalospora, Selenophora, Mosaic virus, Rust (on two consignments).

Disease found in post entry quarantine

Septoria orchidacearum. S. selenophomoides.

Plants collected from their natural habitat in tropical and subtropical regions are likely to have a selection of pests, diseases and 'passengers'. Scale insects, ants and spiders are common. Mealy bug, thrips, leaf roller caterpillars, collembola, sciarid, cockroach, millipedes, slaters, snails, earthworms, bulb mites are occasionally found. (One consignment had twenty different species.) One cut flower import from Singapore had three ant species, a weevil, fly, bee, lacewing and three species of spiders.

Pests and diseases intercepted, not known in New Zealand

* Adoritus sp. Similar to grass grub. A serious pest of flowering plants, roses, cocoa. Not serious on orchids. Intercepted periodically on cut flowers.
* Parlatoria proteus. Cattleya scale. Forms dense colonies at leaf base of orchids and palms. Wide host range.
* Abrallaspis cyanophilli. A scale insect. Wide host range e.g. coffee, eucalyptus, pittosporum, magnolia, strelitzia, anthurium. Frequently intercepted on bananas.
* Hercinothrips spp. At least two species of thrips found on orchids. Potential pest of glasshouse plants.
* Planococcus citri. Citrus mealy bug. A serious pest of orchids, citrus, and glasshouse ornamental plants. Found on nursery stock in PEQ.
* Hemiberpesia lataniae. Latania scale — found on avocado seedlings in PEQ.
* Aspidistra scale. A pest of orchids, citrus, glasshouse plants — intercepted on bananas.
* Guignardia citricarpa. A black leaf spot disease intercepted on orchid plants. A serious disease of citrus.
* Unknown species of septoria leafspot, thrips, leaf roller caterpillar, mealy bug, the significance of which are also unknown.
* Two of the worse nematodes which are not in N.Z. are:-