MR. SANDKUHLE: What about watering?

MR. VERKADE: Your watering problem is minimized. They occupy the same amount of room but they look neater in the flat.

MR SANDKUHLE: You have had no problem from the lack of air on the sides or rotting out of the bottom of the pot?

MR. VERKADE: I haven't seen too much difference.

MR. SANDKUHLE: John, I'd like to make one comment. We have a fine medium for use in the peat pots on the West Coast. We happen to be a user of the UC Mix. Using Redwood sawdust and sand we find in the small peat pots we create quite an algae problem. If not taken care of, it puts quite a crust on the top of the peat pot and, therefore, slows up the percolation of the water. If you are anticipating changing, you want to watch the algae problem.

MR. JACK HILL: What do you do about this algae problem?

MR. SANDKUHLE: At the present time, Jack, we use a copper spray and we have eliminated some of it. We had not noticed it at first and did not take care of it. As a result we had to go in and actually remove the crust. It puts a membrane on top of the medium, somewhere in the neighborhood of twenty-thousandths of an inch, and it prevents the water from going in.

MODERATOR MAHLSTEDE: I think you will all agree that the panel has done an excellent job, so let's give them a hand. (Applause)

It is a pleasure for me to introduce Donald J. Moore, Reforestation Officer, from Hamilton, Bermuda. He has traveled a long way and probably invested quite a bit of money to be here with us this afternoon. After talking to Don before the meeting, I am certain that he has an interesting message to bring us on the topic, "The More Unusual Aspects of Plant Propagation Methods and Experiences in Mist Propagation in Bermuda." Don Moore!

Mr. Donald J. Moore presented his address.

THE MORE UNUSUAL ASPECTS OF PLANT PROPAGATION METHODS AND EXPERIENCES IN MIST PROPAGATION IN BERMUDA

DONALD J. MOORE
Bermuda Botanical Gardens
Paget East, Bermuda

Before proceeding into the main subject matter of this paper, it is, I feel, essential to aquaint you all with a few statistics relevant to Bermuda's geographical location, climatical data and topography. Whilst these factors may not effect propagation to any great extent in a broad sense, they most certainly do dictate problems to us locally. They do this in no uncertain matter.

Our climate may be described as sub-tropical. Geographically, however, we are located in the Temperate zone. Exact location, relevant to the nearest point of land, is 568 miles from Cape Hatteras. The nearest west indian island is Abaca, some 700 miles to the south west. Contrary, to general belief, we are not part of the West Indies, but are indeed, very much an isolated land mass.

We owe our congenial climate entirely to our close proximity to the Gulf Stream. Frost is unknown. The lowest recorded temperature is 41.3 degrees F. The average rainfall may vary somewhat, but to quote official figures, in 1959, we recorded 80.74 inches. June, July and August, are normally the driest months. However, this last August was exceptionally wet, and we recorded 11.55 inches of rainfall in that month.

The Islands cover a total area of some twenty-three square miles. This is of course an extremely small area. An illusion of greater area is created however, by the undulating topography of the country. It is hilly with broad valleys throughout. The highest point above sea level is 250 feet. There are no natural fresh water supplies, but brackish marshes occupy many valleys.

This topography gives some variation in soil types, although light, sandy soils predominate. An exception is a relatively rich red clay loam found in one section.

All soils are basically formed from Aeolian limestone and are therefore completely alkaline, with a pH of 8 and up. Generally speaking, they are very shallow, depths ranging on an average of from 1 - 3 feet. Six inches only down to bare rock, being the rule in many instances. This shallow depth of soil creates an immediate problem when planting out, particularly with woody ornamentals. The following common procedure for planting generally has to be adopted. A wooden stake is placed at the site chosen for a specific plant. A hole is then blasted out with dynamite or drilled, and made ready for planting. Planting may then be carried out.

Summarizing this data, I will now assess the climatical factors, deterrent to optimum plant growth.

Periods of strong wind and accompanying salt spray, decide principally our choice of plant material. Salt spray damage to foliage can be as equally damaging to evergreen foliage as can frost.

Minor, but occasional and prolonged periods of drought, may also have their effect to a lesser degree.

Pathogenic organisms in the soil, unless controlled, may have a field day, with our very high average humidity.

Summarizing soil types, deterrent to optimum plant growth, I would make these observations.

The light texture of our soil, makes water retention virtually impossible.

Drying out is relatively quick after periods of even, prolonged or heavy rainfall. Planting times are in fact, dictated by weather conditions prevailing and variations occur in every season.

The high pH has a three-fold effect. It prevents the cultivation of all acid loving ornamentals, and hinders the progress of those falling in the intermediate range. It locks up many major and trace elements, in a form not available to the plant. Iron deficiency is so commonplace, its appearance is accepted as normal, by many laymen. This high pH has an effet on rooting potential of certain species, but more on this later.

At one time, flora of these islands was dominated by one endemic

tree, namely, *Juniperus bermudiana,* the Bermuda cedar. Today, 99 per cent of these trees are dead, felled, cleared away and replaced.

The arboreal disaster was brought about the entry of a scale insect on coniferous material from the U.S.A., in the mid 1930's.

The pest in question is the Oyster shell scale, *Lepidosaphes newsteadi.* Because of our isolation, the native cedar had remained unmolested for years, and therefore had no genetical resistance to the ravages of this insect. By 1939 the effects of the infestation were becoming clearly visible. During the intervening war years, very little could be done, and by 1945, it became obvious that the greater percentage of the trees were doomed. Suitable chemical control was not available at that time, and all efforts were centered on biological control, this only met with limited success. Other pests contributed to the enemy camp, namely *Acutaspis perseae,* "Black cedar scale," and *Panimerus juniperi,* "Juniper aphid."

The Department of Agriculture, initiated a programme of clearance and replanting in 1945. This programme was known as the Reafforestation programme, but re-beautification would I think be a term nearer to the description of the actual task.

Prior to this period, nursery production of woody plants, had been very limited, and facilities for large scale propagation were non-existent. Also, due to the former dominance of the juniper, the range of desirable ornamentals was also severely restricted. With the cooperation of the governments of Trinidad and Jamaica, nursery production was commenced on our behalf, in these countries. Material was sent in by sea and air, shipped bare root, and grown on in Bermuda for a short while, prior to planting out. By 1950, we were completely dependent of these nurseries, and were producing all material required, ourselves. In 1959, a total of 33,000 trees and shrubs were distributed from the nursery. As facilities have increased so has our production, and in September of this year, 1,850 plants went out in just that one month.

There are three commercial concerns in the island. The largest is in the florist cut flower trade and also produces a quantity of woody stock. As we distribute a certain amount of free material, and sell the remainder at very low cost, it might be said that our competition to this gentleman is somewhat unique and you may feel, unfair?

The other two concerns are a landscaping company, who will shortly be branching out into the production of house plants, and a rose nursery. The Rose Nursery has found a profitable line of business in the sale of budwood to firms in Europe, principally in Germany.

The greater part of our propagation is carried out under slat house conditions, but glasshouses are used to some extent. We are enlarging this latter concern next year.

We also intend to make greater use of the advantages offered by polyethylene and similar products. Wind will be a governing factor however, when considering the erection of all plastic houses.

Slat houses are used on an extensive scale. We constructed out of native juniper, what we consider to be the only house of commercial proportions in Bermuda, some three years ago. This house is 250′ in length, with 13′ wide plant beds on either side of the 12′ wide through-

road. The greatest value of the slat house lays of course in the protection from high light intensity it provides and also in welcome protection from the winter winds.

Frames are of course used extensively for propagation of both seed and cuttings.

Due to the very light nature of our soils it is almost impossible to lift most plant from open beds, with soil attached to the roots. This makes bare root transplanting a hazardous business, particularly with water being a valuable commodity. For this reason, the greater proportion of our stock is grown in cans.

Peat pots are used, for the production of some bedding stock. Clay and plastic pots are used where small quantities of choice exotics are involved.

Many of the methods of plant propagation is relation to cuttings, originated locally, and are typical of those practiced in warmer climates. In some instances, the old way is still the best. However, in most fields, modern methods are to be preferred, and this is the policy I adopted, once having become acclimatized to local conditions. Many plants may be easily grown from relatively thick hardwood internodal cuttings, taken at any time of the year. Subjects propagated in this way, include *hibiscus, nerium oleander, aealypha, polyscias and tamarix.* When these cuttings are inserted in the open ground, where they are intended to grow and remain permanently, no method of propagation could be more simple or effective.

The common method adopted when propagating such material in containers has been to plant each cutting directly into its container. Experience has shown, however, that a high percentage of losses are recorded this way. Prior to rooting, the cutting is critically vulnerable to the adversity of drought or saturation. We are continually hampered by the lack of skilled help, and the art of correct watering cannot be trusted to novices. An almost 100 per cent take of cuttings is ensured, by simply placing your cuttings in a prepared cutting bed, and initiating callus and root formation, prior to potting. This is the only method we use now.

Semi hard wood cuttings of broad-leaved evergreens and flowering shrubs are planted in glasshouse beds and frames in a manner familiar to you all. Bougainvillea roots readily from internodal cuttings of 5 to 7 inches long, but care must be taken when potting off, and the speedier this transference takes place the better.

A method of propagation which we use and which I have developed upon quite considerably, is that of aerial layering, with the use of polyethylene wraps. The polyethylene we use is sold in special widths and is banded and impregnated with Hormodin No. 3. As in some cases, we have also applied Hormodin directly to the cut surface, and have never used clear polyethylene, I cannot say whether the presence of this root accelerator has actually aided or not. Layering is carried out between April and September and the time for rooting varies from species to species, and to a lesser extent from season to season.

The following are species we have had success with: — Ficus in seven species, *Cassia floribunda, Olea europea, Platanus acerifolia, Par-*

kinsonia aculeata and recently an uncommon *Pachira* species, which rooted 100 per cent in twenty days. With regards to the *Platanus,* it is interesting to note, that this Temperate subject thrives under our conditions and grows into a well shaped large tree upon maturity. Because of the recent dearth of literature on the complexities of the genus, *Platanus,* I will keep an open mind, as to whether or not our collection is correctly named.

After severing from the parent plant and potting up, the layers are usually placed under glass for ten days, then into a slat house, followed by gradual exposure to the sun and hardening off. Provided the ball of roots is lightly broken up prior to potting and good sense is shown in watering, these layers grow rapidly into good sized planting specimens, and never show any check in progress.

We have had partial success when air layering *Magnolia grandiflora, Cassia biflora* and *Hibiscus schizopetalus variegata,* but more study in method is required with these plants. Attempts to root, *Grevillea robusta, Jacaranda mimosaefolia, Juniperus silicicola, virginnia* and *bermudiana, Metrosideros tomentosa, Sabinea carinalis* and *Agathis australis* have ended in complete failure.

Some ten years ago, we found it necessary to place a complete ban on the importation of citrus nursery stock. This step was taken because of the great risk of importing the virus tristezia into Bermuda. This virus generally does not reveal its presence until the tree comes into bearing, yet remains masked on the young stock until that time. There is no effective control and infected stock must be destroyed. After placing the ban, came the problem, where are we to obtain young trees from in the future? Nobody locally showed any desire to take it up as a commercial proposition, so the department added further to its enforced commercial activities. Stock trials revealed the local rough lemon as being the most compatible for budding upon. Conventional 'T" budding, with a "shield" bud was tried at first, but percentage of takes was low. Budding with a naked bud, however gave high takes, so this method is the one used now. Budding is carried out from April through to September. Under normal weather conditions, the dry months of June and July show the poorest results. Stocks are usually ready for budding upon one year from planting out and trees ready for sale one year to eighteen months after budding.

After heading back, sucker growth from the stock is usually prolific, and our much stretched man power is fully extended in keeping them clear. Pests such as Diaprepes esurions, the "Donkey beetle," have to be kept under control constantly. Bermuda's climate makes it ideal for many visiting pests, in ever-increasing life cycles.

A rootstock at present under trial with us is the Cleopatra mandarin. It is alleged to offer some resistance to tristezia infection, and is adaptable for early varieties of orange, such as Parson Brown. The tendency for fruit to reduce in size on this stock is one we cannot establish until the trees come into bearing, unfortunately.

Two interesting points I would like to briefly mention before I overlook them are: The greatest proportion of our garden labor comes

from the Azores. These men, whilst extremely hard working, are very set and determined in their ways.

They base their budding ability completely upon the phase of the moon, which determines whether or not they should bud. Despite my successful attempt at one time in budding when the moon's phase is taboo, they cannot be moved from their beliefs. Cosequently, although we bud from April to September, the actual budding time is reduced by half.

The other point of interest, with local flavor is that our budders use the dead leaves of *Pandanus utilis* for budding ties. They would rather work with this material than any other, such as raffia or plastic ties. As their results are satisfactory, there is no gain in us attempting to change things. The leaves are cut into narrow strips and placed in water to soak for one night after gathering. They are then considered ready for use.

Up until two years ago it was our general practice to lift the trees for sale from October through to the end of December. Many people suffered losses when planting in partially exposed sites however. These losses were brought about by persistent salt spray deposit, during prolonged windy periods in January and February. Consequently we now lift, when favorable weather occurs in February, through to early April.

The trees are lifted bare root and pruned as necessary. Fresh top growth is cut back to more mature wood. Whether or not, we would gain any advantage by reducing them harder, as practiced in Florida, we do not know. Practical experiment in this line will be carried out during the coming season.

Last year we sold some 1,700 trees at a cost of $1.40 each. This year some 2,500 are ordered, of which about 1,000 will be ready at an increased cost of a further $1.40 each.

Turning away from economic crops now, and going back into ornamentals, many of the older roses thrive here. Amongst these we are proud to include the rare *Rosa chinesis semperflorens,* which is the parent of a great many of our modern tea roses. This rose was rediscovered here some ten years ago, and I have a slide of it to show you later.

Modern hybrid roses are grown, but cannot be considered as a permanent feature as they should be. These roses, which are imported, are always budded on rootstocks where a period of natural dormancy is essential to provide the very necessary resting period required for perpetuation. Unfortunately our climatical condition is not suitable to the inducement of this resting period. Hence the roses, although profuse in flower, do not live for long. The solution of the problem lays in finding a stock with a natural self-induced period of dormancy. We have found one rose, namely *Rosa odorota major,* which is a strong growing species, having a natural dormancy of some three weeks in July to August.

Up to the present, we have not approached a planned budding programme so we cannot really give any qualified answers. However, a limited amount of budding has been carried out. "Takes" were good but later growth poor, suggesting a possible incompatibility.

It would appear that my allotted time is running out faster than I anticipated, and I still have not mentioned my main subject matter, namely that of mist propagation.

Mist propagation is very new to Bermuda and our work is very much experimental at present. Our unit is of the intermittent mist type, controlled by an electronic leaf. It was designed and manufactured in England to the specifications laid down by The National Institute of Agricultural Engineering.

Whilst we do not experience severe temperatures, it was felt advisable to afford some protection to the unit. Exposure to wind or breeze, however light, would cause serious spray drift and affect coverage. Accordingly, as you will see from slides later, the unit which is in four 6′ x 6′ sections, is placed in frames, fitted with conventional Dutch lights. *The site chosen is completely exposed to full sunlight.*

The unit was first brought into practical use in September, 1959. A major electrical breakdown occurred in December, however, which necessitated removal of the control box, for a complete replacement. For this reason, proper experiment could not commence until July of this year. Since that date, a great deal of plant material has been tried out, with very encouraging success. We have run into some "bugs" however, which may be of interest to you.

Rooting of conifers, particularly junipers has been a virtual failure, despite very profuse callusing which has resulted in many cases, root *initiation has failed to occur. East Malling have assisted us considerably* in diagnosing these failures. Two interesting factors emerge. Our completely alkaline sands and water supply will alone inhibit rooting, simply by causing profuse callus. The ideal soil temperature for root initiation appears to be from 70 to 75° F. for most subjects. On occasions our soared to 80° F. and over, despite the fullest of ventilation, and non-use of electrical heating. This excessive temperature can also inhibit rooting by causing excessive callus.

Leaching of nutrients has also provided us with problems. Its effect on the rooting of *Agathis australis,* has been very pronounced. *Wider use of nutrient foliar sprays will obviously overcome this problem.*

With the exception of "damping-off," which has been a minor concern, the absence of pest and disease problems has betn gratifying pronounced.

Despite assurances that our high light intensity would not affect material, I persisted in keeping heavy shading on the lights. We removed this shading in October last, anticipating the normal drop in light intensity in the Fall. Since then however, the light intensity has been as high as at any other time of the year without having any ill affects on plant material at all. Hence, a complete reversal of my opinion on this matter.

We obviously have an enormous amount more of experimental work to accomplish in this fascinating field of plant propagation.

(*Editor's note*: There followed a short showing of slide material, relevant to the discussion.)

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MODERATOR MAHLSTEDE: We certainly appreciate your giving us a very excellent talk, Don, of your conditions and methods of propagation in Hamilton, Bermuda.

The next paper is entitled, "Evergreen Grafts Under Plastic Covers," and will be presented by Hans Hess. He has driven over very treacherous roads to be with us for the afternoon, and I hope for the rest of the session. Mr. Hans Hess, Hess Nursery, Wayne, New Jersey.

Mr. Hess presented his prepared paper.

EVERGREEN GRAFTS UNDER PLASTIC

C. W. M. Hess, Jr.
Hess Nursery
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For many years there has been little if any change in grafting procedures. The well known pony sash or half sash have constituted the standard enclosure for the Wardian Case. These sash are quite heavy, have an abundance of sharp splinters, and to air the grafted plants they must either be hung or removed to the greenhouse path. This procedure requires about a minute per sash for removal and replacement. This short period of time in itself doesn't mean much until you multiply it by the one hundred and thirty sash in a four bench propagating house, one hundred feet long. Approximately fifteen hours a week are required for the average seven weeks the grafts are in the Wardian Case. You will find that your pocket is lighter by more than one hundred and fifty dollars on this basis.

Realizing this overhead expense, some growers have experimented with mist lines to eliminate the need for using sash. During the summer this has proved very successful in grafting Japanese maples, dogwoods and other deciduous material. Evergreen grafts for the most part do not like this type of treatment. Mist for winter grafting has not been very successful.

In the past five or six years we have seen great advances in the use of plastic, such as for lining greenhouses to conserve heat, building economical greenhouses and even as a substitute for glass. The need for a number of additional sash for a new propagating house and the prohibitive price, prompted us a few years ago to try plastic as a substitute. Light, one by two inch frames, four feet wide were constructed. Four mil plastic was then stapled to this frame. These sash, for labor and material cost less than one dollar and fifty cents, or about twelve cents a square foot compared to seventy five cents a square foot for the conventional pony sash. These sash proved superior to the pony sash, since they were much lighter and easier to handle. The grafts had far more light, since these sash have a narrow frame. There was less moisture loss than with conventional glass sash.

As more and more uses for plastic were found and advertised and from hearing Harvey Gray explain his vapor proof case we decided we might save some more time and money with these plastic sash. We cut our airing of the grafts from a daily operation to once a week and have