MR. FLEMER: On this same subject again, how would you differentiate between *V. opulus* and *trilobum?*

DR. EGOLF: *Viburnum trilobum* has three very prominent lobes, with the upper two lobes being nearly at right angles to the center. The petiole has very small glands and is narrow-grooved. The overall growth of *Viburnum trilobum* is widespreading while *Viburnum opulus* is more upright with a urn-shaped lobe.

MODERATOR CHADWICK: The next subject we have for discussion this morning is on the propagation of *Sciadopitys verticillata,* a plant that perhaps isn't as well known as it should be. I believe it has certain characteristics that warrants its use in landscape work a lot more than it has been used in the past. Probably the reason why it hasn't been used more is the difficulty experienced in propagating this plant.

Dr. Waxman of the University of Connecticut has been working on this problem for sometime, and I am sure that he has an interesting report for us this morning. Sid!

DR. SIDNEY WAXMAN: Thank you, Chad. I am glad you did not say for just how long a time.

Dr. Waxman then presented his paper on the results of experiments with various techniques used to propagate the Japanese umbrella pine.

PROPAGATION OF SCIADOPITYS VERTICILLATA

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The Japanese umbrella pine is certainly a highly desirable tree. It is a pyramidal, closely compact tree with glossy foliage. It is almost entirely free from insect and disease injury, and on the whole is a plant we should use more.

It is an interesting tree from several aspects, ie, it belongs to a genus that is composed of only one species, and no other evergreen resembles it, in fact, no fossil records of it have ever been found. It is thought by some people to be a remnant of an age long past.

There is a natural stand of these trees in the mountains of Japan, (Mount Kojasnin), where they have attained a height of from 79 to 90 feet. Specimens are only rarely seen in this country. However, more people are now becoming quite interested in this plant and there are several nurseries in the New England area that are growing them. The umbrella pine is fairly hardy, growing as far north as Portland, Maine. Most umbrella pine are found in the East. Also, I understand that there are some on the west coast. This tree was first brought into this country by Dr. G. R. Hall of Bristol, Rhode Island as far back as 1862.

There are several reasons why there are so few umbrella pine being propagated. One of these is the slow rate of growth of the seedlings. To give you an example, after the first season's growth from seed, they

will have only two leaves. At the end of the third year, they will have approximately 18 leaves but will have attained a height of only two inches. After about 50 years they may grow to a height of 25 to 30 feet. This, of course, depends greatly on the conditions under which they are grown. The slowest rate of growth occurs during the first four years. Beyond that point, the annual shoot growth may average from 2 to 6 inches.

In view of the slow rate of growth of seedlings, attempts have been made to propagate it by other means. These includes layering, grafting and cuttings. The various techniques and the results that have been obtained with each are discussed in the following sections.

LAYERING

Liberty Hyde Bailey in his well known reference book, entitled the Standard Cyclopedia of Horticulture, reported that in addition to being propagated by seed they can also be propagated by layering. Although I haven't been able to find any further information in the literature concerning the layering of the umbrella pine, it certainly is reasonable to assume that it could be accomplished without too much difficulty. However, since the number of trees available is so limited, the layering method for the present would be out of the question if one were interested in obtaining large numbers of them. The limited numbers of plants available for layering would then also be a reason why so few are being propagated.

GRAFTING

A thesis problem concerning the propagation of the umbrella pine was carried out and published by W. J. Lowry in 1931. In his experiments, Mr. Lowry grafted umbrella pine scions on *Thuja occidentalis*, *Chamaecyparis pisifera* and *Cryptomeria japonica elegans* with no success. He was, however, able to graft onto *Cryptomeria japonica* stock with apparent success. However the eventual growth and survival of these were not discussed.

CUTTINGS

The next approach to this problem is the rooting of cuttings. Lowry reported, in his thesis, the results of the experiments he carried out in 1930. He did not use such hormones as IAA or IBA, since their beneficial effects on root initiation were not known until several years later. However, his rooting environment was not too different from a plastic tent. He attempted to root the cuttings under double glass in a peat-sand mixture. His results after 14 months showed that out of over a thousand cuttings taken, only 14 had rooted.

This should serve as another good reason why this plant has not been propagated to any great extent. Not only are cuttings hard to get in quantity, but they are also extremely difficult to root. The rooting results obtained by Lowry, although they were quite low, were better than those I obtained when I first tried to root them under mist about six years ago. At that time, I took about 100 cuttings during July. I applied various hormones to some and placed them under intermittent mist. After nine months, all cuttings were alive, well callused, but not

a single one had rooted The following year, again, in July I repeated this and included both one year and two year wood. The results remained consistent, in that not a single one rooted.

On March 31st, 1957, I obtained some cuttings from the Arnold Arboretum while on a tour. I placed them in flats of peat and perlite under mist, fully expecting to discard them sooner or later. However, after approximately six months they rooted 40 per cent without the benefits of a hormone.

The following year, one of our students, Mr. Larry Demars, wanted to carry out an experiment on his own and asked me how to root these cuttings. All that I could suggest at that time, was to take them at the end of March He did this and, in addition, treated the cuttings with the following hormones: Hormodin #1, #2, #3, Chloromone 1/3rd, 2/3rds, and full strength, Hormo-root A and B, and two untreated groups. This made a total of 100 cuttings for the experiment. Five months later they were rooted 100 per cent.

In order to explain the reason why he obtained 100 per cent rooting, two facts could be considered: (1) The cuttings may have been taken from a tree that had an inherent ability to root easily, or: (2) It may be that it is the time of the year that determines the rooting response of the cuttings, or to state it more accurately, it might be the stage of growth.

In analyzing my rooting results as well as those of others I found that there were certain periods of the year when the percentage of rooting was very low and other periods when rooting was considerably better. For example, in the thesis by Lowry, I found that even though he took his cuttings during the months of June, July, August, October and November, in 1930 and in 1931 that he had experienced poor rooting on cuttings regardless of the month of collection. In another report, by Dr. J. DeFrance, it was reported that he was able to root 12 cuttings out of the 25 taken. This would be approximately 50 per cent rooting. In this case, the cuttings were taken at the end of January. It appeared then, in these early experiments that greater percentages of rooting were obtained in the periods of January and March, whereas rooting was extremely poor on cuttings taken June through November. It may be that the ideal time to take these cuttings is after the breaking of the winter dormancy but before the new growth develops.

In an effort to answer these two questions, two experiments were set up. In the first one, I wanted to determine whether the tree from which the student obtained his cuttings had a greater potential for rooting then other umbrella pines. In this experiment I managed to obtain cuttings from three different trees, including the one he used. Altogether, 96 cuttings were taken. The results after five months showed that apparently there were no differences in the rooting ability of these three trees. The first tree rooted 93 per cent, the second 72 per cent and the third 84 per cent. In the second phase of this experiment, an attempt was made to determine when cuttings should be taken to obtain maximum rooting. In this case, having only two trees available from which to collect cuttings I took small groups of cuttings at various

intervals starting on February 11 through July 8, of this year.

The results of these experiments which are somewhat variable are as follows: Cuttings taken Februaiy 11th rooted 83 per cent, February 25th, 50 percent, March 25th, 66 per cent, March 31st 91 per cent; Aprii 14, 83 per cent, April 21st, 41 per cent, and Apnl 28th, 25 per cent. Later, a group of 40 cuttings were taken on July 8th and although sufficient time had elapsed for rooting to occur, not one cutting had rooted. *These results show fairly good rooting had occurred on cuttings* taken from February 11th through April 14th. The percentage of rooting of cuttings taken after the middle of April declined, so that we may assume that within this period of February through the middle of April cuttings may be taken with some success. The date that has given the highest percentage of rooting during the experiments carried out the past three years was March 31. The cuttings in most cases were of current year's growth There were some differences between those treated with Hormodin 3 and those not treated. Those treated had more roots as well as a slightly higher percentage that rooted. Cuttings were all wounded by running the point of a knife longitudinally down to the base of the stem on three sides. The medium used was a mixture of 60 per cent German peat moss and 40 per cent coarse perlite. Cuttings in flats containing this mixture were placed under intermittent mist.

In dealing with large numbers of plants I would suggest that propagation from seed would be the ideal thing rather than from cuttings. The only difficulty lies in over-wintering them.

If you are to propagate large numbers, then the first thing is to germinate them from seed. If you want to get a more rapid growth, then use cuttings, but again, be sure the plants you take these cuttings from are of good types.

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MODERATOR CHADWICK: Thanks, Sid, for this report.

Are there any questions?

MR. JIM WELLS: Dr. Waxman, from what position on the plant did you remove the cuttings?

DR. WAXMAN: These cuttings came entirely from lateral growth which could be reached from the ground.

MR. WELLS: Did you notice any difference between height of sampling and rooting?

DR. WAXMAN: No, we have too few cuttings to be able to try this. However, one plant was about ten years old and the other thirty, but there were no differences in rooting

MODERATOR CHADWICK: Are there other questions? Bill Flemer.

MR. FLEMER: Would you very briefly review what you think is the best seed practice with the *Sciadopitys?*

DR. WAXMAN: Ordinarily you can obtain the seed from your

dealer during March or April. Frankly, all seeds come from Japan. When the seeds first come, I put them in a gallon jug of water, and bubble air through it Now the purpose of this is merely to get the seed wet However, I do change the water twice during a one week period. If I didn't bubble air, there wouldn't be enough oxygen. After that, I sow the seed in flats containing a mixture of about 50 per cent peat and 50 per cent perlite. Now if you recall the talk I gave two years ago showing that the length of day affects the germination of seed, you will remember that if the seed gets light at any time it will not germinate.

In germinating seed, they prefer a temperature of 65 degrees, that is not much higher or lower. What I do is to saturate the mixture after the seeds are covered, let it drain and enclose the flats in plastic and put them in an area where I know the temperature doesn't vary too far from 65 degrees. Ordinarily it takes 100 days to germinate, and with this method we find it occurs in 40 to 50 days

These plants are quite small. What I do is leave them in the flat that first year and they make a little growth. I don't think it matters whether you move them out or not. We fertilize them in that mixture and leave them in the flat in the greenhouse. It is not necessary. We have tried putting them out in the frost-free frame, and that works out quite well Perhaps the second year they could go to the frost-free frame for the winter.

MR HANS HESS: Do you have any information as to the length of viability of the seed? Does it have to be current seasons seed or can it be held over?

DR. WAXMAN: I have germinated seeds that were five years old, and the per cent of germination does decrease. The germination after five years was about 50 per cent. Ordinarily when you buy new seeds you might get 60 to 75 per cent germination.

MR VERKADE: Do you get the same results with your light treatment? You said this light would give you practically a year's extra growth. Can you do the same with interrupted light?

DR. WAXMAN: I haven't tried this, but I suspect it will. By interrupted light Pete means that we give them a light for one second out of each minute during the entire night. It takes quite a while to get this response from them.

MR. HARVEY GRAY: Sid, I think you might be interested in the observation which was made by Willard Titus, in that the date you are having your best rooting percentages is the date when the cones are naturally falling from the mature plants.

MR. WELLS: Have you tried a heavy wound, that is, removing a slice from the side of the cutting?

DR WAXMAN: I would be afraid to. I found in the earliest experiment that if we had the slightest wet condition we found rot. I was afraid to give it a heavy wound. A slight wound won't rot and would tend to heal easier So much depends on how wet the medium is.

MODERATOR CHADWICK: Sid, I would like to know what difference you expect from rooting on March 31st and April 1st. Seriously, is there any explanation for this curve you showed?

DR WAXMAN: It is certainly an unlikely time of year for taking evergreen cuttings. Many evergreens taken at this time of year would shoot out top growth before producing roots. The umbrella pine, however, is very slow to start growth. Perhaps there may be a high production of hormones, at this very critical time of the year It is known that just before new growth begins that you get a rise in the level of auxins in the plant and perhaps that is what is needed for rooting cuttings of this plant.

MODERATOR CHADWICK: You will have the answer on that next year?

DR. WAXMAN: We are still working on it, and before I forget, I would gladly accept any contribution of cuttings preferably on March 31st.

MODERATOR CHADWICK: The rest of the morning session is devoted to weed control or the use of herbicides on various types of nursery stock We are going to modify the program a little bit from what is printed in your program, since we feel that perhaps it would be better to get some of the background material or fundamental material, before going on to some of the more practical applications of the problem.

To start with, I would like to introduce the members of the panel: Dr. Kenneth Alban, Department of Horticulture, Ohio State University, John Newhouse, Bagatelle Nurseries, and Dr. Chappell of the Virginia Agricultural Experiment Station.

Dr. Alban is going to lead off the discussion this morning on some of the more fundamental aspects of chemical weed control. Ken!

DR. E. K. ALBAN (Columbus, Ohio): Thanks a lot, Chad.

I thought that starting off today we might just take a look at where we have been and then perhaps see where we might be going.

Having had a little experience with pulling weeds of various kinds in ornamental seedlings, I know this is a real task. We have been just as anxious as Chad and all of you to find a satisfactory method of solving more of our weed problems.

Through the years we have used oil in oil burners and flamers of various sorts to try to control, particularly surface weeds. Then another method that the tobacco seedsman has used, which many of you have perhaps heard about and are familiar with, is the use of a fire. It is rather interesting to watch some of these fellows use a pile of wood, set it afire and keep it moving along the tobacco bed just to the point where they are not burning up the organic matter but are killing a lot of weed seeds. It has been a good method for partial weed control but I think we still come back to one of the best methods we have and that is steam. Whenever you can possibly get a portable steamer in I would recommend it.

The difficulty with the various chemicals is the susceptibility of different crop plants and the tolerance of many of the weed species. You

encounter all of these things which causes a lot more trouble as compared to the use of steam

I think we might just take a brief look at some of the chemical sterilants and fumigants, with which many of you are familiar and evaluate them in relation to their weed control effectiveness.

One oldtimer is formaldehydate, and many of you are familiar with this compound, not only for weed killing ability but more important, for its fungicidal capacity. We would have to say as far as weed control goes, formaldehyde is only a fair to poor chemical.

Now another one that you are not perhaps as familiar with is allyl alcohol, which is a fairly effective herbicide, particularly on soft weed seeds that will be germinating in four or five weeks after treatment. One major objection to allyl alcohol is the large volume of water you have to use with it Quite frequently several hundred gallons of water are necessary in 100 square foot area for the proper functioning of this compound

Another compound that I first ran into trouble with but have learned to live with is Chloropicrin or tear gas. We treated a quarter of an acre with the wind right when we started but not so right when we finished and it is a rather mean material to handle. On the other hand, it will give you fair weed control.

Vapam, a fairly new compound, gives us good weed control if we set up the right conditions. I will discuss this in a little more detail after I complete this list of chemicals.

Mylone is a compound you have heard about and our experience with it has been that it results in only fair weed control.

Eptam is a fairly new one, perhaps not used so much in the nurseries yet but used particularly in potatoes in our vegetable crop work. This compound is rather interesting Incorporated in the soil, we have had very good success in the killing of the weed seeds. This past season on a potato field where we had used Eptam right after planting the potatos we had no weeds in there during the entire season. Even though we continued to cultivate we did a very good job of killing the weeds in the top four or five inches of the soil This is one that perhaps might bear watching and I would say that good and excellent weed control has been obtained.

Another compound you have used and know, is Methyl Bromide or Dowfume. This will give you good weed control. In fact, we can have excellent results if we go to the two pounds per 100 square foot treatment.

Now some of you have used these, some of you have seen them used Some of you have seen some very poor results and perhaps if you are lucky you have seen some good results. I would like to briefly go over the factors that are, we feel, influencing the effectiveness of soil fumigants and soil sterilants The first one that I think is often ignored the most is the physical condition of the soil at the time of treatment. In general, we would say that we would want the soil to be ideal moisture-wise as it would for plowing, discing or rototilling. We would like a soil that did not compact, or fall apart too easily. It needs to be work-

ed up fairly fine allowing at least a six inch area for any of these chemicals to be effective.

Another important factor would be whether or not the chemical is either lighter or heavier than air. This is a decision you must make. Will the chemical seep downward or do we need some kind of cover or seal to prevent escape of the chemical. It is surprising the number of times this is ignored, except with Methyl Bromide The moisture, which I have already mentioned, is very critical. Temperature is very critical. Most of our seedbed work and plant propagation bed work does seem to come in the early spring and this is the poorest time in the world to use any of these chemicals to prepare a seed bed or plant bed The best time is in the fall when you have high enough temperatures to get maximum effectiveness of the chemical. I would say practically none of these I have mentioned will work well when the temperature is below 60 degrees. Preferably the temperature should be in the 70 to 75 degree range, which means late September or early October would probably be a good time for using some of these treatments.

Then another factor, particularly with the granular materials, is distribution Getting these materials mixed thoroughly into the soil is very important. I am sure that the lack of this consideration has resulted in very poor weed control at times. You have some spots with sufficient amounts of the chemical and others with only a trace of the chemical where you get no weed control. Cross discing, cross rototilling after using many of these would help a great deal.

One other area I would like to mention would be that of eliminating noxious perennial weeds ahead of putting any nursery stock on the area. There are certain grasses such as quackgrass, and Johnsongrass that we should take out before we put any nursery stock in the field. We have a lot of good chemicals to do this, and most of them have a minimum residual activity Dalapon does a beautiful job on plant grass as a fall treatment and you could go back on there with most any crop the following spring In cases where you would like to go on the land a little quicker, you would use amino triazole It has been our experience with a wide range of other horticultural plants that we can safely use it within a two-week period, which is necessary for the amino triazole to act on the grass plant. Certain other broad-leaf weeds, such as Canada thistle and dandelion can also be eliminated with amino triazole. This solves a perennial problem which is usually one of your most severe ones after you have a planting established.

Another important thing that is often ignored is eliminating potential weed seed from fence rows and from adjacent areas Our good conservation friends have indicated to me, at least that eliminating some of this cover in fence rows makes sense in our business There are a lot of other areas where they would disagree with this viewpoint I think that if we can take care of some of our weed seeds in the fence rows, in the walkways, and in our roadways, we can help reduce the seed for some of the chemicals that will be discussed later on this program. I have briefly talked about pre-plant treatments

An additional method would be pre-emergence treatments The

term means that prior to the time the crop comes up we apply a chemical which will effectively control weeds, we hope, and not damage the crop. Then we have post-emergence treatment. Here we use directed sprays ordinarily with selective herbicides where we have a crop plant that will tolerate the chemical and a weed species that are susceptible to the chemical. You will hear more about these later two methods of weed control from the other members of the panel

I think one of the important things to remember, from my experience with herbicides, is that you cannot guess on any of these things. You cannot guess on susceptibility of crop plants Everyone of these crop plants is going to be a little bit different and you are dealing with thousands of them and what may work on taxus will not necessarily work on viburnum. I am sure you all realize this, but I think it is worth an additional word of warning that just because you have had success with one particular species don't assume the chemical is safe on others. Thank you very much.

MODERATOR CHADWICK: Thank you, Ken. There will be an opportunity to ask questions after the other members of the panel have presented their material.

We will now turn to a few comments on pre-emergence materials by Dr Chappell, Department of Plant Physiology, Virginia Agricultural Station, Blacksburg, Virginia

DR. W. E. CHAPPELL: When Mr. Van Hof wrote me back in the summer asking me to participate in this program, he suggested that I confine my remarks to pre-emergence weed control. This is what I have done.

Dr. Chappell presented his paper covering the aspects of pre-emergence weed control

PRE-EMERGENCE WEED CONTROL IN NURSERY CROPS

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INTRODUCTION

The term "pre-emergence" when used in reference to weed control usually means an application of chemicals after planting, but before the emergence of the crop or weeds. In the case of transplants or liners, however, it would be pre-emergence to the weeds only. The selection of the chemicals to be used for pre-emergence weed control will depend on whether it is being used on direct seeded crops or whether it is to be applied as a directed spray on lining out stock and also whether a liquid or granular application is being made. Certain sprays cannot be used on liners even when it is directed at the base of the plants without taking some chance of producing some injury The same chemical might be applied as a granular formulation without any injury.