

THE ESTABLISHMENT AND MAINTENANCE OF A STOCK BLOCK OF HARDY HYBRID RHODODENDRONS

RICHARD VANDERBILT
Koster Nursery
Bridgeton, New Jersey

REASON FOR A RHODODENDRON STOCK BLOCK

A good stock block enables one's entire production to be taken from plants that are true to name. It is possible to produce more cuttings of better quality than when cutting plants which are destined to be sold. In working over material to be sold there is always the conflict of wanting to take the best propagating material and simultaneously doing whatever is best for the plant being cut. A stock block allows more flexibility. We may treat salable aged plants, or those being grown to be sold, to produce the maximum amount of body and to encourage flower bud development, while treating mother plants to produce the maximum amount of vegetative growth and to hinder or halt reproductive activity.

In addition a stock block provides a more reliable source of cuttings year after year.

THE ESTABLISHMENT PROCESS

The obvious prerequisite is to procure the plants in the varieties and quantities deemed necessary. One of the most important factors to success is a satisfactory site. If the soil is basically a fast-draining one, it can be fitted to grow rhododendrons if the pH is 5.6 or under. The addition of peat moss alone would lower this to 5.1 to 5.2. Some of our rhododendron soils have a pH as low as 3.8 on which the plants do very nicely.

A moderate amount of shade is a very decided asset when working with rhododendron stock plants, especially the more touchy red varieties. Cuttings strike more readily from a plant that is shaded than from one fully exposed, all other things being equal. Shade may be provided by a lath house or portable shades erected on pipe runners.

We have hit upon using a modified woodland which fulfills these requirements well. The most difficult thing was to determine the amount of thinning needed to produce an abundance of cuttings having a high rooting potential.

Insufficient light is not necessarily detrimental to the health of the plants, but one side effect is that a second growth is rarely produced. Instead, plants become drawn and have greatly enlarged leaves. The presence or absence of this second growth is the determining factor as to what per cent of the cuttings may be safely removed. If a stock plant makes two growths a year, one may remove 100 per cent of the second growth for propagating wood. If, however, one removes all the cuttings from plants producing only one growth a year, the plants will soon die. These plants should have only half the cuttings removed.

We prepare the soil for our stock plants as we prepare all our soil used for growing rhododendrons. The area selected is subsoiled, then spread with peat to a depth of 2 inches which is then rototilled. We use a raised bed that is 5½ feet wide with a 2½ foot aisle. Actually

we raise the bed by removing the soil from the aisle area to a depth of 12-14 inches and putting it on the bed. We use a middlebuster plow that takes much of the hand labor out of this operation. The beds are fertilized with: 1 ton gypsum per acre and 1/2 ton each of: 20 per cent superphosphate, magnesium sulfate, and tankage. This is equivalent in pounds per plowed acre to: 80 pounds of nitrogen, 200 pounds of phosphoric acid, 200 pounds of potassium sulphate, 200 pounds of magnesium sulphate and 1000 pounds of calcium sulphate and oxides. This dose is applied annually as a follow up treatment. The area is then ready to be planted. The plants are mulched immediately after planting with either hay, pine needles or what have you, and renewed as needed. Plants are spaced usually for two or more years of growing and moved as they become crowded. Available area ultimately determines how distant the plants are set. Young plants are never spaced further than the room needed for two years growth as they exhibit a definite preference for close company.

The plants are hand weeded as necessary and sprayed for insect control and leaf diseases 5 to 6 times a year. We use DDT, Kelthane and Parzate for this purpose.

Very often the plants will tend to make only one growth and in July begin to develop flower buds. This can be reversed by pinching out the bud and/or spraying with chelated iron and liquid fertilizer in a concentration of 30 ppm nitrogen.

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CHAIRMAN HILL: Thank you very much, Dick. Now, since we have quite a lot of time remaining, despite our late start, I would like to just impose upon all of you and frame two or three questions for each of you.

Steve, I would like to ask you, No. 1, for a specific definition of juvenility. Just exactly, what is juvenility? How can we insure it? Why, for example, is the growth produced in 1960 on the tip of a ten-year old plant any different than the growth produced in 1960 at the growing end of a two-year old plant?

Next, will you go over once more an evaluation of the importance of this proximity of the stock plant to the propagating facility? You stressed that early in your discussion and I just wonder really how truly important that is. Should be allowed to override numerous other factors?

PROFESSOR O'ROURKE. Juvenility is probably the hardest thing there is to explain in plant growth. We really only guess at most of the causes. We know this, however, that if we take a one-year old plant of almost any kind we can take cuttings from it and they root very, very quickly. We can take cuttings from a two-year plant, but it won't be quite as good. From thereon it depends on the age of the plant as to when this easy rooting stops. In apple, it stops after the second year. In white pine, it stops at about the eighth year, and various other plants at various other times. Now this condition of the

young plant grown from a seedling we call juvenility. It is rather difficult to try to take this particular condition and transfer it over to an old plant where we may get the same phenomenon. We sometimes call this a reversion to juvenility. Whether it reverts or whether it is just an expression of something that is already there, we don't really know, although I think it is the latter.

As an illustration, if we cut down a tree close to ground level we will get sprouts coming up from near the base. Those sprouts will react, perhaps they will even have leaf characteristics, of the juvenile condition. Now we term that juvenility, even though these sprouts come from a very old plant. Now the juvenile condition has nothing to do with the chronological age in the way I am expressing it now, because a tree can be very old sometimes and still give out these shoots near the base that are juvenile in so far as rooting is concerned.

A couple of years ago I gave a talk here on how they kept their apples in the juvenile stage in England. They use hedges and they keep those hedges pruned very, very closely so that no flower buds ever came out on them. They keep the hedges in a vegetative condition. They take hardwood cuttings from these and then root quite well.

I have taken a little longer than I wanted to, but I hope I have expressed it.

MODERATOR HILL: Now, Steve, I hope you will defend yourself and defend this proximity of the stock plants to the propagating facility, recognizing this is 1960 and we all have these things called trucks. How important do you think it is to have the stock plants located near the propagating facility?

PROFESSOR O'ROURKE: As I stated, the stock plants from which you take softwood cuttings should be located close to the propagating facilities. It is only human not to go out to the back woods to see that the cuttings are just in the exact condition for collection. You know how important it is especially with something like lilacs. It is so important in many softwood cuttings that you take them when it is right. It doesn't make much difference about stock blocks for budwood, scionwood or hardwood cuttings, but the ones which bear softwood cuttings, even though it might cost more to use the land up near the greenhouse are worth the effort.

MODERATOR HILL: That is very good. I thought most of us in this room were interested in pure science, therefore, we were not subject to this thing we call human nature. If the stock plants were located quite a distance from the plants we would go back to that place and get them. I am sure we tend to do best those things which are easiest and if it is closer, it is sure enough easier.

Louie, I would like to move over to you where I noticed that you stressed the importance of this pre-plant management of the area you had chosen for the establishment of the stock block. I wonder if the pre-plant treatment you describe is different from that which you would provide for sale plants only for an economic reason or if there is another specific reason, particularly with reference to what would appear to me as the application of excess quantities of available nitrogen.

Next, I wonder if you would defend this matter of what you call large cuttings. Large is a relative term, and therefore, should probably be qualified a little bit. To use one example, let's take a spreading yew. The aspect ratio is, let's say, one inch wide and ten inches high, whereas, the aspect ratio of the plants which we sell, produced from that cutting, are quite the other way. It is perhaps in the ratio of three to two. When the plant is three feet wide, it will be two feet high. Somewhere between the time that cutting strikes root and during its formative growing years, it has to change that aspect ratio. Therefore, I wonder if perhaps it would be better to start with a smaller, shorter cutting than the typically large one. Start out with this factor of weight of wood and tell us how important that is, and why.

Last, Louie, I would like to have you kind of define the whole principle of the stock block.

We are fortunate to have as our Program Chairman this year an outstanding proponent of that second system, which is not the actual establishment of stock blocks but rather, taking a portion of a block of sale plants which are in the process of production. Perhaps, these are not scheduled for sale for a year or so, but the cuttings are annually taken from a select group of these sale plants in the process of being made up. There is obviously quite a lot of difference risk-wise. If we put all our stock blocks in one basket geographically, there is quite a risk. There could be fire. Some careless technician could make a careless application of chemical or fertilizer, whereas, with Martin's program he has his risk distributed over a large area. The likelihood of someone making a mistake, that penalizes his department is much less. Therefore, Louis, will you defend the principle of putting them in one place as opposed to the principle of having them scattered on the premise? Those three things: No. 1 is the specifics of the pre-plant; No. 2 is the size of the cuttings; and No. 3 is the whole stock block principle.

MR. VANDERBROOK: To answer your questions, Jack, I will admit that the pre-planting preparation of this stock block area to the average nurseryman here will perhaps seem to be using an excessive amount of organic as well as chemical material. The reason for that, and it is a good reason which we have found by practical experience, is that those plants that you put in that stock block are going to stand there for a long time. If you continue to cut them back hard, as we have always done, you can leave those plants there for as long as 10 or 15 years. As long as you maintain your fertility you can still get results.

I know that I can't paint a word picture to you fellows to show you what our stock block looks like, but I will attempt to describe it. The manager who purchased our nursery is here, and can verify that many of the stock blocks which we had and which he has used for the first time this year were planted in 42-inch rows. This summer as a result of the fertilizer that had been poured into that stock block the plants were so big that the branches met in the middle of the row. You could hardly see the ground. You could make four or five cuttings from one of the branches.

One of the advantages, I will admit, to the process of fitting the land for salable plants is that we used the cover crop method of preparing the land. On stock block establishment you have to pour on a terrific amount of organic matter, because you are going to have it there for a long time. That is why we add the 40 to 50 cords of cow manure to the acre.

Now to defend the size of the cutting. I don't have to tell the average person here that a man who is perhaps average size, five foot six to eight, is going to be a lot more powerful and have a lot more endurance in doing physical activity than a man who might be four foot two or four foot five, and hasn't got as much body area and muscle area. They say a small man is as good as a big one but the question comes down to endurance. We have found it takes twice as long to get a salable plant or twice as long to get a fit liner if you take two or two and a half inch cuttings than if you take six inch cuttings. There is something about the bigger cutting, the same as the bigger man that has more vigor or more reserve vitality connected with it. Therefore, we lean to the larger cutting. In fact, we used to always put them in, sometimes ten inches long and we didn't cut them back.

Now to defend the stock block as to having all the plants in one location as contrasted to having the spread over the nursery. All of us are not in a situation such as Martin is in Newport, where he has 200 to 300 acres of nursery and can afford to go out and get cuttings from all the plants in that way. Yet he cannot match the speed of gathering that you can get from a stock block where you go in and cut them right down. He doesn't save that time but he perhaps is willing to write that off as a hedge against risk of injury to his plants.

We have never had anything happen to these stock blocks, either chemical or natural. They have always been healthy and produced for us every year.

MODERATOR HILL: I thank you very much, Louie.

Dick, I would like to have you go a little further along this matter of reliability of production. It was a phrase you used in reference to the stock block. It is like a man who grows nothing but carrots. Along comes the carrot knife and he is out of business. On the other hand, a man whose crops are diversified may lose his carrots but he doesn't lose his whole operation. This risk of having all our propagating plants in one location, therefore, subject to the vagaries of that limited environment are obviously more risky than the ones out in the field. Can you think of a couple of good reasons why stock blocks rather than gathering the vegetative material from sale plants should be used in the process?

Next, can you give us the reasons why this stock plant grown in shade produces a toughening which as you say strikes more readily?

The last part of the question I want to ask you is to go over once more this reason for gathering only one-half of the cuttings each time you collect cuttings.

MR. VANDERBILT: Before I get into the rhodos, I would like to comment on the size of the cuttings Louie mentioned. It is not the length of the cuttings but the diameter.

MR. VANDERBROOK: In order to be a good cutting it should have the girth there, too, in order to have viability.

MR. VANDERBILT: We strive to sell two-year old and three-year old plants of rhododendron. We don't deliver any bigger plants. We have four-year olds because they were culled as a three-year old, not because we deliberately start out to grow a four-year old plant.

I would say we probably wouldn't need a stock plant at all. All we would have to cut would be our one-year olds which have been pinched to make a good body. The actual cuttings are extremely small. You cannot take any cuttings from those plants without hurting the body, and the cutting in my mind will take two to three times as long to get a salable plant. They are too small and too thin. We would rather collect from plants that are a little larger.

The second thing comes about if you continually take your cuttings of rhododendron from young, one and two-year old plants. If you do this each year your leaves will tend to get smaller and smaller and eventually you will get down to a two-year old leaf which is about a half inch long. It will look like a real dwarf. The longer it remains the more it tends to behave like the mother plant.

On this reliability thing, if for some reason your one-year olds up and die, this can be a real calamity. If you are depending on these you are out of business. If you have a mother block, you have no one-year olds but at least you have something to start over with.

On this matter of shade, I can't say why this happens but the cuttings we took from shaded plants tended to root up more easily than those collected out in the open field.

On this question of taking half the cuttings, I would say that if the stock plant produces two growths a year, you may remove that entire second growth for cuttings. If you take more than half consistently year after year, you will kill the plant since the rhododendron grows in flushes. When you take the cuttings you remove all the eyes, with that cutting. If it has made only one growth bud and you take the entire growth then the plant has to fall back on buds from a previous season. If you do this year after year it is going to run out of eyes and you are going to kill the plant. That is why I use only one-half the wood on the first flush. However, if they make two, then I don't mind losing all the second one.

MODERATOR HILL: I think that is very good, Dick. I think the reason you have given for taking one-half of the cutting, especially the handling, is different from our familiar juniper and taxus which more or less grow continuously. The taxus have the facility to grow from adventitious buds. That is why they are chosen for topiary work in the West and in Europe.

If I can kind of serve here as an unbiased anchor man on this, I would like to tell you what our thinking has been at Dundee, and what we have done that may be different from anything described here.

As late as two or three years ago we were spacing our stock plants at a deliberate wide spacing. Let's take a plant like spreading yew, for example. If it is to be used continuously as a stock plant over 12, 15

or more years, it is going to ultimately come up to immense size, even with the persistent annual reduction of twig length. Therefore, we space them at an 8' x 8' spacing and it takes a lot of acres. On the other hand, when that plant is large, it produces an awful lot of cuttings.

At the time we thought this through, it appeared that we wanted this space right around the plant for we are believers in Chadwick's theory of using stock plants in sod rather than in clean culture. That can be traced back to the type of planting where we may easily have one of those warm and relatively nice fall periods where the wood does not harden off as rapidly as we would like. When winter comes, it frequently catches that material in a state that is too soft to withstand this sharp drop in temperature. Therefore, any propagating wood taken after that shows considerable deterioration. Frequently they do not root at all. Therefore, the sod is a balancer as far as maintaining good vigorous hardened growth. It is only necessary to supply sufficient fertility to care for the requirements of the sod plus whatever additional you may need for the crop. The sod serves as a balancer during these fall periods where the plant is changed to the point where it is warmer and wetter than average. Our cutting wood in these blocks inside tends to harden up a good bit earlier. Therefore, we can get into the blocks earlier in the season than would be possible otherwise. We like the idea of mowing rather than cultivating. I think it is a toss-up as far as cost goes, providing the plants are arranged at the time of planting so they can be mowed.

I said originally we had planted our stock plants eight feet apart. Now we have switched around and said we are going to leave our rows between these plants eight feet apart and we are going to somewhat crowd those plants in the row. The reason for that being that we find we can get a great many more cuttings per square foot of allocated area if we squeeze these plants until finally we come up with a thing almost like a hedge. We are finding in this way it results in mature multi-stem plants that are completely interlaced. Therefore, you may take a cutting off here, which is in effect attached to a root system well down the row. We do not think that is deleterious in any way. Being in hedge form it facilitates the application of insecticides and fungicides. It lends itself specifically to the banding method of fertilizer application along the base of the stock plants. This sod enables us to get in there in the winter months since it is cleaner and easier to walk upon than a cleanly cultivated place would be.

One of the factors that has not been covered on this stock block proposition versus the taking of cuttings from the sale plant, is this matter of genetic stability. We all know some plants are relatively stable while others like euonymous are unstable. They mutate while you are watching them. Therefore, the forms don't tend to stay the same. Certainly in that case it would be an advantage to selectively take your cuttings from your tiny plants which are in the sale blocks in order to achieve uniformity. *Taxus densiformis*, which we regard as an entirely stable plant, will lend itself to stock block culture in order to achieve this uniformity.

Before I conclude and open this session up for questions, I would like to add that personally I feel there is a great need for basic research in this general area of timing. Research is needed to find out a method of determining when the physiological condition of the plant is right that the cutting material from it will root readily. I have always felt there is a great misconception in this occult art of propagation which says it is the administration of the individual propagator that makes that cutting root. Yet, all of us have had the experience of dropping a cutting under the bench where the condition is surely not one that we would deliberately provide, and that cutting rooted handsomely. We have also seen crops that despite our effort to maintain an optimum bench and house environment that have failed. Therefore, I can't help but think that perhaps the success or failure of an individual propagation lot is dependent far more upon the physiological condition of that plant right at the time the cutting is taken than it is by the handling we give it afterward, within relatively broad limits. I don't know how that can be sorted out.

I understand there have been papers that attempted to relate this basic "rootability" to the carbohydrate-nitrogen ratio. There was just no way that a straight-line relationship could be plotted. Perhaps it is in this X factor that Charlie Hess talked about last year and I hope before this meeting is over he will give us a little more on these hidden factors, which I am sure are nowhere near sufficiently understood. Are there any questions?

MR. HOOGENDOORN: I would like to direct my question to Dick Vanderbilt. Do you find that you get quicker rooting and better rooting out of second flush than first flush growth?

MR. VANDERBILT: It doesn't seem to make too much difference, Case.

MR. DON HARTMAN: My question is to Steve O'Rourke. You made reference to viruses. Were you speaking of this just in regard to fruit trees or are you doing some work also in ornamentals?

PROFESSOR O'ROURKE: We know more about viruses in fruit trees because indexing procedures have been carried out to a much greater degree. However, viruses are breaking out in all types of plants, including ornamentals. The determination of the symptoms and indexing techniques are not advanced to a stage, however, as it is with fruit trees.

MR. HARTMAN: Are they doing any work to find which ornamentals are virus infected?

PROFESSOR O'ROURKE: I believe there are some pathologists working with ornamentals but I am not familiar with the exact ones.

MR. VERKADE: On your rhododendron stock blocks of such difficult to root varieties as C. S. Sargent and Dr. Dresselhuys, are you going to be able to root cuttings off, say seven, eight or nine year old plants?

MR. VANDERBILT: On this juvenility factor, I don't go along with some of it as it applies to rhododendrons. I have taken cuttings

from one-year old plants and have had much worse luck than with cuttings from seven or eight-year old plants. They seem to do just as well. I don't see any effect of juvenility, but this is just my own opinion.

DR SIDNEY WAXMAN (Storrs, Connecticut): This is directed to Dick Vanderbilt. Please give us in a little more detail on how you prevent flower formation in the rhododendron.

MR VANDERBILT: It can't always be prevented. If it does develop, pinch it out. Very often when the first root is formed, if caught early enough, this could be prevented by spraying with Sequestrene iron chelate, or with Peters fertilizer at a concentration of 30 parts per million nitrogen. If this doesn't work you could also pinch out any flower bud that did develop and this would usually start to grow again provided that the plants were fertilized early.

MODERATOR HILL: If I understand his response it is, concerned with upsetting the C-N ratio which would prevent flower bud formation.

MR RICHARD FILLMORE: Mr. Moderator, first of all, I would like to make a comment. You may recall that some years ago we had a banquet speaker who mentioned the work of Dr. Van Slogteren in Holland, who has worked out serological techniques for the determination of viruses in bulbous plant materials. Now, very briefly, they inoculate horses for certain types of plant virus organisms and subsequently remove blood from the horse, purify it in some sort of serum and by introducing this serum into a certain reactive plant, they can tell immediately whether or not that particular bulb is diseased by virus. Now the plant indexing technique of picking up these things by plant responses, in particularly susceptible plants is exceedingly slow and laborious. I think this line of Van Slogteren's if it could be more widely supplied and more broadly supported, although it might take three scientists and ten technicians a long time, and cost a lot of money, holds much for the future.

I want to ask Richard Vanderbilt this question. Do I understand that if one repeatedly takes small leaf cuttings from a well-recognized clone of rhododendron, such as *Rhododendron roseum elegans*, that the size of leaves on a finished plant will be reduced so the plant is almost unrecognizable, let's say after five or ten vegetative generations of this sort of procedure?

MR VANDERBILT: Not quite. With a small leaf cutting from a mature plant you shouldn't have any trouble. It should go on and develop normally.

MR. WILLIAM COLE (Painesville, Ohio): A question to Louie Vanderbrook. On the economics of the stock block, I wondered about your argument of being able to take more cuttings more quickly to supply your needs. Do you think that the extra time it would take to collect your cuttings from the nursery rows would offset the initial cost and capital outlay for the stock block?

MR. VANDERBROOK: There are two angles. It isn't just the capital or cost alone. Sometimes the blocks you are growing on for sale

do not produce as many cuttings as are produced off the stock block. That is one of the reasons for the stock blocks. For instance, in one block we set up we had approximately three hundred *Taxus densiformis* plants set out. From those three hundred plants we got an average of 20,000 cuttings. You are not going to get that from the finished block containing the same number because you are going to sell them.

MR. COLE: Unless you are selling a rooted cutting you are not going to be growing that many plants anyway. Say, for a two-year old plant, if you take one cutting, you can still match your number.

MR. VANDERBROOK: You gain in cutting material and make room for expansion. You can get into the lining-out stock market.

MODERATOR HILL: I don't think there is time for more questions. I think the panel members have done an excellent job.

Our next discussion is going to be on "Mulching Materials and Methods of Application." Dave Dugan is the Moderator for this group, and I am going to turn it over to him.

Mr. David R. Dugan, Dugan Nursery Company, Perry, Ohio, took the chair.

MODERATOR DUGAN: Thank you, Jack. The panel, as you see by your program, consists of Harvey Gray, Case Hoogendoorn, and Dr. Miller.

We will start with Harvey Gray who will give us the basic facts on just what mulching is. We will then let the other two members fill in, both with practical and research facts, to build this subject up. If they don't answer the questions, I am going to take the liberty of calling on the audience for some of their experiences so we can have this thing pretty well thrashed out in an hour's time. Harvey, if you will start the discussion, please.

MR. HARVEY GRAY (Farmingdale, New York): Anything I have to say relative to mulches will be geared to the plantsman as a propagator and will cover such areas as seed in the seed bed, seedlings, transplants, rooted cuttings, grafts, and comparable material that will be in the bed for one to three years and maybe a little longer. My thinking does not include at this time the areas of stock blocks, if you will, or material in the field that may or may not be mulched. I believe our Society is and should concern itself primarily with plant propagation rather than nursery operations and management, and so I will confine my remarks to the plant propagator rather than to the nurseryman.

Mulches, what are they? I think if we would check on a good source of printed information, the Brooklyn Botanical Garden a few years ago did an excellent job on a publication in which a dozen or maybe two dozen authorities presented their ideas relative to mulches. I note that mulches may include a dust mulch for those who are interested in rock gardens for rock plantings. There are pebbles and stone mulches. In the mineral type of mulch, then, we jump a considerable distance from the dust and pebbles and stones, to aluminum foil. As long as we are on the sheet material such as aluminum foil we go to plastic films and paper sheets, such as the pineapple grower uses. There are mulches of shredded paper, paper mache, all sorts and kinds of paper scrap,

organics, waste products of agriculture or agricultural processing, corn cobs, brush, wheat hulls, wood chips from the chipper of the tree operator to the wood chips of industry in the mills and millworking, sawdust, and you go on and on to name as many more as I have already named. As a result we have a terrific variation and number of materials that could be used as mulches.

Now with that in mind, let's jump to the next point I have in mind, and that is, what can we expect these mulches to do? Well, I would say they will control weeds when properly and timely applied. They will control water when this is a factor or feature that we need to concentrate on, and they have a controlling action on soil temperatures. All of these things we find are important as far as transplant beds, and seed beds are concerned.

Now we will move on to the location of our beds in relation to the soil. Whatever our objective may be as far as weed control, water control, and temperature control is concerned we have a decision here as to whether we should or should not use a mulch, because there may be certain detrimental effects connected with its use. Take, for instance, if you would mulch on a heavy clay soil, right away you are pretty apt to be in difficulty. I can recall a young chap who was advised to mulch with crushed corn cobs on an area because his rhododendrons were doing poorly. He made this application of crushed corn cobs to a bottom-land clay soil. Well he had more problems after he applied the mulch than before he applied it. In fact, what he should have done, was lifted the plants out and gotten them out of that area because they were drowning.

On the other hand, we have soils which are light in texture. Here we find that mulching can be helpful, and we may or may not make an application. So we have, then, these different kinds of materials that we could work with. We recognize what they are used for, ie, weed control, soil water control and soil temperature control. We recognize that soil type has an important part to play here.

Then we have another point, and that is the location of these beds in relation to the light intensity. When we have our beds in full sun we have a different situation than when we have it in the shade. When they are in the full sun I raise the question as to whether we should or should not make an application of a mulch. Reasoning this through I would say we ought to take a look at the top and root portions of the plant. Are the plants small leaved or possibly narrow leaved? Do the plants have a deep penetrating root or do they have a very shallow, fibrous root system? Now if the plant has a small or narrow leaf and the root system tends to go down, I believe the place for your plants is in the full sun, as soon as you can get them there. Why? Because in full sun, photosynthetic action has a great part to play in affecting the C-N ratio. The C-N ratio has to do with the amount of combined carbon, that is your cellulose and comparable or allied materials, proportioned against that of the combined nitrogen, with the interplay of proteins and amino acids. Now in the full sun, the plant through photosynthesis will manufacture an abundance of carbohydrate, as Dick Van-

derbilt pointed out, with all other things being equal. But they will produce a large amount of energizing food, that is, the carbon end of the C-N ratio business. So in the full sun we are going to get a large amount of food manufactured where if we were to cut the light we would also cut the amount of food that is produced, bearing in mind that we must have a favorable balance of phosphorus, nitrogen and phosphoric acid. Minor and trace elements also should be given due consideration and adjusted in the full sun.

Why is it, then, that we are making this application of a mulch? Are we putting it on for weed control, water control, or temperature control? Quite likely it is for weed control to an extent. If it is in beds of the sort I have described then aren't we failing to consider the use of materials such as methyl bromide, Vapam, and comparable materials? I am not including in this particular area materials such as Simazine or CIPC but those materials that will serve as a nematocide when applied in the proper amounts. I think that we can make use of this type of material rather than controlling our weeds with mulches.

But if it is a temperature control such as was pointed out yesterday in relation to that physiological breakdown at the soil line with taxus cuttings, might not mulches be the answer to that problem?

If it is water, that is your problem, how in the world can you grow a good crop of plants without irrigation, so what do you need the mulch for?

If, however, you do lean toward the use of mulches, let's take a closer look at some of these materials that have already been suggested. I believe that we should recognize resiliency in our material so that it will not mat down. I believe that we should recognize in material that we choose to use a non-water absorbing material. This will rule out such materials as sawdust and peat moss, because they surely will pick up a terrific amount of water. This invites the roots to grow in the mulch where it is your intention they grow in the medium which has been prepared below for them. So rather than using such materials as peat moss and sawdust, I would suggest the consideration of salt marsh hay, wood chips and shredded sugarcane. These materials possibly should be used over some of the other materials that have been suggested. I think it is most important in the case where the plants are in the sun that we should avoid soil-like materials, such as peat and sawdust, because it does invite the roots to go into the mulch rather than into the medium below.

I prefer to put my plants, and I ask you to consider putting your plants in migrating shade, where one minute the shade is in such a spot and a few minutes later the sun creeps in and the shade moves on. This, I believe, gives your plants a better chance to manufacture this food than they would if they were in full sun, but still you are getting the benefit of reduced water losses and a better control of temperatures. Here are the type of plants I would put in such a migrating shade. It would be those that suffer for the sake of a better term, "cook-out." "Cook-out" sounds like a Boy Scout or Girl Scout' phrase. That is not what I am talking about. I am talking about plants that are large leafed with fibrous roots. If you place a large leafed fibrous rooted cut-

ting or seedling in the full sun you are going to have "cook-out." The temperatures are going to raise havoc with the water loss, both by transpiration and evaporation. So we should see to it that our plants are protected from this rapid loss of water. Migrating shade will do the job better than mulching in the full sun. We also get good control over temperature with migrating shade. We get good control over water. Our beds would be sterilized with methyl bromide or Vapam rather than mulched. However, if you were to mulch, because you failed to practice weed control, a lighter mulch will do the job, if it were in the full sun. I don't know why, but this is my observation over a number of years. I find when I use wood chips I can get away with not much more than a half inch layer of wood chips. These wood chips, of course, come from a mill rather than from the chipper that the brush clean-up fellow use. These chips are of a size like nickels, dimes and quarters, laid down just like so many little plates. This will do a wonderful job of weed control.

MODERATOR DUGAN. Thank you, Harvey. We will pass now to Mr. Case Hoogendoorn for his comments.

MR. CASE HOOGENDOORN: Now you just heard the technical side of mulching. What I am going to give you is just my own experience, which of course is purely commercial. I have already found out that Harvey and I are on opposite sides of the fence.

Mr. Hoogendoorn presented his paper on mulching materials and methods of application. He supplemented his discussion with demonstrations of plant materials grown under this system of culture.

USE OF MULCHES IN THE NURSERY

CASE HOOGENDOORN
Hoogendoorn Nurseries
Newport, Rhode Island

Since we do a lot of propagating, we had the same trouble everyone else has and that is to keep ahead of the weeds in the beds. This is usually all handwork, which is costly and consumes a lot of time.

Before we began to use a mulch, the soil in these beds, consisting of a heavy loam, was very hard in the spring, after the heavy winter rains and quick drying spring winds. Trying to break up that soil in the spring with a scratcher was slow work and was hard on the wrist, which has bothered me for years. So I started to look around for a better method to control these weeds and the hard soil condition. After looking around I started to eliminate various mulch materials for one reason or another.

I had seen the sawdust used, which I thought had disastrous results. It broke down too fast, robbing the soil of nitrate nitrogen. As a result the plants turned yellow and needed constant feeding with nitrat. For that same reason I did not dare to use wood chips, chopped straw or hay. Then we come to peat moss. That looked alright to me at first, but after analyzing the results, I eliminated that also, for these