examined the cuttings for any of these root initials?

DR. KAWASE: I cannot answer the question directly. However, I can say that the diffusate did promote rooting in mung bean cuttings as well as increase rooting in the willow cuttings. The mung bean cuttings have no performed root initials. So I know that it will promote root initiation as well as development of the initials.

VOICE: Did you observe any vascular cell tissue damage on your herbaceous material at 4000 rpm?

DR. KAWASE: Yes, this is sometimes a problem even with willow at the higher speeds.

DR. HESS: We could add another species here, Mokato, *Hedra helix* also works except that we get both 1 and 4 cofactors out from the diffusate.

DR. KAWASE: Yes, I understand that was reported in the last Proceedings.

DR. HESS: That was just straight diffusion but we've also used your centrifugation technique.

DR. KAWASE: Oh, you have used it.

DR. HESS: Yes, I think centrifugation is better because with diffusion over a period of time you have bacterial contamination, but by centrifuging just for an hour I think you get relatively pure materials without contamination.

MODERATOR PINNEY: The next subject, propagation of *Picea pungens glauca* will be given by Mr. Leonard Savella.

PROPAGATION OF PICEA PUNGENS GLAUCA CULTIVARS

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The propagation of Blue Spruce from either seed, layering or grafting has been a practice for many years. It was believed that these were the only methods to reproduce this species commercially and make it profitable.

With the introduction of the mist system of propagation, the Spruces, like many of the other ornamentals that were reproduced in one of these three ways, have become easy to root from cuttings. The procedure is very much the same as most of the ornamentals propagated under mist, except that just a little more care should be taken in timing your cutting.

The following is a step by step method that we use at Bald Hill Nurseries, Inc. which has proven to be very successful:

An outdoor mist bed 6′ wide is prepared with a layer of peat moss 1½ - 2″ thick. Then a layer of sharp sand 6″ thick is put on top of the peat moss. The sand is then rolled with a roller filled with water for compaction. The sand is leveled off so that the surface area is as level as possible. The mist pipes are then placed on top of the bed and connected. Our system is

made of ½″ copper tubing and can easily be placed and connected, by simply making one connection joining the two 20′ sections of mist heads and then joining the system to a regular garden hose which is joined to the spigot. The mist heads are spaced 30″ on center and are made by "Spraying System Co." They are ¼″ T Jet #TN8W stainless steel tip nozzles.

The bed is now ready to receive the cuttings. We go to our two stock plants of Koster Spruce and after carefully examining the new growth, we start to take the cuttings. I say careful examination because this is very, very, important. The cuttings are taken when the new growth is about 2″ to 4″ long and when the terminal buds of each cutting are just about to show or are just showing. If the cuttings do not show a bud, they can be taken because they will root and form buds. The location of the cutting will determine your percentage of success in rooting. Cuttings of the terminal growths are more difficult to root. The cuttings, usually six in number, on both sides and behind these lead shoots root more readily. Then if you look carefully beyond these cuttings toward the main truck and setting on top of the branch, you will notice cuttings of about ¾″ to 1″ long. These cuttings will root almost 100%.

The cuttings are cut just below the node but also making sure the husk covering the node is left with the cutting. *THIS IS MOST CRITICAL.* The cuttings are taken and are immediately dunked into a pail which is half full of water. The reason for this is that the cuttings are so very tender they may dry out unless you handle them this way. When we have taken about (300) cuttings. we then go to the mist bed where they are made ready for sticking. The cuttings are taken from the pail of water and shaken to remove the excess water. They are then dipped into #2 Hormodin powder and set in an empty seed flat, or any kind of flat container and covered with wet burlap to protect them from the wind and sun. Now they are ready for sticking. We take a metal straightedge and cut a line in the sand about 1½″ deep so that when you stick the cuttings they will go in easier and undamaged at the base. The cuttings are taken from under the wet burlap and stuck into the medium. We use a lath as a spacer. When the first row of cuttings are stuck, we tamp the lath gently to firm these cuttings. At the same time, the sand is cut on the front side of the lath to make ready for the next row. This procedure is followed until we have the desired amount of cuttings stuck.

The system is on and operating during the sticking so that the cuttings do not dry out. When we have finished, we water down the entire bed until it is thoroughly soaked. The mist clock is set at 30 seconds every 2 minutes and is set to go on (1) hour after sunrise and off (1½) hours before sunset. This must be progressed as the Summer days get longer. During the very hot and dry days of Summer, the beds should get a thorough drenching about once a month. On very cloudy or rainy days, the system should be shut down completely so as

not to induce leaching. If leaching starts to show, the cuttings will become more difficult to root and many will just simply rot; therefore, this should be watched very closely.

By the middle to the end of September the cuttings should be ready to lift. They are lifted being very careful in the process, not to break any of the roots for they are *extremely tender* and *brittle*. Those that are rooted are transplanted in flats containing a mixture of ½ peat and ½ sand. They are planted 54 and 63 to a flat. When flatting the cuttings a hole is made with a peg so that the roots can be placed in this hole. This will eliminate much of the root "break-off" when transplanting. Also when the cuttings are pressed in, they must be pressed very gently. Let the watering do most of the packing.

Many of the cuttings that die in the flats, die because the roots were broken off in the transplanting. When the flats have been filled, they are brought into the greenhouse and placed on the benches. They stay there for about 4 - 5 weeks during which time they have made new roots and are now ready for hardening. They are put in beds where sides and shades are placed over them. We are very careful in making sure they get proper watering during this period. Before the real cold weather sets in, we cover these beds with sash and shades. This protection brings them through the Winter with light losses due to frost heaving and cold. On warm days during the Winter, we open the sash slightly to air the cuttings and at night they are closed. When Spring arrives. we take the sash off leaving the shades on and the plants are watered and cared for in these beds for 2 years. After this time, the cuttings have formed very good root systems and can now be planted in beds for further growth or can be field lined, depending upon their size.

We have been rooting Blue Spruce for 4 years and they show great promise. The plants are full and have many buds. They show a leader early and seem not to need staking when field lined. I would say that many more Propagators should adopt this method.

VOICE: Sometimes in grafting we experienced that the terminal bud doesn't come out and one of the lateral buds must be able to take the lead. Is this true with cuttings also or does the terminal bud grow out?

LEONARD SAVELLA: The terminal buds grow out because actually it's the one bud that forms first and that's the one that takes over.

JIM WELLS: Have you tried any other form of the spruces and have you tried any different misting periods?

LEONARD SAVELLA: No, I haven't. This whole thing was done accidentally. We were grafting in the wintertime and when we were cutting off some of these lateral shoots some of them looked so really nice that it seemed a shame that there were no roots on them. So I stuck them in the bench in some peat and, low and behold, some of them did root. I said if they can root there, they may be able to root outdoors. So the next

year we tried it and I was just flabbergasted with the results. So that's what we did and we've been doing it every since.

VINCE BAILEY: I noticed in the pictures a few unrooted cuttings. Do you restick them?

LEONARD SAVELLA: Yes. If you restick unrooted cuttings indoors with heat those that are good will root very fast, probably in 2 weeks. And if you look in the back of the room, the one with the longest roots is the one that was restuck.

RALPH SHUGERT: Do you have cost figures on the three year cutting and grafts of the spruce?

LEONARD SAVELLA: No, like everybody else, I just do it. I don't know how much it costs me.

E. STROOMBEEK: I have two questions. Have you taken cuttings from different stock plants and where did the stock plants originate?

LEONARD SAVELLA: The stock plants were bought from Case Hoogendoorn. They are true Kosters. We have tried other varieties and we find Moerheim more difficult and the Hoopsi true to its name, it's tough.

BRUCE BRIGGS: Did you try some with pulling off and leaving the heal rather than cutting them off?

LEONARD SAVELLA: Yes, we tried pulling them, but we had better results with cutting them. It seemed that the right time to take them is just when the pulling stage is past.

BRUCE BRIGGS: We know that spruces root better when they have lots of free air. Can you root the same way inside the greenhouse having it completely open?

LEONARD SAVELLA: There again, I never tried it out, but getting the 85% outdoors, I thought I'd leave well enough alone.

PETER VERMEULEN: Did you find any difference on the position on the stock plant or between the lower cuttings and cuttings higher on the plant?

LEONARD SAVELLA: That's a good question, Pete. We took cuttings as far as we could reach.

HANS HESS: Was this a continual mist that you had on these cuttings or was it intermittent mist?

LEONARD SAVELLA: Intermittent. Here again, I never took the trouble of timing these things. I just put the mist on and when I thought it was enough I left them alone. Maybe if I figured this thing out, they wouldn't root.

MODERATOR PINNEY: Next, we shall learn about cell culture and plant propagation from Dr. John Mahlstede.

CELL CULTURE AND PLANT PROPAGATION

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Plant propagation, defined simply as the multiplication of plants by either sexual or asexual means involves the use of

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