trouble making the buds break the next spring. But if the leaves stay on and they remain in the flat until the leaves normally drop, then there seems to be no trouble whatsoever.

MODERATOR WOOD: Bruce Briggs was born and raised in the industry, in his father's business of Brigg's Nursery, Olympia, Washington. Bruce is one of the most innovative people in our industry. If there is anything around to try, Bruce is going to try it. When anyone in the industry, whether it be in Oregon, Washington, or any place else needs any help, all they have to do is yell for help and Bruce is right there at the front of the line. Bruce Briggs:

RESEARCH AT THE NURSERY LEVEL, II

BRUCE A. BRIGGS

Briggs Nursery
Olympia, Washington 98501

At the 1969 Eastern meeting, I gave a paper entitled, "Research at the Nursery Level"(1) My talk today pursues some of these ideas further and will be in a similar format (mostly slides with some discussion and, hopefully, some questions at the end).

ROOTING IN AIR

We first constructed an air rooting chamber several years ago as a teaching device and the basic structure was described in the 1965 and 1966 IPPS Proceedings (2,3). We have continued using the chamber as a research tool because it offers a quick observation of the rooting progress without, in any way, disturbing its continuance.

Rooting in the air chamber has always been poor in the late fall and winter months. We have decided that this is not only a temperature factor, but that light intensity is much more critical with cuttings under these conditions than when they are struck in a solid medium. This year, even in the long days during July, when the tops were shaded 60%, cuttings which rooted in seven days in full light took over 14 days to root in the shade.

As mentioned in earlier articles, one factor which has needed improvement in this air chamber is a safety provision, in case of a power or water failure. An IPPS member in our area, Warren Berg, used a tray of water under the cuttings to keep them moist. We have been using this method, keeping the mist above and the water-filled tray about an inch or so from the bottom of the cuttings, with the water heated by an electric cable to around 20

to 27°C. With the cold mist on the tops of the cuttings and warm water inside the chamber, the bases of the cuttings are kept covered with moisture. If the temperature of the water is raised too high, it seems to cause a loss of fluids through the base of the cuttings.

DISTILLED WATER FOR HORMONE DILUTIONS

How many times have you failed to achieve the same rooting response, even though carefully following the prescribed directions of another member? Timing (3), condition of stock plants, rooting medium, calcium and other chemicals, light and temperature are just a few of the variable and sometimes limiting factors involved.

For example, we found at our nursery that the effect on a cutting dipped in a 27°C hormone solution in the afternoon, could be *twice* as great as on a similar cutting dipped in the same hormone solution at 10°C in the morning! This effect becomes even stronger as the temperature of the room rises along with the temperature of the solution.

We have has some difficulty in getting clear rooting solutions when testing new combinations of chemicals. Apparently the slight mineral content of various water supplies can greatly affect these dilutions. We finally found that we could produce clear dissolved solutions with the use of either distilled or deionized water. It has proved well worth the small extra expense to buy the mineral-free water for this purpose.

A short note, while we are on the subject of rooting solutions: when we used rutin (5) in the quick dip, our results were that it retarded the rooting of the usually fast and easy-to-root items, while it enhanced the rooting of the usually slow and hard-to-root items.

CEDAR SAWDUST AS A ROOTING MEDIUM

Earlier discussions on the work of John Roller on direct rooting in pine sawdust outside with Rainbird sprinklers was the basis for additional work we continued along this line.

Years ago, we used a layer of any kind of sawdust on the bottom of the flat underneath the other media, as we found that many plants which were to be left in the flats for an extended time responded with better growth. Plants which were normally difficult to transplant, such as *Daphne cneorum*, responded very well, having a much better root system by spring. Then we were able to transplant them directly from the flats into the field. To obtain the same effect, we tried various combinations of sawdust, peat and perlite, etc. but found that we were creating a real

watering problem with so many different media, especially when the plants were put into mixed blocks in the greenhouse.

So, to create a longer water column, we changed from the 2 to 3" deep flat to a 6" deep box. For ease in moving them with our equipment we went to a very large box, 10' by 4', which we filled with a coarse uniform cut of cedar sawdust.

In our Pacific Northwest area, the term cedar sawdust refers to the sawdust from our native *Thuja plicata*. Freshly-cut cedar sawdust must be leached by water before cuttings can be stuck. If put into the boxes fresh, the sawdust can be watered heavily several times and then it would be safe for planting within a couple of days. If left outside in a pile, it can be leached by the normal rainfall over a longer period of time. The sawdust cannot be used fresh, put directly into a peat pot, as adequate leaching does not occur.

We did get excellent rooting with the straight cedar sawdust on some plants. However, the rooting was enhanced with the addition of peat, up to ¼ volume, for ericaceous plants such as rhododendrons and heathers. The addition of up to ¼ volume of coarse perlite enhanced rooting for most conifers and plants requiring good drainage (except *Chamaecyparis obtusa*). Coarse sand could be used to create this better drainage but we did not want to add the extra weight in our large boxes. Additives of calcium in the form of dolomite lime and superphosphate (0-20-0) have also proved beneficial. If the pH is not too low, we try to substitute gypsum for some of the dolomite to improve drainage. On our latest mixes, we are trying a complete fertilizer, including iron and some other minor elements.

USING FERTILIZERS WITH CEDAR SAWDUST

We have found that the cedar sawdust is stable enough and breaks down slowly enough so that we can mix fertilizer with it and apply fertilizer overhead on it without causing too rapid a breakdown. There is some gradual change in medium structure caused by the formation and growth of some algae on the particles, but this is less of a problem with cedar or redwood sawdust than with the softer woods. We would recommend having a chemical analysis of the water, sawdust, and other proposed ingredients before it is decided what chemicals need to be added.

We apply our liquid fertilizer over the tops of the plants (which are rooting directly in the large boxes) through fairly fine watering nozzles, rather than the usual misting nozzles. To date, we have had no chemical build-up or clogging of these nozzles. This overhead application of fertilizer seems to be particularly beneficial to the broadleaved evergreens as well as deciduous

and quick-to-root plants. It seems to have less of an enhancing effect on the conifers and other slow-to-root plants.

EFFECT ON WINTER HARDINESS

An interesting feature of rooting in cedar sawdust, which we have not yet checked out completely, is that it *seemed* to result in a better survival of plants through severe winter conditions. Last summer the *Euonymus* 'Emerald 'n Gold' and 'Emerald Gaiety' cuttings rooted faster and had better color when rooted in cedar sawdust rather than in peat and perlite, perlite, or Douglas-fir (*Pseudotsuga menziesii*) sawdust. During the winter, these plants were left outside in the boxes where they were exposed to temperatures of -18°C. All plants died, *except* those which had been rooted and were still in the cedar sawdust. We need to do additional checking to see if this will hold true on other plants and to see if we can isolate the factor which made the difference. In the meantime, we are becoming increasingly interested in the potentials of cedar sawdust.

LITERATURE CITED

1. Briggs, B.A. 1969. Research at nursery level. *Proc. Inter. Plant Prop. Soc.* 19: 275-279.
2. Briggs, B. A. 1965. Rooting in air. *Proc. Plant Prop. Soc.* 15: 346-347.
3. Briggs, B. A. 1966. An experiment in rooting in air. *Proc. Int. Plant Prop. Soc.* 16:139-141.
4. Roberts, A. N. 1969. Timing in cutting propagation as related to developmental physiology. *Proc. Int. Plant Prop. Soc.* 19: 77-82.
5. Tukey, H. B. Jr. 1971. Development of root promoting substances on *Euonymus compactus* under intermittent mist. *Proc. Int. Plant Prop. Soc.* 21: 343-349.

JOHN EICHELSER: I noticed you mentioned cedar sawdust. Have you tried fir sawdusts? Is there a reason for using cedar instead of fir?

BRUCE BRIGGS: A few years ago we did a lot of work with fir and fir combinations. The reason we have gone to cedar is two-fold. First, because we had a more uniform grind, which is very essential when you are working with a sawdust. Our work with fir years ago was fair; this year we ran cedar sawdust with rhododendrons and other plants; it was a little better. Our results

were superior; this again may be due to uniformity of grind, plus good drainage. But it was better. This is about the only reason for us doing that; we felt we want a medium that would not break down fast, because when it breaks down you have more drainage problems. And with cedar, like redwood in California, breakdown is slow. So we are getting to a product that remains more stable, especially when it is to be used for a long, long period of time.

MODERATOR WOOD: Our next speaker took his undergraduate work at Utah State, then to Michigan State for his Ph.D., then to Washington State at Pullman about 14 years ago, where he has been working in Pomology. Fenton Larson:

SUCCESSFUL DEFOLIATION OF NURSERY STOCK WITH CHEMICALS[1]

FENTON E. LARSEN[2]

Washington State University
Pullman, Washington 99163

Work on chemical stimulation of leaf abscission of nursery stock started at Washington State University in 1962. Some work had been done elsewhere in the United States prior to that time (1,2,12,13,14). Since 1962, sporadic attention has been given to this problem by others in the United States and Western Europe. Apparently somewhat more consistent attention has been given in Eastern Europe. Much work in Europe, however, has been with materials which are more desiccants than defoliants.

In 1967, a report to the International Plant Propagator's Society (IPPS) covered the findings of the early work in Washington (4). Since 1967, several additional reports have been published concerning the most successful treatments (5,6,7,8,9,10) under central Washington conditions. Other materials have been tried which might be useful elsewhere. It is the purpose of this report to briefly present information gathered since the above mentioned report to IPPS (4) and to describe the currently most successful approaches to nursery stock defoliation in Washington.

---

[1]Received for publication August 11, 1973. Scientific Paper No. 4112. College of Agriculture Research Center. Washington State University. Work was conducted under project 1690. The contributions and assistance of the following nurseries are gratefully acknowledged: C and O, Chervenka, Columbia Basin, Heath, Hilltop, May, Milton, Pacific Coast, Van Well, Willow Drive. Contributions of chemicals from various companies is also appreciated.

[2]Professor, Department of Horticulture.