branches. In most cases, flower buds would form the second year after striking and the plants were sold in the fall as 12-15″ and 15-18″ grades.

MR. CARL SCHMIDT: Please repeat the time period of artificial light used while rooting deciduous azaleas.

MR. BRYDON: From five p.m. to twelve midnight August first to Janpary first.

DR. ANDREW LEISER: Have you tried interrupted or intermittent light?

MR. BRYDON: I'm sorry I have not.

DR. ANDREW LEISER: Are azaleas rooted before lights are on?

MR. BRYDON: As a general rule by August the first most of them are forming some roots at the end of the cutting and the lights are turned on August the first to January first. I was assuming that they are rooted before the lights are turned on.

CUTTAGE PROPAGATION OF *Xylosma congestum*

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The basic requirements for the successful propagation of broad-leaved evergreen plants by stem cuttings are as follows:

1. The cutting must have the capacity to form roots when given the proper treatment and environmental conditions.
2. The rooted cuttings must have a viable bud or the capacity to form one.
3. The cutting must have enough leaf surface to promote rooting and the rooted cutting enough leaf surface to promote growth of the bud into a shoot.

If all three requirements are fulfilled a new plant will probably result. If one or more of these requirements is difficult to fulfill the plant will be difficult to propagate by stem cuttings. It is indicated by our general topic "Difficult to Root, General Ornamentals" that it is difficult to fulfill at least one of these requirements for the cuttage propagation of *Xylosma congestum.*

From personal experience and from observation of the results of other propagators it appears that there are two difficulties in the stem cuttage propagation of Xylosma. First of all it may be difficult to get rooting and secondly it is usually difficult to prevent the leaves from abscising during or after the rooting period.

We have been doing some experiments at U.C.L.A. in an effort to analyze these problems and possibly come up with some answers to them. I will present results of two of these experiments and then discuss the factors that seem to be most important for successful propagation of Xylosma by stem cuttings.

In one experiment we tested the effect of two factors, age

of wood and "hormone" concentration, on root initiation and leaf abscision. Wood of different ages was obtained by selecting growing shoots about 18" long which had 1 year old wood at the base and then subdividing them into a tip and middle portion of current season's growth and a basal portion of one year old wood. Cuttings were about five inches long and had four leaves per cutting except for tip cuttings which had four or more leaves. The cuttings were rooted under mist (2 sec./min.) with minimum bottom heat and air temperature thermostatically controlled at 70° F. Maximum air temperatures reached about 95° F. Indolebutyric acid was applied in a talc powder or as a 5 sec. dip in a 50% ethyl alcohol solution. The rooting medium was coarse vermiculite.

The results of this experiment taken after 60 days under mist are shown in the first slide. The most important point brought out by this experiment is that cuttings from current season's growth root at a much higher percentage than those from one year old wood. The average number of leaves remaining on rooted cuttings was 1.7 for basal cuttings (1 year old wood), 1.6 for middle cuttings (current season's growth) and 1.2 for tip cuttings. So even though the tip cuttings rooted at the highest percentage they retained fewer leaves than cuttings of the other two categories.

Secondly, the concentration of indolebutyric acid also affects the percentage of cuttings rooted. Indolebutyric acid solutions of 1.0% and 1.5% were superior to Hormodin 3 as a treatment to promote rooting. The results with 2.0% IBA were variable so it is difficult to draw a conclusion as to its effectiveness. The cuttings treated with IBA solutions had root systems superior to those treated wtih Hormodin 3 and this is illustrated in the next slide. The larger root system may indicate a faster rooting response. However, rooted cuttings which had been treated with Hormodin 3 retained more leaves than those treated with the higher IBA concentrations in alcohol solution.

In the second experiment, the effect of type of humidity control and hormone concentration on root initiation and leaf abscission was tested. The three humidity controls used were mist (with conditions as previously described), closed case and fog or high humidity. In each case bottom heat minimum temperature was theromstatically controlled at 70° F. but air and cutting temperatures were not necessarily comparable. Likewise light intensity was not camparable being a maximum of 2500-3000 foot candles under mist. 500 foot candles in the closed case and 750 foot candles in the fog house. When considering the experimental results. these differences as well as the differences in humidity control should be kept in mind. Material for cuttings was selected in the same manner as for the previously described experiment. However, only the basal portion of current season's growth was used. Hormone treatments and other conditions were as previously described.

The results of this experiment taken after 60 days in the

rooting environment are shown in the next slide. In general, the percentage of cuttings rooting was somewhat higher in the closed case than it was under mist or in the fog house. This could be due to one of several environment factors and not simply humidity control. The effect of hormone treatments was quite similar under the three environments and in general IBA solution treatments gave a higher percentage of rooting than did Hormodin 3.

The average number of leaves retained per cutting was 1.6 for mist, 1.5 for the closed case, and 1.4 for the fog house. Although the number of leaves retained per rooted cutting was not greatly different for the three types of humidity control, there was a great difference in the appearance of the leaves. As shown in the next slide, the remaining leaves of cuttings from the closed case were much darker green in color than those from the mist and slightly darker green than those from the fog house. This observation may be important as leaves that turn yellow have a greater tendency to abscise than leaves that are a dark green color.

The results of these experiments show that current season's wood roots more readily than one year old wood. However, tip cuttings lose more leaves than cuttings from slightly older current season's growth. This is probably due to the fact that the

Table 1. The effect of age of wood and indolebutyric acid treatment on rooting of **Xylosma congestum** cuttings.

"Hormone" treatment	Current Tip	Current Base	1 year Old
Control	12*	25	8
Hormodin 3	48	40	28
1.0% IBA	96	64	33
1.5% IBA	64	64	33
2.0% IBA	76	60	8

*Figures represent the percent of total cuttings which rooted.

Tabe 2 The effect of rooting environment and indolebutyric acid treatment on rooting of **Xylosma congestum** cuttings.

"Hormone" treatment	Rooting Environment		
	Mist	Closed Case	Fog
Control	25*	8	8
Hormodin 3	40	56	44
1.0% IBA	64	80	72
1.5% IBA	64	76	48
2.0% IBA	60	60	44

*Figures represent the percent of total cuttings which rooted

succulent tips have a great tendency to wilt and die back during the rooting period. Cuttings from the slightly hardened, actively growing, current season's growth probably have the best chance of rooting and survival. It has also been shown that hormone treatments can greatly influence the rooting response.

Control of leaf abscission is very difficult. In all of our treatments an average of 50% or more of the original leaves abscised on rooted cuttings. There is some indication that environment may influence the color and quality of leaves retained by cuttings. The fact that sweat box rooted cuttings have leaves with better color than those from mist may indicate that leaching of leaves is a factor contributing to their deterioration. However, other environmental factors such as temperature and light intensity could also be involved. Our present work involves experiments to determine what factors influence leaf deterioration and abscission in Xylosma.

DR. HOWARD BROWN: What is the influence of season of the year on rooting and what effect did timing have on rooting?

DR. HACKETT: I cannot answer this question directly because we haven't tried rooting experiments at various seasons of the year. Our work has been during the late spring and summer when growth is occurring. From our experiments, it can be said that age of wood and vigor of growth are important so perhaps it can be implied that time of year might also be important.

MRS. FRANCES SPAULDING: Are you working on sucrose to overcome leaching and leaf abscission?

DR. HACKETT: We did one experiment in which we presoaked the base of the cuttings in sucrose solution before we stuck them. We could see no difference in leaf retention in this experiment but there was some indication that the root system was somewhat better developed in the sucrose treated cuttings.

MRS. FRANCIS SPAULDING: Have you tried nutrient sprays on cuttings in the afternoons after the mist cuts off?

DR. HACKETT: No, we have not. We tried fertilizing at weekly intervals with a quarter, half, or full strength Hoagland's solution but this only created an algae problem. We intend to try applications of nutrients through the mist system.

MR. IVAN STRIBLING: Have you found that it helps to cut light intensity in the hardening off periods after rooting under mist?

DR. HACKETT: Again, I can't give a direct answer because we haven't worked with the hardening off period. However, in our experiment where we compared closed case with mist as a rooting environment there was a much higher light intensity under mist than there was in the closed case. As you may recall, leaf deterioration was greater under mist than in the closed case. Perhaps this result can be interpreted as an effect of light intensity as well as it can be interpreted as an effect of leaching by mist.

DR. CLARKE: Could you describe xylosma briefly?

DR. HACKETT: It's a shrub. It can be used as a wind break or a shield and is used to a large extent along freeways as a baffling. It is propagated in quite large quantities in southern California.

MR. JOLLY BATCHELLER: I have an experience that might relate to this propagation. My associate took home two five-gallon cans of Xylosma. He put them on the north side of the house and forgot about them for a while. There was a cold spell and they practically defoliated. He brought them back into the greenhouse and they started to leaf out, so he decided to make hardwood cuttings just as they started to grow. He got around ninety percent. I can't tell you whether he used mist, or the media, or whether he used hormone.

I found it true with Fatshedra which roots very easily anyway, but bring this in out of the cold in the greenhouse for a week before making cuttings, you can make single eye cuttings. You get ninety-nine percent.

THE ROOTING OF MONTEREY PINE

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In 1929, J. F. Field stuck branches from nineteen-month-old Monterey pine in the damp, sandy soil in a New Zealand nursery. He found that they produced a large amount of callus in three months and rooted in five months, with roots as regular as those of seedlings. While he made no accurate count, he claims to have achieved at least 95% rooting on this first major attempt to root Monterey pine. These rooted cuttings were four inches tall in 1929, and averaged twelve feet tall in 1934 when he reported his studies in the New Zealand Journal of Forestry.

Based on Field's success, the Australians began rooting Monterey pine on a large scale. M. R. Jacobs reported on his extensive studies in the Australian Capital Territory in 1939. He predicted that 80% rooting success was possible with six-year-old trees, although few of his reported experiments reached this level of success. Like Field, he relied on an open nursery with little protection beyond maintaining the soil moist by watering.

J. M. Fielding reported on continuing Australian operations in 1954. Several of his reports mention rooting percentages in excess of 90%, although most of his data is in the range of 50-80%.

This by no means exhausts the list of foresters who have rooted Monterey pine with disarming ease and great success. It is time, however, to get around to me and us. "Us", who find ourselves here in a session devoted to difficult-to-root species