mist. Those cuttings which show a definite uptake of nutrients and growth while in the propagation bench continue to grow at a faster rate after their removal from the propagation bench than do cuttings which do not receive nutrients.

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MODERATOR HESS: Another technique which has had a tremendous impact upon horticultural industries is the control of plant growth and development by regulation of day length. Dr. Sidney Waxman was among the first to combine the techniques of mist propagation and day length control. He will now tell us about some of the results and implications of this combination.

PHOTOPERIODIC TREATMENT AND ITS INFLUENCE ON ROOTING AND SURVIVAL OF CUTTINGS "LIGHTING UNDER MIST"

SIDNEY WAXMAN

Plant Science Department
University of Connecticut
Storrs, Connecticut

My talk will be confined to the use of light given during the night for the purpose of extending the daylength to which the cuttings are exposed. As you know, many trees and shrubs that are given long days will not become dormant in late summer or fall, as they normally do, but will continue to grow for an extended period of time. This can be accomplished by illuminating the cuttings every night until they have rooted.

A sufficient amount of light to obtain a photoperiodic response can be obtained by placing 75-watt bulbs with reflectors three feet apart and three feet above the cuttings.

The light intensity should be no lower than 30 footcandles and the temperature no lower than 60 degrees Fahrenheit. The lights do not have to be operated continuously, but may be flashed on for five seconds every five minutes throughout the night.

During a 14 hour night, for example, an accumulation of only 14 minutes of light would be expended by flashlighting intermittently. A discussion on flashlighting was presented during the 1962 meetings and is in the Proceedings for that year.

There are many reasons for lighting cuttings at night and they are still based on the fact that long days delay the onset of dormancy while short days hasten dormancy.

Larger concentrations of substances that promote growth are usually present in plants as a result of long day treatment. whereas larger concentrations of inhibitors of growth are present as a result of short day treatment (3).

The response to photoperiodic treatment is by no means the same with all plants. There are some species that exhibit no response whatsoever, i.e. no obvious response.

The behavior exhibited by the many species that do respond is not necessarily uniform. Some of the most sensitive species will react faster than others that are less sensitive. There will also be differences in response among the same species, because the cuttings are of different stages of growth or because of the environment about the stock plants from which the cuttings were taken.

Photoperiodic treatment should be used for a specific reason and should not be applied indiscriminately. If the rooting and eventual growth of a particular species presents no problem, then there is no reason to use lights. Unfortunately, there are many plants that do present problems not only in rooting but also in eventual survival. By the appropriate control of the photoperiod, (i.e.) by long day or by short day treatment some of these problems can be solved.

For example, timing in taking cuttings of some of the deciduous azaleas is critical. Metcalf (1) reported that *Rhododendron calendulaceum* cuttings rooted poorly if the cuttings were taken after June 22. He found, however, that cuttings taken in July or August and given long photoperiods, while under mist, would have a higher percent of rooting than cuttings receiving natural daylengths. By the use of long day treatment, he was able to extend the period during which cuttings of the flame azalea could be taken and rooted.

Experiments in which *Cornus florida rubra* cuttings were given daylength treatments of 9, 18 and 24 hours while under mist showed that rooting occurred on all cuttings regardless of daylength. There *were* differences, however, in the *size* of the root systems. The average number of roots per cuttings dif-

fered considerably; the cuttings subjected to 18 hour days had three times the number of roots as those cuttings subjected to nine hour days and 1½ times as many roots as those given natural days (Table I). In similar experiments, Piringer reported earlier and heavier rooting of holly under long photoperiods (2).

A serious problem in the propagation of some deciduous azaleas, the pink dogwood, *Viburnum carlesi* and others is not only in rooting, but in the overwintering and eventual survival of the rooted cuttings. For various reasons, these plants suffer low rates of survival the first winter. Possible causes of the death of these cuttings may be the result of low carbohydrate level, and/or insufficient hardening of the tissues. As a result, stems may split and buds may blast or wither, depending on the temperatures the cuttings were stored at. Although the exact causes of this problem have yet to be precisely determined, there are some suggestions that may be used to insure a higher rate of survival of these troublesome cuttings. For example, the deterioration or defoliation of the leaves before the cutting has had sufficient time to build up a reserve of stored foods, may be one good reason why these cuttings die during the time they are stored.

Long photoperiods very often will delay defoliation and by doing so, will give the cutting a longer period of time not only to build up a supply of sugars, but also to further increase the size of the root system. The delay of leaf abscission by long photoperiods is all that can be expected for certain plants. With other more sensitive species, long photoperiods will cause the development of new leaves and stems.

Cornus florida cuttings which were rooted in mist, while exposed to 18 and 24 hour photoperiods, produced an additional flush of growth three weeks after they were potted, while the 9 hour and the natural day plants remained dormant. In either of these instances where defoliation is delayed or where additional buds develop the chances for survival are increased. However, because the cuttings are kept green and active for longer periods of time than they normally are, they would have to be subjected to short days, until they have had a chance to harden off. It would be necessary to leave the rooted cuttings in the greenhouse for a longer period of time, under natural daylength to permit them to harden off before they can be overwintered in a cold frame.

Table I. The Effect of Photoperiodic Treatment on the Rooting of *Cornus florida* cuttings.

Photoperiod	Percent Rooting	Avg Number of Roots/Cutting
9 hours	100	8.5
18 hours	100	25.4
24 hours	100	23.7
Normal Day	100	15.4

Another way to overcome the problem of overwintering these difficult species is to keep them under long photoperiods throughout the entire winter. The plants receiving this treatment will continue to produce new growth, until spring, at which time they should be placed outdoors. This last treatment is expensive because of the greenhouse space required and should of course be done only if there is no other sure way of carrying the plant through the winter.

Summary

Long photoperiods:

1. Keep cuttings in an active state of growth.
2. Can, in some instances, increase the percent rooting.
3. Can, in some instances, increase the size and number of roots developed.
4. Extend the season during which cuttings of deciduous azaleas may be taken.
5. Retain foliage and extend the time during which additional roots may develop and carbohydrates are produced.
6. Can induce a short spurt of vegetative growth with the development of additional buds often necessary for survival the following spring.
7. Can keep plants in active growth throughout the winter after which they may be planted out in the spring; a guarantee of survival.

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MODERATOR HESS: Mist propagation can be looked up as a form of automated syringing. Carrying the concept of automation to an even greater level is Peter Vermeulen who will tell us about his experiences with rooting-growing media.

ROOTING-GROWING MEDIA

J. PETER VERMEULEN

John Vermeulen & Son, Inc.
Neshanic Station, New Jersey 08853

By no stretch of the imagination should I be considered an authority on rooting - growing media. At our nursery we are keenly interested and rather heavily engaged in the commercial aspect of the propagation technique of rooting cuttings in a rooting - growing medium in containers. My comments therefore may be useful to others. This is perhaps what Dr. Hess had in mind when he asked me to participate. Having asked him