MODERATOR FLEMER: Thank you very much for a very professional and informed talk on a rather complicated subject. We will have time for a couple of questions.

CASE HOOGENDOORN: All of the yellow rhododendrons you showed were rather pale. The best yellow I have seen is 'Goldsworth Yellow'. What do you see wrong with it?

DAVE LEACH: For one thing, it is difficult to root and for another, some people would disagree with you that it is yellow. I agree that the slides I showed of the yellows do appear pale, but mostly the insufficiencies of the color film are responsible for that. Breeding yellow rhododendrons is extremely difficult; in fact, it is far more difficult than any other thing I have tried to do.

CARMINE RAGANESE: Would you say that 'Full Moon' is the most desirable yellow?

DAVE LEACH: No, I would not. Disregarding hardiness there is one on the West Coast called 'Hotei' and I think it is the yellowest rhododendron in the world today. It's a new hybrid and is pollen sterile so I am using it as a seed parent by growing it in a container and protecting it in the winter time. It is a butter yellow and nearly unbelievable; it was a great triumph for the hybridizer to have produced a yellow with that pigment intensity.

MODERATOR FLEMER: Thank you once again, Dave. While we are on the subject of breeding ericaceous plants we are fortunate in having with us a man known as "Mr. Kalmia" in the Eastern United States today and that is Dick Jaynes from the Connecticut Agricultural Experiment Station. He has been doing some wonderful things in breeding mountain laurel to expand its color range, rootability, and other potentials which have never received much scientific attention until Dick Jaynes began doing this work. He is a skilled hybridist and is going to address us this afternoon on "Selection and Propagation of Improved *Kalmia latifolia* Cultivars."

SELECTION AND PROPAGATION OF IMPROVED KALMIA LATIFOLIA CULTIVARS

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Abstract Mountain laurel occurs in many forms and superior selections are available for propagation Red-budded and white-flowered laurels come true from seed if both the seed and pollen parents are of similar kind. Seed sown in a greenhouse in November will produce plants of sufficient size by the following June to transplant into outdoor beds. Although of limited commercial value, grafting on forced stock in early spring or on unforced stock in June is suc-

cessful Clones vary in their ability to root from cuttings and display an increased reluctance to root as the stock becomes older Cuttings from cuttings or young grafts root more readily than cuttings from the original stock plant. The more "juvenile" the tissue, the more readily it roots. White-flowered and red-budded laurels can be propagated from cuttings by using seedlings of known pedigree as stock plants

"The mountain laurel of the American states (*Kalmia latifolia*) is one of those plants which, if of recent introduction, would be eagerly sought after; but having been an inhabitant of our gardens for nearly a century and a half, it receives but little attention."—a quote from a British magazine published in 1882 (1). We won't make up for 250 years of "under-attention" in the next 30 minutes but let's see where we are and whether this plant deserves more of our attention in the next 10 years.

Variation within the species is considerable and many selections from the wild and from nurseries have been named over the years. Some of these have cultivar names, others are recognized merely as botanical forms.

White-flowered forms (called 'alba') have been cultivated since 1840 (10). Like many "white" rhododendrons most of these show a hint of color in bud or have faint pigment in the open flower.

Pinks—A wide range of superior pink flowering plants are known but restraint has been shown in naming them because of the propagation problems. 'Clementine Churchill' is a pink-flowered cultivar selected at Sheffield Park, Sussex, England.

Red-buds—These plants are striking in bud and as the flowers open. 'Ostbo Red' (also known as 'Ostbo 5' or 'West Coast 5') is a good red-bud cultivar that has been propagated to some extent from cuttings.

Feather petal—A botanical form (*polypetala*) that has 5 petals. A garden oddity rather than a form prized for its floral beauty.

Banded laurel—A botanical form (fuscata) characterized by a deeply pigmented band on the inside of the corolla. The band may be continuous or interrupted.

Large-flowered types—One called 'Silver Dollar' has flowers which are indeed the size of a silver dollar.

Foliage types—Compact and dwarf kinds are known. One of the most striking is the form called 'Myrtifolia' which is a miniature replica of the normal mountain laurel.

So much for a sampling of the variation and horticultural types available within the species. How can they be propagated?

PROPAGATION BY SEED

Seed propagation of mountain laurel has been used by a few nurserymen for years and a commercially accepted method was

described at these meetings by Peter Vermeulen in 1967 (12). Seldom do we find two propagators following exactly the same procedures. Weston Nurseries in Massachusetts grows large numbers of laurel from seed using the same general principles described by Vermeulen but the method varies in several details (personal communication). In general the methods used for *Rhododendrons* will work for *Kalmia.*

The incentive to propagate laurel from seed will increase as we learn how to obtain some of the best forms true from seed. There is now a means to mass produce true-breeding seed on caged plants using bumblebees as pollinators (7, 8). Seed of white-flowering or red-budded plants can be produced by this method.

Fresh *K. latifolia* seed is partially dormant but this fact can be ignored unless the seed is in short supply (9). Fresh seed gives 40-50% germination but seed stratified (moist-cold) for 8 weeks gives 60-75% germination, or 50% greater. The same effect can be obtained by soaking the seed overnight (12-24 hrs) on filter paper saturated with 100 ppm Gibrel (80% gibberellic acid) (Figure 1), a technique we use

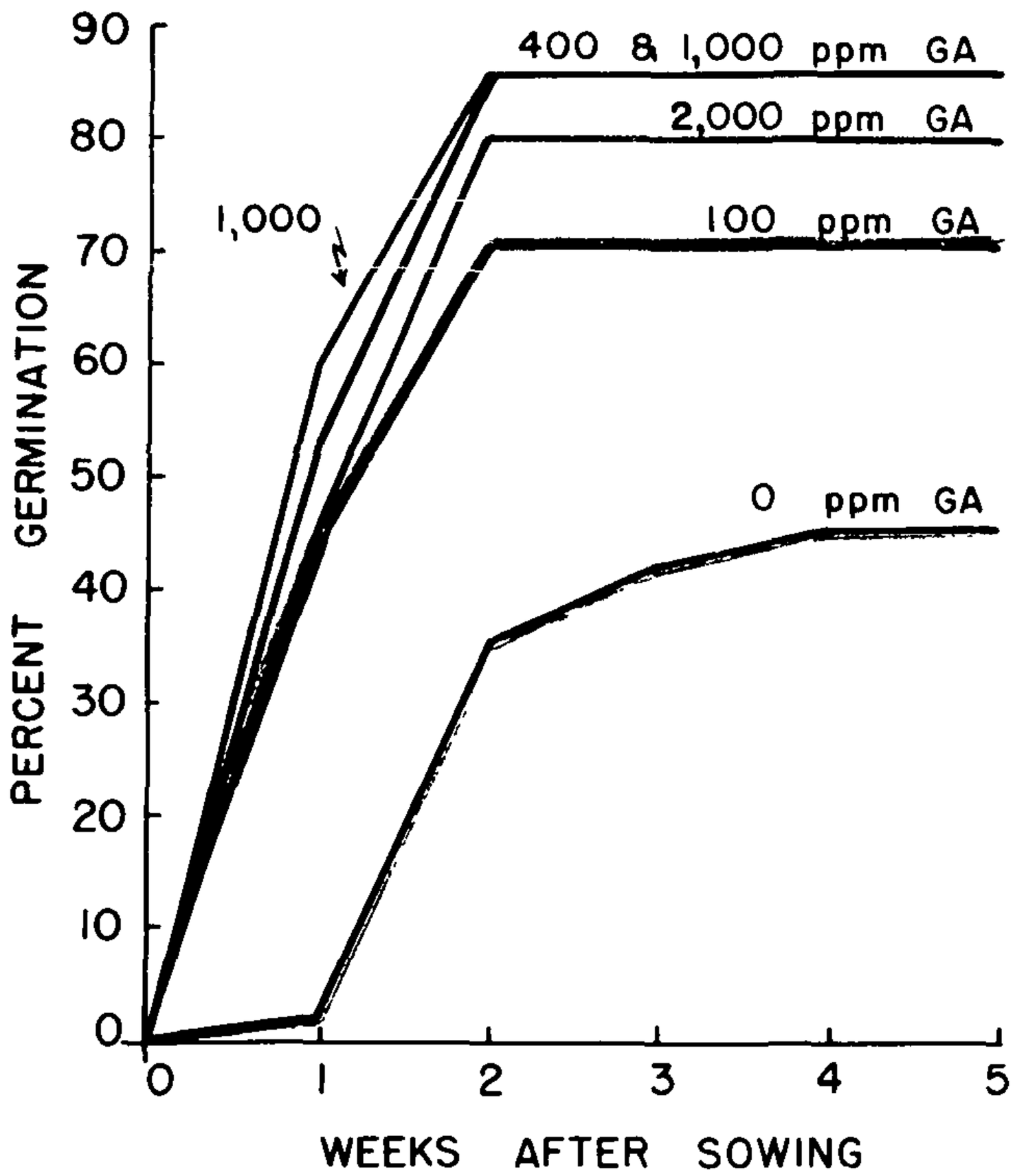

Fig. 1. Effect of gibberellin (GA) on germination of *K. latifolia* seed. Data based on 3 replications of 50 seeds each per treatment. Seed treated with moist-cold conditions for 8 weeks respond as do the gibberellin-treated seeds. After Jaynes (9)

routinely. *Kalmia latifolia* seed that has been stored dry for a year loses its dormancy and requires no treatment.

The beneficial effect of a mycorrhiza (root-associated fungus) on young seedlings was demonstrated by William Flemer in 1949 (4). Whether the fungus is normally present in peat moss or sphagnum moss is not known. Flemer's hope of commercially propagating laurel in sterile culture like orchids has not yet been realized.

Some aspects of our routine for raising laurel from seed in our breeding program may have commercial application. We sow seed in plastic boxes (2" high x 3½ x 7") on top of ⅝" of mix composed of 5 parts sphagnum-peat moss, 4 parts ground sphagnum moss, and 3 parts sand. The boxes are kept under fluorescent lights (about 500 ft-c at the level of the mix, obtained with the boxes 10" below a bank of 4 bulbs) with a daily photoperiod of 16 hrs. Temperature is kept between 70° and 80° F. It is important that temperatures during and immediately after germination not be above 80° nor much below 70° (Figure 2). Above 80° germination is greatly decreased, a

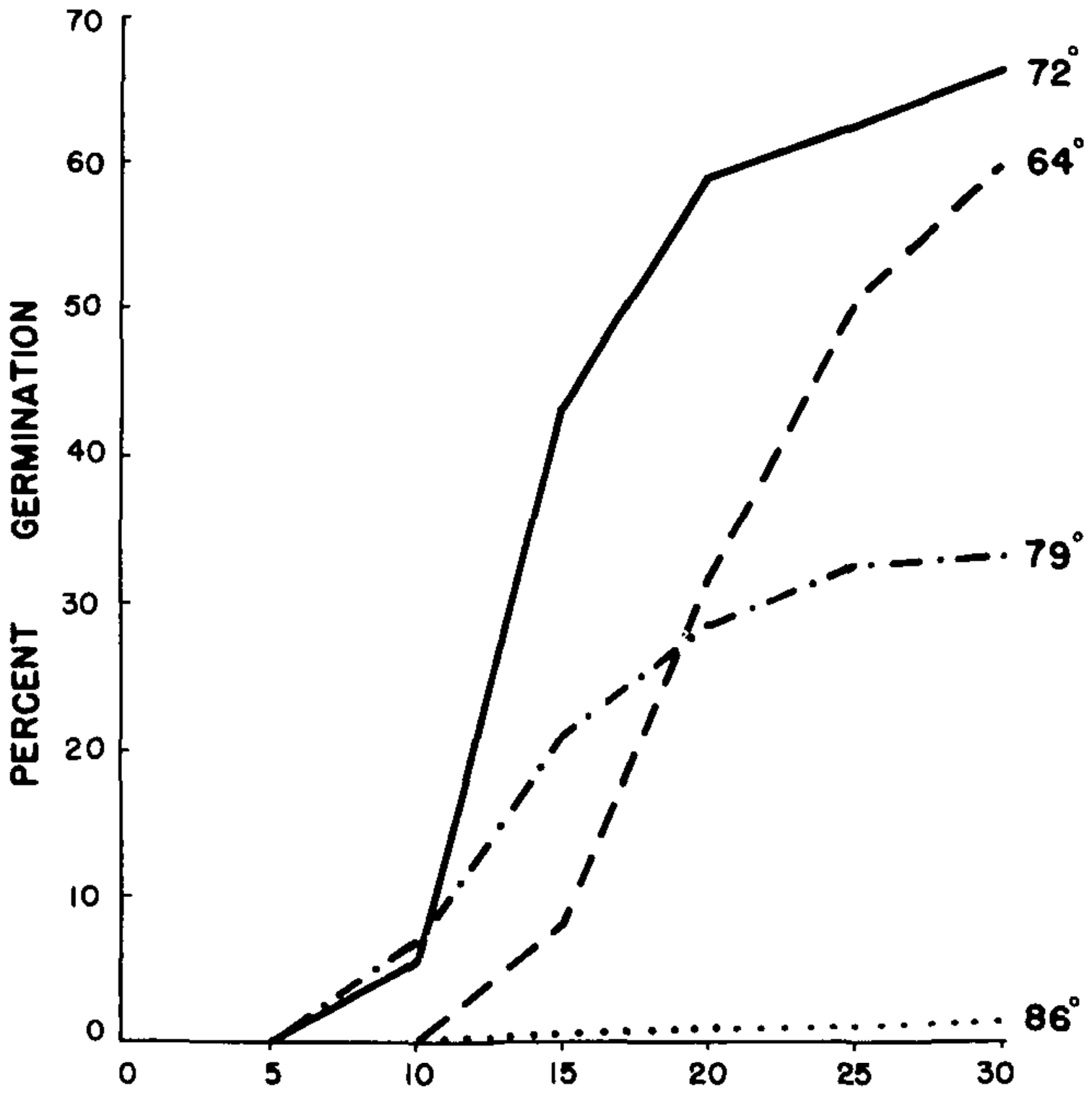

Fig. 2. Seed germination of *K. latifolia* at 64°, 72°, 79°, and 86° F. Note particularly the low germination percentage at the two high temperatures. Data pooled from experiments on 2 northern and 2 southern sources of mountain laurel which showed no correlation between source and germination response at the different temperatures. Each treatment based on 12 replications of 50 seeds each.

phenomenon not observed with other laurel species (9); below 70° growth is retarded.

Seed is best sown in November. The seedlings form 1 to 3 true leaves within 8 weeks at which time (January) they are pricked-off into flats, 60 plants to a 13 x 20 inch flat. Forceps are used for transplanting to holes made by a board with 60 equally spaced nails.

The transplant mix is composed of 4 parts peat moss, 2 parts perlite, 2 parts vermiculite, 1 part ground sphagnum to 1 part composted soil; 1 oz of hydrated lime is added to each bushel of mix. Why use this mix for transplanting and the other for germination? At least a dozen different media were tried for each and these worked best under our conditions. Bands and peat pots were tried but I see no advantage to either for laurel and some disadvantages.

Our plants are grown in a fiberglass house, shaded with 50% saran cloth from April to November. Plants are fertilized with soluble 20-20-20 as indicated by soil testing. No fertilizer is used the first 6 to 8 weeks in the germination boxes. If soil temperatures are 64° , instead of 74° , plant growth is slow and ammonia nitrogen tends to build up. It is best to keep the medium warmer at night than the air temperature by forcing heat up through the flats.

I like to have the plants at least 1 inch high and leaves of adjacent plants touching by June when they are transplanted from the flats to raised beds in a lath house. The plants are spaced 4 inches apart within the row and 7 inches between rows. At the end of the first year plants should be between 2 and 6 inches high. They are ready for the field after the second growing season.

PROPAGATION BY GRAFTING

Mountain laurel can be grafted with little difficulty and suckering is not a serious problem on established grafts. Grafting is generally not commercially economical and is only warranted in special situations Spring grafting in the greenhouse on forced rootstocks is the normal procedure. Dormant scions are side-veneer grafted onto young plants as low as possible. The techniques described for rhododendrons (6) are applicable.

I have found June grafting to be successful and convenient. When I select a flowering plant for use in crosses or additional testing, I like to propagate it immediately. Scions are the current season's growth, firm but not woody. Stocks are small plants which grew vigorously the previous year. Scions are side-veneer or cleft grafted onto last year's growth on that part of the stem which is smooth and has few leaves. Cut rubber bands (# 16) are used to tie the unions. Grafts are placed in a closed plastic tent, shaded from direct sun. After 4 weeks the tent is gradually ventilated over several days, so that after 6-7 weeks the plants can be set out in shaded outdoor beds. Few June-grafted clones

put out a flush of growth until the following spring. Thus little is gained over spring grafting other than possible convenience. The survival of our June grafts has consistently been 80-85%.

PROPAGATION BY CUTTINGS

The inability to readily propagate laurel selections from cuttings has certainly been of prime importance in limiting distribution of improved cultivars. I will review some of the information in the literature on rooting cuttings and add to this from my own work.

The time of the year to take cuttings is the first consideration. The literature is confusing. Tincker (11) had success in January, Curtis (3) cites March, Briggs (2) lists June and July, and Fordham (5) recommends hardwood cuttings from August to December. That about covers the year! Various types of wounding, auxins, and media have been used as well as plastic tents or mist. The closest area of agreement is the application of bottom heat of 70 to 80° F. Rooting, if it occurs, is generally in 3-5 months.

At the Arnold Arboretum, Fordham (5) found the two most effective auxin treatments on hardwood cuttings taken in the fall were a 5 sec dip using IBA plus NAA at 5,000 ppm each, or treatment with a powder formulation of 2,4,5-TP (Silvex) at 1,000 ppm. Cuttings in plastic tents rooted better than those in mist. Our experience with plastic tents and mist has been the same as at the Arboretum, and I suspect the real difference is not one of moisture but of temperature. In the same greenhouse the medium under a tent will run at least 5° and often 8-10° warmer than medium in an open bench receiving mist. If the temperature of the medium is below 70° , root formation is notably slowed. Fordham used a mix of equal parts sphagnum-peat moss and horticultural grade perlite. We use a mix of 5 parts peat to 2 parts perlite.

For fall cuttings the extension of the daylight period to 16 hrs, or interruption of the night with artificial lights, is suggested. A controlled experiment needs to be run but long days appear to benefit rooting and subsequent growth.

One important aspect of the rooting of *K. latifolia* that has received little attention in the literature is the age of the stock plants. It has been known for years that cuttings from young plants generally root more readily than those from older plants. The classical example is the difference in rooting ability of "juvenile" and "mature" English ivy (*Hedra helix*).

Tables 1 and 2 summarize the results of experiments in rooting laurel cuttings from different age stock plants. These results from 1970 confirm my observations of previous years. Cuttings from young *K. latifolia* plants root more readily than from older plants. Cuttings

taken from rooted cuttings or from young grafts will root more readily than cuttings taken from the original stock plant (Table 2). The data from these experiments also indicated clear differences in rooting ability of cuttings from different plants of the same age and size.

Table 1. Rooting of *K. latifolia* cuttings taken in October and examined in February (1970-1971). No auxin or fungicide treatment. Data from cuttings under mist and in a plastic tent.

Source of cuttings (Stock plants)	No. cuttings	No. rooted	Percent rooted
At least 4 yrs. old	1294	269	21
2 yr. seedlings	45	15	33
1-3 yr. old grafts and rooted cuttings	136	81	60
1 yr. seedlings	123	109	89
TOTALS	1598	474	30

Table 2. Comparative rooting of cuttings of one clone (137) of *K. latifolia* taken from stock plants of different ages. No auxin or fungicide treatment.

Age of stock plant	No. cuttings	No. rooted Oct-Feb	Percent rooted
Orig. plant 15 yrs	10	3	30
8 yr. rooted cutting	16	5	31
1 yr. rooted cutting	34	32	94

Thus, we should select clones that root most readily, and once rooted plants are obtained, cuttings should be taken from these and not the original plant to maintain juvenility. If we have seedlings of known pedigree and flower color, then cuttings can be taken from 1 to 2-year-old seedlings. The more juvenile the cuttings the faster they root and the faster they flush out new growth.

By using mountain laurel stock that has an inherent capacity to root, then meaningful experiments on auxin treatments, fungicides, wounding, etc. will be possible. The proper use of benomyl may give us valuable assistance as discussed by our next speaker.

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MODERATOR FLEMER: That was certainly a masterful and complete paper on the status of *Kalmia latifolia*. I look forward to the day when we will have plants which have flowers just as deep a red inside as were some of those which you showed us. We do not have time for questions now and so we will proceed to the next paper which concerns the use of benlate and indolebutyric acid combinations to promote the rooting of cuttings. This will be presented by Dr. John McGuire of the University of Rhode Island.