MODERATOR FLEMER: Thank you very much, Charlie, for this discusion; tell Joe we are sorry he could not be with us. The next paper will be presented by Paul Read who will tell us how to propagate the new University of Minnesota hardy azaleas which are astoundingly hardy out in that bitter cold area of the Midwest.

PROPAGATING THE NEW UNIVERSITY OF MINNESOTA HARDY DECIDUOUS AZALEAS[1]

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Abstract. Cuttings from selected clones of deciduous azaleas, specifically hybrids resulting from reciprocal crosses of *Rhododendron* x *kosterianum*[2] x *R. roseum*, which are winter hardy in Minnesota, were successfully rooted with plastic-tent propagation. Rooting under mist was unsuccessful because of hard water and subsequent salt buildup on cuttings Best rooting occurred in a 1:1 peat-vermiculite or a 1:1 peat-perlite medium, but no single rooting compound gave consistently superior results Succulent cuttings in the elongation stage of growth, having expanding leaves, and cuttings with fully expanded leaves but no terminal bud formation rooted well

INTRODUCTION

Many desirable ornamental plants cannot be widely used in the Midwest due to a lack of sufficient winter hardiness. Such was the case of many deciduous azaleas until the University of Minnesota developed hardy plants from reciprocal crosses of *R.* x *kosterianum* x *R. roseum*. These plants have withstood mid-winter temperatures to −35° F. in open field conditions and bloomed profusely the following spring in various shades of pink. However, until recently, difficulty in asexual propagation has prevented multiplication of desired plants.

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[2]*R. kosterianum* is the specific name referring to the cross, *R. japonicum* x *R. molle*, (mollis hybrids) as a collective group.

LITERATURE REVIEW

In previous work, with various kinds of deciduous azaleas, most propagators (1, 2, 4, 5, 6, 7, 8) preferred using softwood cuttings taken in the spring before the apical bud was formed. However, in one rooting trial (3) hard cuttings with an obvious terminal bud rooted better than very soft cuttings without a terminal bud evident. Cuttings were successfully rooted in plastic-tents (1, 2, 6, 7) and under mist (3, 4, 5, 8). Hormodin#3 was the rooting compound used in most cases (2, 4, 6, 8) whereas Jiffy Grow#2 (20:1) also gave satisfactory results (5). Some people recommended removal of terminal buds (1, 4) and others did not (7), while wounding cuttings was done fewer times (2, 4) than not (1, 5, 7, 8). The propagation medium for deciduous azaleas almost always contained peat moss (1, 2, 3, 4, 6, 7, 8) with sand (1, 2, 6, 7, 8) or perlite (1, 2, 3) added to improve drainage and aeration.

MATERIALS, METHODS AND RESULTS

Preliminary tests proved that mist was unsuccessful, so cuttings were rooted in a plastic-tent in a heavily shaded greenhouse cooled with a fan and pad system. The plastic-tent consisted of 4-mil polyethylene fitted over 12" high sideboards and sealed with lath tacked over its edges. In addition, black polyethylene was suspended over the bench at a 45° angle to keep out afternoon sunlight (Figure 1). Cuttings were hand syringed 2-3 times a day to prevent wilting. Three different rooting media were used: 1:1 peat-perlite, 1:1 peat-vermiculite and 1:1:1 peat-perlite-vermiculite. All media were steam sterilized, treated with Terraclor (1 Tbsp./gal.), and soaked with Peters Acid Grow Fertilizer (21-7-7) at 1 Tbsp./gal. To help prevent disease, cuttings were drenched in a solution of Captan 50% WP (2 Tbsp./gal.), Wiltpruf (0.5% by vol.) and Tween 20 (0.5% vol.) and stored in a cooler until placed in the rooting medium. Light intensity varied within the bench from 200 to 500 ft-c. Temperatures of the media were measured by a Barber-Coleman temperature recorder and ranged from 64° to 80° F, but usually were around 70° F. Medium pH (Table 6) was measured at 10 day intervals using Lamotte indicator solutions and standards. Cuttings were rated on a scale of 1 to 7 (Figure 2) when dug. The total rating for an entire treatment was used when any statistical comparisons were made.

Experiment 1. An experiment was conducted to determine effect of the fungicide drench, five different rooting compounds, and plastic-tent versus mist as a means of propagation. On June 13, 216 cuttings 3-4" long were taken from an F_1 population, designated U. of M.#66190, during the later stage of a growth flush when most of the lower leaves were fully expanded but the terminal buds were not yet formed. After 54 days in a 1:1:1 peat-perlite-vermiculite medium, cuttings from the plastic-tent had rooted significantly better than those under mist

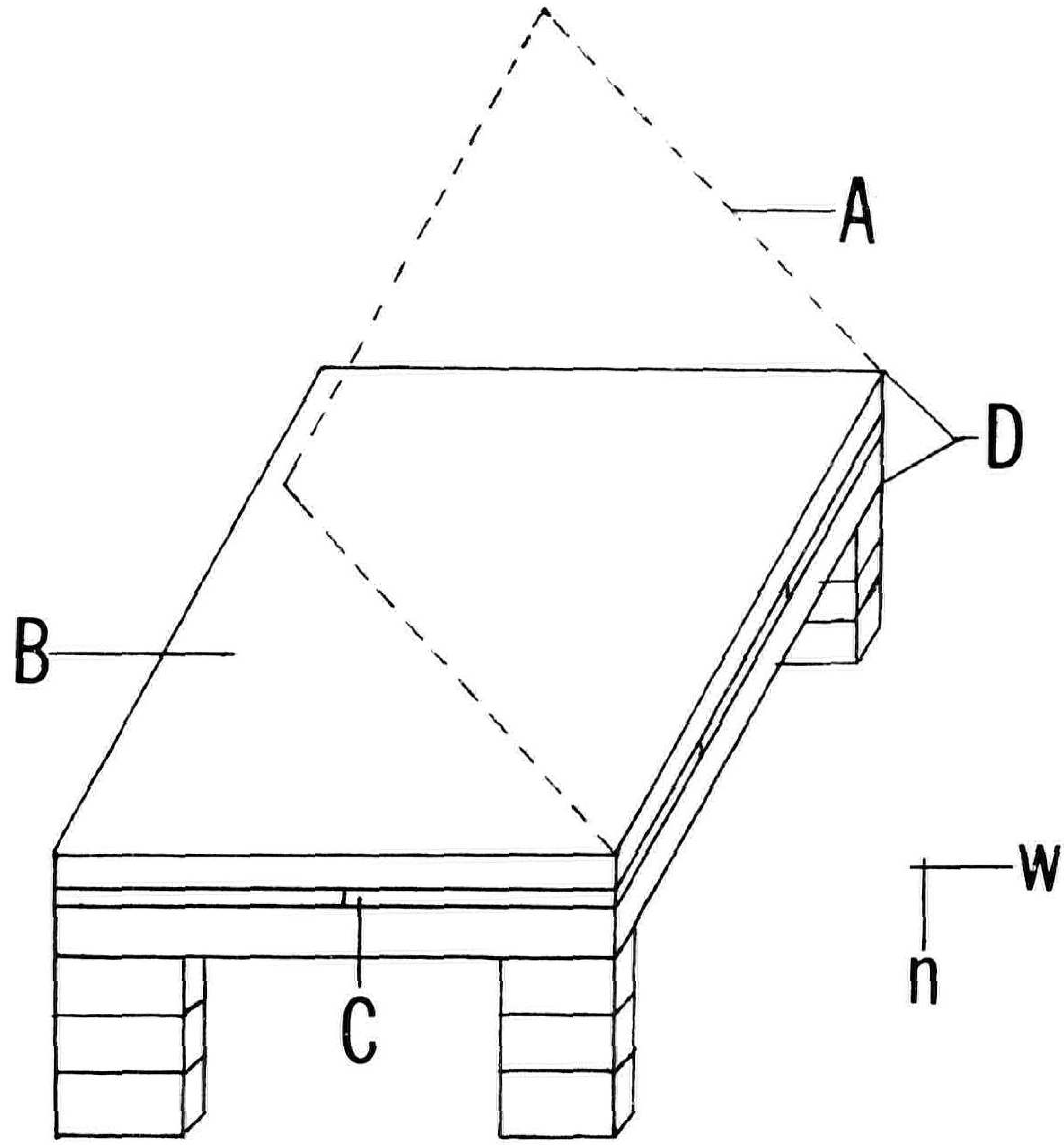

Fig. 1. Diagram of plastic-tent used for rooting U. of M. deciduous azaleas. Components are: A, black polyethylene; B, 4-mil clear polyethylene; C, lath tacked on to hold plastic seal; D, 12" high sideboards.

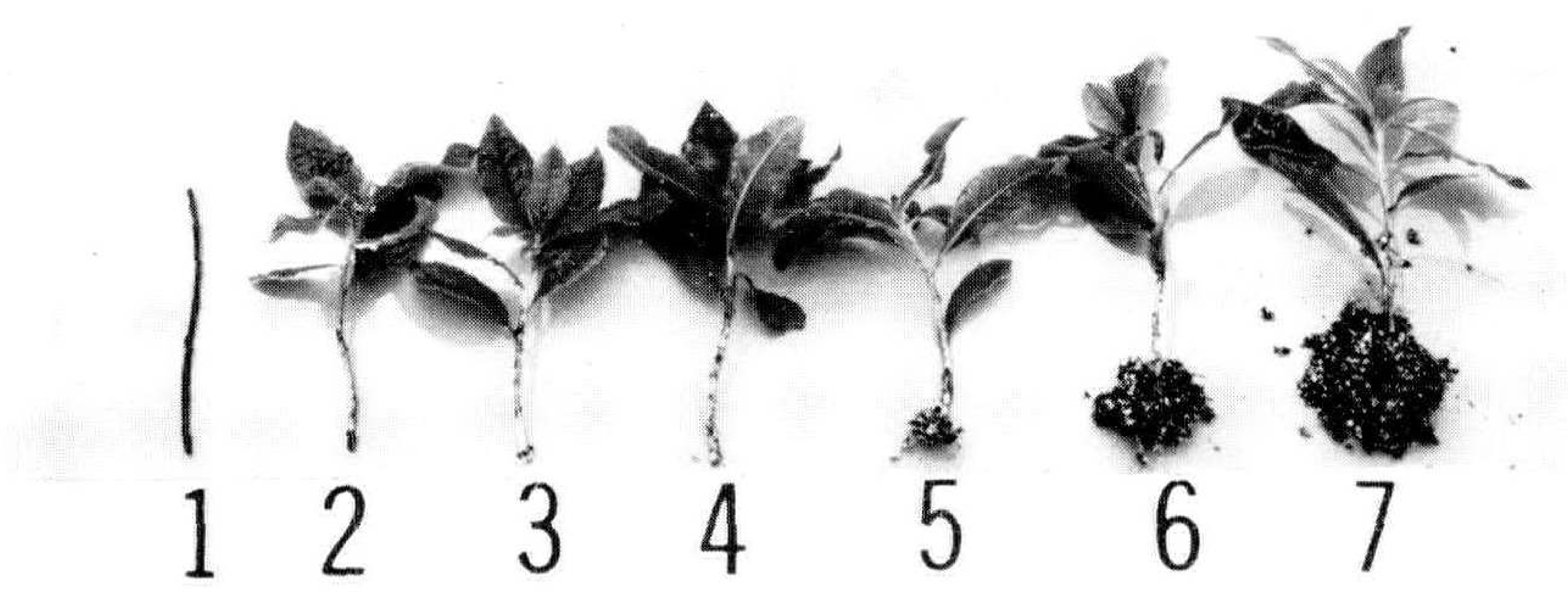

Fig. 2. Method of rating deciduous azalea cuttings. Ratings correspond to: (1), dead; (2), alive but no callus; (3), callus; (4), 1-5 small roots; (5), several roots but no root ball; (6), root ball less than 1½" in diameter; (7), root ball larger than 1½".

(Table 1). Salt buildup under mist during rooting was enough to cause an overall browning and brittleness of the leaves which then abscised. The plants died even if rooted. Drenching the cuttings with the fungicide solution had no apparent effect on cutting performance. All five rooting compounds produced better results than the non-treated checks (Table 2), with Germain[3] and Hormodin#3 the most consistent promoters under all three conditions.

Table 1. The effect of mist, plastic-tent and a Captan drench on the mean rooting response of U. of M. #66190 deciduous azaleas.

Treatment	Ave. Rating per Cutting	Mean of Total Ratings of 6 Treatments[1]	Mean Total % Rooted
Plastic-tent (Drench)	5.8	69.5 a[2]	94.4
Plastic-tent (Drench)	5.6	66.8 a	93
Mist (Drench)	4.3	51.7 b	82

[1]12 cuttings per treatment

[2]Means followed by the same letter do not differ significantly at the 5 percent level (Duncan's New Multiple Range Test)

Table 2. The effect of 5 rooting compounds on drenched and undrenched U. of M. # 66190 deciduous azaleas in a plastic-tent and on drenched azaleas under mist.

Treatment	Ave. Rating per Cutting	Mean of Total Ratings[1]	Mean Total % Rooted
Germain	6.2	74.0 a[2]	97.3
Hormodin 3	6.0	71.7 ab	100
Hormodin 2	5.2	63.0 abc	97.3
Jiffy Grow No. 1 (Quick dip)	5.2	62.3 abc	89
Rootone	4.6	54.7 cd	78
Check	4.2	50.3 d	72

[1]12 cuttings per treatment

[2]Means followed by the same letter do not differ significantly at the 5 percent level (Duncan's New Multiple Range Test).

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[3]Talc preparation of equal parts 4.0% indolebutyric acid (IBA) and 4X Cut-start with 1/16 by volume Phygon.

[4]All IBA solutions contained 5% ethanol

Experiment 2. To determine the effect of cutting maturity on rooting, 40 cuttings were taken at 8-day intervals six different times, beginning May 22 and continuing to July 1, from the same plants of the F_1 population U. of M. #66190. Cuttings taken May 22 were succulent and in the elongation stage of a growth flush with small expanding leaves. Those taken July 1 were semi-hard, green to the base and had terminal buds clearly evident. The cuttings were treated with a 1-minute dip in 100 ppm IBA and one-half placed in a medium of 1:1 peat-perlite and one-half in 1:1 peat-vermiculite. After 75 days, best rooting occurred with the younger cuttings (Table 3) although the results were not consistent in both media. In most instances cuttings rooted better in a medium of 1:1 peat-vermiculite than in 1:1 peat-perlite.

Table 3. Effect of cutting maturity on rooting response of U. of M. # 66190 deciduous azaleas in 1:1 peat-perlite and 1:1 peat-vermiculite media after 75 days.

Date Cuttings were taken	Ave. Rating per Cutting	[1]Total Rating	Total % Rooted
1:1 peat-vermiculite:			
5-22	7.0	140	100
5-30	6.8	135	100
6-7	6.3	126	90
6-15	5.7	113	90
6-23	5.6	112	80
7-1	4.8	95	80
1:1 peat-perlite:			
5-22	5.9	118	85
5-30	4.3	86	60
6-7	3.6	72	40
6-15	4.8	95	75
6-23	5.6	122	95
7-1	4.9	99	70

[1]20 cuttings per treatment

Experiment 3. The effects on rooting of a terminal bud pinch, three hormones, Captan, and two different media were tested using 180 soft cuttings with fully expanded leaves taken June 5 from the F_1 population U. of M. #66192. The four treatments plus an untreated check were duplicated with pinched and unpinched cuttings in a medium of 1:1 peat-perlite and 1:1:1 peat-perlite-vermiculite. A 1 minute dip in 100 ppm IBA, containing 5% dimethyl sulfoxide (DMSO), gave significantly better results than the non-treated cuttings (Table 4). Captan significantly inhibited rooting compared to controls. A 1:1:1 peat-perlite-vermiculite medium caused some inhibition of rooting compared to 1:1 peat-perlite (Table 5) while unpinched cuttings rooted better than pinched cuttings in the same medium.

Table 4. Effect of 3 hormones and Captan on mean total rating of pinched and unpinched cuttings of U. of M. # 66192 deciduous azaleas in two different media for 75 days.

Treatment	Ave. Rating per Cutting	Mean Total Rating[1]	Mean Total % Rooted
IBA 100ppm, 5% DMSO, (1 min)	5.6	50.5 a[2]	83.1
5% DMSO, (1 min)	5.0	45.0 ab	75
Hormodin #3	4.9	44.2 abc	69.4
Check	4.5	40.5 bc	66.7
Captan	3.5	31.8 d	50.0

[1]Ave. of 4 treatments with 9 cuttings in each.

[2]Means followed by the same letter do not differ significantly at the 5 percent level (Duncan's New Multiple Range Test)

Table 5. Mean total effect of pinching terminal bud vs. not pinching on U. of M. #66192 deciduous azalea cuttings in two different media for 75 days.

Treatment	Ave. Rating per Cutting	Total Rating[1]	Total % Rooted
1:1 peat-perlite, No Pinch	5.2	46.4 a[2]	71
1:1 peat-perlite, Pinch	5.2	46.2 ab	84.4
1:1:1 peat-perlite-vermiculite, No Pinch	4.5	40.4 abc	62.2
1:1:1 peat-perlite-vermiculite, Pinch	4.0	36.4 c	53.3

[1]Nine cuttings per treatment.

[2]Means followed by the same letter do not differ significantly at the 5 percent level (Duncan's New Multiple Range Test).

Smaller individual experiments involving a total of more than 1000 cuttings from different stock plants were also conducted. Rooting percentages ranged from 70 to 100 with an average success of 87%. Effects of rooting compounds varied indicating interactions with plants of different parentage.

Table 6. Effect of environment and media composition of pH as measured with Lamotte Indicator Solutions and Standards.

Medium	Initial pH	pH after 60 days
1:1 peat-vermiculite in plastic-tent	4.2	4.5
1:1 peat-perlite in plastic-tent[1]	4.3	4.7
1:1:1 peat-perlite-vermiculite in plastic-tent	4.5	5.8
1:1:1 peat-perlite-vermiculite under mist	4.5	8.4

[1]Ave of 3 separate media.

DISCUSSION

In areas where hard water prevents successful mist propagation of deciduous azaleas, a plastic-tent gives excellent results. A cool area is essential and no direct sunlight can be allowed to strike the plastic enclosure at any time or excessive heat buildup under the plastic can damage cuttings.

Rooting compounds gave inconsistent results in our work. Timing did not seem to be critical, but best results can be expected from younger cuttings taken after the first 2-3 weeks of growth when shoots are 3-4" long with expanding or nearly expanded leaves. In addition, taking cuttings earlier in the spring or summer allows more time for newly rooted plants to produce new shoots before going dormant in the fall, which greatly increases chances of buds breaking dormancy the following spring.

In the interest of producing better branched plants, we do not recommend terminal bud removal. Typically there are several vegetative buds developed at the apex by the time a cutting is rooted. Most of these buds can be induced to develop shoots if the first ones to break are pruned after 3-4 new leaves are produced. Pinching a cutting tends to limit the new shoots to the 1 or 2 lateral buds which develop first.

Cuttings taken in mid-May were potted by mid-July and had 6-8" of new growth by the end of August. Beginning at the end of July the photoperiod was extended from 6 p.m. to 6 a.m. using incandescent lights 3 ft. apart, suspended 2½ ft. above the plants. Plants were then hardened off in cold frames in September or kept under lights to serve as a source of fall cuttings. Initial results indicate it is possible to take 1 or 2 successive crops of cuttings from the young plants rooted during the summer with no ill effects to them. A rather large population of plants can be built up rapidly in this manner.

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MODERATOR FLEMER: We have time for a few questions.

JOE McDANIEL: Do these hybrids have good fragrance?

PAUL READ: Yes, they do; they are quite desirable plants in most of the commonly desired characteristics, however, they are not evergreen.

JIM WELLS: What is the rate of rooting?

PAUL READ: Good, well-rooted cuttings are obtained in less than 2 months, but there is variability among the clones—the easiest rooting one, roots 95-100% all the time and the more difficult ones, 60-80%.

KNOX HENRY: Did you say that the results with Hormodin No. 3 seemed to be better than with the other commercial compounds?

PAUL READ: There was not that much difference and we were quite satisfied with all of the materials used as well as those we formulated ourselves.

JOERG LIESS: Did you use bottom heat?

PAUL READ: We did the first year, but not in later tests. I don't think we need it in the system we are using but I do think it is essential for a mist system.

PETE VERMEULEN: What time of the day were the cuttings taken, what was the environmental conditions of the stock plants, and what was their condition?

PAUL READ: The cuttings were taken in late morning. In some cases, they were placed in a cooler for a day or two before being stuck so I don't think this is a factor to consider. The stock plants were grown in the field and are 10-12 feet tall.

SID WAXMAN: What were the light intensities under the plastic?

PAUL READ: It varied between 200 and 500 ft-c, depending upon the time of the year that the reading was taken.

VOICE: How often did you apply water in the tent?

PAUL READ: This was applied twice a day by hand, but commercially this would be done automatically.

SID WAXMAN: Did you feel you had to water twice a day?

PAUL READ: I don't believe we did, but the student doing this work was from Oregon and he used techniques which were familiar to him and this is one he continued. The cuttings will wilt on the first few hot days after sticking and misting would be beneficial, but beyond this I don't think it is needed with the tent system if you keep the light intensity and the heat down.

JIM WELLS: Are you shading as heavily now as you did in June?

PAUL READ: No, the shade is off the greenhouse now and tents are under a suspended shade cloth because we don't get much light at this time of year.

MODERATOR FLEMER: We thank you for a very fascinating paper, Paul. Our next paper is by an old professional, John Roller. John is going to tell us how to go about rooting juniper softwood cuttings under mist.