Propagation of *Rhododendron chapmanii* by Stem Cuttings[1]

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Abstract

Two experiments were conducted to determine the feasibility of propagating Chapman's rhododendron (*Rhododendron chapmanii* A. Gray) by rooting stem cuttings. In the first experiment, semi-hardwood terminal cuttings taken from native plants, rooted in moderate percentages (43 to 63%) with the percentage of commercially acceptable cuttings (cuttings having a distinct root ball) being less (22 to 53%). The second experiment used hardwood terminal and subterminal cuttings taken from containerized stock plants that originated from cuttings rooted in the first experiment. Percent rooting for total and commercially acceptable cuttings ranged from 81 to 94% and 39 to 64%, respectively. For both experiments, indolebutyric acid (IBA) treatments resulted in an increase in the percentage of commercially acceptable cuttings.

Index words: rare and endangered species, Chapman's rhododendron, auxin, rooting, recovery plans, indolebutyric acid

Introduction

Chapman's rhododendron (*Rhododendron chapmanii* A. Gray) is a member of a species complex of lepidote rhododendrons of the southeastern United States. Horticulturally, it is valuable for its early conspicuous floral display of long tubed, rosy pink corollas and its tolerance to extreme heat. Because it exists only as small isolated colonies of mature plants in restricted habitats in five Florida counties, it is nationally listed as a "Rare and Endangered Species" (1, 6).

All populations of Chapman's rhododendron, except for a disjunct colony in Clay County, Florida, are owned by a single corporation (1, 6) and grow on sites favorable for commercial pulpwood production. Land management practices such as drainage projects, root raking, land clearing, suppression of natural burning and fertilization threaten the restricted environment suitable for this species. The species has also been subjected to additional pressure by horticultural collecting. Consequently, information concerning all modes of reproduction is necessary to aid conservation efforts.

Observations by the senior author and others (5, 6, 7) that the species exists only as mature clumps in the wild, with no seedling populations, suggests, in part, that survival depends on a narrowly defined segment of its genetic potential. This underscores the value of clonal propagation both for recovery efforts with the adapted parental types or production of horticultural selections. Of the various types of asexual propagation, the removal of stem cuttings for rooting or *in vitro* propagation (using actively growing shoot tips) from native populations would appear to have a minimal impact on the population biomass.

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Since there are no published reports concerning asexual propagation of Chapman's rhododendron, experiments were conducted to determine the feasibility of propagating this species by rooting stem cuttings. Prior to initiating these experiments, a preliminary investigation indicated that stem cuttings could be rooted.

Materials and Methods

Plant material, treatment of cuttings and rooting environment. Two experiments were conducted. Experiment 1 examined the influence of media and indolebutyric acid (IBA) formulation on the rooting of cuttings taken from native populations growing in Gulf County, Florida, prior to site disturbance. Experiment 2 investigated the rooting response of terminal and subterminal cuttings treated with two IBA concentrations. Cuttings used in the second experiment were taken from containerized plants growing in a lath house under controlled fertility conditions which were cultivated from material rooted in Experiment 1. In Experiment 1, no more than 3 cuttings were collected from plants randomly selected from field populations. These cuttings were transported to Raleigh in sealed plastic bags, in coolers containing ice.

During final preparation for rooting, each cutting was cut from the base to an approximate length of 10 cm (3.9 in) and the leaves removed from the basal 3 to 4 cm (1.2 to 1.6 in). Flower buds were left on cuttings in Experiment 1 but were removed in Experiment 2. Prior to auxin treatment, all cuttings received a heavy wound consisting of removal of a 2.5 cm x 0.2 cm (1.0 x 0.1 in) strip of bark on the basal portion of the cutting exposing the cambium. When treated with an indolebutyric acid (IBA) solution, the basal 2 cm (0.8 in) of each cutting was dipped into the solution for 1 second, followed by air drying, and insertion into the rooting medium. IBA solutions were prepared by dissolving reagent grade IBA in 50% isopropyl alcohol. When treated with Hormodin 3 (0.8% IBA dispersed in talc), the cuttings were first moistened with water and then the basal 2 cm (0.8 in) were coated with powder. The base of each cutting was gently tapped to remove excess powder.

Following treatment, cuttings were inserted into the rooting medium to a 3 to 4 cm (1.2 to 1.6 in) depth and rooted in individual containers on a raised greenhouse bench. Cuttings treated with Hormodin 3 were inserted with a dibble and the medium firmed around the cuttings. Intermittent mist operated 8 seconds every 2.5 minutes during daylight hours. Day/night ambient air temperatures were 23.9/15.6°C (75/60°F) and bottom heat was maintained at 21°C (69.8°F).

Experiment 1: Media and IBA formulation. Semihardwood cuttings were taken on October 26, 1981, transported to Raleigh, and stored at 5°C (41°F). Two IBA formulations were employed: nontreated, 5000 ppm (0.5%) IBA in 50% alcohol, and 8000 ppm (0.8%) IBA in talc (Hormodin 3). These rooting treatments were combined with two rooting media, 1 peat:1 vermiculite (by volume) and 1 pine bark:1 sand (by volume). The pine bark had been screened through a 1.3 cm^2 (0.5in^2) screen, and the fine particles retained for the study. Following treatment, the cuttings were inserted into 6.4 cm^2 (2.25 in^2) Jiffystrips peat pots and the pots placed on a 7.6 cm (3 in) layer of 1 peat:1 vermiculite (by volume). The experimental design was a randomized complete block with a factorial arrangement of treatments (3 auxin treatments x 2 media) and had 5 blocks with 24 cuttings per block per treatment and a sixth block with 16 cuttings per treatment.

The experiment was terminated after 21 weeks. Cuttings were evaluated using a scale of 1 to 5 where 1 = dead or nonrooted, 2 = few roots, no root ball, 3 = a root ball such that the cutting could be removed from the pot with the root ball intact, 4 = roots penetrating the peat pot and 5 = roots penetrating the peat pot and a root ball forming in the medium below. Cuttings rated 3 or greater were considered to be of commercial quality. Standard analysis of variance procedures were used for data analysis.

Experiment 2: Terminal vs. subterminal cuttings and auxin concentrations. Hardwood cuttings were taken on January 5, 1984, from 2-year-old containerized stock plants growing in a lath house at University Research Unit 4 in Raleigh which were grown from cuttings produced in Experiment 1. Since Chapman's rhododendron has semi-indeterminate growth flushes, cuttings were taken from shoot growth which was long enough to produce both a terminal and subterminal cutting or just a terminal cutting. Three rooting treatments were employed: nontreated, 5000 ppm (0.5%) and 10000 ppm (1.0%) IBA in 50% alcohol. Following treatment, cuttings were inserted into 7 cm^2 (2.75 in^2) plastic rose pots containing 1 peat:1 perlite (by volume). The experimental design was a randomized complete block with a factorial arrangement of treatments (2 types of cuttings x 3 auxin treatments). There were 6 blocks containing 8 terminal and 6 subterminal cuttings per treatment.

The experiment was initiated on January 5, 1984 and was terminated at 11 weeks. Cuttings were evaluated using a rating scale of 1 to 7, where 1 = dead, 2 = nonrooted, living, 3 = 1 to 2 roots, 4 = more than 2 roots, no root ball, 5 = an asymmetrical root ball less than 3 cm (1.2 in) in diameter, 6 = a symmetrical root ball less than 3 cm (1.2 in) in diameter and 7 = root ball greater than 3 cm (1.2 in) in diameter. Cuttings rated 5 or greater were considered to be of commercial quality. Standard analysis of variance procedures were used for data analysis.

Results

Experiment 1: Media and IBA formulation. Cuttings taken from native populations rooted in moderate percentages (Table 1). Regardless of the rooting medium or IBA formulation, the percentage of commercially acceptable cuttings was always less than total percent rooted. However, treatment of cuttings with either formulation of IBA significantly increased the yield of commercially acceptable cuttings.

Analysis of variance for total rooted (data not presented) indicated a media effect ($PR > F = 0.02$) but no block effect, auxin effect or interactions. The analysis of variance for commercially acceptable cultivars (data not presented) showed a media effect ($PR > F = 0.01$) plus an auxin effect ($PR >= 0.02$) with no interactions or block effects.

Total rooting of cuttings in the 1 peat:1 vermiculite medium was not influenced by auxin treatment (Table 1). Significant differences were not evident in the data for commercially acceptable cuttings, but IBA treatments increased the percentage of commercially acceptable cuttings by 48 to 58%.

For cuttings rooted in 1 bark:1 sand, treatment with IBA did not significantly increase rooting percentages, although actual increases of 10 to 33% and 58 to 73% were noted for total rooted and commercially acceptable, resp.

Experiment 2: Terminal vs. subterminal cuttings and auxin concentration. Cuttings (terminal and subterminal) taken from containerized stock plants rooted in higher percentages, both total rooted and commercially acceptable, than cuttings taken from plants growing in a wild state (Tables 1 and 2). In addition, as was observed in Experiment 1 (Table 1), the percentage of commercially acceptable cuttings was considerably less than the total percent rooted (Table 2). Regardless of the type of cutting (subterminal or terminal), IBA treatment, particularly 10,000 ppm, significantly increased the percentage of commercially acceptable cuttings.

The analysis of variance of total percent rooted (data not presented) indicated no block effect, auxin effect, cutting position effect or interactions. However, the analysis of variance for commercially acceptable cuttings (data not presented), indicated an auxin effect ($PR > F = 0.02$) but no block effect, cutting position effect or interactions.

Discussion

The experiments demonstrated that Chapman's rhododendron can be propagated by rooting stem cuttings (Tables 1 and 2). Although cuttings taken from native plants rooted in moderate percentages (43 to 63%) with the percentage of commercially acceptable cuttings being less (22 to 53%), cuttings from containerized plants growing under controlled fertility rooted in much higher percentages, both total rooted (81 to 94%) and commercially acceptable (35 to 64%). Auxin treatment of cuttings proved to be extremely important in increasing the percentage of commercially acceptable cuttings.

Table 1. Rooting response of *Rhododendron chapmanii* stem cuttings taken from native populations, as influenced by rooting medium and IBA formulation (Experiment 1).

Medium[y]	IBA formulation	Rooting (%)[z]	
		Total rooted[x]	Commercially acceptable[w]
Peat:vermiculite	Nontreated	63.2 b[v]	33.7 ab
	8000 ppm in talc	63.2 b	53.1 b
	5000 ppm in 50% alcohol	62.5 b	50.0 b
Bark:sand	Nontreated	43.1 a	22.2 a
	8000 ppm in talc	47.2 ab	35.1 ab
	5000 ppm in 50% alcohol	57.3 ab	38.5 ab

[z]Based on 136 cuttings per treatment.

[y]1:1 by volume.

[x]Cuttings rated 2 or greater.

[w]Cuttings rated 3 or greater.

[v]Means within a column followed by the same letter are not significantly different at the 5% level using Fisher's (protected) LSD test.

Table 2. Rooting response of *Rhododendron chapmanii* stem cuttings taken from containerized stock plants, as influenced by cutting position and three IBA concentrations (Experiment 2).

Cutting position	IBA concentration	Rooting (%)[z]	
		Total rooted[y]	Commercially acceptable[x]
Subterminal	0 ppm	91.7 a[w]	38.9 a
Subterminal	5000 ppm	94.4 a	52.8 a
Subterminal	10000 ppm	91.7 a	63.9 b
Terminal	0 ppm	81.3 a	35.4 a
Terminal	5000 ppm	91.7 a	60.4 a
Terminal	10000 ppm	93.8 a	62.5 b

[z]Rooting data for subterminal cuttings is based on 36 cuttings per treatment and data for terminal cuttings is based on 48 cuttings per treatment.

[y]Cuttings rated 3 or greater.

[x]Cuttings rated 5 or greater.

[w]Means within a column followed by the same letter or letters are not significantly different at the 5% level using Fisher's (protected) LSD test.

Greater rooting of cuttings in Experiment 2 in comparison to Experiment 1 which used cuttings from native plants may have been due to more uniform stock plant cultural conditions, possible clonal effects resulting from inadvertent selection for increased rootability, or storage of cuttings used in Experiment 1. Other possible explanations for increased rooting may have been a capacity for hardwood cuttings to root in higher percentages than semi-hardwood cuttings or the 1 peat:1 perlite rooting medium being superior to 1 peat:1 vermiculite or 1 bark:1 sand.

Cuttings in Experiment 2 rooted in higher percentages, even though prior to taking these cuttings the containerized stock plants had been exposed 10 days earlier to what proved in the spring to be root killing temperatures of -15 °C (5 °F). In previous years, unprotected container-grown Chapman's rhododendron were fatally injured at approximately -15 °C (5 °F). Cutting stress, possibly as dessication from the December freeze, undoubtedly contributed to some experimental variability in Experiment 2. Mortality of container plants was probably due to root injury since plants cultivated in soil beds were unaffected by the same temperatures. Also, containerized plants overwintered in an unheated, clear polyethylene-covered structure located in a lath house were not affected by the low temperatures. It is interesting to note that while the unprotected stock plants had been killed by the freeze, less than 10% cutting mortality was observed at the close of the experiment.

Hall and Cannon (2) conducted rooting studies using stem cuttings of another member of the southeastern lepidote rhododendron complex, Carolina rhododendron (*R. carolinianum* Rehder). They reported greatest rooting from cuttings taken in the fall and winter from native populations in Avery County, North Carolina. In the present study, cuttings were taken in the fall and early winter. In preliminary experiments, cuttings taken at various times of the year all rooted to some extent, but the authors feel that best results are to be obtained from late fall and early winter-collected cuttings.

Rhododendron stem cuttings are normally taken as terminal cuttings representing the entire current season's growth flush (2, 3, 4, 8). The ability to root subterminal cuttings of Chapman's rhododendron (Table 2) should prove invaluable in making greater use of genetic material resulting from its semi-indeterminate growth habit which can produce growth flushes up to 1 m (39.4 in) in length.

Observations from preliminary experiments and Experiment 1 indicated that cuttings with flower buds rooted as well as disbudded cuttings or cuttings pre-

pared from entirely vegetative shoots. The presence of flower buds on rooted cuttings, however, did inhibit subsequent vegetative budbreak. It is therefore recommended that for cultural reasons, flowering wood be disbudded during preparation for rooting.

Higher rooting percentages and possibly greater mean separation may have occurred if Experiment 2 (Table 2) had been terminated at 15 rather than 11 weeks, when most of the cuttings rated 4 (more than two roots, but no root ball) might have produced a root ball receiving a rating of 5 or greater. The authors feel that a minimum of 15 weeks should be allowed to achieve optimal rooting.

The authors would like to stress that since Chapman's rhododendron is a rare and endangered species, the collection of material from native populations is currently strictly regulated. The Rare and Endangered Species Act was amended in 1982 to forbid the removal of plants and plant material from federal land. The removal of rare and endangered species from private land in Florida will be closely controlled by pending Florida state legislation which should be enacted in 1985.

The cuttings used in Experiment 1 (collected in 1981) were taken after the pine overstory of several plant populations was harvested and prior to when the debris and remaining vegetation, which included Chapman's rhododendron, was destroyed by heavy equipment during site preparation for reforestation. Such forest management techniques result in near total elimination of standing vegetation. Often, following site preparation, plants of Chapman's rhododendron that are not killed outright rapidly regenerate vegetatively along with many other species of the previous plant community.

The presentation of the data from Experiment 1 is for comparison with Experiment 2 and is not intended to encourage unauthorized collection from the wild. Cultivated seedling material is currently available commercially from several sources. Vegetative propagation of these plants should be possible using the procedures described in Experiment 2.

Significance to the Nursery Industry

These experiments demonstrated that while hardwood and semi-hardwood cuttings of Chapman's rhododendron can be rooted in moderate to high percentages without auxin application, IBA applied as a concentrated dip (5000 to 10000 ppm) or talc formulation (8000 ppm) will significantly increase the rooting percentage of commercially acceptable cuttings. There is then, absolutely no reason to collect whole plants from scarce native populations to either re-establish former colonies for recovery plans or to select clones of horticultural value. The research also showed that the rooting response of terminal and subterminal cuttings is virtually identical, which should permit a nurseryman to take advantage of the semi-indeterminate growth habit of this species. It should also be stressed that winter protection must be provided for containerized plants of Chapman's rhododendron grown in areas subjected to temperatures below -12.2 °C (10 °F). Plants in landscape situations or containers in overwintering structures in Raleigh have withstood outside temperatures below -15 °C (5 °F).

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