Effects of Growth Stage, Branch Order, and IBA Treatment on Rooting Stem Cuttings of 'Yoshino' Cryptomeria

Laura G. Jull, Stuart L. Warren, Frank A. Blazich, and J. C. Raulston
Department of Horticultural Science, North Carolina State University, Raleigh, North Carolina 27695-78609

INTRODUCTION

Little research has been published on vegetative propagation of Japanese cedar, *Cryptomeria japonica* (L.f.) D. Don, and its cultivars by stem cuttings. The objective of this study was to investigate the effect of growth stage, branch order, and indolebutyric acid (IBA) treatment on adventitious rooting of stem cuttings of 'Yoshino' cryptomeria.

METHODS AND MATERIALS

Forty 10-in. tips of first-order laterals with second-order laterals attached were taken from each of six 10-year old trees growing in the North Carolina State University Arboretum, Raleigh, on five dates, representing four different growth stages: 7 August 1992 and 9 July 1993, softwood; 6 November 1992, semi-hardwood; 15 January 1993, hardwood; and 12 March 1993, prebudbreak. Budbreak occurred about mid-April 1993. Cuttings were taken throughout the entire crown of a tree.

Treatments were as follows:

A) Tips, terminal 8 in. of first-order laterals;

B) Distal halves, terminal 4 in. of tips of first-order laterals;

C) Proximal halves, basal 4 in. of tips of first-order laterals; or

D) Tips, terminal 4 in. of second order laterals. Lower branches were removed from the basal 1.6 in. of cuttings, and each type of cutting was treated with 0, 3000 (0.3%), 6000 (0.6%), or 9000 ppm IBA dissolved in 50% isopropyl alcohol.

Cuttings were inserted in a 4 peat : 3 perlite (v/v) medium in a raised greenhouse bench and maintained under natural photoperiod and irradiance (light intensity) at day/night temperatures of 75/60F. Intermittent mist operated 6 sec every 3.3 min from 7 a.m. to 7 p.m. daily. Cuttings were sprayed initially and weekly thereafter alternating benomyl and captan.

Cuttings were arranged in a randomized complete block design with a factorial arrangement of treatments (4 branch orders × 4 IBA levels) and six blocks. Five cuttings made a treatment combination for each block.

Cuttings were harvested after 12 weeks for each growth stage. Percent rooting, number of primary roots >0.04 in., root area, root length, and root dry weight (dried at 158F for 72 h) were recorded.

RESULTS AND DISCUSSION

Stem cuttings of 'Yoshino' cryptomeria can be rooted at any growth stage. However, the branch order from which a cutting is prepared is critical. Regard-

less of growth stage, rooting of cuttings from distal halves of first-order laterals and tips of second-order laterals never exceeded 55% and 35% (Fig. 1). However, for cuttings from tips of first-order laterals and the proximal halves of first-order laterals rooting ranged from 59% to 87% and 68% to 78% (Fig. 1).

Hardwood cuttings taken 15 January 1983 from the tips of first-order laterals and proximal halves of first order laterals exhibited the highest overall rooting with a mean of 79%, followed closely by softwood cuttings taken on 7 August 1993 with a 77% mean (Fig. 1). Softwood cuttings of 9 July 1993 gave similar results. Cuttings taken on 6 November 1992 and prebudbreak cuttings taken on 12 March 1993 rooted in lower percentages. Mean rooting exceeded 63% and 72% for the same two branch orders. Branch order generally influenced all measurements of rooting (Table 1).

Table 1. Effects of branch order on the overall rooting response of hardwood stem cuttings of 'Yoshino' cryptomeria taken 15 Jan 1993.

Branch order	Rooting (%)	Root area (cm^2)	Root dry wt (mg)
First-order[z]	86.7 a[y]	4.3 a	64.2 a
Distal half	55.0 c	1.1 c	17.7 b
Proximal half	71.7 b	3.4 b	53.0 a
Second-order	12.5 d	0.2 d	4.6 b

[z] First-order = tips (terminal 8 in.) of first-order laterals, distal = distal halves (terminal 4 in.) of first-order laterals, proximal = proximal halves (basal 4 in) of first-order laterals, and second-order = tips (terminal 4 in.) of second order-laterals.

[y] Mean separation within columns by LSD, p = 0.05. Data averaged over all IBA levels.

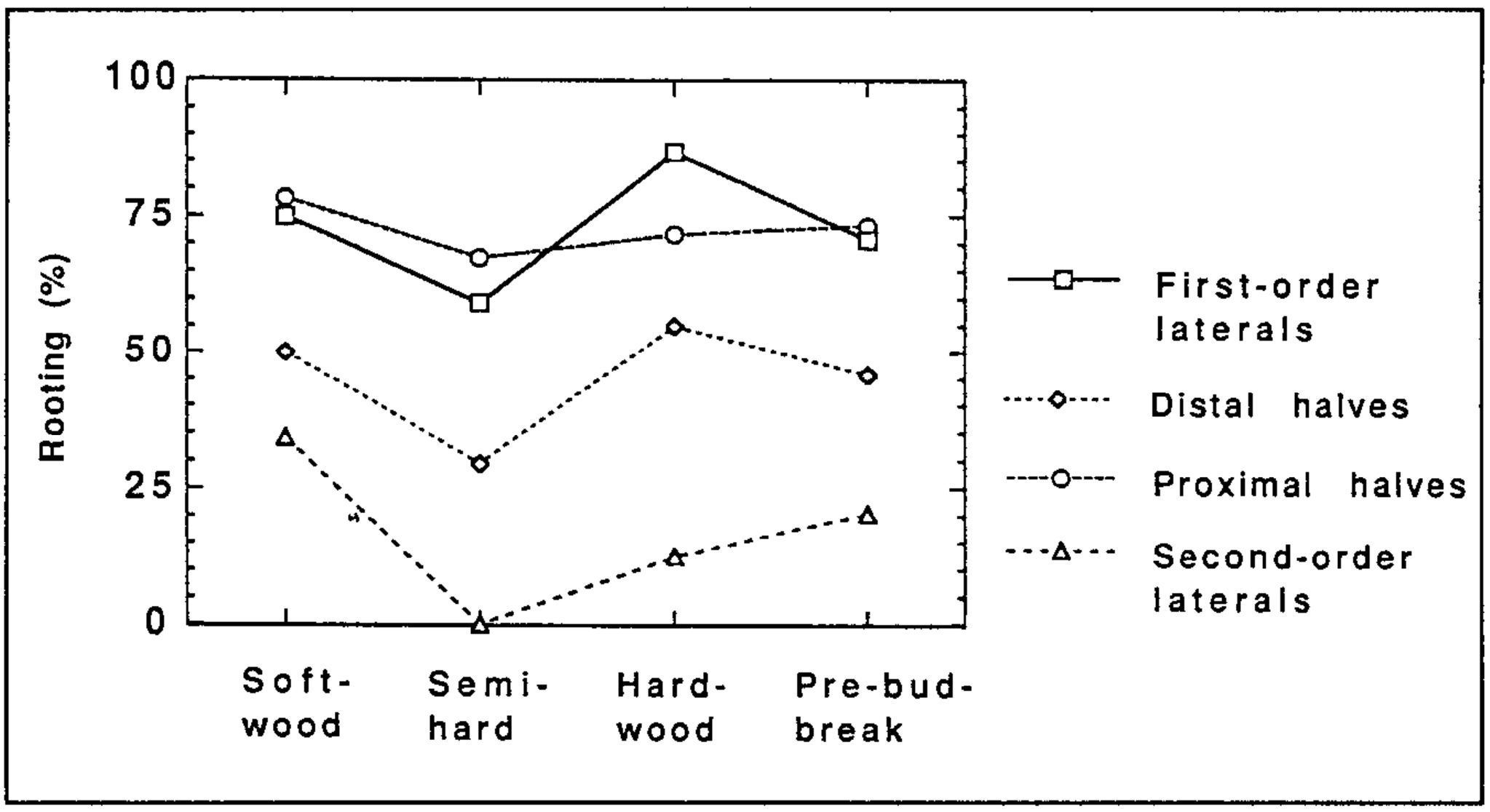

Figure 1. Effect of growth stage and branch position on mean percent root of stem cuttings of 'Yoshino' cryptomeria. Each symbol represents a mean of 24 observations. Percent rooting was averaged over all IBA concentrations.

IBA increased rooting percentages for all growth stages except softwood cuttings. Contrary to current recommendations for rooting stem cuttings of Japanese cedar (Dirr, 1990; Doran 1957; Mitsch, 1975; Nakayama, 1978), 3000 ppm IBA produced maximum rooting percentage with hardwood cuttings (Table 2). For root area and root dry weight, the pooled IBA mean was significantly greater than the cuttings not treated with IBA. IBA increased root area by 35% compared with nontreated cuttings (Table 2). Root length, except for tips of second-order laterals, was linear with increasing concentrations of IBA.

In summary, stem cuttings of 'Yoshino' cryptomeria rooted at any time of year. Hardwood cuttings taken in January gave 72% to 87% rooting when tips of first order laterals or proximal halves of first-order laterals were treated with 3000 ppm IBA. However, 9000 ppm IBA gave the maximum root length and number of roots.

Table 2. Effects of IBA concentration on the overall rooting response of hardwood stem cuttings of 'Yoshino' cryptomeria taken 15 Jan 1993.

IBA conc. (ppm)	Rooting (%)	Root area (cm^2)	Root dry wt (mg)
0	43.3	2.0	33.9
3000	63.3	2.4	37.6
6000	56.7	2.3	34.1
9000	62.5	3.4	50.4
Significance [z]			
Linear	NS	NS	NS
Quadratic	NS	NS	NS
IBA vs Control [y]	***	**	*

[z] NS, *, **, *** nonsignificant or significant at $p \leq 0.05$, 0.01, and 0.001, respectively. Data averaged over all branch orders.

[y] Linear contrast.

LITERATURE CITED

Beaumont, D. A. 1977. Programme of the propagation system used at Ardmore Nurseries LTD. Comb. Proc. Intl. Plant Prop. Soc. 27:331-333.

Black, D. K. 1972. The influence of shoot origin on the rooting of Douglas-fir stem cuttings. Comb. Proc. Intl. Plant Prop. Soc. 22:142-159.

Bogdanov, B. 1983. Cuttings from coniferous species: Types and rooting for containers. Comb. Proc. Intl. Plant Prop. Soc. 33:308-313.

Creech, J.L. 1984. Cryptomeria has many landscape uses. Amer. Nurseryman 159(5):46-47.

Dirr, M. A. 1990. Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation, and uses. 4th ed. Stipes Publishing Co., Champaign, Illinois.

Dirr, M. A., and **C. W. Heuser, Jr.** 1987. The reference manual of woody plant propagation: From seed to tissue culture. Varsity Press, Athens, Georgia.

Doran, W. L. 1957. Propagation of woody plants by cuttings. Univ. Mass. Agr. Expt. Sta. Bul. 491.

Hartmann, H. T., D. E. Kester, and **F. T. Davies, Jr.** 1990. Plant propagation: Principles and practices. 5th ed. Prentice Hall, Englewood Cliffs, New Jersey.

Lahiri, A. K. 1975. Propagation of *Cupressus cashmıriana* Royle and *Cryptomeria japonica* Don by stem cuttings. Indian Forester 101(5):264-268.

Miller, N. F., L. E. Hinesley, and **F. A. Blazich**. 1982. Propagation of Fraser fir by stem cuttings: Effects of type of cutting, length of cutting, and genotype. HortScience 17:827-829.

Mitsch, J. 1975. Propagation of dwarf conifers. Comb. Proc. Intl. Plant Prop. Soc. 25:388-392.

Nakayama, M. 1978. On the varieties of Japanese cedar. *Cryptomeria* and their propagation experiments by cuttings. Aichi-Ken Ringyo Shikenjo Hokoku 14:169-170.

Orndorff, C. 1974. Scheduling plant propagation. Comb. Proc. Intl. Plant Prop. Soc. 24:388-392.

SAS Institute. 1990. SAS/STAT user's guide. Vol. 2, SAS Institute Inc. Cary, N. C.

Tripp, K. E. and **J. C. Raulston**. 1992. *Cryptomeria* evaluations at the NCSU Arboretum. Comb. Proc. Souther Nurserymen's Assoc. Res. Conf., 37th Annu. Rpt. p. 336-339.