Timing and Potassium Indole-3-Butyric Acid Treatments on Rooting Stem Cuttings of *Cephalotaxus harringtonia*

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Stem cuttings from a prostrate clone of *Cephalotaxus harringtonia* (Forbes) K. Koch (Japanese plum-yew) were taken monthly from Sept. 1994 through Aug. 1995, treated with 0 or 10,000 ppm K-IBA, placed in a greenhouse under intermittent mist, and evaluated after 16 weeks. Cuttings taken from December to Feburary, and treated with K-IBA averaged 85% rooting, 10 roots per cutting, and 35 cm total root length. The next highest rooting percentages (78%) were noted for nontreated cuttings taken from March to May. Poorest rooting occurred for cuttings taken from June to August and September to November. Chemical name used: potassium indole-3-butyric acid (K-IBA).

INTRODUCTION

Cephalotaxus harringtonia (Japanese plum-yew), and its botanical varieties and cultivars offer unlimited landscape potential for U.S.D.A. hardiness Zones 5 through 8 (U.S.D.A., 1990). Plants are heat and drought tolerant, sun and shade adaptable, and resist deer browsing (Dirr, 1990; Tripp, 1994). Consumer demand for these taxa has increased steadily in the past three years. In 1994, the low growing forms (*C. harringtonia* var. *drupacea* and 'Prostrata') were named Georgia Gold Medal Award recipients, which resulted in depletion of nursery inventory in Georgia. In addition, demand for plants exists because *C. harringtonia* contains alkaloids with antitumor activities (Delfel and Rothfus, 1977; Perdue et al., 1970; Powell et al., 1972).

Plants can be propagated by seeds (Creech, 1986; Dirr and Heuser, 1987), although seeds are not readily available and germination requirements are not well defined. Asexual propagation by tissue culture has been reported, but has emphasized alkaloid production and not plant regeneration (Delfel, 1980; Delfel and Rothfus, 1977; Wickremesinhe and Arteca, 1991). Wickremesinhe and Arteca (1993) regenerated plantlets from callus cultures, but reported limited establishment (<5%). Janick et al. (1994) successfully propagated plants from zygotic embryos cultured in vitro; however, this approach does not ensure phenotypic uniformity. Stem cutting propagation of *C. harringtonia* is not well defined, although most plants are propagated by cuttings (Dirr, 1992; Tripp, 1994). Tripp (1994) reported that stem cuttings can be rooted year-round except during the spring growth flush period, with or without auxin treatment. Rooting percentages of mid March cuttings treated with indole-3-butyric acid (IBA) as a talc formulation and nontreated cuttings were similar (Dirr and Heuser, Jr., 1987). According to commercial growers, rooting may take six months or longer and plants often develop slowly because of sparse root systems. The production of a salable plant often takes two to three years (Tripp, 1994). This study was initiated to determine the effects of timing and auxin treatment on the rooting of *C. harringtonia* stem cuttings.

MATERIALS AND METHODS

Eighty, terminal, 15-cm long cuttings of *C. harringtonia* were taken monthly from 15 Sept. 1993 through 15 Aug. 1994, from a prostrate clone growing on the campus of the University of Georgia, Athens. Cuttings were pruned to a 10-cm length and the needles were removed from the basal half of the stem. Half the cuttings were quick-dipped to a depth of 2.5 cm for 5 sec in 10,000 ppm K-IBA (potassium indole-3-butyric acid) in water, while the remaining were nontreated (control). Bases of the cuttings were air-dried for 20 min before insertion into cells (7.62 cm × 7.62 cm × 7.94 cm) filled with a medium of perlite and peat (3 : 1, v/v). Cuttings were maintained under natural photoperiods and irradiance with day/night of 30/21C. Intermittent mist operated daily 2.5 sec every 5 min from 8:30 AM until 6:00 PM. Misting was extended in the summer to compensate for longer days. Bottom heat (21±3C) was provided from Dec. through Mar. A completely randomized design was used with five replicates per treatment, and eight cuttings per replicate. Rooting percentages, number of roots and root lengths were determined after 16 weeks. Roots ≥ 5 mm in length were included in the data, and a cutting having one or more root(s) was classified as rooted. Data were grouped into four, 3-month periods (seasons) because there were seasonal trends in rooting responses. Significant differences between the nontreated and K-IBA treatments were tested for each season. Data were subjected to ANOVA.

RESULTS AND DISCUSSION

Timing and K-IBA treatment affected rooting of *C. harringtonia* (Table 1). Cuttings taken in Dec. to Feb. and treated with K-IBA had significantly higher percent rooting (PR), mean number of roots (NR), and mean total root lengths (TRL) than the nontreated cuttings. These cuttings also had the highest PR, NR, and TRL compared to the other seasons and treatment. Cuttings taken in Mar. to May and treated with K-IBA had significantly higher NR than the nontreated cuttings, although there were no significant differences in PR and TRL. The Mar. to May control cuttings averaged 5 roots/cutting and 13 cm TRL. Percent rooting, although not significantly different from K-IBA treated cuttings, was 11% higher. The effects of IBA and K-IBA on the rooting of *Cephalotaxus* taxa have not been clearly documented (Dirr and Heuser, 1987; Tripp, 1994). The inconsistencies in rooting response are possibly related to the season when the cuttings were taken. In this study, cuttings were responsive to exogenous K-IBA application in Dec. to Feb. and to a lesser degree in Mar. to May. In Sept. to Nov., treatment effects were nonsignificant. However, K-IBA treatment significantly reduced rooting in June to Aug. The June to Aug. cuttings were soft and were maintained as terminal cuttings even when new growth was present. Although K-IBA dissolved in water is generally less injurious to cuttings than the free acid of IBA dissolved in an organic solvent, the 10,000 ppm rate induced basal necrosis on the majority of cuttings. In retrospect, a lower K-IBA rate may have been both noninjurious and stimulatory.

The June to Aug. and Sept. to Nov. cuttings that rooted never attained the quality standards, i.e., NR and TRL, of the Dec. to Feb. and Mar. to May cuttings (Table 1). Low temperature preconditioning has improved the rooting of many gymnosperms including *Abies* Miller (fir) (Dirr and Heuser, 1987); *Chamaecyparis* Spach. (falsecypress) (Hartmann et al., 1990); *Juniperus* L. (juniper) (Barnes, 1993; Dirr and Heuser, 1987; Hartmann et al., 1990); *Picea* Dietr. (spruce) (Mitsch, 1975);

Taxus L. (yew) (Barnes, 1993; Hartmann et al., 1990); and *Thuja* L. (arborvitae) (Barnes, 1993). The Dec. to Feb. cuttings and the Mar. to May cuttings rooted in 10 to 12 weeks. It is possible the nontreated cuttings from June to Aug. and Sept. to Nov. would root if given more time. Growers report sticking cuttings in summer and waiting 12 months or longer for complete rooting. Nontreated and treated (8000 ppm and 20,000 ppm IBA-talc) mid March cuttings of *C. harringtonia* var. *drupacea* 'Duke Gardens' rooted 63%, 70%, and 73%, respectively, when examined two years later (Dirr and Heuser, 1987). Cuttings of 'Duke Gardens' taken in late Sept. and treated with 3000 ppm K-IBA failed to root by April although they were in excellent condition.

Table 1. The effects of timing and K-IBA on rooting percentage, root number, and root length of stem cuttings of *Cephalotaxus harringtonia*.

	Season			
Auxin Treatment	Sept. - Nov.	Dec. - Feb.	Mar. - May	June - Aug.
	Rooting (%)			
Nontreated	30.0	21.8	78.3	55.8
K-IBA	34.2	84.9	66.7	0.8
	NS	***	NS	***
	Mean no. roots[1]			
Nontreated	1.6	2.3	4.9	3.5
K-IBA	3.6	10.0	7.8	0.2
	NS	***	***	***
	Mean total root length (cm)[1]			
Nontreated	2.7	6.1	13.1	9.7
K-IBA	6.0	35.0	14.4	0.5
	NS	***	NS	***

[1] Means are per rooted cutting.
NS, *** Nonsignificant or significant at P=0.001.

The taxonomy of *Cephalotaxus* species and cultivars is confusing (Tripp, 1994). Differences possibly exist in the rooting responses of the various taxa. A study is currently underway to collect and accession as many taxa as possible for chemotaxonomic and propagation studies. Based on our work with the low-growing clone of *C. harringtonia,* cuttings should be taken in Dec. to Feb. or Mar. to May and treated with 10,000 ppm K-IBA.

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