Propagation of *Lindera umbellata* by Stem Cuttings[1]

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Abstract

Stem cuttings of *Lindera umbellata* Thunb. (Chinese spicebush) were taken on three dates representing three growth stages (softwood, semi-hardwood, or hardwood). Semi-hardwood and hardwood cuttings were treated with 0, 2500 (0.25%), 5000 (0.5%), 7500 (0.75%), or 10,000 (1.0%) ppm of the free acid of indolebutyric acid (IBA) dissolved in 50% isopropyl alcohol, whereas softwood cuttings were treated with the same concentrations of the potassium (K) salt of IBA (K-IBA) dissolved in distilled water. All cuttings were placed in a raised greenhouse bench and rooted under intermittent mist. After 12 weeks, the cuttings were harvested and various data recorded. The majority of the hardwood cuttings died, with none of the survivors rooting. Softwood cuttings survived but with overall rooting of only 5%. Response of the semi-hardwood cuttings to IBA was quadratic with the greatest rooting (73%) observed for those cuttings treated with 7500 ppm IBA. However, root number and root length were not significantly affected by IBA treatment. Sixty of the rooted semi-hardwood cuttings were potted and later provided with overwinter protection in an unheated greenhouse but only three of these cuttings were alive by the following summer.

Index words: auxin, indolebutyric acid, adventitious rooting, Lauraceae.

Significance to the Nursery Industry

Lindera umbellata (Chinese spicebush) is a large deciduous shrub distinguished by extraordinary fall color with persisting, silvery-beige foliage and glossy black fruit (drupes), providing winter interest. The species is generally resistant to environmental stresses, pests, and various diseases, and is therefore an excellent choice as a low maintenance, ornamental shrub. This study demonstrated that semi-hardwood cuttings of *L. umbellata* can be rooted at >70% when treated with 7500 (0.75%) ppm of the free acid of IBA dissolved in 50% isopropyl alcohol. However, overwinter survival of the rooted cuttings was extremely poor.

Introduction

There are many species of *Lindera* Thunb. suitable for landscapes in the southeast United States. These plants exhibit resistance to environmental stresses, insect pests, and disease and are adaptable to a wide range of growing conditions (12).

Lindera umbellata (Chinese spicebush) is an attractive deciduous species in the Lauraceae. It is indigenous to 'scrubland' up to elevations of 3000 m (9850 ft) in China from Kiangsi to West Sichuan, and in Honshu, Shikoku, and Kyushu, Japan (11), where it grows as a large, spreading shrub. In its native habitat, this species can reach 6 m (19.7 ft), and a mature specimen growing at the JC Raulston Arboretum, Raleigh, NC, measured 4 m (13.1 ft) tall with an equal spread. The narrow, oblong leaves of *L. umbellata* [7.6 to 12.7 cm (3 to 5 in) long by 2.5 cm (1 in) wide], have silvery undersides, turning a striking orange and yellow color in the fall. Glossy, round black fruit (drupes), 8 mm (0.31 in) in diameter (7), also mature in the fall and the foliage turns silvery-beige in winter and often persists, providing year round interest. There are no known insect or disease problems associated with Chinese spicebush, and it has exhibited drought tolerance at the JC Raulston Arboretum where it is grown in full sun with no supplemental irrigation. These attributes suggest this species may have considerable landscape potential for the southeastern United States.

In addition to its ornamental qualities, *L. umbellata*, as well as other *Lindera* spp., have been studied for their potential roles in modern medicine (1, 8, 9), as well as having a history of traditional medicinal use. Recent research has found bark extracts of *L. umbellata* to inhibit growth of melanoma cells (16). If this species proves to be useful in the treatment of certain diseases, asexual propagation will be essential for generating clones of desired genotypes, with propagation by stem cuttings being a simple and inexpensive method.

Sexual (seed) propagation has been reported for several species of *Lindera*, although at the risk of unpredictable plant-to-plant variation (6). Propagation by stem cuttings, however, would facilitate cloning of desirable genotypes, possibly leading to named cultivars. No research has been reported on propagation of *L. umbellata* by seed or stem cuttings, although *L. obtusiloba* Bl. (Japanese spicebush) has been propagated sexually and by semi-hardwood cuttings treated with indolebutyric acid (IBA) (4). The native North American *L. benzoin* (L.) Bl., is reported to have been rooted from 'half-ripe' stem cuttings, but in low percentages, and can also be propagated by seed (4). With the aforementioned reports supporting the possibility of vegetative propagation of *L. umbellata*, the following research was conducted to investigate the feasibility of propagating this species by stem cuttings.

Materials and Methods

Terminal stem cuttings were taken on June 22, 2000 (softwood), August 3, 2000 (semi-hardwood), and December 9, 2000 (hardwood), from a single plant in the adult growth phase growing at the JC Raulston Arboretum. Following collection, cuttings were placed in plastic bags and kept on ice while being transported to the Horticultural Science Greenhouses, Raleigh, NC. Cuttings of all growth stages were

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trimmed from the bases to 12 cm (4.7 in), and leaves of the softwood and semi-hardwood cuttings were removed from the lower third of each cutting. Cuttings taken at the hardwood stage were stripped of flower buds prior to auxin treatment. The basal 1 cm (0.4 in) of each cutting was treated for 1 sec with 0, 2500 (0.25%), 5000 (0.5%), 7500 (0.75%), or 10,000 (1.0%) ppm IBA. Semi-hardwood and hardwood cuttings were treated with the free acid of IBA dissolved in 50% isopropyl alcohol while the softwood cuttings were treated with the potassium (K) salt of IBA (K-IBA) dissolved in distilled water. After auxin treatment, the cuttings were air dried for 15 min before insertion into a raised greenhouse bench containing a steam pasteurized medium of peat:perlite (1:1 by vol). Greenhouse air temperatures ranged from 18C (65F) to 29C (85F) and natural photoperiod and irradiance were provided. Bottom heat was utilized to maintain the minimum temperature of the rooting medium at 21C (70F). Intermittent mist operated 5 sec every 5 min from sunrise to dusk, and chlorothalonil (Daconil; Syngenta, Inc., Greensboro, NC), a preventative fungicide treatment, was applied weekly as a spray to runoff, at a concentration of 4 ml/liter (1.0 tbsp/gal).

For each growth stage, the experimental design in the mist bed was a randomized complete block with eight cuttings per treatment and six replications. After 12 weeks the cuttings were harvested and various data recorded to include percentage rooting, and number and length of primary roots ≥ 1 mm (0.04 in). A cutting having one root ≥ 1 mm (0.04 in) was considered rooted. Data for each growth stage were subjected to analysis of variance and regression analysis.

Following evaluation, 60 rooted semi-hardwood cuttings were transplanted into individual 0.9-liter (1-qt) containers using a medium of pine bark:sand (8:1 by vol), and topdressed with 3 g of a 3–4 month, controlled-release fertilizer having an analysis of $15N–9P_2O_5–12K_2O$ plus micronutrients (Osmocote, Scotts-Sierra Hort. Products Co., Marysville, OH). The containers were placed on a gravel pad at the Horticulture Field Laboratory, Raleigh, where they received daily overhead irrigation. In the late fall these plants were placed in an unheated greenhouse for overwintering.

Results and Discussion

The majority of the hardwood cuttings (87%) died by the end of the 12-week rooting period, and none of the surviving cuttings rooted. On the other hand, 75% of the softwood cuttings survived, although only 5% rooted, mostly with one short root ≈10 mm (0.4 in) in length. Each of the surviving softwood cuttings developed large masses of callus on the basal portion, each being an average of 1.9 cm (0.75 in) in diameter. Auxin treatment had no effect on rooting of softwood cuttings, although callus formation increased with higher auxin concentrations. It is unknown whether the callus blocked adventitious roots from emerging, or if adventitious roots would have eventually developed had the cuttings been left in the bench for a longer period. Stem cuttings of various genera such as oak (*Quercus* L.) and olive (*Olea* L.) have also been reported to produce callus but no roots during rooting experiments (3, 15).

The best results were observed at the semi-hardwood stage, with auxin treatment having a quadratic effect on percentage rooting (Table 1). Cuttings across all treatments rooted, with the highest percentage for cuttings treated with 7500 (0.75%) ppm IBA (73%). Although auxin treatments stimulated rooting, the nontreated cuttings also rooted (23%), indicating that auxin treatment was not absolutely essential for rooting at the semi-hardwood stage. Callus began to develop on the basal ends of the semi-hardwood cuttings by week 3 of the experiment, and increased in diameter [≈1.9 cm (0.75 in)] by week 12.

Table 1. Effects of IBA treatments on rooting of semi-hardwood cuttings of *Lindera umbellata.*

Treatment (ppm IBA)	Rooting[z] (%)	Mean root no.[y]	Mean root length[y] (mm)
Nontreated	23.0	2.6	23.6
2,500	43.7	2.7	42.2
5,000	56.2	3.5	53.9
7,500	73.0	3.8	38.4
10,000	58.3	3.0	29.4
Linear	NS	NS	NS
Quadratic	*	NS	NS

[z]Each value is based on 48 cuttings.

[y]Each value is based on the number of cuttings which rooted for a particular treatment.

NS, * Nonsignificant or significant at $P < 0.05$, respectively

Mean root length appeared to exhibit a quadratic trend with increasing auxin concentration, however, it was not significant ($P = 0.06$), and ranged from 23.6 mm (0.9 in) to 53.9 mm (2.1 in) (Table 1). Although mean root number also appeared to follow a quadratic response to IBA treatment, the differences were very small and not significant ($P = 0.51$).

None of the rooted semi-hardwood cuttings which were potted produced a flush of new growth before being placed in an unheated greenhouse for overwintering. The following spring, only six of the 60 plants were alive and produced a weak flush of growth, and of these six, three survived the first growing season. Poor overwinter survival is not uncommon for cuttings which have not produced a flush of new growth following rooting, and various strategies have been investigated in attempts to overcome this problem (2, 5, 10, 13, 14, 17). This suggests that *L. umbellata* may require a flush of growth before overwintering in order to survive.

Although results herein demonstrate that semi-hardwood stem cuttings of *L. umbellata* can be rooted in percentages >70%, additional research is necessary to improve overwinter survival of rooted cuttings. In actuality, this problem must be overcome before rooting stem cuttings can be regarded as a successful means to propagate *L. umbellata*.

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