development, pre-germination position can. Change of seed position during radicle emergence can result in distortions of stems and roots.

The pre-germination stage at which seeds of different tree species become geotropically sensitized may vary. Observations of these various position effects should be made for all species being grown in order to improve seed handling techniques and to minimize or eliminate unnecessary stem and root distortions that may result in unusable or unsalable trees. Because distortions may be hard to see in trees that produce small seedlings, growers may need to look for stem and/or root distortions on older trees and relate their observations to their seed handling techniques.

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Effects of Wounding, IBA and Basal Trimming on Rooting of Boxwood Cuttings[1]

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Abstract

Wounding, indole butyric acid (IBA) and trimming of cuttings to a basal node were evaluated for their effects on rooting of *Buxus sempervirens* L. (American boxwood), *B. sempervirens* L. 'Suffruticosa' (English boxwood), *B. microphylla* var. *koreana* Nakai. (Korean boxwood), and B. microphylla var. *japonica* (Müll. Agr.) Rehd. and Wils. (Japanese boxwood) cuttings. Rooting of all cultivars was improved by a 5 second dip in a 0.4% aqueous solution of the potassium salt of IBA. Wounding the basal end of the cuttings only improved rooting for Korean and Japanese boxwoods. However, the combination of wounding and IBA dip gave the best results for all cultivars. Trimming the cuttings to a basal node was beneficial only to Korean boxwoods.

Index words: propagation, *Buxus sempervirens*, *Buxus microphylla*, indole-3-butyric acid

Introduction

American and English boxwoods are valued in the landscape throughout the southeastern and eastern coastal regions of the United States. The more rapidly growing Korean and Japanese boxwoods are often used although they are not as finely textured.

The boxwoods are commonly propagated by cuttings taken at any time of the year (1), however, success and speed of rooting varies with the season (4). Rooting studies on Jojoba (*Simmondsia chinensis* (Link) C.K. Scheid.) (Buxaceae) indicated a positive response to the combination of stem wounding and IBA treatment (3). The possibility of similar treatment effects on boxwood cuttings was investigated in the following study.

Materials and methods

Terminal cuttings of Korean and Japanese boxwoods were collected in late June. Terminal cuttings of English and American boxwoods were collected in early July. The basal ends of the cuttings were cut either just below a node (nodal cutting) or above a node (internodal cutting). The cuttings were trimmed to 9–10 cm (3.5–4 in) and the leaves were stripped from the basal 4 cm (1.5 in) of each cutting. Two cm (0.78 in) of the base of half of the cuttings were wounded by a single incision through the cortex with the point of a scalpel. Both wounded and unwounded cuttings were treated with either a 0.4% solution of the potassium salt of IBA (United States Biochemical Corp.) or left untreated. Treatment was by dipping the basal 2 cm (0.78 in) of the cuttings into the solution for 5 seconds and allowing the cuttings to air dry 15 minutes. All cuttings were stuck 4 cm (1.63 in) in 52 cm × 40 cm (20.5 in × 15.5 in) plastic flats containing moist peat and perlite (1:1 by vol.). Flats were placed on raised outdoor mist benches covered with 47% shade cloth under natural sunlight. Cuttings were misted 5 seconds every 5 minutes from 6:30 AM to 6:30 PM. A randomized complete block design was used of 5 replications with 10 cuttings per treatment. The *B. microphylla* cuttings were evaluated after 12 weeks and the *B. sempervirens* cuttings were evaluated after 28 weeks. Measurements included number and length of rooted cuttings per treatment. Data

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were subjected to standard analysis of variance procedures and differences in percent rooting determined by angular transformation.

Results and Discussion

Rooting percentages of wounded nodal cuttings of Korean boxwood treated with IBA were significantly higher ($P < .001$) than internodal cuttings, regardless of treatment (Table 1). Percent rooting of both nodal and internodal cuttings were significantly improved by wounding and/or IBA. Numbers and lengths of roots were increased by IBA alone and by the combination of IBA and wounding.

There was no difference in rooting between nodal and internodal cuttings of Japanese boxwood (Table 2). However, wounding and/or IBA caused a highly significant increase in percent rooting ($P < .001$). Both dipping in IBA and wounding plus dipping in IBA increased the number of roots and root length.

Internodal cuttings of English boxwood rooted the best and produced the most and longest roots (Table 3). Treating the cuttings with IBA caused an increase in numbers of roots and root lengths. The combination of wounding and IBA produced the best results.

Method of cutting preparation had no significant effect on rooting or root development of American boxwood cuttings (Table 4), however, treatment with IBA did improve rooting. The combination of wounding and IBA resulted in the highest rooting percentage and root number.

Table 1. Nodal and internodal cuttings of Korean boxwood as influenced by wounding and IBA.

Treatment					
Type of Cutting	Wounding	IBA	Percent rooting[z]	No. of roots	Root length (cm)
Nodal	–	–	23.4 c	2.6 c	1.4 c
Nodal	+	–	52.4 b	3.8 c	1.6 c
Nodal	–	+	65.2 ab	7.4 b	5.6 b
Nodal	+	+	80.4 a	10.6 a	9.8 a
Internodal	–	–	13.7 c	2.4 c	1.4 c
Internodal	+	–	17.4 c	2.6 c	1.2 c
Internodal	–	+	54.4 b	8.6 a	5.0 b
Internodal	+	+	52.4 b	7.0 b	3.8 bc

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level using Duncan's Multiple Range Test.

Table 2. Nodal and internodal cuttings of Japanese boxwood as influenced by wounding and IBA.

Treatment					
Type of Cutting	Wounding	IBA	Percent rooting[z]	No. of roots	Root length (cm)
Nodal	–	–	4.8 d	1.2 c	0.8 b
Nodal	+	–	27.9 c	2.0 c	1.0 b
Nodal	–	+	59.2 ab	4.4 b	2.4 a
Nodal	+	+	78.5 a	6.4 a	2.4 a
Internodal	–	–	6.9 d	1.6 c	0.8 b
Internodal	+	–	29.5 c	2.0 c	1.0 b
Internodal	–	+	42.8 bc	5.2 ab	2.4 a
Internodal	+	+	72.8 a	6.8 a	2.6 a

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level using Duncan's Multiple Range Test.

Table 3. Nodal and internodal cuttings of English boxwood as influenced by wounding and IBA.

Treatment					
Type of Cutting	Wounding	IBA	Percent rooting[z]	No. of roots	Root length (cm)
Nodal	–	–	11.5 b	1.6 d	0.6 c
Nodal	+	–	12.8 b	2.2 d	0.8 c
Nodal	–	+	26.8 ab	3.4 bcd	1.8 bc
Nodal	+	+	41.3 a	3.8 bcd	1.6 bc
Internodal	–	–	41.9 a	4.4 abc	2.4 ab
Internodal	+	–	56.0 a	4.8 abc	2.0 abc
Internodal	–	+	46.0 a	5.2 ab	2.4 ab
Internodal	+	+	51.3 a	6.8 a	3.4 a

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level using Duncan's Multiple Range Test.

Table 4. Nodal and internodal cuttings of American boxwood as influenced by wounding and IBA.

Treatment					
Type of Cutting	Wounding		Percent rooting[z]	No. of roots	Root length (cm)
Nodal	–	–	61.2 c	6.8 bcd	3.2 bc
Nodal	+	–	45.9 c	4.6 d	3.0 c
Nodal	–	+	87.2 ab	8.2 abc	4.6 abc
Nodal	+	+	88.2 ab	9.4 ab	3.2 bc
Internodal	–	–	54.3 c	5.4 d	3.4 bc
Internodal	+	–	48.0 c	4.6 d	2.4 c
Internodal	–	+	70.5 bc	8.2 abc	5.4 ab
Internodal	+	+	92.5 a	11.4 a	5.6 a

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level using Duncan's Multiple Range Test.

Significance to the Nursery Industry

Boxwoods are popular landscape plants; however, they tend to root slowly and erratically. This study evaluated the effects of IBA, wounding and cutting preparation as they effect rooting of English, American, Korean and Japanese boxwoods.

Wounding followed by IBA treatment of 0.4% gave the best rooting response for all 4 cultivars. IBA alone improved rooting, but not as much as the wound/IBA combination. Only Korean boxwood cuttings benefitted from being trimmed to a basal node.

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