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IBA Formulation, Concentration, and Stock Plant Growth Stage Affect Rooting of Stem Cuttings of *Viburnum rufidulum*[1]

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Abstract

Viburnum rufidulum Raf. (southern or rusty blackhaw) has potential to be a popular landscape plant as it is an attractive large shrub tolerant of many common landscape stresses. However, propagation difficulties have thus far limited wide scale use. Therefore, the influence of IBA formulation and concentration on adventitious rooting of stem cuttings of southern blackhaw taken at different stock plant growth stages throughout the year were investigated. Liquid formulations of the potassium salt (K-salt) of indolebutyric acid (K-IBA) at 0, 3000, 6000, or 9000 ppm (0, 0.3, 0.6, or 0.9%) as well as talc formulations of IBA at 1000, 3000, or 8000 ppm (0.1, 0.3 or 0.8%) were utilized. Talc formulations failed to stimulate rooting regardless of concentration or growth stage. A quick-dip of K-IBA increased rooting percentage at all growth stages. Softwood and hardwood cuttings had the highest rooting percentages. Hardwood cuttings treated with 6000 ppm (0.6%) or 9000 ppm (0.9%) rooted 90 and 100%, respectively. Softwood cuttings treated with 6000 ppm (0.6%) rooted 87%. K-IBA improved root number per rooted cutting for softwood cuttings, whereas root length was unaffected by K-IBA at any growth stage.

Index words: adventitious rooting, Caprifoliaceae, indolebutyric acid, plant propagation, rusty blackhaw, southern blackhaw.

Significance to the Nursery Industry

Viburnum rufidulum (southern or rusty blackhaw) is a large deciduous shrub or small tree with attractive spring flowers, lustrous green leaves, showy fruit, and beautiful fall color. The species is remarkably drought tolerant and has few insect or disease problems. However, wide-scale nursery production and landscape usage are minimal due, in part, to propagation difficulties. The ability to reproduce plants by rooting stem cuttings would allow nurserymen to add southern blackhaw to their inventory. Additionally, successful clonal propagation would facilitate future cultivar development of this species, of which there is currently very few selections. Results herein suggest stem cuttings of southern blackhaw can be rooted at all growth stages utilizing a quick-dip of K-IBA at 6000 ppm or 9000 ppm (0.6 or 0.9%). Highest rooting was achieved with softwood or hardwood cuttings. Percent rooting was poor or nonexistent without IBA treatment, but was greatly enhanced with as little as 3000 ppm (0.3%) K-IBA. Common talc formulations of IBA were unsuccessful for rooting cuttings and should be avoided by the propagator.

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Introduction

Viburnum spp. L. (viburnum) represents a large group of shrubs and small trees with species well adapted to landscape use over a wide geographical range. Species and cultivars are available with showy flowers, fragrant flowers, attractive foliage, attractive fruit, and brilliant fall color (1). The large range of selections ensure there is a viburnum for nearly every landscape situation.

A lesser known species of *Viburnum* is the southern or rusty blackhaw (*Viburnum rufidulum*), which is native to coastal North Carolina, south to the Florida panhandle, and west to central Texas, Oklahoma, Missouri, and southeastern Kansas (6). Plants occur on a range of soils from dry rocky hillsides to rich moist valleys. The wide geographic distribution of the species and range of soil characteristics where it occurs suggest the species may be useful in a variety of landscape situations. Established plants are pest and disease free, and are drought tolerant.

Southern blackhaw will eventually form a large shrub or can be trained into a small tree reaching approximately 6 m (20 ft) in height with a rounded canopy. When flowering, the tree is adorned with a showy display of 13 cm (5 in) diameter flat-topped white cymes. Flowering is followed by clusters of 1.25 cm (0.5 in) long green drupes that progress to a pink/rose color by late summer before finishing blue/black with a waxy bloom. The leaves are 5.0 to 7.5 cm (2 to 3 in) long, oval, leathery, and lustrous green. As fall progresses, the leaves turn a dark red and may persist for some time before falling.

In spite of its ornamental characteristics, *V. rufidulum* is rare in the nursery industry. Personal communication between the author and nursery professionals suggest propagation may be a limiting factor. One report suggests stem cuttings root with ease when collected throughout summer and treated with 3000 to 8000 (0.3 to 0.8%) ppm indolebutyric acid (IBA) in talc or as a quick-dip and placed under intermittent mist (2). Others reported stem cuttings treated with a quick-dip of IBA at 5000, 10000, 15000, or 20000 (0.5, 1.0, 1.5, or 2.0%) ppm or 3000 (0.3%) ppm IBA as a talc formulation rooted 100% after 5 months in a fog chamber (5). Non-treated cuttings rooted 83%. However, 5 months is generally not considered commercially acceptable for rooting cuttings and other suggested methods (2) have not been realized by many propagators. Other reports regarding propagation of *V. rufidulum* by stem cuttings are lacking.

Recent reports have demonstrated the species dependant effects of auxin formulation on the rooting of stem cuttings. One reported 85% rooting of stem cuttings of species of *Rhamnus* L. (buckthorn) when treated with 3000 or 8000 (0.3 or 0.8%) ppm IBA in a talc formulation (8). However, identical IBA concentrations dissolved in acetone and applied as a quick-dip yielded less than 15% rooting. Similarly, the highest percentage of rooted stem cuttings (89% rooting) of × *Cupressocyparis leylandii* (A.B. Jacks. & Dallim.) Dallim. & A.B. Jacks (leyland cypress) was achieved by treating with 3000 (0.3%) ppm IBA in talc (4). Cuttings treated with 8000 (0.8%) ppm IBA talc or quick-dips of 2500 or 5000 (0.25 or 0.5%) ppm IBA in 50% isopropyl alcohol rooted 61, 65, and 60%, respectively. In another report, percent rooting of softwood stem cuttings of two clones of *Quercus phillyreoides* A. Gray (ubame oak) was unaffected by talc or liquid formulations of IBA (7). However, mean root number per rooted cutting was improved with talc over the liquid formulation. In contrast, softwood stem cuttings of *Ulmus parvifolia* Jacq. (lacebark elm) failed to root when treated with 1000, 3000, or 8000 (0.1, 0.3, or 0.8%) ppm IBA in talc (3).

Therefore, the objective of this research was to determine if adventitious rooting of stem cuttings of *V. rufidulum* is influenced by the growth stage of the stock plant, K-IBA concentration, or IBA formulation.

Materials and Methods

Terminal stem cuttings, approximately 20 cm (8 in) in length were collected throughout the canopy of three non-clonal mature specimens of *V. rufidulum* growing at the John C. Pair Horticultural Center near Wichita, KS. Trees were growing in a sandy loam soil under uniform fertility when cuttings were collected on August 25, 2005 (semi-hardwood), June 14, 2006 (softwood), and December 15, 2006 (hardwood). Cuttings from all three stock plants were combined and processed randomly to avoid confounding treatment responses regarding the influence of stock plant genotype.

Following collection, cuttings were maintained cool and moist during further processing. From the initial cutting material, terminal cuttings 15.3 cm (6 in) in length were prepared from the most recent season's growth. Leaves were removed from the lower half of softwood and semi-hardwood cuttings prior to auxin treatment. Stem tissue at the proximal end of the cuttings at all growth stages was lignified and rigid. Softwood cuttings had immature terminal leaves with no visible terminal bud, whereas semi-hardwood and hardwood cuttings had a well defined terminal bud.

Following preparation, the basal 1 cm (0.4 in) of all cuttings was treated for 3 sec with 0, 3000, 6000, or 9000 ppm (0, 0.3, 0.6, or 0.9%) K-IBA dissolved in distilled water. Cuttings were air dried for 10 min before inserting the basal 4 cm (1.6 in) into flats 9 cm (3.5 in) deep containing a medium of perlite:peat (1:1 v/v) and placed on a raised greenhouse bench. Bottom heat was maintained at 21 ± 1C (70 ± 2F) for hardwood cuttings only. In addition to the above treatments, at each growth stage, the basal 1 cm (0.4) of another group of cuttings was moistened with distilled water prior to treating with 1000, 3000, or 8000 ppm (0.1, 0.3, or 0.8%) IBA in a talc formulation (Rhizopon, Phytotronics, Earth City, MO). Excess talc was removed by tapping the cutting on the side of the container. Cuttings were then inserted into the previously mentioned flats after using a dibble to form a hole in the substrate. For each growth stage the experimental design was a randomized complete block with seven blocks, and five cuttings per treatment per block.

Cuttings were maintained under natural photoperiod and irradiance with days/nights of 24 ± 5C (75 ± 9F)/18 ± 5C (65 ± 9F) for softwood and semi-hardwood cuttings and days/nights of 16 ± 3C (60 ± 5F)/ 10 ± 3C (50 ± 5F) for hardwood cuttings. Intermittent mist operated daily 6 sec every 8 min from sunrise to sunset for the softwood and semi-hardwood cuttings. Mist was applied by deflection type nozzles with a capacity of 32.2 liters (8.5 gal) per hour. Hardwood cuttings were misted once daily by hand to run-off.

Data were collected after 8 weeks for softwood cuttings, 11 weeks for semi-hardwood cuttings, and 10 weeks for hardwood cuttings. Data included percent rooting, number of roots ≥ 1 mm (0.04 in) in length, and root lengths of the rooted cuttings. A cutting was considered rooted if it had one adventitious root ≥ 1 mm (0.04 in) in length. Data were subjected to analysis of variance and regression analysis.

Table 1. Effect of K-IBA concentration on percent rooting of stem cuttings of *Viburnum rufidulum* taken at different growth stages.

K-IBA concn. (ppm)	Percent rooted cuttings		
	Softwood	Semi-hardwood	Hardwood
0	29[z]	0	0
3,000	60	49	75
6,000	87	31	90
9,000	77	40	100
Linear	**	*	**
Quadratic	*	NS	**

[z]N = 35.

NS, *, ** not significant, significant at $P \leq 0.05$, or significant at $P \leq 0.01$, respectively.

Results and Discussion

Rooting stem cuttings of *V. rufidulum* treated with a talc formulation of IBA was generally unsuccessful. Although some softwood (24%) and semi-hardwood (4%) cuttings treated with a talc formulation rooted, the overall percentage was low, unaffected by IBA concentration, and statistically similar to the nontreated controls. In neither case was root number or root length improved by application of talc IBA. The mean number of roots per rooted cutting at the softwood and semi-hardwood stage was 2.8 and 3.0, respectively. Mean root length of softwood and semi-hardwood cuttings was 12 and 17 mm (0.5 and 0.7 in), respectively. Hardwood cuttings did not root (0%) when treated a talc formulation of IBA. The poor rooting of cuttings treated with talc formulated IBA was unexpected considering a previous report suggested cuttings root readily when treated in such a manner (2). Although these findings are similar to those reported for *U. parvifolia* (3), talc formulations of IBA are generally considered suitable for rooting various species (4, 7, 8).

Overall rooting of softwood (63%), semi-hardwood (30%), and hardwood (66%) stem cuttings was improved with a quick-dip of K-IBA (Table 1). The response of softwood and hardwood cuttings was quadratic with maximum rooting of softwood cuttings (87%) occurring with 6000 ppm (0.6%) and maximum rooting of hardwood cuttings (100%) occurring with 9000 ppm (0.9%) K-IBA. The response of semi-hardwood cuttings was linear, with maximum rooting (49%) occurring at 3000 ppm (0.3%). A dramatic increase in rooting by K-IBA treatment was evident at all growth stages. Semi-hardwood and hardwood cuttings did not root without K-IBA treatment, however, 3000 ppm (0.3%) improved rooting to 49 and 75%, respectively. Softwood cuttings rooted without K-IBA (29%), however, rooting was doubled (60%) by treatment with 3000 ppm (0.3%) K-IBA. Increasing K-IBA concentration increased rooting of softwood and hardwood cuttings, however, rooting of semi-hardwood cuttings did not improve. These results were slightly different from a previous report where 100% rooting was achieved regardless of IBA concentration (5). However, in the aforementioned report, cuttings were rooted in a fog chamber over a period of 5 months. In the present investigation a more commercially applicable mist system and rooting time frame of 8 weeks were employed. Perhaps most unexpected was the high rooting percentage of the hardwood cuttings. This procedure is promising as there would be little concern of overwintering difficulties with hardwood cuttings.

The number of roots per rooted cutting was affected by K-IBA only at the softwood growth stage. Mean root number per rooted cutting at 0, 3000, 6000, or 9000 ppm (0, 0.3, 0.6, or 0.9%) K-IBA was 2.6, 5.8, 7.9, and 8.4, respectively. Root number of the semi-hardwood (5.5) and hardwood (4.4) cuttings was unaffected by auxin treatment. Mean root length was not influenced by K-IBA application and averaged 13.8, 19.0, and 21.4 mm (0.5, 0.7, and 0.8 in) for softwood, semi-hardwood, and hardwood cuttings, respectively.

Results herein demonstrate stem cuttings of *V. rufidulum* can be rooted in commercially acceptable numbers using a quick-dip of K-IBA. Commonly used talc formulations of IBA should not be used as overall rooting was poor with these treatments. Liquid formulations of K-IBA from 6000 to 9000 ppm (0.6 to 0.9%) were sufficient to root stem cuttings of *V. rufidulum* in only 8 to 10 weeks.

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