Cutting Type Affects Rooting Percentage of Vegetatively Propagated Sparkleberry (*Vaccinium arboreum*)[1]

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Abstract

Commercial blueberries, particularly *Vaccinium corymbosum*, have very specific needs for optimum growth; hence, growing sites are limited. Plants require acidic soil (pH 4.0–5.5), good drainage, thorough aeration, and a constant moderate amount of moisture. To overcome these restrictions, cultivars could be grafted onto a plant adapted to less desirable growing conditions. One potential rootstock is *V. arboreum* (sparkleberry), which has the ability to grow in many areas that could not be used for commercial blueberries. In the past, propagation of *V. arboreum* has been difficult, but there has not been much research on the subject. Currently, *V. arboreum* plants are commercially propagated from seeds. Asexual propagation techniques will be necessary for rapid clonal propagation of selected cultivars of *V. arboreum*. The current study evaluated the rooting percentage and growth characteristics of juvenile *V. arboreum* softwood, semi-hardwood, and hardwood cuttings subjected to a 10-second basal quick-dip in 0, 1000, 2500, 5000, or 7500 ppm IBA. Rooting percentage was not affected by IBA concentration. The factors that influenced rooting were the source of the cutting and the cutting type (softwood, semi-hardwood, or hardwood). Greatest rooting percentages were observed when softwood cuttings were used. There was also success using semi-hardwood cuttings from plants that had been cut back and allowed to sprout new shoots. The results of this experiment can be used to determine the feasibility of using stem cuttings to commercially propagate selected varieties of *V. arboreum*.

Index words: softwood, semi-hardwood, hardwood, juvenile, winter huckleberry, rooting percentage.

Species used in this study: sparkleberry (*Vaccinium arboreum* Marsh).

Chemicals used in this study: indole-3-butyric acid (IBA).

Significance to the Nursery Industry

Vaccinium arboreum (sparkleberry) is an attractive species, native to the southeastern United States, that is primarily propagated by seed, though seed germination rates are low. Recent interest in the potential of *V. arboreum* as a rootstock for cultivated blueberry species led to the current study. Asexual propagation of this species will be necessary to propagate selected varieties for desirable rootstock and/or ornamental characteristics. Previous studies had very limited success in propagating *V. arboreum* via stem cuttings, which indicated that this is a very hard-to-root species. This research study demonstrated that cutting type greatly influences rooting percentage of *V. arboreum*. Softwood, and potentially semi-hardwood, juvenile cuttings appear to offer the greatest opportunities for rooting success. Rooting percentage was not influenced by IBA concentrations. The lowest rooting percentages were observed using hardwood cuttings. Inducing juvenile shoot formation by cutting mother plants, and then using softwood cuttings, may provide feasible ways to asexually propagate *V. arboreum* commercially.

Introduction

In recent years, there has been an increase in consumer demand for fresh blueberries throughout the year, which also increases the demand for sites suitable for growing blueberries. Commercial blueberries, including highbush (*Vaccinium corymbosum* L.) and rabbiteye (*Vaccinium ashei* Reade), have very specific growing requirements. As part of the Ericaceae family, commercial blueberries favor acidic soils in the range of pH 4.0–5.5 (7). Blueberries also need to have a high amount of organic matter within the soil, as well as iron and nitrogen in the NH_4+ form (3). Other soil characteristics include good drainage, thorough aeration and a relatively consistent moderate amount of moisture (1). In addition to having specific growing needs, commercial blueberries also have fibrous, shallow root systems that are sensitive to drought and wind damage (5). Because of all these limitations, suitable growing sites are in short supply unless the soil is adapted using costly amendments.

One way to overcome a poor growing environment would be to use a rootstock that has the capability to grow where others cannot. A potential rootstock for commercial blueberries would be the sparkleberry (*Vaccinium arboreum* Marsh), which has many desirable qualities that give it the ability to grow in many areas that would be unsuitable for commercial blueberries. *V. arboreum* is one of the few *Vaccinium* species that can tolerate calcareous soils, meaning they survive in conditions with higher pH levels, from pH 4 to pH 7 (7). *V. arboreum* is also able to grow in situations where the prominent form of nitrogen in the soil is nitrate (3). Plants can tolerate soils with limited quantities of iron and are more efficient at acquiring nitrate than commercial blueberries (6).

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V. arboreum has a coarse root system with a long taproot (5), which makes it a very drought resistant species and less likely to be uprooted due to wind (1). Finally, *V. arboreum* has an erect growth habit consisting of a single trunk that would minimize fruit loss when using mechanical harvesting techniques (2). With the increased demand for blueberries as a healthy snack, *V. arboreum* could be used to increase blueberry production to meet the growing demands.

In the past, *V. corymbosum* has been successfully grafted onto *V. arboreum*, which shows that there is a genetic affinity and grafting is possible (4). *Vaccinium ashei* has also been successfully grafted onto *V. arboreum* (2), again, showing a genetic affinity. Techniques that have proven successful include early spring cleft, whip or side grafts and late summer t-budding (2).

In order to use *V. arboreum* successfully as a rootstock, there would need to be a way to clonally propagate ideal specimens in large quantities. To date, there has not been much research on the propagation of *V. arboreum*. Stockton (9) tried to propagate *V. arboreum* using softwood stem cuttings and K-IBA quick-dips. Four different concentrations of K-IBA dissolved in water were used (0, 10000, 15000, and 20000 ppm). A peat:perlite:sand (2:2:1 by vol) substrate was used. Cuttings were placed under intermittent mist for 8 seconds every 10 minutes during daylight hours. After 60 days, cuttings were checked for rooting and minimal to no success was seen in all of the treatments (9). Reese (8) used semi-hardwood stem cuttings and different treatments to try to enhance rooting, including various levels of IBA+NAA, willow water, and Hormodin 3 (0.8% IBA powder). A pine bark:peat (1:1 by vol) substrate was used, and cuttings were placed in a rhizotron under intermittent mist. Similar to the previous study, little rooting was observed, with a range of 0–12.5% rooting percentage among the treatments. The control treatment had 0% rooting and all of the treatments were statistically similar, suggesting that none of the treatments influenced the rooting success (8). A subsequent study using hardwood cuttings and different combinations of wounding and hormones resulted in only two rooted cuttings for the entire experiment. Hence, previous research suggests *V. arboreum* is a very hard-to-root species, with no indication of viable treatments to enhance rooting of stem cuttings.

In addition to stem cuttings, rhizome cuttings have been evaluated by Stockton (9). Rhizome sections were taken from July until November. The caliper of the rhizomes varied from 0.5–3 cm in diameter and 10–30 cm in length. Rhizomes were placed vertically with either the distal end up or the proximal end up and at least 3 cm below the surface of the substrate. Though percent rooting was not reported, some root formation did occur. Stockton (9) concluded that this would not be an ideal way to propagate *V. arboreum* because the success rate is not high enough to make it worthwhile, and because harvesting rhizomes likely results in the death of the stock plant.

Determining a viable way to propagate *V. arboreum* would benefit commercial blueberry production, and support selection and marketing of *V. arboreum* as a landscape plant. Partly due to the difficulty of propagation, *V. arboreum* is seldom marketed as a landscape plant. However, *V. arboreum* can grow to be an aesthetically pleasing semi-evergreen small tree, with attractive fall color, exfoliating bark, and edible fruit. Since *V. arboreum* tolerates drought and a range of soil types, it is an attractive woodland shrub/small tree for xeriscaping and native plant landscaping. A viable way to clonally propagate *V. arboreum* is necessary to allow for selection of plants with desirable ornamental and rootstock characteristics.

The objectives of this study were to determine whether cutting type (softwood, semi-hardwood, or hardwood), cutting position (terminal or subterminal), IBA concentration, or the interaction of these treatments influence rooting of *V. arboreum* stem cuttings. Previous experiments did not specify if the cuttings were taken from juvenile or mature wood. For this study, two different sources of juvenile wood were used.

Materials and Methods

Cutting propagation material of *V. arboreum* was collected from two locations. Water sprouts from native, mature plants were collected from the Robert Trent Jones Golf Trail at Grand National (RTJ) in Opelika, Alabama (lat. 32°69'N, long. 85°44'W, USDA hardiness zone 8a). Shoots from latent buds on mature plants that had been cut back were also taken. These were collected from Stone County, Mississippi (SCMS; lat. 30°80'N, long. 89°17'W, USDA hardiness zone 8b). Softwood, semi-hardwood, and hardwood cuttings were collected and prepared as both subterminal and terminal cuttings. All cuttings were prepared to 10.1–12.7 cm (4–5 in); basal leaves were removed and 2–3 leaves were left intact on the softwood and semi-hardwood cuttings.

Auxin solutions were prepared using Hortus IBA Water Soluble Salts® (Hortus USA Corp.) and deionized water. The basal end of each cutting was cut at a 45° angle and received a 10-second basal quick-dip to a depth of 3 cm (1.1 in) in either water (control) or a solution of 1000, 2500, 5000, or 7500 ppm IBA. Cuttings were then inserted to a depth of 3 cm (1.1 in) into a cell in a 48-cell tray in a peat:perlite (1:1, by vol) substrate.

Hardwood cuttings from RTJ were collected and inserted into substrate on March 1, 2011. Hardwood cuttings from SCMS were taken on March 6, 2011, and inserted into substrate on March 8, 2011. Softwood cuttings from RTJ were collected and inserted into substrate on May 20, 2011. Softwood cuttings from SCMS were collected on June 19, 2011, and inserted into substrate on June 20, 2011. Semi-hardwood cuttings from RTJ were collected and inserted into substrate on July 6, 2011. Semi-hardwood cuttings from SCMS were collected on June 19, 2011, and inserted into substrate on June 21, 2011. After they were inserted into substrate, the cuttings were placed in a 4-ft-wide by 8-ft-long by 3-ft-tall polyethylene covered enclosure to ensure the relative humidity stayed above 60% inside a greenhouse at the Paterson Greenhouse Complex at Auburn University. Overhead mist was provided within the enclosure for 2 seconds every 10 minutes during daylight hours. Maximum photosynthetically active radiation measured in the greenhouse on the cutting bench with a quantum meter (Model QMSS, Apogee Instruments, Inc., Logan, UT) was 800 $\mu mol \cdot m^{-2} \cdot sec^{-1}$. Temperature was recorded hourly using data loggers (Watchdog A150 Temp/RH Logger; Spectrum Technologies, Inc., Aurora, IL) and daily maximum/minimum temperatures on the cutting bench were 34 ± 6C (93 ± 10F) and 23 ± 3C (73 ± 5F).

A completely randomized design was used with 30 cuttings (replications) per treatment. Rooting response (rooted or unrooted) was recorded for all cuttings, with a cutting considered rooted when any sign of adventitious roots were seen emerging from the stem. Additional data collected include number of primary roots emerging from the stem of each rooted cutting, total length of primary roots on each rooted cutting, number of rooted cuttings with new shoots, total shoot length on each rooted cutting, number of cuttings that formed callus, and callus caliper of cuttings with callus.

The treatment design was a 2 × 2 × 3 × 5 complete factorial design with four factors: 1) source (water sprouts from mature plants or sprouts arising from latent buds on cut back plants), 2) cutting position on the stock plant (terminal and subterminal), 3) cutting maturity (softwood, semi-hardwood and hardwood) and 4) IBA rate (0, 1000, 2500, 5000, and 7500 ppm), for a total of 60 treatment combinations. The experimental design was a completely randomized design. Data were analyzed using generalized linear models with the GLIMMIX procedure of SAS (version 9.2; SAS Institute Inc., Cary, NC). Rooting was analyzed using the binomial distribution and a logit link function, count data were analyzed using the Poisson distribution and a log link function, and measurement data were analyzed using the normal distribution and the identity link function. Comparisons of least squares means were conducted using the Schaffer-Simulated adjustment for multiple comparisons.

Results and Discussion

In all the results, source refers to whether the cutting came from water sprouts of mature, wild plants from RTJ, or from plants that had been cut back and allowed to sprout shoots from latent buds in SCMS. Type refers to whether the cutting is softwood, semi-hardwood, or hardwood. Position refers to whether the cutting is subterminal or terminal. IBA refers to the IBA quick-dip rate to which the cutting was subjected.

In the full model for rooting, the four-way interaction term was not significant. Examining progressively reduced models, the only significant three-way interaction term was source × type × position, indicating the way that source and type affected rooting of cuttings varied depended on position. Rooting percentages of subterminal cuttings were similar for softwood cuttings from both RTJ and SCMS, but terminal softwood cuttings from SCMS cuttings had a significantly lower rooting percentage than RTJ cuttings (Table 1). For hardwood, rooting percentage was statistically similar when using terminal cuttings, but when using subterminal cuttings RTJ cuttings had a higher rooting percentage than SCMS cuttings (Table 1). Because the effects of source and type on rooting varied with position of the cutting, separate analyses were run for subterminal and terminal cuttings. Based on the statistical analysis, position alone did not influence rooting percentage.

Subterminal cuttings. There were no significant effects of IBA rate on rooting percentage, root number, or root length on subterminal cuttings (Table 2). There were also no significant effects of IBA rate on shoot number, shoot length, callus percentage, or callus caliper (data not presented). The source and type of cutting did influence the rooting percentage. The highest rooting percentage occurred when using softwood cuttings from RTJ (38.6%) and SCMS (34.6%), and semi-hardwood cuttings from SCMS (28.5%) (Table 3). None of the treatments significantly influenced the number of primary roots per rooted cutting. Type of cutting significantly influenced the length of primary roots. The longest roots were produced by SCMS semi-hardwood cuttings with an average

Table 1. Rooting percentages of softwood and hardwood, subterminal and terminal stem cuttings of *Vaccinium arboreum* from two locations.

Source	Type	Rooting (%)	
		Subterminal	Terminal
RTJ[z]	Softwood	38.5a[x]	43.3a
SCMS[y]	Softwood	34.3a	29.2b
RTJ	Hardwood	10.3b	1.9c
SCMS	Hardwood	0.6c	1.8c

[z]Robert Trent Jones Golf Trail, Opelika, AL; cuttings taken from water sprouts of mature plants.

[y]Stone County, MS; cuttings from juvenile shoots resulting from plants cut back in February 2010.

[x]Shaffer-Simulated grouping for source × type least squares means (α = 0.05); n = 150.

total root length of 23.3 cm (9.2 in) SCMS softwood, SCMS hardwood, and RTJ semi-hardwood had statistically similar root lengths, with average total root lengths of 18.3, 17.0, and 17.1 cm (7.2, 6.7, and 6.73 in), respectively (Table 3).

The source and type of cutting both significantly influenced the number of new shoots on rooted cuttings. Hardwood cuttings from both SCMS and RTJ had more new shoots (1.5 and 2.4, respectively) than softwood and semi-hardwood cuttings from either source (Table 4). The type of cutting and the source × type interaction both significantly influenced the length of new shoots. The longest shoots were observed on the RTJ hardwood cuttings with an average total combined shoot length of 5.3 cm (2.0 in) (Table 4).

Source, type, and source × type all significantly influenced the percent of cuttings that formed callus. The RTJ softwood cuttings had the highest percent callus with 82.4% (Table 4). Source and type also influenced the callus caliper. RTJ hardwood cuttings had the greatest callus caliper with an average diameter of 7.1 mm (0.28 in). Statistically similar callus calipers were observed in RTJ softwood and SCMS hardwood cuttings with average diameters of 6.5 and 6.8 mm (0.26 and 0.27 in), respectively (Table 4).

Terminal cuttings. Similar to subterminal cuttings, there were no significant effects of IBA rate on rooting percentage, root number, or root length (Table 5). There were no significant effects of IBA rate on shoot number, shoot length, callus percentage, and callus caliper measured on terminal cuttings (data not shown). The source and type of cutting both significantly influenced rooting percentage. The highest rooting percentage was observed on the RTJ softwood cuttings with 43.3% rooting (Table 6). Softwood cuttings from SCMS had 29.2% rooting, which was greater than hardwood cuttings from both sources (2.0%). None of the treatments significantly influenced the number of primary roots on each rooted cutting or the total combined length of primary roots (Table 6).

Shoot number was not significantly influenced by source × type. Softwood and hardwood cuttings from both RTJ and SCMS all had shoot numbers of less than one per cutting (Table 7). None of the factors influenced the shoot length (Table 7). The source and type of cutting significantly influenced the percent of cuttings that formed callus. The highest percentage of cuttings with callus was observed with softwood cuttings from both RTJ and SCMS with 73.4

Table 2. **Influence of IBA rate on rooting percentage, number of roots, and root length of subterminal *Vaccinium arboreum* stem cuttings.**

IBA rate (ppm)	SCMS[z] Softwood	SCMS[z] Semi-hardwood	SCMS[z] Hardwood	RTJ[y] Softwood	RTJ[y] Semi-hardwood	RTJ[y] Hardwood
			Rooting (%)			
0	26.6[x]	36.6	0.0	33.0	3.3	11.6
1000	30.0	16.6	0.0	36.6	6.6	8.3
2500	36.6	43.3	3.3	35.0	10.0	11.6
5000	36.6	23.3	0.0	36.6	16.6	13.3
7500	43.3	23.3	0.0	51.6	10.0	8.3
Significance[w]	NS	NS	NS	NS	NS	NS
			Roots (no.)			
0	2.0	2.4	0.0	2.3	1.0	2.0
1000	1.9	3.4	0.0	2.9	1.0	1.8
2500	1.8	1.6	1.0	2.5	3.0	1.7
5000	2.3	2.7	0.0	1.6	1.6	2.0
7500	1.8	3.1	0.0	2.7	1.0	2.0
Significance	NS	NS	NS	NS	NS	NS
			Root length (cm)			
0	18.4	22.9	0.0	16.8	11.6	14.5
1000	19.0	22.5	0.0	15.3	12.7	8.5
2500	17.7	18.0	16.5	16.7	29.7	9.7
5000	22.2	27.7	0.0	12.1	16.6	11.3
7500	15.2	29.7	0.0	18.4	9.8	7.9
Significance	NS	NS	NS	NS	NS	NS

[z]Stone County, MS; cuttings taken from juvenile shoots resulting from plants cut back in February 2010.

[y]Robert Trent Jones Golf Course in Opelika, AL; cuttings taken from water sprouts of mature plants.

[x]n = 30.

[w]NS: nonsignificant at α = 0.05.

and 33.9% of cuttings forming callus respectively (Table 7). Callus caliper was not significantly influenced by any of the treatments (Table 7).

In general, the type of cutting greatly affects the rooting success of *V. arboreum*, but IBA rate does not appear to influence rooting. Previous research done by Stockton concluded that IBA did not influence rooting in softwood cuttings (9). Much higher concentrations of IBA were used in his study (0, 10,000, 15,000, and 20,000 ppm) compared to our study. The high rates may have been detrimental to rooting, as very little rooting was seen. In this study, IBA rate did not influence the rooting percentage of subterminal or terminal cuttings (Tables 2 and 5). Lower rates of IBA were used and rooting percentages of softwood cuttings were fairly high compared to previous research (9), but this response was not due to the IBA treatments.

Table 3. **Effect of cutting source and cutting type on percent rooting, number of roots and root length of subterminal *Vaccinium arboreum* stem cuttings.**

Source	Type	Rooting (%)	Roots (no.)	Root length (cm)
RTJ[z]	Softwood	38.6a[x]	2.2	16.0bc
SCMS[y]	Softwood	34.6a	1.9	18.3ab
RTJ	Semi-hardwood	9.2b	1.6	17.1abc
SCMS	Semi-hardwood	28.5a	2.4	23.3a
RTJ	Hardwood	10.6b	1.9	10.7c
SCMS	Hardwood	0.7c	1.0	17.0abc

[z]Robert Trent Jones Golf Trail, Opelika, AL; cuttings taken from water sprouts of mature plants.

[y]Stone County, MS; cuttings taken from juvenile shoots resulting from plants cut back in February 2010.

[x]Shaffer-Simulated grouping for source × type least squares mean (α = 0.05); n = 150.

Table 4. **Effect of cutting source and cutting type on shoot number, shoot length, percent with callus and callus caliper of subterminal *Vaccinium arboreum* stem cuttings.**

Source	Type	Shoots (no.)	Shoot length (cm)	Callus (%)	Callus caliper (mm)
RTJ[z]	Softwood	0.2c[x]	0.4c	82.4a	6.5ab
SCMS[y]	Softwood	0.4bc	0.8c	48.5b	4.9c
RTJ	Semi-Hardwood	0.5bc	0.9c	29.6c	5.4bc
SCMS	Semi-Hardwood	1.3b	3.1b	36.3bc	4.4c
RTJ	Hardwood	2.4a	5.3a	43.8b	7.1a
SCMS	Hardwood	1.5ab	2.5bc	3.5d	6.8ab

[z]Robert Trent Jones Golf Trail, Opelika, AL; cuttings taken from water sprouts of mature plants.

[y]Stone County, MS; cuttings taken from juvenile shoots resulting from plants cut back in February 2010.

[x]Shaffer-Simulated grouping for source × type least squares means (α = 0.05); n = 150.

Table 5. Influence of IBA rate on rooting percentage, number of roots, and total root length of terminal *Vaccinium arboreum* stem cuttings.

IBA rate (ppm)	SCMS[z]		RTJ[y]	
	Softwood	Hardwood	Softwood	Hardwood
Rooting (%)				
0	36.7[x]	0.0	36.7	3.3
1000	20.0	3.3	60.0	0.0
2500	26.7	6.6	36.7	3.3
5000	23.3	0.0	40.0	3.3
7500	40.0	0.0	43.3	0.0
Significance[w]	NS	NS	NS	NS
Roots (no.)				
0	1.8	0.0	2.3	1.0
1000	2.3	1.0	2.9	0.0
2500	1.8	3.0	2.5	2.0
5000	2.3	0.0	1.6	3.0
7500	2.4	0.0	2.7	0.0
Significance	NS	NS	NS	NS
Root length (cm)				
0	20.7	0.0	13.2	10.8
1000	20.8	1.7	16.1	0.0
2500	14.7	5.7	15.6	15.9
5000	22.1	0.0	19.4	29.4
7500	21.7	0.0	20.1	0.0
Significance	NS	NS	NS	NS

[z]Stone County, MS; cuttings taken from juvenile shoots resulting from plants cut back in February 2010.

[y]Robert Trent Jones Golf Course in Opelika, AL; cuttings taken from water sprouts of mature plants.

[x]n = 30.

[w]NS: nonsignificant at α = 0.05.

Table 6. Effect of cutting source and cutting type on percent rooting, number of roots and root length of terminal *Vaccinium arboreum* stem cuttings.

Source	Type	Rooting (%)	Roots (no.)	Root length (cm)
RTJ[z]	Softwood	43.3a[x]	2.2	16.9
SCMS[y]	Softwood	29.2b	2.0	20.1
RTJ	Hardwood	2.0c	2.0	19.3
SCMS	Hardwood	2.0c	2.7	6.4

[z]Robert Trent Jones Golf Trail, Opelika, AL; cuttings taken from water sprouts of mature plants.

[y]Stone County, MS; cuttings taken from juvenile shoots resulting from plants cut back in February 2010.

[x]Shaffer-Simulated grouping for source × type least squares means (α = 0.05); n = 150.

Table 7. Effect of cutting source and cutting type on shoot number, shoot length, percent with callus and callus caliper of terminal *Vaccinium arboreum* stem cuttings.

Source	Type	Shoots (no.)	Shoot length (cm)	Callus (%)	Callus caliper (mm)
RTJ[z]	Softwood	0.0	0.0	73.4a[x]	5.8
SCMS[y]	Softwood	<1.0	0.3	33.9a	5.4
RTJ	Hardwood	<1.0	0.6	15.2b	6.4
SCMS	Hardwood	<1.0	0.7	0.0b	*[w]

[z]Robert Trent Jones Golf Trail, Opelika, AL; cuttings taken from water sprouts of mature plants.

[y]Stone County, MS; cuttings taken from juvenile shoots resulting from plants cut back in February 2010.

[x]Shaffer-Simulated grouping for source × type least squares means (α = 0.05); n = 150.

[w]There were no cuttings with callus in SCMS hardwood, therefore no caliper data.

In previous research there was virtually no success rooting *V. arboreum* using softwood, semi-hardwood or hardwood cuttings. In the current study, the best rooting percentage occurred using softwood cuttings. The percent rooting of softwood cuttings ranged from 29.2–43.2%, which is a great improvement compared to any previous research. The source of the cutting also had a significant influence on the rooting percentage. Softwood cuttings rooted well for both sources, and hardwood cuttings did not root well for either source. However, there was a difference between the rooting percentages for RTJ and SCMS semi-hardwood cuttings. Semi-hardwood cuttings from SCMS had a similar rooting percentage to softwood cuttings, and the cuttings from RTJ had a very low rooting percentage (Table 3). This was likely due to the quality of the cuttings obtained. There were more juvenile cuttings to choose from at the SCMS location because the plants had been cut back, and the cuttings did not appear to be as lignified as the semi-hardwood cuttings from RTJ; i.e. the semi-hardwood cuttings from SCMS were closer to softwood cuttings compared to those obtained from RTJ. As in previous studies, the hardwood cuttings had very little rooting success. Hardwood cuttings of many species are generally less successful than softwood and semi-hardwood cuttings, so this was not surprising.

Since virtually no rooting success was observed in previous research (8, 9), the >30% rooting observed with softwood cuttings in this study is encouraging. Although this may still not be a commercially feasible way to propagate *V. arboreum*, it demonstrates that it is possible to root cuttings and that the methods could potentially be improved. The next steps will be to discover ways to increase rooting to a commercially acceptably success rate. Manipulating propagation environments via fog tents, altering light intensity, or using bottom heat may prove to be beneficial. Wounding to expose more cambial tissue, which was not utilized in this study, or various chemical pretreatments may prove to be advantageous for increasing rooting percentage of *V. arboreum* cuttings. In addition to cuttings and micro-propagation, other propagation methods could be explored, such as air or mound layering.

Literature Cited

1. Ballinger, W.E., E.P. Maness, and J.R. Ballington. 1982. Anthocyanins in ripe fruit of the sparkleberry, *Vaccinium arboreum* Marsh. Can. J. Plant Sci. 62:683–687.

2. Ballington, J.R., B.W. Foushee, and F. Williams-Rutkosky. 1990. Potential of chip-budding, stub-grafting or hot-callusing following saddle-grafting on the production of grafted blueberry plants. Proc. N. Amer. Blueberry Res.-Ext. Workers Conf. 114–120.

3. Darnell, R.L. and S.A. Hiss. 2006. Uptake and assimilation of nitrate and iron in two *Vaccinium* species as affected by external nitrate concentration. J. Amer. Soc. Hort. Sci. 131:5–10.

4. Galletta, G.J. and A.S. Fish. 1971. Interspecific blueberry grafting, a way to extend *Vaccinium* culture to different soils. J. Amer. Soc. Hort. Sci. 96:294–298.

5. Lyrene, P.M. 1997. Value of various taxa in breeding tetraploid blueberries in Florida. Euphytica 94:15–22.

6. Poonnachit, U. and R. Darnell. 2004. Effect of ammonium and nitrate on ferric chelate reductase and nitrate reductase in *Vaccinium* species. Ann. Bot. 93:399–404.

7. Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, NC.

8. Reese, J.C. 1992. Propagation of farkleberry (*Vaccinium arboreum*) for use as a blueberry rootstock. M.S. Thesis. Mississippi State Univ., Starkville.

9. Stockton, L.A. 1976. Propagation and autoecology of *Vaccinium arboreum* and its graft compatibility with *Vaccinium ashei*. M.S. Thesis. Texas A&M Univ., College Station.