HortScience 48(8):1018–1020. 2013.

Propagation of Four Underused Native Species from Softwood Cuttings

Julia A. Cartabiano and Jessica D. Lubell[1]

Department of Plant Science and Landscape Architecture, University of Connecticut, 1376 Storrs Road, Unit 4067, Storrs, CT 06269

Additional index words. *Ceanothus americanus*, *Corylus cornuta*, *Lonicera canadensis*, *Viburnum acerifolium*, indole-3-butyric acid

Abstract. **Interest in native plants for landscaping is increasing and nursery growers must expand their product offerings by adding new native species. Softwood stem cutting propagation of four underused northeastern U.S. native species [*Ceanothus americanus* (L.), *Corylus cornuta* (Marsh.), *Lonicera canadensis* (Bartr.), *Viburnum acerifolium* (L.)] was studied. *V. acerifolium* cuttings containing two nodes taken mid-June to mid-August rooted at nearly 100% with at least 15 roots per cutting. Exogenous auxin application did not enhance rooting of two-node *V. acerifolium* cuttings. Single-node *V. acerifolium* cutting success and quality of rooting increased with increasing concentration of auxin applied and reached a maximum of 80% rooting, whereas untreated cuttings only rooted at 53%. *C. cornuta* cuttings taken mid-June to mid-August rooted at greater than 85%. Hormone concentration did not affect rooting percentage for *C. cornuta;* however, cuttings treated with 3000 and 8000 ppm indole-3-butyric acid (IBA) had more and longer roots than untreated cuttings. June was the optimal time to collect cuttings of *C. americanus* (57% rooting) and *L. canadensis* (49% rooting), and rooting hormone did not significantly impact propagation success. *C. cornuta* and *V. acerifolium* could be propagated at a level necessary for consideration as a new commercial crop by general wholesale nurseries looking to add select native shrubs to their product lines. All four species evaluated could be viable commercial crops for nurseries that specialize in native plants.**

There is strong consumer interest in native plants for landscaping [Garden Writers Association Survey (2010), 2011]. Landscape architects and master gardeners would like to use more native plants but have found that a broad palette of native plants is not readily available from growers (Brzuszek et al., 2007, 2010). Although some native plants are produced in large quantities by the nursery industry and are widely used in landscaping, growers must expand their product lines by adding new species to capitalize on the native plant market.

Four ornamental and adaptable northeastern U.S. native shrub species that are relatively unknown in the horticultural trade are *Ceanothus americanus* (L.), *Corylus cornuta* (Marsh.), *Lonicera canadensis* (Bartr.), and *Viburnum acerifolium* (L.). These native shrubs have the potential to become revenue-generating crops for the nursery industry if successful propagation protocols are developed. For example, *Amelanchier laevis* (alleghany serviceberry) is currently a popular native ornamental for landscaping, but this species was less well known in the early 1990s (M. Brand, personal communication). Production of this plant by the nursery industry was facilitated by development of reliable propagation protocols by Still and Zanon (1991).

Vegetative propagation is often desired over sexual propagation for commercial nursery production because it generates more uniform plants (Hartmann et al., 2002), which are useful to a wider range of landscape applications. Deciduous shrubs, like the four native species identified, are generally propagated using softwood stem cuttings taken sometime during spring to summer. However, research has shown that for some species, softwood cutting success is improved when cuttings are taken at more specific times within this broad seasonal range (Dehgan et al., 1989; Dirr and Heuser, 1987; Pijut and Moore, 2002; Schrader and Graves, 2000). Therefore, this study evaluated whether cutting timing impacts propagation success of the four identified native shrubs. In addition, the impacts of increasing concentration of rooting hormone and transplanting timing of rooted cuttings were evaluated.

Materials and Methods

Timing. On three dates in 2012, softwood stem material was collected from mature plants of *C. americanus*, *C. cornuta*, *L. canadensis*, and *V. acerifolium*. *C. americanus* was collected in Ashford, CT, on 14 June, 12 July, and 9 Aug. *C. cornuta* and *V. acerifolium* were collected in Willington, CT, on 10 June, 8 July, and 5 Aug. *L. canadensis* was collected in Petersham, MA, on 12 June, 10 July, and 7 Aug. Plant material was placed in plastic bags in a chilled ice chest for transport to the University of Connecticut Plant Science Research and Education Facility in Storrs, CT, where it was processed into cuttings 10 to 15 cm in length with two or three nodes, except for *V. acerifolium* cuttings, which had two nodes. Cuttings were wounded (1.5 cm × 2 mm) twice on opposite sides and dipped in talc-based, IBA rooting hormone at 3000 ppm [Hormodin® #2 (OHP Inc., Mainland, PA)] and inserted in 1.3-L plastic flats (6.4 cm × 12.7 cm × 16.5 cm) filled with medium composed of two parts Canadian sphagnum peatmoss (Fafard Inc., Agawam, MA), one part horticultural-grade vermiculite (Whittemore Co., Lawrence, MA), and one part horticultural-grade perlite (Whittemore Co.). Plant material was collected in early morning and all cuttings were stuck within 4 h of collection. An experimental unit consisted of a flat with 10 cuttings and there were seven flats (or replications) per cutting timing per species. Flats of cuttings were held on a polyhouse bench under intermittent mist that provided 10 s of mist every 6 min. A separate randomized complete block design was arranged for each species. Cutting flats from June and July were randomized on the mist bench once cutting flats from July were complete. Similarly, cutting flats from June, July, and August were randomized on the mist bench once cutting flats from August were complete. After 8 weeks, cuttings were harvested and experimental units were evaluated for percentages of rooted cuttings. Root count (the number of roots longer than 0.5 cm) and root length (the average of the three longest roots) for the rooted cuttings in an experimental unit were averaged to obtain a value for each unit.

Hormone concentration. Softwood stem material was collected during the second week of July for *C. cornuta* and *V. acerifolium* in 2011 and for *C. americanus*, *C. cornuta*, *L. canadensis*, and *V. acerifolium* in 2012 from the same locations as for the timing study, except for *L. canadensis*, which was collected in Nobleboro, ME. Methods for transporting plant material and cutting size were as described for the timing study, except for *V. acerifolium* cuttings, which consisted of single-node cuttings in 2011 and two-node cuttings in 2012. Reproductive shoots of *V. acerifolium* generally consist of a terminal flower bud distal to a vegetative node, and non-reproductive shoots consist of two or more vegetative nodes. Because reproductive shoots were more abundant than non-reproductive shoots at the collection site, single-node cuttings, prepared by removing the flower bud from reproductive shoots, were used in 2011. In 2011 we conducted a pilot study comparing single-node cuttings prepared from reproductive shoots as described and two-node cuttings from non-reproductive shoots and found that two-node cuttings had significantly greater rooting percentage (data not shown). Based on the pilot study results, two-node cuttings prepared from non-reproductive shoots were used for the hormone concentration study in 2012.

Received for publication 24 Apr. 2013. Accepted for publication 11 June 2013.
We thank Bryan Connolly for help in locating plant material.
[1]To whom reprint requests should be addressed; e-mail Jessica.lubell@uconn.edu.

Cuttings were wounded twice on opposite sides and treated with talc-based IBA rooting hormone at 0 ppm, 1000 ppm [Hormodin® #1 (OHP Inc.)], 3000 ppm [Hormodin® #2 (OHP Inc.)], or 8000 ppm [Hormodin® #3 (OHP Inc.)]. Control cuttings were wounded as described but not treated with rooting hormone. Experimental units, intermittent mist conditions, cutting harvest, and data collection were as described for the timing study. A separate randomized complete block design was arranged for each species.

Transplanting timing. Softwood stem material of *C. cornuta* and *V. acerifolium* was collected during the third week of July 2011 in Willington, CT. Methods for transporting plant material and preparing cuttings and the intermittent mist conditions were as described for the timing study. Twelve cutting flats (experimental units) were prepared for each species. After 8 weeks, half of the flats for each species, chosen at random, were harvested and rooted cuttings were transplanted to containers. Rooted *V. acerifolium* cuttings were potted in 160-mL square containers and rooted *C. cornuta* cuttings were potted in 307-mL square containers using a medium composed of four parts aged pine bark (Fafard Inc.), two parts Canadian sphagnum peatmoss (Fafard Inc.), and one part sand (particles 0.05 to 2 mm in diameter). The remaining six cutting flats for each species were removed from the mist bench and placed on a bench in a hoophouse, and the roots were undisturbed. Undisturbed flats and transplanted rooted cuttings were overwintered in a minimally heated (36 °F minimum heat) hoophouse and were allowed to break dormancy naturally in Spring 2012. During the third week of Apr. 2012 (39 weeks after sticking cuttings), at the first signs of budbreak and leaf emergence, undisturbed flats were harvested and rooted cuttings were transplanted as described previously. On 1 June 2012, viable plants were counted. Percent survival was calculated by dividing the number of viable plants by the total number of plants potted. Plant height (measured from soil surface to apex of foliage) and width (measured twice, at right angles, and averaged) were recorded for each plant on 31 July 2012.

Rooting percentage, root count, and root length data were subjected to analysis of variance (PROC MIXED) and mean separation using Fisher's least significant difference test ($P \leq 0.05$) using SAS for Windows Version 9.2 (SAS Institute, Cary, NC). The difference between transplanting timings for percent survival was determined using multiple comparisons for proportions and Tukey's test (Williams and LeBlanc, 1995).

Results

Timing had no significant effect on rooting percentage, root count, or root length of *C. cornuta* with cuttings reaching 85% to 90% rooting percentage and four to five roots per cutting (Table 1). Similarly, timing had no effect on rooting percentage, root count, or root length of *V. acerifolium*, and cuttings rooted at nearly 100% with at least 15 roots per cutting. For *C. americanus*, rooting percentage was significantly greater for cuttings collected in June (57.1%) than for cuttings collected in July (47.1%) and August (34.3%). June-collected *C. americanus* cuttings had the greatest root count (5.1 cm) and root length (5.7 cm). Cuttings of *L. canadensis* collected in June had greater rooting percentage (48.6%) than cuttings collected in July (10%) and August (20%). Timing had no effect on root count and root length for *L. canadensis*.

There was no significant difference for rooting percentage, root count, or root length between IBA treatments and the untreated control for *L. canadensis* (Table 2). The same was found for *C. americanus* for rooting percentage and root length, but root count was greatest at 8000 ppm IBA. For *C. cornuta*, there was no significant difference between IBA treatments and the control for rooting percentage, but there were differences for root count and root length, and the trends were consistent for both data collection years. Root count for *C. cornuta* increased as hormone concentration increased from 0 ppm to 8000 ppm IBA. Root length for *C. cornuta* cuttings treated with 8000 ppm IBA was greater than the control in 2011 and greater than all other treatments in 2012. Rooting percentage was 100% for all treatments of *V. acerifolium* from two-node cuttings in 2012, and there was no significant difference between treatments for root count and root length. In 2011, single-node cuttings treated with 3000 and 8000 ppm IBA had greater rooting percentage (78.6% to 80%), root count (8.3 to 9.4), and root length (4.9 cm to 5.3 cm) than the control (53.4%, root count = 5.0, 3.7 cm long).

More of the cuttings of *C. cornuta* and *V. acerifolium* transplanted at 39 weeks, after a cold period, survived than did cuttings transplanted at 8 weeks after sticking (Table 3). One-year-old plants of *C. cornuta* and *V. acerifolium* were ≈24 inches tall and 18 inches wide and 20 inches tall and 18 inches wide, respectively.

Discussion

Cumming (1976) states that for a plant to be considered a viable commercial nursery crop, it must be able to be propagated with at least 50% rooting success; however, growers strive to reach a level of 80% rooting success (S. Ruffino, personal communication). Growers focusing on production of only native plants may find 50% rooting to be acceptable, whereas general wholesale growers looking to add select native plants to their product lines will require rooting success beyond 80%.

Some growers have reported difficulty propagating *V. acerifolium*; however, we found it to be the easiest shrub to propagate of the four natives evaluated, and therefore it has the most obvious potential to be a mainstream nursery crop. Nearly 100% rooting can be achieved with *V. acerifolium* cuttings containing two nodes taken mid-June through mid-August (Tables 1 and 2). During the same time period, *V. acerifolium* may also be propagated at acceptable rooting rates for commercial production (65% to 80%) using single-node cuttings treated with 1000 ppm IBA (Table 2). Two-node cuttings of *V. acerifolium* may root better than single-node cuttings because they have greater reserves of carbohydrates and endogenous root morphogens and auxin (Hartmann et al., 2002; Smalley and Dirr, 1987). In this study, single-node cuttings were derived from reproductive shoots with flowers in bud. It has been suggested that flower induction can result in reduced formation of root promoting "cofactors" produced in leaves and translocated to the sites of adventitious root formation (Adams and Roberts, 1965). Although the flower buds were removed from *V. acerifolium* stems to make single-node cuttings, their initial presence may have impaired rooting of single-node cuttings.

C. cornuta can be propagated at 85% rooting or greater when cuttings are taken

Table 1. Rooting percentage, root count, and root length for softwood cuttings of *Ceanothus americanus*, *Corylus cornuta*, *Lonicera canadensis*, and *Viburnum acerifolium* propagated on three different timings (June, July, and August) in 2012.

Timing	Rooting (%)	Root count[z]	Root length (cm)[y]
C. americanus			
14 June	57.1 a[x]	5.1 a	5.7 a
12 July	47.1 ab	2.7 b	2.1 b
9 Aug.	34.3 b	2.6 b	2.7 b
C. cornuta			
10 June	91.4 a	4.1 a	9.7 a
8 July	85.7 a	5.1 a	6.7 a
5 Aug.	88.6 a	4.9 a	8.1 a
L. canadensis			
12 June	48.6 a	6.1 a	4.7 a
10 July	10.0 b	4.9 a	3.3 a
7 Aug.	20.0 b	3.0 a	3.4 a
V. acerifolium			
10 June	97.1 a	15.4 a	6.6 a
8 July	97.1 a	20.0 a	7.9 a
5 Aug.	100.0 a	19.0 a	6.4 a

[z]Root count is the number of roots longer than 0.5 cm.
[y]Root length is the average of the three longest roots.
[x]Mean separation within column, within species, indicated by different letters, by Fisher's least significant difference at $P \leq 0.05$.

Table 2. Rooting percentage, root count, and root length for softwood cuttings of *Ceanothus americanus*, *Corylus cornuta*, *Lonicera canadensis*, and *Viburnum acerifolium* propagated in July of 2011 and 2012 and treated with talc-based indole-3-butyric acid (IBA) at 0, 1000, 3000, or 8000 ppm.

	Rooting (%)		Root count[z]		Root length (cm)[y]	
IBA (ppm)	2011	2012	2011	2012	2011	2012
C. americanus						
0	—	34.3 a[x]	—	2.3 b	—	3.5 a
1000	—	40.0 a	—	2.0 b	—	3.1 a
3000	—	47.1 a	—	2.7 ab	—	2.1 a
8000	—	38.6 a	—	3.6 a	—	4.6a
C. cornuta						
0	64.0 a	78.6 a	3.0 c	3.4 c	8.6 b	6.7 b
1000	63.7 a	74.3 a	4.0 bc	3.9 bc	9.4 ab	6.6 b
3000	81.3 a	85.7 a	4.6 ab	5.1 ab	9.9 ab	6.7 b
8000	75.8 a	84.3 a	5.4 a	6.0 a	10.9 a	8.7 a
L. canadensis						
0	—	34.3 a	—	7.8 a	—	7.4 a
1000	—	27.1 a	—	6.7 a	—	6.6 a
3000	—	31.4 a	—	6.3 a	—	7.4 a
8000	—	41.4 a	—	5.6 a	—	6.5 a
V. acerifolium[w]						
0	53.4 b	100.0 a	5.0 b	21.9 a	3.7 b	7.9 a
1000	65.7 ab	100.0 a	6.7 ab	19.9 a	4.6 ab	7.7 a
3000	80.0 a	100.0 a	8.3 a	0.0 a	4.9 a	7.9 a
8000	78.6 a	100.0 a	9.4 a	20.9 a	5.3 a	7.6 a

[z]Root count is the number of roots longer than 0.5 cm.

[y]Root length is the average of the three longest roots.

[x]Mean separation within column, within species, indicated by different letters, by Fisher's least significant difference at $P \leq 0.05$.

[w]Single-node cuttings were used in 2011 and two-node cuttings were used in 2012.

Table 3. Percent survival and height and width of 1-year-old plants of *Corylus cornuta* and *Viburnum acerifolium* propagated from softwood cuttings and transplanted at 8 or 39 weeks after sticking cuttings.

Transplant timing			Plant size (cm) at 1 year	
(weeks after sticking)	Survival (%)[z]	No.	Ht	Width
C. cornuta				
8	53 b	17	65.5	50.5
39	92 a	24	59.2	43.4
V. acerifolium				
8	56 b	48	49.3	44.5
39	100 a	31	48.5	46.5

[z]Mean separation within column by multiple comparisons for proportions and the Tukey test at $P \leq 0.05$.

mid-June to mid-August and treated with 3000 ppm IBA (Tables 1 and 2). These results indicate that this species, in addition to *V. acerifolium*, has the potential to be a new nursery crop. In this study, 78% of the cuttings not treated with IBA rooted, and this percentage was not significantly different from hormone-treated cuttings (Table 2). However, untreated cuttings had fewer roots and root length than treated cuttings. Similar results were found for two species of native *Rhamnus, alnifolia*, and *lanceolata*, in which non-treated cuttings rooted at 75% but had fewer roots than those treated with talc-based IBA (Sharma and Graves, 2005).

Exogenous auxin did not appear to be necessary for rooting cuttings of *C. americanus* and *L. canadensis*; however, cutting timing significantly affected propagation success. Rooting was optimal at the earliest cutting date evaluated, which was June (Table 1). There was no statistical difference in rooting between *C. americanus* cuttings taken in June (57%) and July (47%), but June cuttings produced more and longer roots. Cuttings of both *C. americanus* and *L. canadensis* taken in June rooted at acceptable rates for specialty native plant nurseries. It may be possible to achieve greater percent rooting for these species if cuttings are taken earlier than mid-June. *L. canadensis* stems likely reach the proper degree of hardening for softwood cutting success earlier than the June cutting date because this species breaks bud early in spring, well before most other native shrub species. *C. americanus* does not leaf out particularly early in spring; however, this species may require very soft stem tissue to allow for adventitious rooting.

To optimize cutting survival, rooted cuttings of *C. cornuta* and *V. acerifolium* should be left in rooting containers for a period of cold dormancy before transplanting. Growers who overwinter their *C. cornuta* and *V. acerifolium* in the container in which they were rooted can expect close to 100% survival (Table 3). Fall transplanting will result in 50% attrition, reducing the potential for these species to be viable commercial nursery crops. Similar findings have been reported for several woody plant genera, including *Acer*, *Hamamelis*, *Hydrangea*, *Fothergilla*, *Stewartia*, and *Viburnum* (Dirr and Heuser, 1987).

Based on these findings, two of the four native species evaluated could be commercially viable nursery crops for general wholesale nurseries, and all four could be viable crops for specialty native plant nurseries provided there are no limitations to post-propagation container production. It is likely that with further research into optimizing propagation all four native species could be viable commercial nursery crops for general wholesale nurseries. This work demonstrates that novel native species are a potential source of new crops for the nursery industry.

Literature Cited

Adams, D.G. and A.N. Roberts. 1965. Effect of flower buds on rooting response—Tested. Ore. Ornamental. Nursery Dig. 9:1–2, 56.

Brzuszek, R.F., R.L. Harkess, and L. Kelly. 2010. Survey of master gardener use of native plants in the southeastern United States. HortTechnology 20:462–466.

Brzuszek, R.F., R.L. Harkess, and S.J. Mulley. 2007. Landscape architects' use of native plants in the southeastern United States. HortTechnology 17:78–81.

Cumming, W.A. 1976. Evaluation and propagation of saskatoons. Proc. West. Can. Soc. Hort. 25:76–80.

Dehgan, B., M. Gooch, F. Almira, and M. Kane. 1989. Vegetative propagation of Florida native plants: III. Shrubs. Proc. Fla. State Hort. Soc. 102:254–260.

Dirr, M.A. and C.W. Heuser. 1987. The reference manual of woody plant propagation. Varsity Press, Athens, GA.

Garden Writers Association Survey (2010). 2011. End-users. Nursery Mgt. 26:22.

Hartmann, H.T., D.E. Kester, F.T. Davies, Jr., and R.L. Geneve. 2002. Plant propagation: Principles and practices. 7th Ed. Pearson Education Ltd., Upper Saddle River, NJ.

Pijut, P.M. and M.J. Moore. 2002. Early season softwood cuttings effective for vegetative propagation of *Juglans cinerea*. HortScience 37: 697–700.

Schrader, J.A. and W.R. Graves. 2000. Propagation of *Alnus maritima* from softwood cuttings. HortScience 35:293–295.

Sharma, J. and W.R. Graves. 2005. Propagation of *Rhamnus alnifolia* and *Rhamnus lanceolata* by seeds and cuttings. J. Environ. Hort. 23:86–90.

Smalley, T.J. and M.A. Dirr. 1987. Effect of cutting size on rooting and subsequent growth of *Acer rubrum* 'Red Sunset' cuttings. J. Environ. Hort. 5:122–124.

Still, S.M. and S. Zanon. 1991. Effects of K-IBA rates and timing on rooting percentage and root quality of *Amelanchier laevis*. J. Environ. Hort. 9:86–88.

Williams, R.H. and W.G. LeBlanc. 1995. Pairwise comparisons among proportions. Educ. Psychol. Meas. 55:445–447.