Optimizing container production of American fly honeysuckle (Lonicera canadensis), beaked filbert (Corylus cornuta), and maple leaf viburnum (Viburnum acerifolium)

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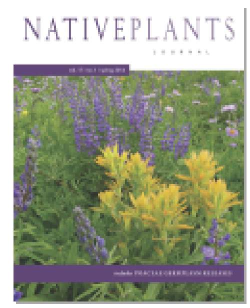
Native Plants Journal, Volume 17, Number 1, Spring 2016, pp. 39-46 (Article)



Published by University of Wisconsin Press
DOI: 10.1353/npj.2016.0009

Optimizing container production of American fly honeysuckle (*Lonicera canadensis*), beaked filbert (*Corylus cornuta*), and maple leaf viburnum (*Viburnum acerifolium*)

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ABSTRACT

American fly honeysuckle (*Lonicera canadensis* W. Bartram ex Marshall [Caprifoliaceae]), beaked filbert (*Corylus cornuta* Marshall [Betulaceae]), and maple leaf viburnum (*Viburnum acerifolium* L. [Caprifoliaceae]) are native shrubs useful for northeastern and north-central US landscapes with dry, shaded conditions. Objectives of this study were to evaluate the impact on growth in containers of 1) growth media amended with expanded shale at 3 rates; 2) 2 rates of controlled-release fertilizer; and 3) pruning of maple leaf viburnum. Expanded shale added to growth media composed of 4 parts pine bark, 2 parts peat moss, and 1 part sand did not improve growth for these species, and significantly larger plants of American fly honeysuckle were produced in the control media (lacking expanded shale) than in the amended media. Over a 2-y production cycle, the higher fertility rate of 2.5 g nitrogen (N)/pot produced American fly honeysuckle plants that were larger and had more shoots than did American fly honeysuckle plants that received 1.0 g N/pot. For beaked filbert, the higher fertility rate can produce greater growth, but may not do so every year. Fertility rate did not affect growth of maple leaf viburnum. Plants of maple leaf viburnum that were pruned after transplanting into trade #1 containers had visual quality ratings 2 times greater than unpruned plants. Pruned maple leaf viburnum had equivalent plant height and width and a more symmetrical and full appearance than did unpruned maple leaf viburnum plants.

Lubell J, Shrestha P. 2016. Optimizing container production of American fly honeysuckle (*Lonicera canadensis*), beaked filbert (*Corylus cornuta*), and maple leaf viburnum (*Viburnum acerifolium*). Native Plants Journal 17(1):39–46.

KEY WORDS
expanded shale, controlled-release fertilizer, pruning, Betulaceae, Caprifoliaceae

NOMENCLATURE
USDA NRCS (2015)

Photos by Jessica Lubell

CONVERSIONS
1 m = 3.3 ft
1 cm = 0.4 in
1 mm = 0.04 in
1 l = 0.26 gal
1 ml = 0.034 oz
1 g = 0.035 oz
(°C × 1.8) + 32 = °F

Nursery growers are interested in expanding the palette of native shrub offerings, especially for use in dry, shaded locations for which suitable native material is lacking. Three attractive northeastern and north-central US native shrubs to fill this important niche are American fly honeysuckle (*Lonicera canadensis* W. Bartram ex Marshall [Caprifoliaceae]), beaked filbert (*Corylus cornuta* Marshall [Betulaceae]), and maple leaf viburnum (*Viburnum acerifolium* L. [Caprifoliaceae]), because they are found in dry, shaded conditions (Dirr 2011; Table 1). American fly honeysuckle is native from New Brunswick to Manitoba in Canada, and south to Connecticut, Pennsylvania, and Michigan (Hightshoe 1988). In the wild, plants are found growing on rocky, wooded slopes or ravines and in moist or dry woods, but always with good soil drainage. Beaked filbert ranges from Newfoundland, Canada, south along the spine of the Appalachian Mountains to northern Georgia, west through southern Ontario, Canada, northern Wisconsin, and northern Minnesota to Saskatchewan, Canada. In the wild, plants are found along rock walls and the edges of woods, on hillsides, clearings, and in thickets (Cullina 2002; Dirr 2011). Plants grow in dry, well-drained soils and tolerate considerable shade. The contiguous native range for maple leaf viburnum extends from Maine south along the Appalachian Mountains to northern Georgia and west to Michigan (Hightshoe 1988). Small populations are found in isolated sections at the northern extent of the native range in New Brunswick, Canada, and at the southern extent from Florida to Louisiana. In the wild, plants are found colonizing dry, wooded slopes and the margins of woods (Cullina 2002; Dirr 2011). Plants grow in dry, rocky or sandy soils and tolerate considerable shade.

Tubular flowers of American fly honeysuckle.

Cartabiano and Lubell (2013) demonstrated that these 3 natives can be successfully propagated from softwood stem cuttings for nursery production purposes. Successful container culture would be the next step in developing nursery production protocols for these plants. Because these natives grow along roadsides in dry, gravelly soils (Hightshoe 1988), the first objective was to evaluate container growth media amended with expanded shale to produce media resembling the natural soil in which these plants are found. We expected these native plants to require less fertilizer in container culture than did other nursery crops, since these natives are found in the forest understory growing in relatively infertile woodland soils.

TABLE 1

Ornamental and landscape value, and propagation and container production.

Common name	Ornamental and landscape value	Propagation and container-grown production recommendations
American fly honeysuckle	Multi-stemmed, low-mounded habit (60 cm to 1.5 m). Lime-green summer foliage. Early spring tubular yellow flowers. Red berries in summer. Especially useful for dry, shade locations and valuable for low growth form. Informal border, foundation, massing at margins of woods.	Stem cuttings taken May to June using 3000 ppm indole-3-butyric acid (IBA) root at about 50%. Young plants require lower fertility levels than established containers. Shade at 30 to 50% is beneficial.
Beaked filbert	Plants in southern New England reach 1 to 2 m tall. Spreading branches. Dark-green leaves turn yellow in fall. Edible nuts with involucres resembling a duck's bill. In full sun, plants produce dense mounds. Use in groups or along the edge of woods.	Stem cuttings taken in July using 3000 ppm IBA can be expected to root at about 75%. Equal parts peat, perlite, and vermiculite rooting media. Overwinter in propagation container. Rooted cuttings develop slowly.
Maple leaf viburnum	Open, upright, colonizing habit (1 to 2 m tall). Three-lobed foliage is dark green in summer and raspberry pink in fall. White flower clusters in June. Fruits ripen red then purple black. Excellent for dry, shade locations. Mass plantings and naturalizing.	Nearly 100% rooting with 2-node cuttings taken from vigorous vegetative shoots in June to mid-August treated with 1000 ppm IBA. Single node cuttings with flower bud removed can be expected to root at about 70%. Prune to produce more uniform, symmetrical habit in containers.

Notes: Descriptions are based on observations in Connecticut and from literature sources (Hightshoe 1988; Cullina 2002; Dirr 2011; Cartabiano and Lubell 2013).

Raspberry-pink fall color on maple leaf viburnum.

Therefore, the second objective was to evaluate a range of rates of controlled-release fertilizer on plant growth and performance in containers. Wild plants of maple leaf viburnum tend to develop a sparse and open habit (Dirr 2011), and this form in containers would not be salable. Nursery plants are pruned during production to grow salable-quality plants having dense and symmetrical canopies. The final objective was to compare the growth potential of pruned and unpruned plants of maple leaf viburnum.

MATERIALS AND METHODS

Media and Fertility Study

Plants used in this experiment were supplied from the propagation studies of Cartabiano and Lubell (2013). Work was conducted at the University of Connecticut Plant Science Research and Education Facility located in Storrs, Connecticut. The media and fertility study consisted of separate factorial experiments, with 3 growth media and 2 fertility rates, for each of the 3 species. This study was first conducted in 2013 and was repeated in 2014. Two-y-old uniform liners of beaked filbert and maple leaf viburnum grown in 307-ml containers were transplanted into 3-l (trade #1) containers on 20 May 2013 and 19 May 2014. Liner plants were 26 cm tall and 18 cm wide at time of transplanting. American fly honeysuckle grew more slowly in container culture than the other species, therefore smaller containers were used, and the same plants were carried through from 2013 to 2014. On 20 May 2013, 2-y-old uniform liners of American fly honeysuckle grown in 106-ml square containers were transplanted into 307-ml square containers, and on 19 May 2014, they were transplanted into 3-l containers. At transplanting, liners of American fly honeysuckle were 10 cm tall and 9 cm wide in 2013 and 30 cm tall and 32 cm wide in 2014. The growth medium was 4 parts aged pine bark (Fafard Inc, Agawam, Massachusetts): 2 parts Canadian sphagnum peat moss (Fafard Inc): 1 part sand (particles 0.05 to 2 mm diameter, by volume) amended with dolomitic lime at 0.5 kg/m^3 (1.1 lb).

Expanded shale, of particle sizes ranging from 10 to 15 mm diameter (Bigelow Brook Farm, Eastford, Connecticut), was then added to the medium at rates of 0, 20, and 50% (by volume) to create 3 experimental growth media. Air-filled porosity, total porosity, container capacity, bulk density, and pH were measured on 3 samples of each experimental growth media (Table 2). Physical parameters of the growth media were determined according to Bragg and Chambers (1988) and Niedziela and Nelson (1992). Pore electrical conductivity was recorded with a WET Sensor (Delta-T Devices Ltd, Cambridge, United Kingdom). Controlled-release fertilizer (CRF) 15N:3.9P_2O_5:10K_2O (Osmocote Plus Standard 8–9 mo 15-9-12; Everris NA Inc, Dublin, Ohio) was applied at time of transplanting as topdressing at the rate of 1g N (0.2 oz) or 2.5 g N per 3-l container and 0.25 g N or 0.625 g N per 307-ml container. The higher rate of N used was halfway between the low and medium recommended rates on the fertilizer product sheet (Everris NA 2015), and the lower rate of N used was half the lowest recommended rate on the product sheet. Irrigation was provided during the growing seasons by trickle emitters at the rate of 800 ml per d. Study

TABLE 2

Initial pH, pore electrical conductivity, air-filled porosity, container capacity, total porosity, and bulk density of container growing media.

Expanded shale content (%)	pH	Pore electrical conductivity (mS/m)	Air-filled porosity	Container capacity	Total porosity	Bulk density (g/cm^3)
			Percentage by volume (%)			
0	5.3	77.0	12.1	65.1	77.2	0.34
20	5.8	68.7	14.0	60.6	74.6	0.45
50	5.8	63.3	15.4	50.3	65.7	0.56

Notes: Media composed of 4 parts pine bark, 2 parts peat moss, and 1 part sand amended with 0, 20, or 50% expanded shale.

plants of American fly honeysuckle were overwintered from November 2013 to April 2014 in a white polyethylene-covered hoop house and were irrigated by hand as needed based on visual observation of the media. During the 2013 growing season, the foliage of American fly honeysuckle had bleached and turned yellow, indicating light irradiation was supra-optimal. Therefore, in 2014, American fly honeysuckle plants were shaded with black, woven polypropylene material to provide 50% of maximum irradiation.

Pruning Study

The pruning study was also conducted at the University of Connecticut Plant Science Research and Education Facility. This experiment was repeated for 2 y, in 2013 and 2014. Uniform liners in 307-ml containers of maple leaf viburnum, supplied from the propagation studies of Cartabiano and Lubell (2013), were transplanted to 3-l containers on 20 May 2013 and 19 May 2014. The growth media was 4 parts pine bark: 2 parts peat moss: 1 part sand (by volume) amended with dolomitic lime at 0.5 kg/m^3. The same CRF used for the media and fertility study was applied at time of transplanting as topdressing at the rate of 2.5 g N per container. On 21 May 2013 and 22 May 2014, plants were selected at random for pruning to a height of 12 cm or were left unpruned. The average initial height of unpruned plants was 38 cm. Trickle irrigation was used as described for the media and fertility study.

Experimental Design and Data Analysis

For the media and fertility study, the 3 species were randomized separately. For each species, the experimental design was a randomized complete block design with 10 replications, and the experimental unit was a single containerized plant. The pruning study for maple leaf viburnum was also a randomized complete block design with 10 replications, and the experimental unit was a single containerized plant. Data were collected for all plants during the second week of August in both years. Plant height and width and number of shoots were measured for all plants. Plant width was measured twice, at right angles to each measurement, and averaged. Plant size was calculated as the product of height and 2 perpendicular widths. Pruning study plants were rated visually using a scale of 1 to 3, where 1 represented an asymmetrical plant, 2 represented a partially symmetrical plant, and 3 represented a completely symmetrical plant. Data were subjected to analysis of variance using the PROC MIXED procedure, and means separation using Fisher's least significant difference test ($P \pm 0.05$) using SAS (Statistical Analysis Software, version 9.2 for Windows; SAS Institute, Cary, North Carolina). For the media and fertility study, for each species the interaction was not significant; therefore, only the 2 main effects, media and fertility rate, are shown (Table 3).

RESULTS AND DISCUSSION

Additions of expanded shale to the growth media resulted in decreases in pore electrical conductivity and total porosity and increases in air-filled porosity, container capacity, and bulk density (see Table 2). The pH of growth media amended with expanded shale was slightly higher at 5.8 than the control growth media at 5.3. This observation was not unexpected since expanded shale is an alkaline (pH ~8) material (Sloan and others 2010).

Additions of expanded shale generally reduced plant growth of American fly honeysuckle (see Table 3). For this species, the high fertility rate decreased plant width and size in 2013, but increased plant width, size, and number of shoots in 2014. These results suggest that young, recently rooted cuttings of American fly honeysuckle require less fertilizer than established container plants, which benefit from a higher fertility rate. It may also be that full sun conditions in 2013 produced warmer growth media temperatures, resulting in more rapid nutrient release from CRF prills whose nutrient-release rate is temperature-dependent (Oertli 1980).

Beaked filbert plants produced in the control growth medium had greater plant height and size in 2013 than plants in the experimental growth media, but in 2014, no significant differences were seen among plants in the different growth media (Table 3). In 2013, plants receiving the higher fertility rate produced greater plant width and size, but plant growth was not significantly different in 2014. Although results were not similar over the 2-y study, growers may want to use a higher fertility rate when producing beaked filbert, since they may see benefits in some growing seasons.

Maple leaf viburnum grew similarly across the types of growth media and fertility levels (Table 3). Pruning reduced plant height, as expected, and had no effect on plant width (Table 4). Pruning improved visual rating, and although not significant, it may have increased branching slightly. Visual rating is critical when marketing native plants, since consumers prefer dense, symmetrical plants and, therefore, would be more likely to purchase a pruned than an unpruned maple leaf viburnum. Growers attempting to produce maple leaf viburnum in containers should plan for an early season hard prune to help develop a uniform marketable shape.

Sloan and others (2010) found that additions of up to 30% expanded shale to media composed of 75% pine bark and 25% peat moss did not affect growth of shantung maple, but additions of 60% expanded shale did decrease growth, possibly because of reduced nutrient and water availability. Similarly, in our study, reduced growth occurred when additions of 50% expanded shale were used, but not with lower amounts of expanded shale. In green roof systems growing sedums, Rowe and others (2006) found that additions of shale generally

TABLE 3

Plant height, width, size, and number of shoots for containers of American fly honeysuckle, beaked filbert, and maple leaf viburnum.

Year	Main effect treatments	Height (cm)	Width (cm)[z]	Plant size (1000 cm^3)[y]	Number of shoots
		American fly honeysuckle			
2013[w]					
	Expanded shale content (%)				
	0	22.1 a[x]	17.5 a	8.1 a	3.0 a
	20	19.1 ab	17.0 a	6.1 ab	3.0 a
	50	16.3 b	15.8 a	3.8 b	3.0 a
	Fertility rate (g N/pot)				
	0.25	20.6 a	18.3 a	7.7 a	3.0 a
	0.625	17.5 a	14.9 b	4.1 b	3.0 a
2014					
	Expanded shale content (%)				
	0	40.9 a	53.1 a	126.9 a	9.0 a
	20	44.0 a	44.2 b	92.7 ab	9.0 a
	50	36.5 a	42.4 b	63.6 b	9.0 a
	Fertility rate (g N/pot)				
	1.0	42.2 a	41.9 b	72.5 b	8.0 b
	2.5	38.6 a	50.9 a	114.1 a	10.0 a
		Beaked filbert			
2013					
	Expanded shale content (%)				
	0	46.5 a	33.1 a	54.4 a	4.0 a
	20	34.4 b	29.9 a	30.9 b	4.0 a
	50	38.2 ab	31.6 a	43.8 ab	4.0 a
	Fertility rate (g N/pot)				
	1.0	37.5 a	27.5 b	32.2 b	3.0 a
	2.5	41.9 a	35.5 a	53.8 a	5.0 a
2014					
	Expanded shale content (%)				
	0	41.2 a	38.1 a	65.0 a	9.0 a
	20	47.6 a	39.5 a	78.6 a	10.0 a
	50	44.5 a	42.5 a	87.9 a	10.0 a
	Fertility rate (g N/pot)				
	1.0	44.2 a	38.9 a	71.3 a	9.0 a
	2.5	44.5 a	41.1 a	83.1 a	10.0 a

(continued)

TABLE 3 *(continued)*

Plant height, width, size, and number of shoots for containers of American fly honeysuckle, beaked filbert, and maple leaf viburnum.

Year	Main effect treatments	Height (cm)	Width (cm)[z]	Plant size (1000 cm³)[y]	Number of shoots
Maple leaf viburnum					
2013					
	Expanded shale content (%)				
	0	38.9 a	29.5 a	36.1 a	4.0 a
	20	43.9 a	29.9 a	38.8 a	4.0 a
	50	45.2 a	29.2 a	36.1 a	4.0 a
	Fertility rate (g N/pot)				
	1.0	45.7 a	29.7 a	41.5 a	4.0 a
	2.5	39.6 a	27.7 a	30.5 a	4.0 a
2014					
	Expanded shale content (%)				
	0	34.8 a	30.2 a	33.3 a	7.0 a
	20	34.3 a	30.5 a	33.6 a	7.0 a
	50	32.3 a	23.1 a	19.0 b	6.0 a
	Fertility rate (g N/pot)				
	1.0	32.8 a	27.9 a	27.5 a	6.0 a
	2.5	34.8 a	28.2 a	29.7 a	6.0 a

Notes: Grown in media amended with 0, 20, or 50% expanded shale at 2 different rates of top-dressed controlled-release fertilizer.

[z]Plant width was measured twice, at right angles to each measurement, and averaged.

[y]Plant size was the product of the height and 2 perpendicular widths.

[x]Means separation within columns, within species, within main effect treatment by Fisher's LSD test with different letters denoting significance at $P \leq 0.05$ ($n = 10$).

[w]All plants were grown in 3-l containers, except for plants of American fly honeysuckle in 2013, which were grown in 307-ml containers.

TABLE 4

Plant height, width, visual rating, and number of shoots for maple leaf viburnum.

Year	Pruning treatment	Height (cm)	Width (cm)[z]	Visual rating[y]	Number of shoots
2013					
	Pruned	33.5 b[x]	29.7 a	2.5 a	5.0 a
	Unpruned	58.7 a	27.9 a	1.2 b	4.0 a
2014					
	Pruned	31.2 b	30.0 a	2.7 a	9.0 a
	Unpruned	40.9 a	33.8 a	1.5 b	8.0 a

Notes: Grown in 3-l containers and pruned to 12 cm aboveground or left unpruned (average initial plant height of 38 cm) in 2013 and 2014.

[z] Plant width was measured twice, at right angles to each measurement, and averaged.

[y] Visual rating: 1 = asymmetrical plant, 2 = partially symmetrical plant, 3 = completely symmetrical plant.

[x] Means separation within columns, within year by Fisher's LSD test with different letters denoting significance at $P \leq 0.05$ ($n = 10$).

decreased growth, similar to what we observed with native shrubs.

We have found that American fly honeysuckle, beaked filbert, and maple leaf viburnum can be successfully grown in containers for the retail nursery market. All 3 species can be grown well in a 4-part softwood bark, 2-part peat moss, and 1-part sand growth media and a controlled-release fertilizer at low to medium recommended rates (Figure 1). Maple leaf viburnum benefits from early season pruning in container culture. We have observed that American fly honeysuckle and beaked filbert develop more slowly than other nursery crops early on, but they grow quickly once established in containers. Our experience indicates that shade is beneficial for container production of American fly honeysuckle. We are currently conducting experiments to determine an optimum amount of shade for American fly honeysuckle and several other woodland shrubs.

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Figure 1. Marketable trade #1 containers of American fly honeysuckle (A); beaked filbert (B); and maple leaf viburnum (C), grown using 4 parts pine bark: 2 parts peat moss: 1 part sand media and 2.5 g N/pot Osmocote Plus Standard 8–9 mo 15-9-12 controlled-release fertilizer.

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