HRI's Mission:

To direct, fund, promote and communicate horticultural research, which increases the quality and value of ornamental plants, improves the productivity and profitability of the nursery and landscape industry, and protects and enhances the environment.

3. Esau, K. 1960. Anatomy of Seed Plants. John Wiley and Sons, New York.

4. Harmer, R. 1988. Production and use of epicormic shoots for the vegetative propagation of mature oak. Forestry 61:305–316.

5. Henry, P.H. and J.E. Preece. 1997. Production and rooting of epicormic shoots generated from dormant stem sections of *Acer* species. HortScience (in press).

6. Ikemori, Y.K. 1987. Epicormic shoots from the branches of *Eucalyptus grandis* as an explant source for *in vitro* culture. Commonwealth For. Rev. 66:351–356.

7. Read, P.E. and G. Yang. 1991. Influence of plant growth regulators and season on growth responses of woody plant stems. Acta Hort. 300:173–176.

8. SAS Institute. 1990. SAS/STAT User's Guide. Vol. 2. SAS Institute, Inc., Cary, NC.

Growth of *Viburnum dentatum* and *Syringa* x *prestoniae* 'Donald Wyman' in *Sphagnum* Peat and Coir Dust-Based Substrates[1]

Michael R. Evans and Jeffery K. Iles[2]
Department of Horticulture
Iowa State University, Ames, IA 50011

Abstract

Bare-root viburnum (*Viburnum dentatum* L.) were grown in 25:0:75, 50:0:50, 75:0:25, 100:0:0, 0:25:75, 0:50:50, 0:75:25, and 0:100:0 peat:coir:sand (by vol) substrates, and Preston lilac (*Syringa* x *prestoniae* McKelv. 'Donald Wyman') were grown in 25:0:65:10, 50:0:40:10, 75:0:15:10, 0:25:65:10, 0:50:40:10, and 0:75:15:10 peat:coir:bark:sand (v/v) substrates over two seasons. After one season of growth, viburnum grown in 25% and 50% coir were taller than plants grown in comparable peat-based substrates, and overall, plants grown in coir-based substrates were taller than plants grown in peat-based substrates. Lilac plants grown in coir-based substrates had similar heights as plants grown in peat-based substrates. After two seasons, viburnum grown in 100% coir had greater plant width than plants grown in 100% peat. No significant difference occurred between plants grown in 25% and 50% peat or coir. No significant difference occurred in shoot fresh mass between viburnum plants grown in coir and peat-based substrates. However, those grown in 50% and 100% coir had greater root fresh mass than those grown in comparable peat-based substrates. Overall, root fresh mass was greater for plants grown in coir-based substrates than peat-based substrates. After two seasons, height and root fresh mass were not significantly different between substrates for lilac. Plant width was greater for plants grown in 25% and 50% coir than for plants grown in 25% or 50% peat. Plants grown in 75% coir had greater shoot fresh mass than plants grown in 75% peat.

Index words: lilac, viburnum, root media.

Species used in this study: viburnum (*Viburnum dentatum* L.); and Preston lilac (*Syringa* x *prestoniae* McKelv. 'Donald Wyman').

Significance to the Nursery Industry

Peat moss is used extensively to formulate substrates for container production of nursery crops. However, environmental concerns and costs have created significant interest in the development of peat alternatives. Coconut coir dust (coir) is produced from the husk of the coconut and is essentially a waste product. Coir has been studied extensively for use as a greenhouse substrate component with positive results. However, limited information is available on the suitability of coconut coir as a nursery substrate component. Growth of viburnum and lilac in coir-based substrates was found to be similar to or greater than that of plants grown in comparable peat-based substrates. Based upon the results of this study, we concluded that coir can be successfully used as a substitute for peat when producing container-grown viburnum and lilac, and presumably other woody plants.

[1]Received for publication April 16, 1997; in revised form June 25, 1997. Journal Paper No. J-17370 of the Iowa Agriculture and Home Economics Experiment Station, Ames, IA. This research was partially funded by the Iowa Nursery and Landscape Association Research Corporation.

[2]Assistant Professors.

Introduction

Unlike field-grown stock, container-grown nursery crops are produced in substrates composed of peat moss (peat), composted bark, perlite, styrofoam, sand vermiculite, or field soil (4, 12, 17). Among these materials, peat is one of the most widely used. Environmental concerns (1, 3) and increasing prices have generated significant interest in the development of alternatives to peat. Most research into the development of peat alternatives has focused on the use of municipal or agricultural wastes. Among the materials examined for use in containerized nursery production include pulp and paper sludge (20), composted turkey litter (21), rice hulls (13), composted sewage sludge (16), shredded waste tires (11) and composted yard waste (2). However, some of these materials are proving unsuitable because of their high degree of variability or their likelihood of containing undesirable materials such as glass, metal fragments or heavy metals. Other materials are not produced in volumes large enough to impact the market. Any potential peat substitute must have suitable physical and chemical properties, be available in significant quantities, and must be uniform and economically compatible with potential markets. One material purported

to meet these requirements and marketed as a peat alternative is coir dust.

Coir dust is produced from the mesocarp tissue, or husk, of the coconut fruit and originates primarily from Sri Lanka, India, Philippines, Indonesia, Mexico, Costa Rica, and Guyana. The husk contains approximately 60% to 70% pith tissue with the remainder being fiber of varying lengths (personal communication, F. Soriano, Soriano Fiber, Philippines). After the husk is ground, the long fibers are removed and used for various industrial purposes such as rope and mat making. The remaining material, composed of short and medium-length fibers as well as pith tissue, is commonly referred to as waste-grade coir. The waste-grade coir may be screened to remove part or all of the fiber, and the remaining product is referred to as coir dust and now more commonly as coir.

Although coir products have been used in tropical countries for the production of some ornamentals, little published information is available concerning the usefulness of these products as container nursery substrate components. Seeni and Latha (18) reported coconut husks could be used in the production of *Phalaenopsis* hybrid orchids, and Talukdar and Barooah (19) reported coconut fiber moss resulted in 'superior flowering' in *Dendrobium densiflorum* orchids. Lokesha et al. (14) found average root length and mass were greater for *Acalypha* (copperleaf) when grown in coir than in a soil-based substrate, and the percentage of *Bougainvillea* (Bougainvillea) cuttings that rooted in coir dust was 56% compared to 7% in sand. Erwiyono and Goenadi (5) used coir as a production substrate for cocoa seedlings and found the best substrate was a combination of 25% coconut husk and 75% sand. Evans and Stamps (7) reported higher root fresh mass in *Pelargonium* x *hortorum* (geranium) 'Pink Elite' when grown in coir-based substrates than when grown in peat-based substrates. They also reported *Tagetes patula* (marigold) 'Janie Bright Yellow' and *Petunia* x *hybrida* (petunia) 'Blue Lace Carpet' had higher shoot fresh mass when grown in coir-based substrates than when grown in peat-based substrates.

The objective of this research was to compare the growth of *Viburnum dentatum* and *Syringa* x *prestoniae* 'Donald Wyman' in coir and peat-based substrates, and to determine the suitability of coir as a substrate component for producing containerized nursery crops.

Materials and Methods

Prior to formulation of substrates, dolomitic limestone was added (4.15 kg/m^3 or 12 lbs/yd^3) to the *Sphagnum* peat (peat) and the peat was pasteurized at 60C (140F) for 30 min. The peat was allowed to incubate at 21C (70F) for 10 days before use at which time the pH was 5.1. Coir also was pasteurized and allowed to incubate for 10 days after which time the pH was 5.2. Sand used in substrates was of a coarse grade and washed, and the pine bark was 1 cm (0.4 in) in diameter and composted.

Test substrates for *Viburnum dentatum* (viburnum) were 25:0:75, 50:0:50, 75:0:25, 100:0:0, 0:25:75, 0:50:50, 0:75:25 and 0:100:0 peat:coir:sand (by vol). Test substrates for *Syringa* x *prestoniae* 'Donald Wyman' (lilac) were 25:0:65:10, 50:0:40:10, 75:0:15:10, 0:25:65:10, 0:50:40:10, and 0:75:15:10 peat:coir:bark:sand (by vol).

On May 20, 1994, bare-root 22 to 25 cm (9 to 10 in) tall viburnum and 45 to 50 cm (18 to 20 in) tall lilac plants potted into 11.4 liter (3 gal) containers filled with the test substrates. After potting, Sierra 15–10–10 plus microelements (Scotts-Sierra, Marysville, OH) was surface applied at 50 g (0.11 lbs) per container. Plants were placed on gravel under 25% shade and irrigated daily.

On November 22, 1994, plant heights were measured. Plants were then laid on their sides and covered with a bonded 4-mil white polyethylene-microfoam 0.6-cm thermoblanket (Ametek, Wurtland, KY) pulled tightly over the plants and secured with landscape timbers. On April 15, 1995, plants were uncovered, spaced on 90 cm (36 in) centers and fertilized with 50 g (0.11 lbs) fertilizer as previously described. On October 15, 1995, the experiment was terminated and data taken.

At the termination of the study, plant height, width, shoot fresh mass and root fresh mass were recorded. Height was measured from the soil line to the highest point of the plant. Width was calculated as the average of two width measurements at perpendicular lines across the plant. Root fresh mass was determined by washing and screening the rootmass.

The design was a complete randomized block with ten blocks. An analysis of variance was conducted to determine if substrate significantly affected plant growth. Single degree of freedom contrasts were performed to determine significant differences between comparable peat and coir-based substrates.

Results and Discussion

After one season of growth, viburnum plants grown in 25% and 50% coir were 33 cm (13 in) and 40 cm (16 in) tall, respectively, and were significantly taller than plants grown in 25% and 50% peat-based substrates, which were 28 cm (11 in) and 30 cm (12 in) tall, respectively (Table 1). Plants grown in 75% and 100% coir had similar heights to plants grown in comparable peat-based substrates. Overall, plants

Table 1. Growth of viburnum in *Sphagnum* peat and coir dust-based substrates.

Substrate (peat:coir:sand)[z]	Height after year one (cm)	Height (cm)	Width (cm)	Shoot fresh mass (g)	Root fresh mass (g)
25:0:75	28	70	68	340	324
50:0:50	30	80	79	396	414
75:0:25	50	70	66	340	449
100:0:0	43	75	68	620	917
0:25:75	33	75	61	400	418
0:50:50	40	81	72	505	791
0:75:25	50	70	69	365	374
0:100:0	40	82	79	601	1193
Significance	**df**				
Treatment	7	*	*	*	**	***
Block	9	NS	NS	NS	NS	NS
25 versus 25[y]	1	*	NS	NS	NS	NS
50 versus 50	1	**	NS	NS	NS	**
75 versus 75	1	NS	NS	NS	NS	NS
100 versus 100	1	NS	NS	*	NS	*
coir versus peat	1	*	NS	NS	NS	*

NS, *, **, *** Nonsignificant or significant at the 0.05, 0.01 or 0.001 level, respectively.

[z]Indicates the proportion of each component (v/v).

[y]Numbers indicate the proportion of peat and coir in substrates contrasted.

Table 2. Growth of lilac in *Sphagnum* peat and coir-based substrates.

Substrate (peat:coir: bark:sand)[z]		Height after year one (cm)	Height (cm)	Width (cm)	Shoot fresh mass (g)	Root fresh mass (g)
25:0:65:10		70	97	73	1022	1365
50:0:40:10		65	98	80	1004	1238
75:0:15:10		62	99	84	1777	1258
0:25:65:10		68	92	84	1030	1308
0:50:40:10		65	98	89	1133	1409
0:75:15:10		64	92	86	1820	1335
Significance	**df**					
Treatment	5	NS	NS	**	*	NS
Block	9	NS	*	*	*	NS
25 versus 25[y]	1	NS	NS	**	NS	NS
50 versus 50	1	NS	NS	*	NS	NS
75 versus 75	1	NS	NS	NS	*	NS
coir versus peat	1	NS	NS	**	NS	NS

NS, *, ** Nonsignificant or significant at the 0.05 or 0.01 level, respectively.

[z]Indicates the proportion of each component (v/v).

[y]Numbers indicate the proportion of peat and coir in substrates contrasted.

grown in coir-based substrates were taller than plants grown in peat-based substrates. The tallest viburnum plants occurred in the 75% peat and 75% coir substrates. After 1 year of growth, lilac plants grown in comparable peat and coir-based substrates had similar heights and ranged from 64 cm (25 in) to 70 cm (28 in) tall. Overall, lilac plant height was similar among peat and coir-based substrates (Table 2).

After two seasons, viburnum plant height ranged from 70 cm (28 in) to 82 cm (32 in) and was not significantly different among comparable substrates (Table 1). Viburnum plants grown in 100% coir had a mean width of 79 cm (31 in) which was significantly greater than the 68 cm mean width of viburnum grown in 100% peat. Plant widths were similar for plants grown in 25%, 50% and 75% peat or coir. Overall, viburnum plant widths were similar for plants grown in peat and coir-based substrates. Viburnum shoot fresh mass ranged from 340 to 620 g (0.75 to 1.4 lb) and was not significantly different among comparable substrates. However, viburnum grown in 50% and 100% coir had root fresh weights of 791 and 1193 g (1.7 to 2.6 lb), respectively. These root fresh weights were significantly greater than those of plants grown in 50% and 100% peat, which averaged 414 and 917 g (0.9 to 2 lb), respectively. Overall, root fresh mass was greater for plants grown in coir-based substrates than for plants grown in peat-based substrates.

After two seasons, lilac height and root fresh mass ranged from 92 to 97 cm (36 to 38 in) and 1238 g to 1409 g (2.7 to 3.1 lb), respectively, and were not significantly different among substrates (Table 2). Lilac plants grown in 25% and 50% coir had mean widths of 84 cm and 89 cm (33 and 35 in), respectively, which was significantly greater than the 73 cm and 80 cm (29 and 31 in) widths of lilac grown in 25% and 50% peat. Overall, plants grown in coir were wider than plants grown in peat-based substrates. Lilac grown in 75% coir had greater shoot fresh mass than plants grown in 75% peat. Overall, plants grown in coir and peat-based substrates had similar shoot fresh mass.

Many factors impact plant growth and could be responsible for the increased shoot growth in lilac and increased root growth observed in viburnum. One possible explanation is nutritional differences. Evans et al. (6) reported that coir contains high levels of essential mineral elements including P and Cl. Phosphorus has been demonstrated to be involved in root proliferation and Cl has been demonstrated to be involved in root growth in several species (10). Although, a complete fertilizer was provided to each plant, differences in the mineral element content of the substrates might have contributed to the differences in growth.

Evans and Stamps (7) reported increased shoot growth and root fresh mass in *Pelargonium* x *hortorum* (geranium) in coir-based substrates as compared to peat-based substrates. Waber and Evans (22) reported increased shoot fresh mass and bract area in *Euphorbia pulcherrima* (poinsettia) in coir-based substrates. In both of these cases, increased growth was attributed to increased water availability. Water availability also may have contributed to differences in growth observed in lilac and viburnum. Although physical properties of these substrates were not determined and water-holding capacities of the substrates were unknown, Evans et al. (6) reported coir-based substrates had higher water-holding capacities than comparable peat-based substrates. It is therefore possible that the coir-based substrates used in these experiments had higher water-holding capacities than the comparable peat-based substrates. Reduced growth in woody plant species due to water stress has been documented in numerous species (8, 9, 15). Because plants in this study were irrigated once daily rather than on demand, differences in water availability may have occurred during the study which could account for the differences observes in growth of viburnum and lilac.

Growth of viburnum and lilac in coir-based substrates was found to be similar to or greater than that of plants grown in comparable peat-based substrates. Based upon these results, we conclude that coir can be successfully used as a substitute for peat when producing container-grown viburnum and lilac, and presumably other woody plants. The ultimate decision on using coir would thus depend upon economic considerations, and the optimal substrate would depend upon the environment and production conditions.

Literature Cited

1. Barkham, J.P. 1993. For peat's sake: Conservation or exploitation? Biodiv. Conser. 2:556–566.

2. Beeson, R.C., Jr. 1996. Composted yard waste as a component of container substrates. J. Environ. Hort. 14:115–121.

3. Buckland, P. 1993. Peatland archaeology: A conservation resource on the edge of extinction. Biodiv. Conserv. 2:513–527.

4. Bunt, A.C. 1988. Media and Mixes for Container-Grown Plants. Unwin Hyman Ltd, London.

5. Erwiyono, R. and D.H. Goenadi. 1990. The potential use of coconut husk material as a potting media: growth of cocoa seedlings on coconut husk/sand potting media. Indonesia J. Crop Science 5:25–34.

6. Evans, M.R., S. Konduru, and R.H. Stamps. 1996. Source variation in physical and chemical properties of coconut coir dust. HortScience 31:965–967.

7. Evans, M.R. and R.H. Stamps. 1996. Growth of bedding plants in sphagnum peat and coir dust-based substrates. J. Environ. Hort. 14:187–190.

8. Graves, W.R. and L.C. Wilkins. 1991. Growth of honeylocust seedlings during high root-zone temperature and osmotic stress. HortScience 26:1312–1315.

9. Graves, W.R. 1994. Seedling development of sugar maple and black maple irrigated at various frequencies. HortScience 29:1292–1294.

10. Hartman, H.T., A.M. Kofranek, V.E. Rubatzky, and W.J. Flocker. 1988. Plant Science: Growth, Development and Utilization of Cultivated Plants. Prentice Hall. Englewood Cliffs, NJ.

11. Jarvis, B.R., J.B. Calkins, and B.T. Swanson. 1996. Compost and rubber tire chips as peat substitutes in nursery container media: Effects on chemical and physical properties. J. Environ. Hort. 14:122–129.

12. Judd, R.W., Jr. 1983. Soilless mixes for nursery production. J. Environ. Hort. 1:106–109.

13. Laiche, A.J., Jr. and V.E. Nash. 1990. Evaluation of composted rice hulls and a lightweight clay aggregate as components of container-plant growth media. J. Environ. Hort. 8:14–18.

14. Lokesha, R., D.M. Mahishi, and G. Shivashankar. 1988. Studies on use of coconut coir dust as a rooting media. Current Research, Univ. of Agric. Sci., Bangalore, India 17(12):157–158.

15. Nash, L.J. and W.R. Graves. 1993. Drought and flood stress effects on plant development and leaf water relations of five taxa of trees native to bottomland habitats. J. Amer. Soc. Hort. Sci. 118:845–850.

16. Purman, J.R. and F.R. Gouin. 1992. Influence of compost aging and fertilizer regimes on the growth of bedding plants, transplants and poinsettia. J. Environ. Hort. 10:52–54

17. Robertson, R.A. 1993. Peat, horticulture and environment. Biodiv. Conserv. 2:541–547.

18. Seeni, S. and P.G. Latha. 1990. Post-transplantation growth of *Phalaenopsis* hybrid seedlings in community pots. J. Orchid Soc. India 4(1-2):127–133.

19. Talukdar, M. and S. Barooah. 1987. Effect of pot mixture on flowering in *Dendrobium densiflorum*. Acta Hort. 205:145–148.

20. Tripepi, R.R., M.W. George, A.G. Campbell, and B. Shafii. 1996. Evaluating pulp and paper sludge as a substitute for peat moss in container media. J. Environ. Hort. 14:91–96.

21. Tyler, H.H., S.L. Warren, T.E. Bilderback, and K.B. Perry. 1993. Composted turkey litter: II. Effect on plant growth. J. Environ. Hort. 11:137–141.

22. Waber, A.A. and M.R. Evans. 1996. Growth and development of *Euphorbia pulcherrima* 'Freedom' and *Lilium longiflorum* 'Nellie White' in sphagnum peat- and coir dust-based substrates. HortScience 31:657.