Waste-derived Media for Pot-in-pot Shade Trees©

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INTRODUCTION

There is little information on substrates for pot-in-pot shade tree production (Murray et al., 1997; Tilt et al., 1993). This research examined various organic waste-derived substrates for growing shade trees in pot-in-pot systems.

MATERIALS AND METHODS

Seedling whips of green ash (*Fraxinus pennsylvanica*), Japanese birch (*Betula platyphylla* var. *japonica*), and silver maple (*Acer saccharinum*) were grown for two seasons in 76-liter pots. The pots were trickle irrigated and fertilized with controlled-release fertilizers. Treatments included a control nursery mix [pine bark, compost, and topsoil (50B:15C:35S, by volume)] and nine other mixes classified into three groups: Group I (25%, 50%, or 75% bark mixed with 50%, 25%, or 0% wood chips, and 25% paper mill sludge); Group II (25%, 50%, or 75% bark; 50%, 25%, or 0% wood chips; and 25% peat); and Group III (25%, 50%, or 75% peat; 50%, 25%, or 0% wood chips; and 25% paper mill sludge). Selected physical properties of the substrates were determined at the start of the experiment (Table 1). Electrical conductivity [EC, a measure of the soluble salts concentration using substrate : water (1 : 2, v/v) extracts] was taken at various intervals during the two seasons (Table 2).

RESULTS

In both years, trunk diameters of the three species were highest with Group III substrates, intermediate with Group II, and least with Group I (Fig. 1, data shown for 2nd year only). Trunk growth was positively correlated with water retention porosity (Table 3), which ranged from 42% to 57%, 38% to 42%, and 20% to 27% for Groups III, II, and I, respectively (Table 1). Trunk diameters of Group II and III trees were equal to, or slightly exceeded (10% to 12%), those of the nursery mix. The nursery mix had a water retention porosity of 49% (Table 1) and generally the highest content of soluble salts (Table 2). The high-peat (50% and 75%) substrates marginally but consistently produced trees with the largest trunk diameters (Fig. 1), although with birch (not the other species) shorter trees resulted as the peat content increased (Fig. 2).

DISCUSSION

This study provides new and important information about using waste-derived substrates for pot-in-pot culture of shade trees. An important underlying objective of the research was to demonstrate and recommend the use of selected wastes and their combinations for use as alternative amendments or substitutes for traditionally reliable peat moss, a nonrenewable resource. The results indicated that Group III substrates, especially the two with the highest proportions of peat (50% and 75%), were marginally but consistently the best of the 10 substrates. The high water retention capacity of these peat-based substrates was a key to this result.

If waste products can be substituted and used with positive effects or, in the worst case situation, small diminutive effects on growth which seem to be of little economic importance as in this study, then there may be an overall benefit to using them, particularly if they are readily available or less expensive than peat.

Table 1. Physical properties analysed at the start of the experiment in organic waste-derived substrates used for growing pot-in-pot shade trees.

	Bulk density	Total porosity	Aeration porosity	Water retention porosity
Substrates[z]	(g cm^{-3})	(%)	(%)	(%)
Nursery mix				
50B : 15C : 35S	0.58	65	15	49
Group I				
25B : 50WC : 25SL	0.29	63	43	20
50B : 25WC : 25SL	0.31	59	32	27
75B : 0WC : 25SL	0.31	60	33	27
Group II				
25B : 50WC : 25P	0.24	66	28	38
50B : 25WC : 25P	0.23	62	24	38
75B : 0WC : 25P	0.24	74	27	42
Group III				
25P : 50WC : 25SL	0.30	64	22	42
50P : 25WC : 25SL	0.23	75	18	57
75P : 0WC : 25SL	0.18	70	16	54
SE	0.02	1.1	1.6	2.2
Recommended values	0.2-0.75	>50	15-30	25-35

[z]B = pine bark; C = compost; P = peat; S = soil; SL = paper mill sludge; WC = wood chips.

Table 2. EC (dS m^{-1}) determined during two growing seasons in organic waste-derived substrates used for growing pot-in-pot shade trees.

	1994					1995			
Media[z]	25 May	20 June	2 Aug	27 Sept.	24 Nov.	9 May	27 June	17 July	25 Aug.
Control									
50B : 15C : 35S	0.4[y]	0.7	1.1	1.1	1.0	0.4	0.6	0.8	0.2
Group I									
25B : 50WC : 25SL	0.3	0.4	0.6	1.0	1.0	0.2	0.4	0.4	0.2
50B : 25WC : 25SL	0.3	0.3	0.7	1.0	1.2	0.2	0.5	0.7	0.2
75B : 0WC : 25SL	0.3	0.5	0.8	1.3	1.4	0.3	0.5	0.7	0.2
Group II									
25B : 50WC : 25P	0.3	0.4	0.7	1.2	1.1	0.3	0.5	0.4	0.2
50B : 25WC : 25P	0.3	0.3	0.8	1.1	1.0	0.3	0.4	0.5	0.2
75B : 0WC : 25P	0.2	0.5	0.9	0.9	1.1	0.3	0.3	0.5	0.2
Group III									
25P : 50WC : 25SL	0.3	0.4	0.9	1.0	1.1	0.3	0.5	0.6	0.1
50P : 25WC : 25SL	0.2	0.4	1.0	0.8	1.0	0.3	0.3	0.4	0.1
75P : 0WC : 25SL	0.1	0.3	0.6	1.0	0.7	0.3	0.2	0.5	0.1
LSD[x]	0.17	0.17	0.27	NS	0.31	0.1	NS	NS	0.1

[z] B = pine bark; C = compost; P = peat; S = soil; SL = paper mill sludge; WC = wood chips.
[y] Each datum represents an average over three species and four replications; medium : water (1 : 2, v/v) extracts.
[x] Least significant difference at P 0.05; NS = nonsignificance at P 0.05.

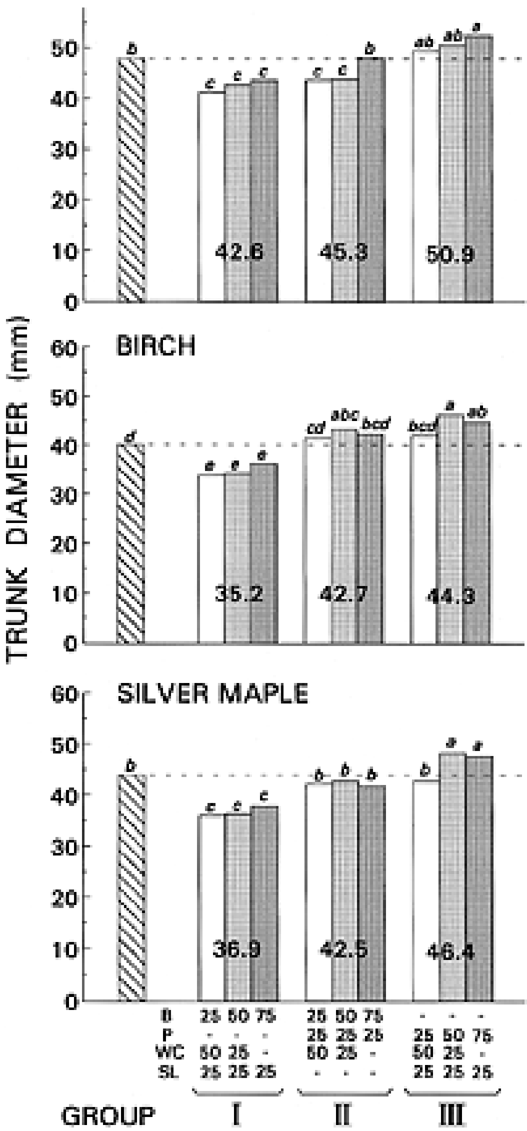

Figure 1. Trunk diameter of ash, birch, and silver maple trees after 2 years of pot-in-pot culture with three substrate groups formulated from various combinations of bark (B), peat (P), wood chips (WC), and paper mill sludge (SL). The horizontal broken line represents growth in the control nursery mix [bark, compost, and soil,(50B : 15C : 35S, by volume)] shown on the left. Comparisons between individual substrate treatment means within species are separated (*a*-*e*) by LSD at P 0.05. Group substrate means are shown inside the bars.

Table 3. Correlation of trunk diameter and height of pot-in-pot grown shade trees with substrate porosity characteristics.

	Trunk diameter (mm)			Height (cm)		
Porosity	Ash	Birch	Silver maple	Ash	Birch	Silver maple
1994						
Aeration	-0.65*	-0.65*	-0.66*	-0.65*	-0.68*	-0.48
Water retention	0.69*	0.71*	0.75*	0.73*	0.72*	0.58
1995						
Aeration	-0.68*	-0.69*	-0.75*	-0.73*	-0.58	-0.72*
Water retention	0.73*	0.78**	0.82**	0.71*	0.59	0.78**

* Significant at P 0.05 or 0.01
** n = 10.

LITERATURE CITED

Murray, C.L., G.P. Lumis, and **C. Chong.** 1997. Response of shade trees grown in in-ground containers to three container substrates. J. Environ. Hort. 15:183-186.

Tilt, K., D. Williams, C. Montgomery, B. Behe, and **M.K. Gaylor.** 1993. Pot-in-pot production of nursery crops and Christmas trees. Alabama Coop. Ext. Service, Auburn Univ., AL. Circular ANR-893.