Stem Cutting Propagation in Whole Pine Tree Substrates©

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Wood-based substrates have been identified as substitutes for pine bark (PB) and peat moss (P) in container production of ornamental crops. Ideally, these substrates would be used for the propagation and production of such crops. An experiment was conducted to determine the effectiveness of processed whole pine trees (WPT) as a substrate for rooting stem cuttings. Four substrates [WPT, WPT:P (1 : 1, v/v), PB, and PB:P (1 : 1, v/v)] were used to evaluate root development of subterminal cuttings of ×*Cupressocyparis leylandii* 'Murray' and *Salvia leucantha*. The WPT produced the least total root length and total root volume for both species. However, the addition of peat resulted in greater total root length for *S. leucantha*. Although the PB and PB:P treatments had similar total root length and total root volume in *S. leucantha*, the addition of peat to PB had a negative effect on ×*C. leylandii* 'Murray' root development. The addition of peat altered the substrate physical properties, resulting in decreased air space and increased container capacity in WPT:P and PB:P. *Salvia leucantha* and ×*C. leylandii* 'Murray' cuttings responded differently when peat was added to PB, suggesting ideal physical properties may differ among species.

INTRODUCTION

A quality substrate is one key factor in successfully propagating and producing ornamental crops in containers. Commercial propagators commonly use peat moss (P), pine bark (PB), perlite, and vermiculite as components of a substrate, yet personal preferences range from using a single component to combining select components at various ratios. Propagation substrates composed of traditional components, if properly selected, can provide an optimum balance of air and water for healthy root development (Bilderback and Lorscheider, 1995; Hartmann et al., 1990). Alternative materials may be acceptable for use in propagation, although they must be evaluated thoroughly before commercial use.

Pine bark and peat-based substrates are also used for the production of nursery and greenhouse crops, respectively, but profitability and interest in recycling waste materials or by-products have enhanced the desire for utilizing alternative substrate components (Duke et al., 2008). The high transportation costs and variable annual harvest of Canadian peat moss have an impact on greenhouse producers in the United States (Fain et al., 2008; Canadian Sphagnum Peat Moss Association, 2008). Nursery producers will likely continue to experience a decline in PB supplies and a rise in cost for the foreseeable future, due to PB's use as boiler fuel and a slight decline in the timber market (Lu et al., 2006). Ideally, an alternative substrate component should be cost effective, sustainable, and regionally available.

Wood-based substrates have been identified as acceptable supplements or replacements for peat moss and pine bark. Wood-based materials obtained from pine trees include clean chip residual (CCR), processed whole pine trees (WPT), and chipped pine logs (CPL). Both WPT and CPL substrates have been used successfully in producing a variety of crops in a greenhouse environment, although slightly higher fertilizer rates are required compared to a peat-lite substrate (Boyer et al., 2008; Fain et al., 2008; Wright and Browder, 2005). Since WPT substrates can be used in crop production, their effectiveness for use in propagation should be addressed. Demonstrating the versatility of WPT substrates is essential to expanding their commercial use and availability. The objective of our experiment was to evaluate WPT as a rooting substrate for stem cutting propagation of ornamental crops.

MATERIALS AND METHODS

Four substrate treatments [WPT, WPT:P (1 : 1, v/v), PB, and PB:P (1 :1 , v/v)] were used to evaluate root development of stem cuttings of two species (×*Cupressocyparis leylandii* 'Murray' and *Salvia leucantha*). The WPT was processed with a hammermill to pass through a 0.64-cm (0.25-in.) screen. Each substrate was amended per cubic meter (cubic yard) with 1.07 kg (4 lb) of Harrell's 16-6-12 (N-P-K) Plus 5-month formulation and 1.36 kg (5 lb) dolomitic limestone. Individual containers (T.O. Plastics SVD-250) were filled with a substrate treatment and completely randomized in 6 carry trays (T.O. Plastics SPT-250-32-PF), which were placed under a greenhouse mist system to saturate substrates before use. Subterminal, 10.8-cm (4.25-in.) cuttings of field-grown ×*C. leylandii* 'Murray', and subterminal, single node cuttings of landscape-grown *S. leucantha* were prepared on 14 Feb. 2008 and 11 March 2008, respectively. On respective preparation days, all cuttings received a 1-sec basal quick-dip in a 1000 ppm IBA solution (Dip'N Grow® Lite) and a single cutting was inserted into each container for a total of 192 cuttings per species. Throughout the experiment, intermittent mist was maintained at 8 sec every 15 min from 8:00 to 18:00. Root development was evaluated at 49 days after sticking (DAS) for the *S. leucantha* cuttings and 138 DAS for the ×*C. leylandii* 'Murray' cuttings. At this time, roots (if present) were washed and digitally scanned for analysis using Win-Rhizo software to obtain total root length and total root volume. Substrate physical properties were obtained using the North Carolina State University porometer

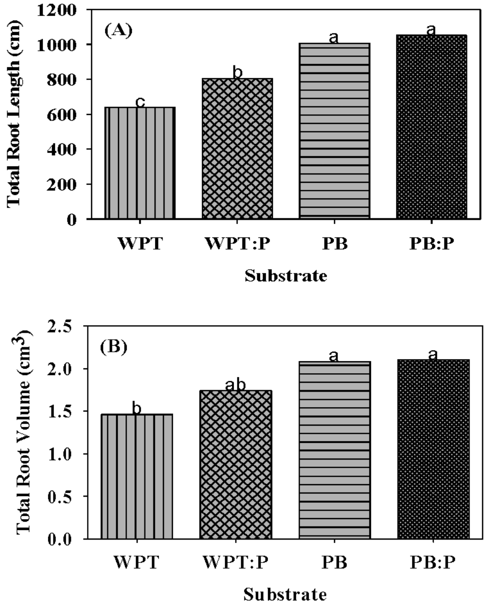

Figure 1. Total root length (A) and total root volume (B) of *Salvia leucantha* stem cuttings rooted in 100% whole pine tree (WPT), 1 whole pine tree:1 peat (WPT:P), 100% pine bark (PB), and 1 pine bark:1 peat (PB:P) substrates. Means with different letters indicates significance.

method. Assumptions of normality and common variance were verified using the GLM and UNIVARIATE procedures of SAS (Version 9.2; SAS Institute, Inc., Cary, North Carolina). Treatment means were compared using the simulation-stepdown method at the 0.05 significance level using the GLIMMIX procedure of SAS.

RESULTS

Salvia leucantha cuttings had 100% rooting for all four substrate treatments. On average, cuttings in WPT had the least total root length and total root volume among all treatments (Fig. 1A and 1B). Conversely, PB:P resulted in the greatest total root length and total root volume among all treatments. Overall, cuttings rooted in PB:P had 39% greater total root length compared with WPT-rooted cuttings. Similarly, a 30% greater total root volume was obtained on average in the PB:P treatment compared with the WPT treatment. The addition of peat to WPT resulted in a 21% and 16% increase in total root length and total root volume, respectively.

Rooting percentage for ×*Cupressocyparis leylandii* 'Murray' varied among the substrate treatments. Ninety-six percent of the cuttings rooted in WPT:P and PB:P substrates, while cuttings in WPT and PB substrates rooted at 90% and 94%, respectively. Callus had developed on all but three of the unrooted cuttings, one cutting each for WPT, WPT:P, and PB:P. The greatest mean total root length and total

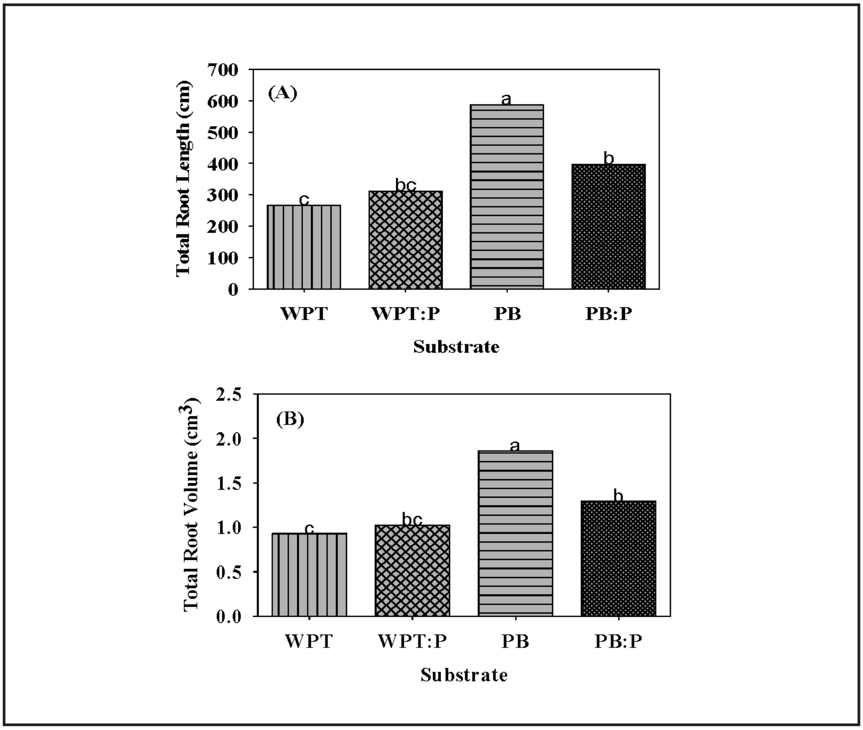

Figure 2. Total root length (A) and total root volume (B) of ×*Cupressocyparis leylandii* 'Murray' stem cuttings rooted in 100% whole pine tree (WPT), 1 whole pine tree:1 peat (WPT:P), 100% pine bark (PB), and 1 pine bark:1 peat (PB:P) substrates. Means with different letters indicates significance.

Table 1. Physical properties of substrates[z].

Substrates	Air space	Container capacity	Total porosity
	Volume (%)		
100% Whole Pine Tree (WPT)[y]	31.0[x] a	51.7 b	82.7 b
1 Whole Pine Tree:1 Peat (WPT:P)	16.5 b	64.8 a	81.3 b
100% Pine Bark (PB)	35.5 a	51.8 b	87.3 a
1 Pine Bark:1 Peat (PB:P)	16.3 b	66.6 a	82.9 ab

[z]Analysis performed using the North Carolina State University porometer method.

[y]Whole pine trees processed to pass a 0.64-cm screen.

[x]Treatment means were compared using the simulation-stepdown method at the 0.05 significance level (different letters within the column designate significance) using the GLIMMIX procedure of SAS.

root volume occurred in the PB treatment, and the least in the WPT treatment (Figs. 2A and 2B). Compared with the WPT treatment, average total root length and total root volume were 55% and 50% greater in the PB treatment. Average total root length and total root volume was reduced by 32% and 31% with the addition of peat to PB.

The physical properties of the WPT and PB substrates were altered by the addition of peat (Table 1). Air space decreased by 47% and 54% in WPT:P and PB:P, respectively, compared with WPT and PB. Compared with WPT and PB, WPT:P and PB:P had 20% and 22% greater container capacity, respectively.

DISCUSSION

We discovered WPT substrates can be used to root stem cuttings of *S. leucantha* and ×*C. leylandii* 'Murray'. The addition of peat to WPT resulted in significantly greater total root length for *S. leucantha*, but it had no effect on total root volume. Although ×*C. leylandii* 'Murray' root development was similar in WPT and WPT:P, the addition of peat to PB had a negative effect on root development. The addition of peat resulted in substrates with reduced air space and greater container capacity, yet the effect on root development varied between *S. leucantha* and ×*C. leylandii* 'Murray'. The modified physical properties of WPT:P resulted in significantly greater total root length of *S. leucantha* cuttings. Although the addition of peat to PB did not have a significant effect on *S. leucantha* root development, total root length and total root volume were significantly lower for ×*C. leylandii* 'Murray' cuttings in PB:P.

It is clear that the ideal substrate physical properties of a rooting substrate can vary among plant species. In addition to determining acceptable physical properties for a rooting substrate composed of WPT, differences in substrate chemical properties and possible phytotoxicity should also be investigated. The goal of future experiments will be development of protocols for enhancing root development in WPT substrates.

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