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Rooting of Three Landscape Species in Gasifier Residue-Based Propagation Media[1]

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Abstract

The rooting of azalea (*Rhododendron indicum* L. 'Prudence'), privet (*Ligustrum sinensis* L.), and boxwood (*Buxus microphylla japonica* L. 'Richardii') hardwood cuttings in 5 propagation media composed of combinations of gasifier residue (GR), Canadian sphagnum peat (P), and/or horticultural perlite (Per) indicated that superior root initiation and root development occurred in several GR:P media mixtures. Rooting of both azalea and privet was greater in the 3GR:1P medium than in 1P:1Per. Boxwood root development was superior in both the 1GR:1P and 3GR:1P media than the 1P:1Per medium. The percent air space of gasifier residue-based media did not change over 16 weeks of greenhouse exposure, however there was nearly a 50% reduction of air space in 1P:1Per medium.

Index words: *Rhododendron* sp., *Juniperus, Buxus,* % air space, propagation

Introduction

The nursery industry has successfully used a large variety of materials and media combinations to propagate woody plant cuttings (4,11,14). Preferred characteristics of a propagation medium are: 1) consistent quality, 2) absence of disease and insect pests, 3) absence of toxic chemicals, 4) ability to hold and supply water, 5) light weight, and 6) adequate drainage and aeration (4,10).

Sphagnum peat moss is a common component in propagation media, however, it has several drawbacks when not properly managed including excessive water retention, poor aeration, high cost and fluctuating supplies. Calcined clay, vermiculite, perlite, expanded plastic, sand, and pine and hardwood bark are among the materials used to improve one or more deficiencies of peat moss (4,14). However, the first 4 components are relatively expensive, and bark is presently being evaluated as an alternative fuel source, as a result supplies may become limited and more costly to the nurseryman in the future. Residue from the gasification of bark and wood chips has been successfully used as a container medium for woody plants (12). Present supplies of residues are limited and localized, however, with the predicted growth of gasifier-based power generation significant quantities may become generally available in the near future. Physical characteristics determined for gasifier residue alone and in combination with pine bark, Canadian sphagnum peat, and/or sand have indicated that a medium composed of 3GR:1P (by volume) has excellent aeration and water-holding characteristics (13).

A major physical characteristic of a successful rooting medium is the % air pore space (6,7,10), which depends on the depth and the particle size distribution of a medium (2,15). Recommendations for medium aeration (air pore space) range from 5 to 30% of the medium volume, depending on the species and the method of measurement (1,2,3,5,9). DeBoodt and Verdonck (2) suggest a 20-30% air pore space based on a medium at 10 cms (4 in) tension for the "ideal substrate." In addition, a medium must be resistant to loss of this aeration during the propagation cycle. Cuttings are commonly misted to reduce net water loss, however, this tends to saturate moderately to poorly drained media, and reduce aeration and subsequent rooting of cuttings. The objective of this study was to determine the potential of several gasifier residue-based media for the propagation of three common landscape species.

Materials and Methods

Hardwood terminal cuttings [10 cm (4 in) long] of azalea, privet and boxwood were taken on January 3-5, 1983 from stock plants grown in full sunlight. Leaves

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were stripped from the basal 2.5 cm (1 in) of the cuttings and were dipped in a 3000 ppm IBA solution and inserted in one of five experimental media. Media were composed of horticultural grade perlite (Per), Canadian sphagnum peat moss (P), or gasifier residue (GR) in the following combinations: 1P:1Per, 1GR:1Per, 1GR:1P, 3GR:1P or GR (by volume). Particle size distribution of GR was similar to that previously described, 85% of the particles were within 4.00-0.42 mm, 7% were larger than 4.00 mm and 12% were smaller than 0.42 mm (13). Each medium was amended with 3.5 kg (7.7 lb) of Osmocote 18N-1.3P-8.3K (18-3-10), 2.4 kg (5.3 lb) superphosphate, and 1.2 kg (2.6 lb) Micromax[3] micronutrient additive per m^3 (yd^3). Initial pH was adjusted to 5.0-6.0 with dolomitic lime for 1P:1Per, and with agricultural sulfur for all other media. Media were moistened and then incubated in plastic bags at room temperature until the pH values were stabilized. Cuttings were propagated in media-filled 6x6 cm (2.5x2.5 in) cups and placed under intermittent mist in a rigid fiberglass greenhouse fitted inside with 35% saran shade and maintained between 13 °C (70 °F) and 29 °C (85 °F). The mist cycle was controlled by a 'Mist-A-Matic'[4] with an average application of 2 sec/5 min between 11 A.M. and 4 P.M. This was the minimum interval required to provide continuous leaf wetness.

The design was a randomized complete block with 3 replications per treatment and 12 cuttings per replication. Each species was considered a separate experiment. Root quality index, rooting percent, number of primary roots and root dry weight were determined 16 weeks after sticking. Primary root number was not determined on azalea due to the large number and minute size of roots. Extra cups of media without cuttings were included in each of the three blocks for bimonthly approximations of soluble salts and pH using the saturated paste method, and for initial and 16 week measurements of % air space using previously described methods (13).

Results and Discussion

Initially all media except GR had similar % air space (Table 1) and were higher than the optimum level suggested by DeBoodt and Verdonck (2). The only medium which significantly changed over 16 weeks of greenhouse exposure was 1P:1Per which had nearly 50% loss of air space making it lower than all other media tested. In comparison, GR medium lost only 1% air space while the other media lost about 21% each, lowering them to approximately the suggested range of 20-30% (2). When subjected to the heavy misting regime, 1P:1Per medium became waterlogged encouraging growth of algae on the medium surface. All other media drained sufficiently under these conditions such that algal growth was not a problem. The pH of all media at the end of the experiment ranged from 5.1 to 5.6; soluble salts were maintained at acceptable levels from 0.8 to 1.4 mhos x 10^{-3}.

Rooting of azalea was superior in 3GR:1P medium when all parameters were considered (Table 2). Though

[3]Sierra Chemical Co., Milpitas, CA.

[4]E.C. Geiger, Harleysville, PA.

Table 1. Percent air space of 5 propagation media sampled initially and after 16 weeks of greenhouse exposure.

Media[x] (by volume)	Percent Air Space[z]	
	Initial	16 wks
GR	33 bc[y]	32 c
3GR:1P	41 abc	32 c
1GR:1P	43 ab	33 bc
1GR:1Per	48 a	38 abc
1P:1Per	39 abc	21 d

[z]Medium % air space according to DeBoodt and Verdonck (2).

[y]Means followed by the same letter or letters are not significantly different at the 5% level according to the HSD test.

[x]Medium components: GR—gasifier residue, P—Canadian sphagnum peat moss, Per—horticultural perlite.

the root quality rating of cuttings in GR and 1GR:1P was similar to that of 3GR:1P medium, the % rooting and root dry wt indicated that azalea rooting was superior in the latter. Percent rooting in both 1GR:1Per and 1P:1Per was poor with only 14% of the cuttings rooting in the 1P:1Per medium. This was a result of excessive waterlogging in the 1P:1Per medium with a consequent reduction in aeration. Azalea is considered to have a greater than average aeration demand during rooting and growth (5,8). However, the 1GR:1Per medium might have been too dry.

Privet propagated in 1GR:1P media produced greater root dry wt than the other media (Table 2). The 1GR:1P, 3GR:1P and GR combinations were comparable in root quality rating, % rooting and root number of privet and were superior to the 1P:1Per medium.

Rooting of boxwood was superior in the 1GR:1P medium compared to the 1P:1Per medium (Table 2). Poor rooting in 1P:1Per probably resulted from reduced media aeration, similar to that encountered in the other species. Number of primary roots in 3GR:1P was similar to 1GR:1P although all other parameters were inferior, indicating that roots were initiated but did not elongate as rapidly in 1GR:1P. This root growth reduction was caused by poor anchoring of the boxwood cuttings in the coarser media without peat. This resulted in the heaving of the cuttings with subsequent dehydration of roots, and was also observed in GR and 1GR:1Per media. This did not occur with azalea or privet.

Rooting of cuttings from 3 landscape species was superior in gasifier residue or gasifier residue:peat media compared to peat:perlite, when subjected to a heavy misting regime. Though species preferences were observed, a 3GR:1P medium would be satisfactory for propagating many plants. This medium drained freely and maintained adequate % air space after 16 weeks of greenhouse exposure. The 1P:1Per is generally satisfactory for commercial propagation, but water management can be critical in maintaining aeration. The superior air:water relations of 3GR:1P would allow less stringent water management without the risk of waterlogging.

Table 2. Rooting parameters for azalea, privet and boxwood in 5 propagation media.

Species	Media[z] (by volume)	Root quality rating[y]	% Rooting	No. of primary roots	Root Dry wt (g)
Azalea	GR	3.2 a[x]	78 ab	——[w]	.02 b
	3GR:1P	3.9 a	100 a	——	.05 a
	1GR:1P	2.6 ab	66 b	——	.02 b
	1GR:1Per	1.6 b	36 c	——	.01 b
	1P:1Per	1.4 b	14 c	——	.01 b
Privet	GR	3.6 a	94 a	5.3 a	.03 ab
	3GR:1P	3.3 a	86 a	5.2 a	.03 ab
	1GR:1P	3.7 a	78 a	5.1 a	.04 a
	1GR:1Per	2.4 ab	47 ab	2.8 ab	.02 ab
	1P:1Per	1.4 b	16 b	0.5 b	.004 b
Boxwood	GR	2.5 ab	55 b	3.0 b	.05 b
	3GR:1P	2.9 ab	67 ab	5.2 a	.07 b
	1GR:1P	4.2 a	95 a	8.0 a	.15 a
	1GR:1Per	2.6 ab	58 ab	3.6 b	.06 b
	1P:1Per	2.3 b	50 b	3.5 b	.06 b

[z]Media components: GR—gasifier residue, P—Canadian sphagnum peat moss, Per—horticultural perlite.
[y]Root quality rating—1 = no roots, 2 = one root, 3 = good rooting, 4 = very good rooting, 5 = excellent rooting.
[x]Means within species and parameter followed by the same letter or letters are not significantly different at the 5% level according to the HSD test.
[w]Number of roots not determined for azalea.

Significance to the Nursery Industry

Though species preferences were observed, a 3-gasifier residue:1-peat medium would be satisfactory for propagating many plant species. This medium drained freely and had superior aeration compared to 1-peat:1-perlite medium after 16 weeks of greenhouse exposure under a heavy misting regime. Based on the cost of 1-peat:1-perlite medium of $36/m³ ($29/yd³), the relative cost savings of using gasifier residue, 3-gasifier residue:1-peat, 1-gasifier residue:1-perlite or 1-gasifier residue:1-peat media are 57%, 61%, 48% and 37%, respectively. The 1-peat:1-perlite is generally satisfactory for commercial propagation but maintaining aeration can require careful water management. Superior air:water relations of the 3-gasifier residue:1-peat media would allow less stringent water management without the risk of waterlogging.

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