# Rooting of Three Ornamental Plants in Eight Propagation Substrates©[1]

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**Parboiled rice hulls (PBH) and coconut coir (CC) are being evaluated as potentially new substrates for the propagation industry. Peat moss (PM) and perlite (PER) have been used in many propagation studies showing suitable rooting characteristics for woody ornamentals. The objective of this study was to evaluate the effect of PBH, CC, PM and PER substrates used individually or in combination (1 : 1, v/v) on the rooting of semihardwood cuttings from three woody ornamentals. Results indicated that in general substrate pH decreased during the rooting period. Based on rooting percentages and number of roots per cutting, PM continues to be a good rooting substrate; PM:PER, and CC:PER also appear to be good rooting substrates. Parboiled rice hulls (PBH) appear to be a suitable rooting substrate when combined with peat moss.**

## INTRODUCTION

A wide range of substrates have been used in the propagation of ornamental plants. Propagators tend to use substrates which they are either familiar with or which they have had success on propagating more than one species (Copes, 1977). While peat moss and perlite are considered staples in cutting propagation, alternatives such as coconut coir and rice hulls are being evaluated. Limited research has been conducted on the use of composted rice hulls in propagation (Agbo and Omaliko, 2006); though a number of large commercial nurseries have been evaluating the use of parboiled rice hulls (PBH) as a rooting substrate in plant propagation. When coconut coir was evaluated as a propagation substrate it resulted in a better developed root system on ericaceous plants (Matysiak and Nowak, 2008). Coconut coir has been shown to increase rooting of several woody ornamentals (Stoven and Kooima, 1999).

Characteristics that are frequently cited for a preferred propagation substrate are: consistent quality, absence of disease and insect pests, absence of toxic chemicals, ability to hold and supply water, and adequate drainage and aeration (Regulski, 1984). If one of these essential characteristics is missing it can reduce rooting percentages or alter root morphology. The objective of this study was to evaluate the effect of eight substrates on the rooting of semihardwood cuttings from three woody ornamentals.

## MATERIALS AND METHODS

Cutting wood from terminal shoots of 'Natchez' crapemyrtle (*Lagerstroemia* 'Natchez'), border forsythia (*Forsythia ×intermedia* Zab.) and small viburnum (*Viburnum obovatum* Walt.) was collected on 26 May 2009 from stock plants grown in full sunlight. Cutting wood was wrapped in moist paper towels and held in a cooler

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**Table 1.** Initial and final pH for the eight substrates evaluated on the rooting of forsythia and crapemyrtle cuttings.

| | | Final pH[Z] | |
|---|---|---|---|
| Substrate[Y] | Initial pH[Z] | Crapemyrtle | Forsythia |
| PER | 6.1 | 7.0 | 7.1 |
| PER:PM | 3.4 | 3.7 | 3.8 |
| PM | 3.6 | 3.4 | 3.3 |
| PM:PBH | 4.4 | 4.0 | 4.0 |
| PBH | 6.2 | 6.0 | 6.1 |
| PBH:CC | 6.1 | 5.3 | 5.6 |
| CC | 6.1 | 5.7 | 5.6 |
| PER:CC | 5.6 | 5.3 | 5.6 |

[Z]Note that pH was measured using saturated paste method on 27 May (initial) and again on 29 July (final) 2009.

[Y]Substrates were used individually or in combination (1:1, v/v). PER = perlite; PM = peatmoss; PBH = parboiled rice hulls; CC = coconut coir.

until cuttings were prepared. On 27 May 2009 cuttings were prepared by stripping basal leaves and trimming the cuttings to a finished length of 8–11 cm (4–5 nodes), 8–10 cm (3–4 nodes), and 8–11 cm (4–5 nodes), respectively for forsythia, crapemyrtle, and viburnum. Prior to sticking the cuttings, the basal 3.5 cm of the cuttings were dipped in Schultz TakeRoot Rooting Hormone talc (Schultz Co., St. Louis, Missouri; 0.1% indole-3-butyric acid) and inserted into one of eight propagation substrates. Substrates were horticultural coarse grade perlite (PER; Scotts Miracle Grow, Marysville, Ohio), peat moss (PM; Majestic Earth, Agawam, Massachusetts), coconut coir (CC; AgroCoir, Agrococo, Laguna Niguel, California; Initial EC = 0.5 $mmhos \cdot cm^{-1}$) and parboiled rice hulls (PBH; Riceland Foods, Stuttgart, Arkansas). Substrates were used individually or in combination (1 : 1 v/v) as listed in Table 1.

Cuttings were stuck in 38-cell plastic trays (5.5 cm top inside diameter (ID) and 3.8 cm bottom ID and 5.8 cm height) to a depth of 4 cm. Trays were placed under intermittent mist in a poly-covered greenhouse with 50% black shade cloth. The greenhouse temperature was maintained between 21 °C and 32 °C. The mist cycle was controlled by an electronic leaf (Phytotronics, Inc., Earth City, Missouri) with an average cycle of 15 sec per 6 min during 24 h. Rooting results for crapemyrtle and forsythia were evaluated on 29 July 2009 (62 days after sticking). Rooting substrate was carefully removed from the cuttings. The longest root on each cutting was measured as well as the number of roots per cutting. Roots were excised from the cutting using a razorblade and then weighed. Cutting mortality was monitored during the rooting period.

The experimental design was completely randomized with eight substrates, three species, and nine single cutting replicates. Data were analyzed with JMP 8 (SAS Institute, Inc., Cary, North Carolina) and means separated by Tukey's HSD test ($P = 0.05$).

**Table 2.** Effect of rooting substrate on cutting survival and rooting percentage for forsythia and crapemyrtle semihardwood cuttings.

| | Rooted (%)[Z] | | Alive, but not rooted (%)[Y] | | Mortality (%)[X] | |
|---|---|---|---|---|---|---|
| Substrate[W] | Forsythia | Crapemyrtle | Forsythia | Crapemyrtle | Forsythia | Crapemyrtle |
| PER | 89 | 100 | 11 | 0 | 0 | 0 |
| PER:PM | 100 | 100 | 0 | 0 | 0 | 0 |
| PM | 100 | 89 | 0 | 11 | 0 | 0 |
| PM:PBH | 100 | 56 | 0 | 33 | 0 | 11 |
| PBH | 89 | 56 | 11 | 0 | 0 | 44 |
| PBH:CC | 100 | 56 | 0 | 0 | 0 | 44 |
| CC | 100 | 56 | 0 | 0 | 0 | 44 |
| CC:PER | 100 | 100 | 0 | 0 | 0 | 0 |

[Z]Percentage of cuttings rooted as of 29 July 2009.

[Y]Percentage of cuttings alive, but not rooted as of 29 July 2009.

[X]Percentage of cuttings that died in the mist bed between 27 May and 29 July 2009 (62 days).

[W]Substrates were used individually or in combination (1 : 1, v/v): PER = perlite; PM = peatmoss; PBH = parboiled rice hulls; CC = coconut coir.

## RESULTS

Cuttings from forsythia and crapemyrtle were harvested on 29 July 2009 and evaluated for rooting response. Viburnum cuttings were not harvested on this date since they had not yet rooted. Rooting substrates evaluated and the initial and final pH are listed in Table 1. In general substrate pH decreased during the rooting period. The exceptions to this were PER and PER:PM in which substrate pH increased during the rooting period (Table 1).

**Effect of Rooting Substrate on Cutting Survival and Rooting Percentage for Forsythia and Crapemyrtle Semihardwood Cuttings**. In general rooting percentage was higher for forsythia than crapemyrtle (Table 2). The highest rooting percentage for both species was observed in PER:PM and CC:PER. For crapemyrtle the highest cutting mortality was observed in PBH, PBH:CC, and CC substrates. The highest cutting mortality for viburnum (data not shown) was in PER:PM, and PM. This high mortality may be explained by the very low pH of these substrates. Although not quantified, basal necrosis was observed on forsythia and crapemyrtle cuttings in these same substrates. This basal necrosis did not seem to decrease rooting performance in these two species. We chose to evaluate the number of cuttings that were alive and healthy at the time of data collection, but had not yet rooted, since it is likely that these cuttings would eventually root given enough time.

**Effect of Rooting Substrate on Root Length, Root Fresh Weight, and Number of Roots per Cutting.** Mean number of roots per cutting showed a significant interaction between substrate and species, therefore the two species were analyzed separately. Rooting substrate had no effect on the number of roots per cutting for crapemyrtle, however, it did effect the number of roots per cuttings for forsythia (Table 3). Mean number of roots per cutting was significantly larger when forsythia cuttings were rooted in PM than PER, PBH, or CC. For root length and fresh weight, because there was no significant interaction between substrate and species,

**Table 3.** Effect of rooting substrate on mean number of roots for forsythia and crapemyrtle.

| | Mean roots (No.) | |
|---|---|---|
| Substrate[Z] | Forsythia | Crapemyrtle |
| PER | 8 b[Y] | 3 a |
| PER:PM | 12 ab | 5 a |
| PM | 16 a | 5 a |
| PM:PBH | 12 ab | 5 a |
| PBH | 8 b | 5 a |
| PBH:CC | 10 ab | 4 a |
| CC | 9 b | 5 a |
| CC:PER | 11 ab | 4 a |

[Z]Substrates were used individually or in combination (1 : 1, v/v). PER = perlite; PM = peatmoss; PBH = parboiled rice hulls; CC = coconut coir.

[Y]Similar letters within columns were not significantly different at $P = 0.05$ using Tukey's HSD test.

**Table 4.** Effect of rooting substrate on mean root length and root fresh weight for forsythia and crapemyrtle.

| Substrate[Z] | Mean longest root (cm) | Mean root FW[X] (mg) |
|---|---|---|
| PER | 9.4 b[Y] | 449.3 b |
| PER:PM | 15.8 a | 993.3 a |
| PM | 15.9 a | 995.6 a |
| PM:PBH | 14.2 ab | 948.0 a |
| PBH | 12.6 ab | 686.7 ab |
| PBH:CC | 13.8 ab | 679.9 ab |
| CC | 11.8 ab | 592.6 ab |
| CC:PER | 14.5 a | 858.2 ab |

[Z]Substrates were used individually or in combination (1 : 1, v/v). PER = perlite; PM = peatmoss; PBH = parboiled rice hulls; CC = coconut coir.

[Y]Similar letters within columns were not significantly different at $P$= 0.05 using Tukey's HSD test.

[X]FW = Fresh weight.

the data were analyzed as an average of both species. Root length was significantly longer in PER:PM, PER, and CC:PER than PER (Table 4). Also PER:PM, PM, and PM:PBH substrates yielded significantly larger root mass than PER.

## DISCUSSION

Based on the rooting percentage and the number of roots per cutting under these rooting conditions, PM continues to be a very good rooting substrate. This is somewhat surprising considering the low substrate pH (approximately 3.5). Based on these same criteria, PER:PM, and CC:PER also appear to be good rooting substrates under these rooting conditions. While fairly similar in physical properties, these two substrates differ greatly in substrate pH. Parboiled rice hulls (PBH), which have not previously been investigated as a rooting substrate, appear to be a suitable rooting substrate when combined with peat moss.

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