# Substituting Pine Wood for Pine Bark Affects Physical Properties of Nursery Substrates

Pine bark is included in container nursery substrates at 60% to 80% by volume for most substrate blends. Cost of pine bark is dependent on factors such as transportation and processing cost that are tied directly to fuel cost. Alternative sources to pine bark that are regionally abundant and sustainable are needed for nursery substrates. The objective of this research was to determine the influence of substituting pine bark at commercial nursery operations with commercially harvested and processed pine wood on substrate physical properties.

Four cooperating nursery sites were recruited to use pine wood as a substitute for 0%, 50%, or 100% of the pine bark fraction in their substrate while using their traditional physical and chemical amendments (Table 1). Physical properties including particle size distribution (PSD), air space (AS), container capacity (CC), total porosity (TP), unavailable water (UAW), bulk density ($D_b$), and moisture characteristic curves (MCC) were determined for each substrate at each cooperator site. Amendment with pine wood did not have any consistent or predictable effect on AS, CC, TP, or $D_b$ of the resultant substrates (Table 2). Pine wood had little identifiable effect on plotted MCC (Figure 1), although it reduced calculated available water in one substrate.

It was concluded that substitution of pine bark with pine wood can result in changes to substrate physical properties that might lead to irrigation management changes, but none of these changes were considered negative or drastic enough to cause physical properties to be outside of acceptable ranges.

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Table 1. Description of substrate components and amendments of the standard substrate for each cooperating nursery site.

| Site | Substrate components | Fertilizers incorporated | Other amendments |
|---|---|---|---|
| Site 1 | 100% pine bark | Harrell's 18-2-5 at 6.5 kg·m$^{-3}$ | AquaGro 2000[z] at 0.6 kg·m$^{-3}$ |
| Site 2 | 67% pine bark | Harrell's 18-4-8 at 4.7 kg·m$^{-3}$ | Bifenthrin[y] at 3 kg·m$^{-3}$ |
| | 20% sphagnum peat | Harrell's 14-7-0 premix at 4.2 kg·m$^{-3}$ | |
| | 13% MSW compost[x] | | |
| Site 3 | 60% pine bark | Osmocote 15-9-12 at 4.7 kg·m$^{-3}$ | |
| | 30% sphagnum peat | Dolomitic limestone at 4.4 kg·m$^{-3}$ | |
| | 10% sand | | |
| Site 4 | 65% pine bark | Dolomitic limestone at 5.0 kg·m$^{-3}$ | |
| | 21% sphagnum peat | | |
| | 7% Regrind compost[w] | | |
| | 7% haydite[v] | | |

[z]Media surfactant.
[y]Insecticide.
[x]MSW = municipal solid waste compost.
[w]Regrind compost is a hammermilled, steam-sterilized, composted product comprised of unsold plants from previous seasons. This material is produced and used exclusively by the cooperating site.
[v]Expanded shale lightweight aggregate.

Table 2. Physical properties of substrates from four cooperating nursery sites.

| Cooperator site[y] | Pine wood substitution (%)[x] | Air space[w] | Container capacity | Total porosity | Unavailable water | Bulk density |
|---|---|---|---|---|---|---|
| | | (%) | | | | (g·cm$^{-3}$) |
| Site 1 | Standard | 31.9 c[v] | 45.7 NS | 77.6 c | 29.9 a | 0.194 a |
| | 50:50 PW:PB | 40.0 b | 45.0 | 84.6 b | 26.4 b | 0.179 b |
| | 100:0 PW:PB | 48.7 a | 42.3 | 91.6 a | 24.2 c | 0.161 c |
| Site 2 | Standard | 26.9 NS | 60.6 NS | 87.5 NS | 24.7 NS | 0.178 a |
| | 50:50 PW:PB | 26.3 | 59.1 | 85.4 | 24.2 | 0.157 c |
| | 100:0 PW:PB | 28.8 | 58.9 | 87.7 | 23.7 | 0.167 b |
| Site 3 | Standard | 16.5 b | 58.0 a | 74.5 b | 25.8 a | 0.268 a |
| | 50:50 PW:PB | 34.0 a | 52.3 b | 86.3 a | 22.5 b | 0.244 b |
| | 100:0 PW:PB | 36.1 a | 50.9 b | 87.0 a | 19.8 b | 0.238 b |
| Site 4 | Standard | 21.9 NS | 55.8 c | 77.7 c | 21.4 b | 0.225 a |
| | 50:50 PW:PB | 20.2 | 63.5 b | 83.6 b | 24.4 a | 0.200 c |
| | 100:0 PW:PB | 20.3 | 68.2 a | 88.5 a | 23.8 a | 0.215 b |

[x]Sites 1 through 4 substrates consisted of 100%, 67%, 60%, and 65% pine bark, respectively.
[w]Air space is percent volume of a 7.6 × 7.6-cm core filled with air after saturation and drainage. Container capacity is percent volume of the same core filled with water after drainage. Total porosity is calculated as the sum of air space and container capacity. Unavailable water is the percent volume of water in a 7.6 × 2.5-cm core at 1500 kPa.
[v]Means with different letters within a column and cooperator site are significantly different according to Fisher's protected least significant difference test ($\alpha = 0.05$).
NS = nonsignificant difference for a group of means within a column and cooperator site.

Figure 1. Moisture characteristic curves for substrates at four cooperating nursery sties.