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

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Abstract. **Pine bark (PB) is currently imported from southern U.S. states to nursery growers in the upper midwest and northeast United States. Alternatives to PB that are regionally abundant and sustainable are needed for nursery substrates. The objective of this research was to determine the influence of pine wood (PW), which consisted of chipped and hammermilled pine trees (excluding branches and needles) on substrate physical properties when substituted partially or wholly for PB in substrates typical of Ohio. Four cooperating nursery sites, each with unique substrates comprised primarily of PB, were recruited to use PW as a substitute for 0%, 50%, or 100% of the PB fraction in their substrate. All other physical and chemical amendments used traditionally at each site were incorporated. 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. Pine wood was generally more coarse than all but one of the PB materials used by the four cooperating sites. Amendment with PW did not have any consistent or predictable effect on AS, CC, TP, or D_b of the resultant substrates. Pine wood had little identifiable effect on plotted MCC, although it reduced calculated easily available water in one substrate. It was concluded that substitution of PB with PW 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.**

Pine bark is the primary component in container nursery substrates, comprising 60% to 80% by volume of most substrate blends. Pine bark is a commodity used by other industries including fuel generation, fiber (Lu et al., 2006), charcoal, landscape mulch, and as a source for extracting biochemicals. Pine bark is primarily generated as a byproduct in the forest products industries, in which trees are debarked for the purpose of obtaining clean wood. The price for PB at any given time is dependent on supply/demand dynamics in the forest products industries as well as transportation and processing costs, which are tied directly to fuel costs.

A compelling body of research has emerged on the use of whole pine trees as an alternative component to replace PB as the base substrate (Boyer et al., 2008; Fain et al., 2008, Jackson et al., 2010; Wright and Browder, 2005). The nursery and greenhouse industries can bypass the forest products industry by harvesting whole trees using independent contractors, thus avoiding dependency on the economic volatility of the forest products industry. This research is also appealing to northern U.S. states that could use local pine tree stands instead of the current practice of importing PB from wood mills located primarily in southern U.S. states. The goal of this research was to evaluate the horticultural feasibility of using PW to replace all or part of the PB fraction currently used in container nursery production in Ohio. Specifically, the first objective was to determine the influence of substituting PB at commercial nursery operations with commercially harvested and processed PW on substrate physical properties.

Materials and Methods

Chipped pine (*Pinus taeda*) logs, including bark and wood but excluding branches and needles, were secured commercially from southern Ohio in Mar. 2011. Chips were passed through an industrial hammermill twice (Peterson Pacific, Eugene, OR), first through 7.5-cm screens and then through 5.0-cm screens. The resulting material, hereafter referred to as PW, was stored in a large unprotected pile until delivery to four nursery cooperators throughout northern Ohio identified hereafter as Sites 1 through 4. Once delivered, each cooperator was instructed to produce three substrate blends including: 1) their standard substrate (Table 1) with PB as the primary component; 2) a modified substrate with 50% of the PB replaced by PW but with all other physical and chemical amendments similar to their standard substrate; and 3) a modified substrate with 100% of the PB replaced with PW but all other amendments similar to the standard substrate. All substrates were mixed at each cooperating nursery site using their standard equipment and mixing procedures. The resulting substrates were piled on concrete slabs until they were filled in pots for crop production. Before filling pots, a subsample of each substrate was collected and stored in plastic tubs in a climate-controlled building until analyses could be completed. In addition to the mixed substrates, a sample of the PB used by each cooperating site was also collected, stored, and analyzed.

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.

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