A Comparison of Nutrient Requirements Between Pine Chip and Pine Bark Substrates

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Significance to Industry: Japanese holly plants were grown in pine bark (PB) and pine chip (PC) substrates and fertilized at four different fertility rates. Results suggest that a higher rate of fertilizer is required to achieve plant growth in PC comparable to plant growth in PB. Utilizing PC as a substrate can provide a reliable and beneficial substrate alternative when plants are fertilized adequately.

Nature of Work: Producing substrates from wood products can make it possible both to limit the use of expensive materials like peat and to utilize a renewable forestry resource. Due to the relatively low cost and high availability of wood products, serious consideration should be given to the development of this material as an alternative, organic container substrate. Previous work has shown the acceptable use of wood materials as a component in container substrates when derived from trees (3, 4, and 2). Most recently, Wright and Browder (5) demonstrated that woody and herbaceous plants could be grown in 100% PC substrate produced from a debarked loblolly pine log (Pinus taeda L.), compared to a 100% PB substrate. More research is needed to determine the feasibility of growing plants in a substrate composed of 100% wood material, including the fertility rate required over the production cycle of container grown nursery crops.

The objective of this research was to study the effect of increasing fertilizer rate on growth of Japanese holly (Ilex crenata Thunb.'Compacta') in 100% PC compared to PB. Pine chips were produced by taking chips from roughly ground debarked pine logs and further grinding them in a hammer mill to pass through a 6.35 mm (0.25 inch) screen. Pine chips were amended with 5% (by volume) 16/30 particle size calcined clay (Oil-Dri Corp., Chicago, IL.) and 0.6 kg·m-3 (1 lb·yd-3) CaSO4. No pre-plant amendments were added to PB since none are needed for standard Japanese holly production. Treatments of Osmocote Plus (15N-3.9P-10K) (O.M. Scott Horticulture Products, Marysville, OH) were incorporated in PB and PC at rates of 3.5, 5.9, 8.3, or 10.7 kg·m-3 (6, 10, 14, and 18 lb·yd-3) respectively. Japanese holly liners were potted in 3.8 liter (1 gal) plastic containers containing either PB or PC and grown on greenhouse benches in Blacksburg, VA. This study was a completely randomized design with six single container replications per treatment.

At the end of the experiment, shoot dry weights were determined as well as substrate respiration rates (µmol CO2·m-2·s-1) for each substrate and treatment using a LI-6400 soil CO2 flux chamber (LI-COR, Lincoln, NE). All data were analyzed by ANOVA using SAS and subjected to regression analysis using SigmaPlot (version 9.01 SPSS Inc., Chicago, IL).

Results and Discussion: There was a significant substrate x fertilizer rate interaction for shoot dry weight: at fertilizer rates of 3.5 and 5.9 kg·m-3 (6 and 10 lb·yd-3), shoot dry weight was higher for PB than PC; at 8.3 kg·m-3 (14 lb·yd-3), dry weight was about equal for the two substrates; at 10.6 kg·m-3 (18 lb·yd-3), dry weight was higher for PC than PB (Fig. 1). Substrate respiration rates (µmol CO2·m-2·s-1) were higher in PC than in PB with the magnitude of difference decreasing as fertilizer rate increased (Fig. 2). The higher fertilizer requirement may relate to the higher substrate respiration for PC (Fig. 2). Higher respiration may be due to the higher C/N ratio of PC , as reported in previous work (1), compared to PB, leading to increased microbial N immobilization with PC. A higher fertilizer requirement for PC compared to PB is of concern and must be addressed before PC can become a viable substrate for nursery crop production.

Literature Cited:

1. Bollen, W.B. and K.C. Lu. 1957. Effect of Douglas fir sawdust mulches and incorporations on soil microbial activities and plant growth. Soil Sci. Soc. Proc. 21:35-41.
2. Conover, C.A. and R.T. Poole. 1983. Utilization of Melaleuca quinquenervia as a potting medium component for greenhouse production of foliage plants. HortScience 18:886-888.
3. Maas, E.F. and R.M. Adamson. 1972. Resistance of sawdusts, peats, and bark to decomposition in the presence of soil and nutrient solution. Soil Sci. Soc. Amer. Proc. 36:769-772.
4. Pudelski, T. 1978. Using waste products of wood industry and paper mills as substrates and organic fertilizers in growing vegetables under protection. Acta Hort. 82:67-71.
5. Wright, R.D. and J.F. Browder. 2005. Chipped pine logs: A potential substrate for greenhouse and nursery crops. HortScience 40:1513-1515.

Figure 1. Shoot dry weights of Japanese holly grown in pine bark (PB) or pine chips (PC) incorporated with four different rates of Osmocote 15-9-12.

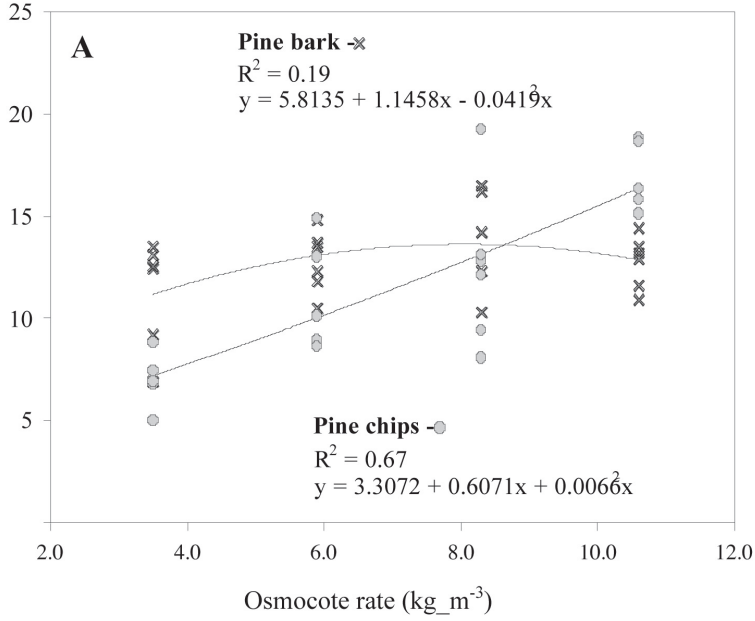

Figure 2. Substrate respiration rates (µmols CO2·m-2·s-1) for pine bark (PB) and pine chips (PC) incorporated with four different rates of Osmocote 15-9-12.