A typical stand of loblolly pine trees. Pine tree substrate can be produced by chipping freshly harvested pine trees and grinding them in a hammer mill.

Photo by Robert Wright

By Brian E. Jackson

Back to the Grind

Pine tree substrate encourages prolific root growth in container plants

Pine tree substrate (PTS) studies at North Carolina State University continue to reveal its benefits and potential as a container substrate.

Wood substrates are different than other traditional substrates in that a new material is created and used rather than mined, such as peat (a non-renewable resource) or using a by-product of another industry, such as pine or Douglas fir bark. The development of a new substrate for container-grown nursery crops is timely since the availability of pine and Douglas fir bark is currently unpredictable due to reduced forestry production and its increased use as fuel and landscape mulch.

What is PTS?

PTS is produced by chipping freshly harvested pine trees, which produces wood chips approximately 1 inch by 1 inch by ¼ inch (typical pulp wood chips). Trees can also be ground in other machines such as tub grinders and mulch grinders, which produce shredded wood that

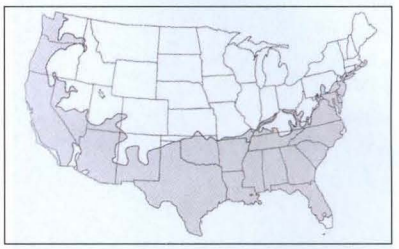

Figure 1: Potential planting range for loblolly pine trees in the United States

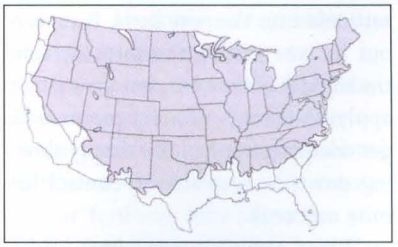

Figure 2: Potential planting range for Eastern white pine in the United States

Three-gallon arborvitae grown in PTS (left) and pine bark (right) have well-developed and solid rootballs with healthy root systems. Shrinkage was no different between the two substrates.

Photo by Brian Jackson

needs to be further processed in a hammer mill to reduce its particle size. When ground in a hammer mill, wood chips pass through screens to produce a substrate with desired particle size range designed to meet specific physical property requirements.

Wood particle size percentages affect substrate water-holding capacity and air space. Research has shown that wood chips produced from pine logs (with or without bark) or entire pine trees (including limbs or needles) are acceptable for producing PTS.

No plant growth difference was observed with the inclusion of bark, limbs or needles compared to growing in pine wood only.

Root growth in PTS

PTS-grown plants exhibit prolific root growth, which is often greater than that of plants grown in bark or peat-based substrates. The higher percentage of air space in PTS is likely the reason for accelerated plant root growth.

Studies were conducted on woody

PTS can be produced in a hammer mill to any specified particle size. Pine trees can be harvested, chipped and processed into a substrate and potted the same day since no composting or aging of the wood is required.

Photo by Robert Wright

shrubs to compare root growth in PTS and in pine bark. Preliminary data (root number and length) showed faster and a higher number of roots growing from the rootball of container-grown plants PTS compared to pine bark. The Horhizotron, a root growth measuring apparatus, was used to conduct this study. The accelerated root growth is considered an advantage of PTS-grown plants, especially when stepping up plants into larger containers or when being transplanted into the landscape.

Estimated cost of PTS

Pine chips produced for the paper industry or for fuel can be purchased for $5 to $7 per cubic yard, but price varies by availability and market. After adding the costs of grinding and extra fertilizer, a nursery could produce a substrate for less than $15 per cubic yard, compared to at least $40 for traditional peat substrates and $15-$20 or more for aged pine bark, depending on shipping distance.

One cost advantage of PTS, and potentially any wood substrate, is it can be produced locally where acceptable tree species are available.

The potential geographic planting range of loblolly (Figure 1) and Eastern white pines (Figure 2) covers a large portion of the country where greenhouses and nurseries are located. The reduction in shipping costs could be substantial if substrates can be locally grown and produced. Another cost advantage of PTS is related to its inherently high air space (compared to peat or bark substrates) which results in no cost associated with adding aggregates such as perlite, vermiculite or pumice to improve aeration.

PTS commercialization efforts

PTS research began in 2004 at Virginia Tech. The university has patented the process of grinding wood (regardless of wood/tree species) for the specific

purpose of using the material as a substrate for plant growth. If a wood substrate is produced that contains 0.5 percent of its volume in particles 0.05-mm or less, the patent is applicable and appropriate actions should be taken to respect the patent and its potential licensing requirements.

As a result of grower interest in PTS and wood substrates in general, an effort has been underway with a number of growers to test PTS on a wide range of nursery and greenhouse crops. Commercial substrate producers see the potential of PTS as a viable container substrate because of the cost savings.

The North Carolina State research team is working with these companies to evaluate PTS for commercial production. The opportunity also exists for larger growers — both nursery and greenhouse — or a consortium of smaller growers to purchase a hammer mill and produce PTS for themselves where pine chips are available. Future efforts will focus

PTS changes fertilizer rates

There are different fertility requirements for crop production in pine tree substrates (PTS). An additional 3-4 pounds of controlled-release fertilizer is needed per cubic yard of PTS, compared to pine bark, for the production of woody plants. The need for additional fertilizer continues into the second year of a two-year crop.

Production of herbaceous crops require an additional 100 ppm nitrogen during fertigation events compared to plants grown in either pine bark or peat moss substrates.

If perennials are fertilized with controlled release fertilizers, apply supplemental liquid fertilizer immediately after transplanting plugs.

The reason for the additional fertilizer is due to higher microbial nutrient immobilization which occurs in PTS compared to traditional substrates. But nitrate leaching is less than nitrate leaching in pine bark.

on commercialization of PTS by helping growers and commercial substrate companies apply research results from our many experiments to the production and use of PTS.

For more: *www.ncsu.edu/project/woodsubstrates.*

The author wishes to acknowledge Robert Wright at Virginia Tech for beginning this pine tree substrate project in 2004, and for guiding much of the research reported in this article. The author also wishes to express appreciation to the American Floral Endowment, Virginia Agricultural Council, Virginia Nursery & Landscape Association and numerous nurseries in the Mid-Atlantic region for supporting this research.

Brian E. Jackson is assistant professor, Department of Horticultural Science, North Carolina State University, Raleigh, N.C., brian_jackson@ncsu.edu.

The Horhizotron is used to evaluate root growth of woody shrubs in PTS and pine bark.

Photo by Brian Jackson