Grinding Pine Logs To Use As A Container Substrate

Learn how a new container substrate can help growers take a different approach to production with this research from Virginia Tech.

By Robert Wright and Joyce Latimer

Researchers in the Department of Horticulture at Virginia Tech are grinding whole pine logs to create a new container substrate. This new substrate, called WoodGro, is a different approach to container substrate production: This new material can be used as a container substrate rather than mining peat (a non-renewable resource) or using a byproduct of another industry, such as pine bark or coconut coir. Whole debarked loblolly (*Pinus taeda*) pine logs are chipped, and the chips are further ground to produce a substrate designed to meet specific substrate requirements (porosity, water-holding capacity, etc.) for a wide variety of plant genera and plant sizes at an affordable cost (See Figure 1, top right).

Cost

Pine chips produced for the paper industry or for fuel can be purchased for $5-$6 per cu.yd. After adding the costs of grinding and fertilizer additions, one could conceivably produce a substrate for less than $15 per cu.yd. compared to $40 or more for traditional peat-lite substrates.

Another advantage of this substrate material is it can be produced in close proximity to growers, where acceptable tree species are available. This is a cost advantage compared to peat moss, which incurs shipping costs from Canada or point-of-substrate manufacturing. Since the substrate is ground to the correct particle size to provide the desired aeration and water-holding capacity, there is no cost associated with adding aggregates, such as perlite and vermiculate. We have shown that substrate air space decreases and water-holding capacity increases as pine chips are ground more finely (See Figure 2, bottom right).

For comparison purposes, the air space (16.8 percent) and water-holding capacity (68.4 percent) of a commonly used commercial peat-lite substrate are designated with an "x" on Figure 2. Therefore, irrigation requirements for WoodGro during production can be similar to commercial substrates if the pine chips are ground appropriately. A range of greenhouse crops have been produced successfully with this substrate, including chrysanthemum, poinsettia, geranium, as well as seven genera of annuals and seven genera of herbaceous perennials.

Fertilizer Requirements

In most studies, additional fertilizer is required for WoodGro compared to a commercial peat-lite substrate. Figure 3, page 36, shows the effect of fertilizer rate on growth of poinsettia 'Prestige'. At the lower fertilizer rates, growth is higher with peat-lite substrate, but at the higher rates, there is no difference in growth. A typical growth response to increasing fertilizer additions is shown in Figure 4, page 36, for chrysanthemum 'Baton Rouge'. We have concluded that it takes about 100 ppm more nitrogen from a 20-10-20 soluble fertilizer to produce comparable plants in WoodGro compared to the commercial peat-lite substrate. This was also the case for poinsettia.

Incremental additions of peat moss to WoodGro have been shown to improve growth ▶

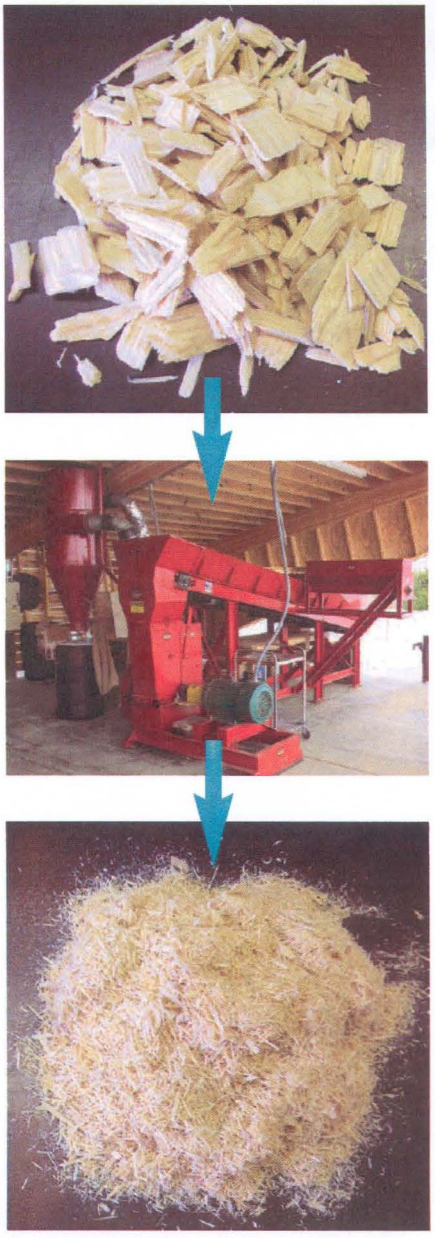

Figure 1. Pine tree chips can be further ground with a hammer mill to produce a substrate that show promise as an alternative to peat moss and pine bark. (Photos: Robert Wright)

Effect Of Substrate Particle Size

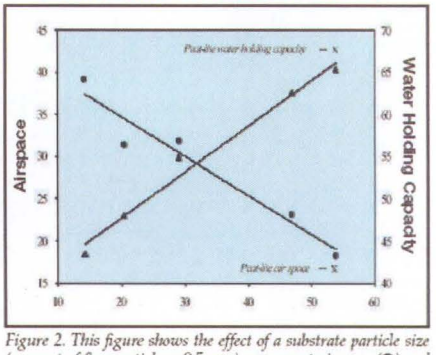

Figure 2. This figure shows the effect of a substrate particle size (amount of fine particles <0.5 mm) on percent airspace (●) and percent water holding capacity (▲). How these values compare with a commercial peat-lite substrate is also noted with an "x."

Figure 3. Poinsettia 'Prestige' is shown grown at different fertilizer rates of a 20-10-20 soluble fertilizer in peat-lite (left) or WoodGro (right) substrates. At the lower fertilizer rates (100-ppm nitrogen), plants are larger in peat-lite, but at the higher fertilizer rates (300-ppm nitrogen), there is no difference in growth.

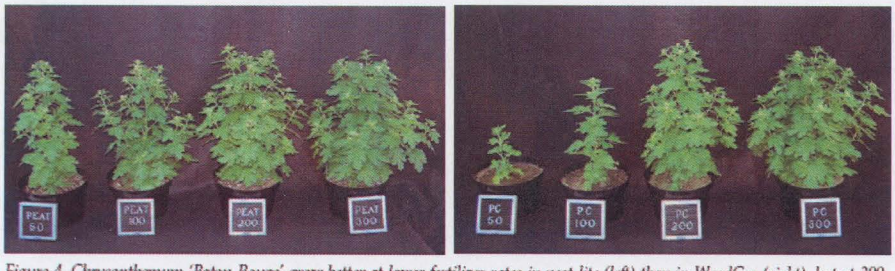

Figure 4. Chrysanthemum 'Baton Rouge' grow better at lower fertilizer rates in peat-lite (left) than in WoodGro (right), but at 300-ppm nitrogen, growth is not different.

of marigold, especially at lower fertilizer rates (See Figure 5, right). This is likely because peat increases the retention of nutrients available for plant uptake and growth, whereas at the higher rates of fertilizer, nutrient retention is not as relevant. Additions of peat may also reduce the effect of toxins in newly harvested trees. Root growth is also equal and often better in this substrate compared to root growth in peat-lite or pine bark.

Nitrogen Leaching And Immobilization

Reasons for the higher nitrogen requirement are likely twofold: There is more leaching of nutrients from WoodGro since the CEC (substrate/soil's ability to hold nutrients) is very low compared to peat, and there is microbial immobilization (tie up) of nitrogen with WoodGro due to the high carbon:nitrogen ratio of the non-composted chips compared to peat moss.

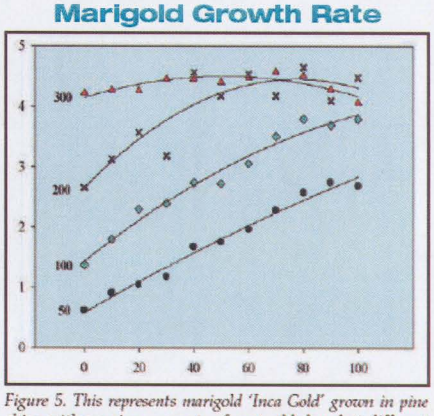

Figure 5. This represents marigold 'Inca Gold' grown in pine chips with varying amounts of peat added and at different fertilizer rates. Adding peat moss to pine chips increased growth, but at the higher rates of fertilizer (300-ppm nitrogen from a 20-10-20), adding peat did not influence growth.

Evidence of a higher level of microbial immobilization of nitrogen has been documented by

Fig. 6. Vinca 'Cooler Pink' (left), marigold 'Bonaza Yellow' (middle) and petunia 'Wave Purple' (right) grown in quart containers in a pine bark substrate (left side) and WoodGro (right side). Plants were transplanted to landscape in June 2005 and evaluated in September. There were no visual differences in landscape performance.

demonstrating that substrate respiration (measure of microbial activity) is about five times higher than peat-lite. Even though there is evidence of microbial activity, it does not result in substrate shrinkage of WoodGro over a 2-3 month plant production cycle for greenhouse crops. Even after 1-2 years in larger containers with woody nursery crops, very little substrate shrinkage has occurred with this substrate material compared to pine bark.

Landscape Performance

To answer questions pertaining to the landscape performance of bedding plants and herbaceous perennials produced in WoodGro, a wide variety of these plants has been glasshouse grown with the substrate and then transplanted into outdoor soil for evaluation during the 2005 and 2006 summers. There was no visible difference in quality and growth after a summer in the landscape between plants produced in WoodGro and those produced in a pine bark substrate (See Figure 6, above).

Toxins

In some instances, when freshly harvested chips are used as a substrate, there can be a considerable growth reduction of young marigold and tomato seedlings when planted as 144-cell plugs into WoodGro. However, aging of cut logs before grinding and aging of WoodGro after grinding reduced the extent of the toxicity. This growth reduction is likely due to the presence of polyphenolics and other organic compounds present in wood at the time of harvest that may dissipate with time.

Conclusions

Research to address issues related to additional nutrient requirements and toxins in newly harvested logs is ongoing. Overall, it appears that ground pine trees offer a viable alternative to peat moss and pine bark as a container substrate. WoodGro offers potential cost reductions while providing a clean, durable, high-quality substrate for floricultural crops. GPN

Joyce Latimer is a professor and extension specialist for greenhouse crops in the Department of Horticulture, Virginia Tech., Blacksburg, Va. She can be reached at jlatime@vt.edu or (540) 231-7906. Rober Wright is a professor of horticulture at Virgina Tech. He can be reached at wrightr@vt.edu.