

Current Issues and Recent Advances in the Container Substrate Industry

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Significance to Industry: There have been, are, and always will be issues relating to growing media that deserve attention and consideration by both growers and mix manufacturers. The upside to this reality is that there has been a lot of valid research conducted on the discovery, development and use of many successful alternative media components in the past 8-10 years. Looking forward, the biggest factors in determining if any new or alternative components are viable are: 1) location of the grower, 2) proximity of growing media components and 3) the transportation costs associated with them. Every grower and mix manufacturer must look at their own situation and assess what materials are cost effective to be worth their investment. Growers should be cautious when changing mixes or trying new components. Based on the broad range of local alternative components, most locations will have materials available to them that are viable options for cutting costs while maintaining proper growing media quality. After all, the goal of researching these new materials is not to change grower practices, but to provide stable, sustainable and cost effective alternatives to growers.

Nature of Work: Growing media selection and performance remain one of the most important factors in horticultural crop production. The Horticultural Substrates Laboratory (HSL) at NC State University has been working on soils and growing media-related issues since 1980 and at no time during that history has our industry had more interest in new discoveries in growing media research than now. In the past eight years there have been a record number of publications (trade magazine, extension bulletins, websites, scientific journals, etc) addressing issues with traditional growing media components and introducing alternative materials. Several factors have prompted the spike in grower and manufacturer interest in recent years, including:

- 1) Canadian peat shortage of 2011 due to unusually wet weather during the harvest months which resulted in the lowest peat supplies in decades. This saw a significant increase in growing media costs and in some cases the utilization of mixes containing peat extenders/alternatives.
- 2) Pine bark industry saw increased cost and lower supplies (2010-2011) due to proposed government subsidies for biofuel (Biomass Crop Assistance Program – BCAP). This threat prompted interest in alternatives for the nursery industry but also elicited concern from growing media manufacturers as well considering the heavy use of pine bark in many greenhouse mixes.

- 3) Variability in pine bark consistency, water holding capacity, and hydrophobicity from source to source (supplier to supplier). Partially as a result of the BCAP threat and partially due to trends in consumer demand, the processing and handling of pine bark has changed in recent years which has led to changes in product quality and performance in some situations.
 - 4) High cost of perlite in growing media continues to warrant interest in alternatives. In most situations, perlite is the single most expensive media component (by volume). In addition, a more recent complaint of many growers and mix manufacturers has been the variability in perlite particle size and consistency from source to source (and from batch to batch). This variability and inconsistency leads to variable air and water properties in growing mixes.
 - 5) General increase in transportation and fuel costs which have affected the cost of all growing media components, and as a result led to greater interest in locating and developing "local" growing media components. Transportation costs are, and will remain the biggest concern for the growing media industry. Not only do transportation costs influence peat, perlite and pine bark but these costs will also be the defining factor that determines the feasibility and success of any new or alternative media component in the future.
 - 6) The growing public perception and demand of "green", "sustainable" and "local" concepts have made its way to growers and mix manufacturers attempting to meet these market trends/demands and offer products that fit these requirements. The interest in local alternative media components has the immediate advantage of reduced freight (transportation costs) to growers and distributors but a more broad-based and novel advantage may be the opportunity for new marketing strategies. Many growing mix manufactures are already promoting new product labels that include phrases like "all natural", "organic and sustainable", "environmentally friendly" to highlight the use of new alternative and sustainable components in their mixes.
 - 7) Storage issues associated with long-term quality control of growing mixes that contain new alternative organic materials that are decomposing, consuming the starter charge, or experiencing substantial pH changes during storage. The rush to supply new growing mix formulations (or components) has sometimes precluded the long-term evaluations during storage (bulk or bags) that is needed for product quality assurance.
 - 8) Lack of understanding of the processing requirements and variables that influence the manufacturing of organic materials (i.e. trees/wood) for use in growing media. With many growers and mix manufacturers currently developing their own new mixes, many are purchasing equipment to process raw organic materials and are not producing consistent products. The initial processing/harvesting of materials slated for use as growing media components is as important as any other factor or step in the production of and successful use of growing media. Processing is likely THE most important factor. If not processed correctly, other factors including blending, handling, storage, amendments (lime, starter charges, wetting agents, etc.) are of secondary importance in many cases. Processing is also the key to being able to consistently reproduce any growing media or media component from region to region, season to season or year to year. Currently, there is a tremendous void of relevant
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information available to the horticulture industry aimed at addressing issues associated with the processing and engineering of raw organic materials for use as growing media components.

Results of Current Research with Wood Substrates

Perlite Replacements: Pine wood chips (PWC) made from loblolly pine (*Pinus taeda*) are one of the many wood-based growing media components that have been discussed in recent years. Through the extensive research of pine tree substrates (including WholeTree and clean chip residual) there have been many suggestions made that these materials provide the porosity to peat-based greenhouse mixes that would exclude the need for perlite. Until recently, no official experimental data or recommendations have existed on how wood chips can be used as aggregates (2). The main reason for this was due to a lack of consistency and knowledge about how pine wood is processed. Research at NC State University in 2011 and 2012 has provided a wealth of knowledge about using PWC as an alternative to perlite. When amended with peat at ratios of 10, 20 or 30% (by volume) compared to the same ratios of perlite, no differences were seen in 1) physical properties (air and water holding), 2) fertility requirements, 3) plant growth regulator rates/efficacy, 4) disease (*Pythium* sp. and *Rhizoctonia* sp.) occurrence or 5) shrinkage or decomposition (2). Based on these results (and at those ratios), no cultural changes in crop production are needed to switch from perlite to PWC. Even though perlite can be completely substituted with PWC with no change in cultural practices, the addition of 5% perlite to mixes is still advised because the general public (consumers) have the perception that the white particles of perlite are actually fertilizer! It is estimated that the cost of PWC, including the acquisition of pine trees, equipment to process the trees, and actual manufacturing (energy, man hours, etc.) will be ~50% cheaper than perlite. The broad geographic natural range of loblolly pine makes PWC available to local markets across much of the southeastern US with limited/minimal freight costs.

Peat Alternatives/Extenders: Many materials have been touted over the years as the "replacement for peat", yet peat remains a good and viable material for containers. Despite some reports and beliefs, peat is an extremely abundant resource with approximately 270 million acres in Canada alone, of which only a tiny portion is being harvested for horticultural consumption. The peat producers (suppliers) are also going to great lengths (and expenses) to "lightly" harvest peat bogs and restore them after harvest in a way that has minimal impact on the environment. There are materials currently on the market that are able to be used like peat or in conjunction with peat. These we call alternatives or extenders, not "replacements" as it is not possible to "replace" peat due to its specific properties and success as a growing media, but instead only find suitable substitutions to it. Pine tree substrates (PTS) have made the biggest push in the industry in recent years. It was just a few short years ago when the first work was published (2005) on the concept of using fresh, non-composted pine wood as a viable alternative to peat moss in the production of greenhouse crops. At that time, the idea of using fresh wood in mixes was met with much skepticism (with good reason) by the industry, academics and manufacturers. As more and more

researchers (university and mix manufacturer R&D folks) looked into this material and came to the same conclusions that there is indeed great potential with using wood, the perceptions have become more positive and now are very optimistic. Since 2005, more research has been conducted and reported on the use of wood-based substrates or substrates containing wood components, than any other alternative material. Reasons for the high interest in pine tree substrates include: 1) the availability of pine trees (specifically loblolly pine) in the United States, 2) the renewability and sustainability of using pine trees, 3) pine trees are fast growing and conceivably can be grown specifically for use as a substrate component - growing the media of the future - 4) wood/pine fiber has a low bulk density, light weight and can be easily compressed for shipment, 5) crops grown in mixes containing wood have consistently shown increased/improved root growth and 6) pine wood does not breakdown, shrink or really even lose its yellow color during crop production, not even long-term 3-4 month crops. It is important to point out that there is a difference in pine tree substrates (often referred to as pine/wood fiber) used as peat extenders and those that are used for aggregates (PWC described above). Pine wood processed in a fashion to be a peat extender (see section below on processing differences) will be more fibrous in nature, hold and release water similar to that of peat, and can be used up to 40% in a growing mix without many if any changes to irrigation and fertility practices. Above 40%, nitrogen tie-up will be a problem for some crops and increased fertilizer rates will be needed. Wood inherently has a high pH, ranging from ~5.0-6.0 most often, depending on the season of year the trees are harvested. Less lime may be required for mixes containing >30% wood to prevent pH levels from being too high during crop production. Root growth of greenhouse crops grown in mixes containing pine tree substrates (as peat extenders or perlite replacements) has been observed and reported for many years to be enhanced both in speed of rooting and overall root mass (1). Research in 2011-2013 at NC State University has proven this phenomenon to be factual and researchers there are now focusing on how to further modify and improve greenhouse mixes with wood for the specific purpose of enhancing root growth (1).

Pine Wood Chips & Pine Tree Substrate Processing: Recent processing technologies and discoveries have enabled manufacturers to produce different wood components that serve different roles when incorporated in growing mixes. As previously described, pine wood can be used as either a perlite or a peat replacement. Processing of freshly harvested pine trees is the key to make different products from the same trees. If trees are harvested and first passed through a "shredder" to reduce the log to smaller pieces before being further processed in a hammer mill the end result will be more "fibrous" (peat-like) compared to pine logs that are first passed through a "chipper" and then further processed through a hammer mill will produce "blockular" wood chips that have clean edges, no fibers and are sized similar to perlite particles. Many additional factors other than machine type are important in the processing of wood including 1) screen size of hammer mill, 2) size (horse power) of hammer mill, 3) air handling system of hammer mill, 4) moisture of wood at the time of grinding, 5) species of wood being ground as well as several others. To produce a consistent wood product these processing factors must be considered.

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