Substrate DISCREPANCIES

Because of variations in pine bark supplies, understand the differences and what they could mean to your crop.

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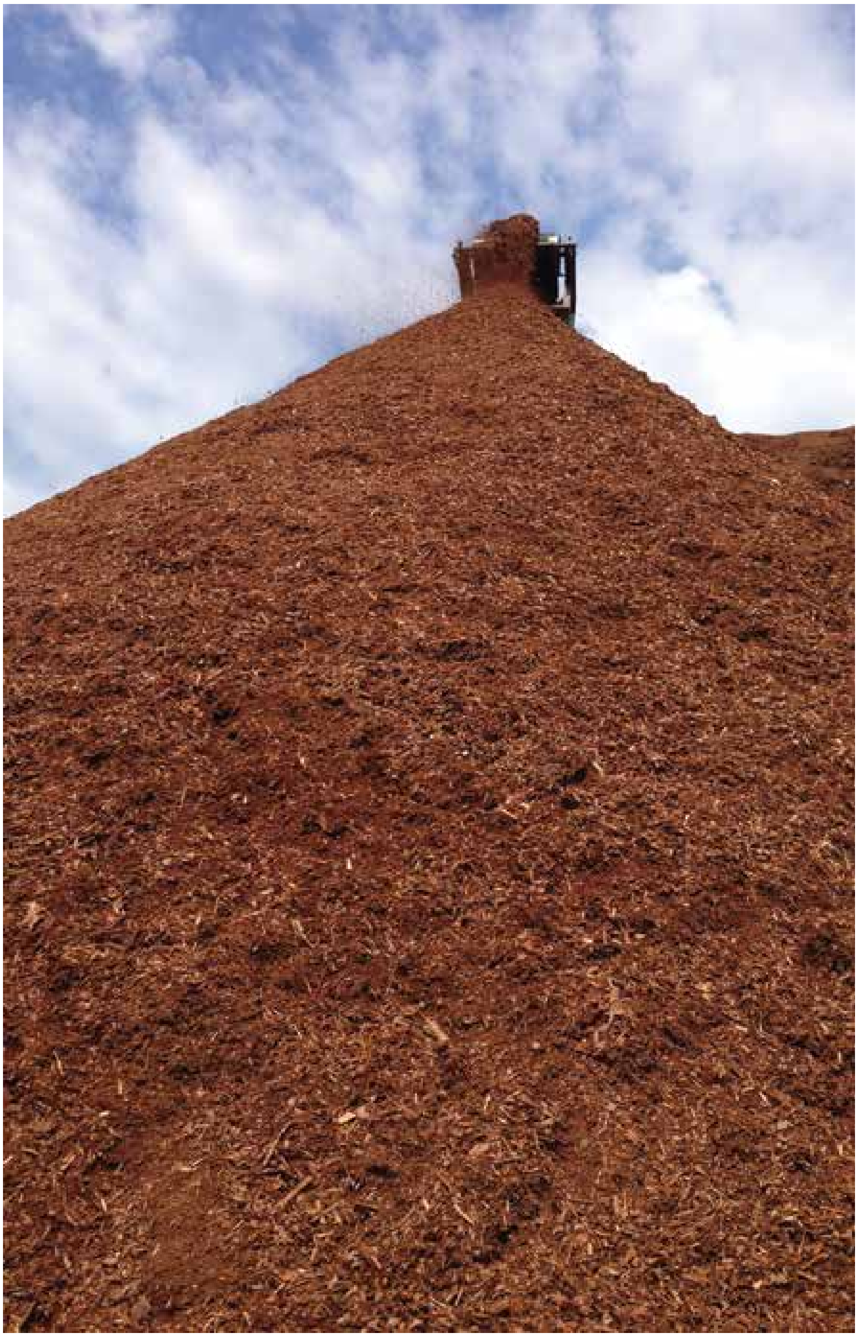


One of these barks is not like the others,
One of these barks just doesn't belong,
Can you tell which bark is not like the others
By the time I finish my pine bark song?

Bark substrates are as traditional and familiar to nursery growers as the lyrics to the Sesame Street song that we all know so well. Bark has been an important component in horticultural substrates for years, and is rapidly increasing in greenhouse professional mixes and in retail potting soil mixes. In the nursery industry, bark is the most common substrate component used in the U.S. Bark is obtained as a byproduct of the timber industry when it is stripped off logs after harvest. After being removed, it is often used as fuel or processed to make many products including landscape mulch/nuggets or horticultural substrates. Bark from loblolly or longleaf pine trees is most prominent in the southern U.S. and Douglas fir bark is predominately used on the West Coast, as it is the abundant species in that part of the country.

Bark is not bark is not bark

This is well known by any grower who has switched bark suppliers and realized that the consistency and properties are not the same. Switching supplies and/or suppliers can often mean different crop management strategies (mainly irrigation) are needed. To assess some of the variation among pine bark supplies, researchers at NC State University conducted a survey of pine bark processors and their products. The processing and handling methods were determined as thoroughly as possible and all materials (fresh and aged barks) were analyzed for 1) pH, 2) EC, 3) seedling toxicity/phytotoxicity, 4) physical properties (porosity, air space, water holding, bulk density), 5) particle size distribution, 6) percent white wood (by volume), 7) physical properties of bark with the white wood removed, 8) percent cambium (inner bark), 9) physical properties of the bark with the cambium removed, 10) influence of sand amendment on physical properties, and 11) wettability (hydration efficiency). A total of 24 bark materials were analyzed from eight different bark suppliers/producers. This article will only highlight some of the differences found.

Aging and handling

Aging is a modified composting process (no nitrogen source added) in which the bark is piled on the ground in windrows and allowed to age for a period of time, usually six months to one year. For some suppliers, the aging time can be significantly less due to space shortages, product demand, or their preference. Our survey found the shortest aging time to be six weeks and the longest to be one year. Regardless, piles should be irrigated during periods without rainfall to prevent excessive drying and piles should be turned periodically to release heat buildup and allow consistent aging. Aged bark will have more fines than unaged bark and therefore will theoretically hold more water once used in a growing media. Proper screening can add or remove the fines generated over time during aging to create very consistent products regardless of the time or method of aging.

White wood and cambium (inner bark) content

White wood is a term used to describe the actual pine wood, or xylem, that accompanies the bark during the debarking process. In five fresh bark supplies shown in this article, the white wood ranged from 5-22 percent and in the aged bark (from the same suppliers as the fresh) it ranged from 5-14 percent. The most likely reason for the differences in white wood content related to the method of bark removal from the logs and/or the initial screening of the fresh bark before processing. We have all seen a bark supply that had a lot of large white wood in it. There is no official standard or guideline for how much white wood is allowed for the bark to be considered "good quality" or "acceptable." However, a general rule is that 10 percent white wood is acceptable in bark mixes. The reality is, white wood is completely OK and with the recent development and use of pine substrates it is acceptable and often beneficial for it to be in substrates.

Cambium (technically the inner bark) is the stringy, often fibrous material that is often found in fresh bark supplies in the spring of the year. This material is often screened from bark before aging, but depending on the processing techniques it can be present in higher amounts. Cambium accounted for 24 percent (by volume) in one of the pine barks tested in our studies. How it "behaves" in a container is not fully understood. It could be beneficial in water holding and wicking properties or it could promote water channeling. Its presence is not necessarily a bad thing, just be aware.

Physical properties

The five bark materials used as examples in this article all had total porosities around 80 percent. The air space of the materials varied greatly from 30-45 percent and the water holding capacities of the barks ranged from 34-51 percent. The recommended BMP guidelines for nursery substrates is 20-30 percent (used to be minimum 10 percent but that has been discounted in recent years as way too low) air space and 45-65 percent water holding capacities. The variation in these properties is direct-

Nursery containers filled with a pine bark substrate that has a high percent white wood content. The white wood particles shown here are very large and would change the hydrophysical properties of the bark (less water holding and channeling of irrigation water).

Bark cambium (inner bark) is often seen in pine bark supplies (top). Much of the material is separated from the bark before aging but some sources can have a high percentage in the bark itself (bottom). This material can change the substrate dynamics, water movement, and air percentages.

ly related to the particle size of the bark, which is a direct result of the processing of the materials. The range of particle sizes (and shapes) in bark fit together in a matrix and helps create the porosity (air and water) of the bark substrate. Processors can screen bark to create any particle size combination.

When the white wood particles were removed from the bark samples, the resulting physical properties were quite interesting. In general, when white wood was removed the air space of the barks generally increased as did the water holding capacities. This varied among sources. What was observed is that it doesn't matter so much what the percent white wood is in a bark mix, it is the particle size of the white wood that makes the difference. For example, 10-15 percent white wood in a bark substrate may not affect physical properties at all if the particle size is similar to the bark, but on the other hand, as little as 5 percent of white wood with a large (length or diameter) particle size can greatly change the physical properties of a bark.

Sand is still often added to bark nursery substrates — whether for the added weight to prevent container blow overs or just because it is "tradition." When sand is added to pine bark it often results in unacceptably high water holding capacities with aged bark sources that contain a lot of fines. In fresh bark substrates, 10 percent sand can effectively increase water holding capacity. Whether sand can increase, decrease, or have absolutely no effect on air and water properties is completely dependent on the bark it is being added to. Other than weight, often nothing positive is gained from its incorporation.

Fresh versus aged bark

Based on conversations with suppliers around the Southeast, industry demand for fresh bark (known as green bark) has increased recently. One of the main driving forces behind the increased interest and use of fresh bark is that it is significantly lighter in weight and thus, cheaper to transport. Fresh bark tends to have more white wood, but even after aging a lot of the white wood remains, it is just stained black and not as easily seen. Freshly harvested bark also possesses a much higher amount of naturally occurring waxes and acids. These waxes can make fresh pine bark repel water, which may complicate irrigation/wetting during crop production. Studies using fresh pine bark have shown that nitrogen immobilization is not an issue that can negatively affect crop growth.

Reasons for supply/supplier variations

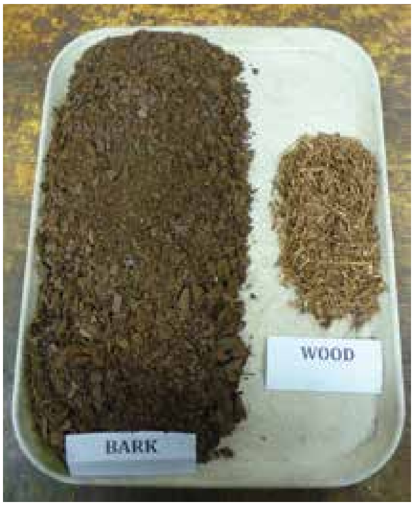
There are many factors that can cause variability in pine bark sources. These variability's can exist between/among different suppliers, but also it can (and very often does) vary from season to season at the same supplier. Let's briefly highlight some of the possible reasons for bark variability.

Biological: 1) Pine species from which the bark is taken. 2) Thickness of the bark at harvest. Pulp trees will have thinner (and less) bark than saw timber trees. The tree planting density can also influence bark thickness. 3) Harvest Season. The harvest date of trees also plays a role in the variability of pine bark. Trees harvested (and bark removed) in the colder months will be more uniform, while trees (bark) harvested in the spring months tends to be more varied and "stringy" and contain more white wood and cambium. During the spring sap is flowing in the pine trees so when the bark is removed from the tree it tends to peel and stick together more than bark that is removed in the colder months when the sap is not flowing. 4) Location of tree harvest. Warmer climates produce faster growing trees (generally speaking) than cooler climates. Tree growth rate and wood formation can influence bark thickness, brittleness, and quality. 5) Soil type the trees were grown in. For example, Manganese (Mn) content of bark (and its influence on plant growth) varies from location to location and is influenced by the soil type. Some Mn toxicities for crops have been reported in recent years.

Mechanical: 1) Method of bark removal from trees. Ring, Drum, or Flail debarking machinery all have different mechanisms of removing the bark from trees. Some may rip and tear the bark more than others and some will include more white wood than others. 2) Hammer milling. The milling of pine bark can be greatly influenced by moisture content of the bark at the time of grinding, thickness/chunkiness of the bark nuggets, screen size in the hammer mill, horse power, speed of the mill, torque and feeding consistency, wear of hammers in the mill, type of hammers in the mill, hammer tip speed, air handling capability of the mill, etc. 3) Handling. Bark can be hammer milled first, then screened and aged. Others may pre-screen the material and then grind and then age. Some age, then screen, then mill. Many different ways to process bark. All/any can produce a good quality product but do not assume every processor/supplier does it the same. For example, if "Supplier A" separates large pine nuggets, mini nuggets and fines. The nuggets and mini nuggets are then bagged and sold retail as decorative landscape mulches and the "fines" portion are then aged and used as/in growing media and then "Supplier B" takes fresh bark nuggets and does not separate it in size fractions

The particles of pine bark have various shapes and sizes. The percentage of each "size class" often referred to as Coarse, Medium, and Fine particles, is determined most by the amount of aging and if it is screened. The percentage of each particle size/group help make up the air and water percentages in a substrate.

but instead the fresh bark is hammer milled to yield a single end-product. The only similarity in the end-products from the two different processes above is that they are both fresh. Otherwise, they now have completely different properties (percent fines, water holding, air space, aging potential, nutrient immobilization, etc.) and therefore will react differently when used in a growing mix. 4) Bark pile management. How often were the piles turned during the aging process? How high are the piles?



When white wood was removed from bark samples, the air space of the barks generally increased as did the water holding capacities. Researchers observed that the percent of white wood in a bark mix isn't as important as the particle size of the white wood.

Continued research

At NC State University in the Horticultural Substrates Laboratory, we continue our efforts to better understand bark processing and handling so that many of these issues can be better understood. Our work continues with the recent addition in 2014 of the NCSU Substrate Processing and Research Center (SPARC), which is a larger-scale facility for milling, drying, screening, and processing bark and wood materials as substrates and substrate components. Horticultural crop production is rapidly becoming more specialized, precise, and efficient. Your substrate should be the same. So remember, bark is not bark is not bark. Check your supplies so you don't get bitten. **NM**

Did you guess which bark was not like the others?

Did you guess which bark just didn't belong?

If you guessed one specifically, then I'm afraid you were wrong!

Because all barks are different and all sing their own song!

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