Growing Media for Containers
Part 1: The Organics

Over the next couple of issues, we will be looking at container potting mixes and the characteristics of the components used to make them. Successful production and growth of plants in containers is largely dependent on the physical, chemical and biological properties of the growing media. Most natural soils will have 5% or less organic matter, whereas potting mixes are usually 60% or more organic matter. But like natural soils, potting mixes should provide the plant with a continuous supply of air, water and nutrients and provide a matrix for the plant to become established and stabilized.

A good container potting mix should be heavy enough to stabilize the plants growing in it and not be easily tipped over yet light enough to make handling and moving a doable chore. The mix should drain easily while retaining a reservoir of plant-accessible water. The soil should have plenty of pore space for gas exchange and maintain an aerobic environment for soil microorganisms. There should be sufficient CEC (cation exchange capacity) to retain soil nutrients and make them available for plant use.

Potting mixes traditionally contain a high percentage of organic components like peat, coir and bark and a lower percentage of inorganic components like sand, perlite and vermiculite.

Peat

Peat is formed by the slow decomposition of mosses, reeds and sedges in a wet environment where biomass accumulates under low pH and low oxygen conditions – conditions not conducive to microbial activity. Peat is the partly decomposed remains of plants that grow in swampy conditions. The most common are the Sphagnum mosses (*S. fuscum, S. angustifolium, S. magellanicum*, etc.), hypnum moss (*Hypnum cupressiforme*) and sedges (*Caryx* spp.). Peat comes in various forms under various names (sphagnum peat, sedge peat, white peat, dark peat, black peat) depending on what plant species make up the majority of the biomass and how much decomposition has occurred.

Peat being harvest from peat bogs.

Sustainability issues surround the harvesting of peat moss. It only grows in a few areas worldwide where peat bogs can survive. Peat moss grows slowly from sphagnum moss debris that decompose in an oxygen-free environment beneath the water in a peat bog, and it takes many years for the moss to turn into peat and renew the resource. Careful peat mining works to minimize the environmental impact of peat harvesting so that the resource isn't depleted, but other more renewable options, such as coconut coir, are sometimes preferred over peat. Peat bogs are also huge carbon sinks and the draining and mining of peat releases carbon dioxide.

Growing Media for Containers
Part 1: The Organics

Peat moss is the most used form of peat in the horticulture industry. This is the least decomposed form of peat and is:

- Light tan in color
- Very lightweight (bulk density of 50-370 lbs./yd^3 depends on type and compaction)
- Acidic (pH of 3.5-4.1)
- Very porous (93% pore space by volume)
- High water-holding capacity (20-45% by volume)
- CEC 150-250 meq/L
- Hydrophobic (resists wetting) and requires a wetting agent, sometimes included by the manufacturer

Dried and sifted peat moss.

Peat moss is added to potting mixes to increase water-holding capacity and aeration while reducing weight. Because of the low pH, potting mixes high in peat moss often contain lime (calcium carbonate) to help raise the pH to the 6.5 range.

Sphagnum moss is young residue and is commonly used for shipping packing with plants, propagation and lining baskets.

Coconut with seed removed showing fibrous husk used to make coir.

Coir

Since around 1990, there has been a dramatic increase in the use of coir fiber in the horticulture industry. Coir is derived from the coconut fruit – the fibrous material that makes up the coconut husk (the mesocarp). Long fibers are extracted after soaking and used for brushes, matting and insulation. The remaining material is mostly short fibers and pith. This material is often composted for several months, dried and then used as a potting material (coir dust). Coir pith can be very high in salts (Na, Cl, K) and is washed with water or solutions to remove the salts prior to processing for horticultural use. Increased consistency and reliability of the finished product has led to the widespread use of coir as an organic potting media substrate.

Coir is:

- Light tan in color
- Lightweight (bulk density of 67-150 lb./yd^3 depending on origin)
- Slightly acidic (pH 5.0-6.9)
- Porous (86-96% pore space by volume)
- High water-holding capacity (20-38% by volume)
- CEC 70-150 meq/L
- Less hydrophobic than peat, rewets easier

Coir is used much like peat to increase water-holding capacity and aeration while reducing weight of potting mixes. The high lignin content of coir when compared to peat makes it more resistant to microbial breakdown.

Growing Media for Containers
Part 1: The Organics

Bark

Bark is a forest industry by-product, especially of sawmills, and bark from softwoods and hardwoods is often a major component of growing media. Bark used to be discarded as a waste product until the 1960s when its value as a mulch and growing media was recognized. Its use has steadily increased, particularly pine bark. Aged bark is the preferred form and refers to material being left in piles for months or years. Aging allows for the dissipation of potentially phytotoxic materials (phenols and terpenes) and reduces the potential for nitrogen immobilization when used. Bark can also be composted prior to use. Composted bark has less nitrogen drawdown than aged bark.

Pine bark chips – screened.

Pine bark is:

- Variable in color but tends to be dark
- Has a bulk density of 246-455 lb/yd^3
- Slightly acidic (pH 4.0-5.5, liming may be necessary)
- Porous (70-89% pore space by volume for screened aged pine bark)
- Water-holding capacity of 16-27% by volume

CEC 30-74 meq/L

Unlike peat and coir, aged pine bark can contribute macro- and micro-nutrients to the media

Pine bark is screened to various sizes: < 1mm, 1-2mm, 2-4 mm, 4-6.3mm. Unscreened pine bark is very variable in particle size. Bark is used in potting mixes to increase porosity and water-holding capacity.

Rice Hulls

Parboiled rice hulls.

Rice hulls are the outermost protective cover for the rice grain. The hulls are removed during milling following parboiling. Rice hulls are made up of cellulose, hemicellulose, lignin and silica. Lignin (15-25%) and silica (15%) confer a high degree of stability to the rice hulls which degrade very slowly. Parboiled rice hulls can make up as much as 40-50% of potting mixes.

Growing Media for Containers
Part 1: The Organics

Parboiled rice hulls are:

- Light tan in color
- Has a bulk density of 337-506 lb./yd³
- Variable (pH 4.6-7.0, fresh pH is lower than aged parboiled)
- Porous (89-93% pore space by volume)
- Water-holding capacity of 20-23% by volume
- Low CEC 4-7 meq/L
- High substrate stability leads to very little N immobilization

Rice hulls are also used to increase potting mix porosity and water-holding capacity. The very low CEC makes rice hulls very inefficient and retaining nutrients.

Finished compost from the LaSalle Park demonstration garden in Jefferson Parish. Garden maintained by Louisiana Master Gardener Volunteers.

Compost

Composted organic matter can be made from all forms of biomass and is extremely variable in physical and chemical characteristics. Compost can be made from strictly plant material or strictly manures or a combination of organic materials.

Compost that is used in potting mixes should be finished compost and should be made using the hot composting method. Cold composting will break down the organic matter, but it will not kill weed seeds or pathogenic organisms whereas hot composting will do both.

- Compost can vary in color but tends to be dark
- Bulk density variable (251-934 lb/yd³)
- pH tends higher (7.0-8.0)
- Porosity 76-92% pore space by volume
- Water-holding capacity 35-68% by volume
- CEC of finished compost is greater than 600 meq/L

Though not considered a fertilizer, compost contributes a broad range of nutrients

Compost is used in potting mixes to improve texture, aeration, water-holding capacity, biodiversity and nutrients.

Learn how to make compost at home with the LSU AgCenter Home Composting Class. The class is available online at the following link: https://www.lsuagcenter.com/topics/lawn_garden/master%20gardener/home-composting-class

Growing Media for Containers Part 1: The Organics

Biochar

Biochar is defined by the International Biochar Initiative as "The solid material obtained from the thermochemical conversion of biomass in an oxygen-limited environment". Biochar is charcoal that is produced by the thermal decomposition of materials at elevated temperatures (400°C to 700°C) in an atmosphere where oxygen is absent or greatly limited. It is used as a soil conditioner for both carbon sequestration and soil health benefits. Biochar is a stable solid that is rich in carbon and can endure in soil for thousands of years.

Screened biochar. Note the charcoal appearance.

Because the production process and starting materials can be so varied, the chemical and physical properties of the finished product is also variable. Post-production screening to size the product also has an influence on the biochar characteristics:

- Black in color
- Bulk density (172-506 lb/yd³) can be variable
- pH is generally high (9.4-12)
- Porosity of 90-95% by volume
- Water-holding capacity 14-20% by volume
- CEC can be variable (50-400 meq/L) effected by temperature of production and starting material
- Biochar is very hydrophobic (easily wetted)

As you can see, the properties of biochar can vary greatly. But as it becomes more common in horticultural use, there is an incentive for manufacturers to provide a product that is more consistent and reliable.

Conclusion

Organic components are the major constituents in potting mixes. This can include any or all of the materials discussed above. Other organic materials that are sometimes used in potting mixes include: wood-based substrates (wood chips, sawdust, etc.), cotton gin trash, and bagasse. The organic potting mix components will breakdown over time but at different rates. Some, like coir, are more resistant to breakdown and might be a better choice for potting mixes where plants are expected to spend years in the same container. While potting mixes can be 100% organic components, most also have an inorganic constituent as well. We will discuss these in next month's installment. In part 3, we will be looking at basic recipes for potting mixes and their use.

References:

Handreck, K. and N. Black, 2010. Growing Media for Ornamental Plants and Turf, 4th ed.

Jacques, D. and R. Walden, 2015. A Review of the Major Growing Media Components.

Joseph, S., Taylor, P., Rezende, F., Draper, K. and A. Cowie. 2015. The Properties of Fresh and Aged Biochar.

Raviv, M.J., Lieth, J.H. and A. Bar-tal, 2019. Soilless Culture: Theory and Practice.

Robbins, J.A. 2018. Growing Media for Container Production in a Greenhouse or Nursery – Part I: Components and Mixes, Part II: Physical and Chemical Properties.

~Dr. Joe Willis