quantities through the irrigation system or controlled-release fertilizers are used to provide a continuous supply of nutrients at optimal levels and to minimize nutrient loss due to leaching.

Although a ***high nutrient-holding capacity*** is desirable, some thought must be given to soluble salt buildup that may injure plants. Media with desirable water-holding and aeration characteristics will usually allow for periodic leaching necessary to prevent or reduce salt accumulation. ***Salt accumulation*** is generally not a problem unless the irrigation water is saline or the fertilizer source, rate and/or scheduling result in excess salt concentrations. Container media with 50% to 60% peat or pine bark of moderate particle size (1/8 to 3/8 inch) have proven to have adequate cation exchange capacity (CEC) for efficient production of woody plants in containers. Typical CEC values (meq/100 ml) for several container substrate components are aged pine bark (10.6), sphagnum peat moss (11.9), vermiculite (4.9), and sand (0.5).

Rapid decay of organic matter in container media can result in decreased volume and subsequently, decreased aeration. Consequently, careful attention should be paid to the ***C:N ratios*** of organic matter components in potting mixes.

Organic Media Components

Suitable media components in potting mixes influence the growth behavior of plants during container production. Ultimately, plant quality during production influences potential success in the landscape.

Peat moss is the most common growth media component for container production. However, there can be tremendous diversity among the characteristics of peat from different sources or different locations within an individual peat bog. Peat must have a high fiber content to provide internal waterholding capacity (small pores) yet allow drainage of pores between particles (large pores).

Peat is a term applied to a type of soil formed from partially decomposed mosses or sedges accumulated in bogs over a period of hundreds or thousands of years. Although the term "peat moss" is widely used, it is not correct. The correct designation should be "moss peat," which indicates those peats formed from moss plants. *Sphagnum peat* is the preferred peat of most greenhouse operators because of its high waterholding capacity, adequate air space, high cation exchange capacity and resistance to decay. Sphagnum peat is formed from sphagnum mosses in very acid bog conditions that have preserved most of the plant fiber structure. The acidity of sphagnum peat ranges from pH 3.0 to 4.0.

Hypnum peats are derived from hypnum mosses, have a higher and much broader pH range (4.0 to 7.5), and less persistent fibers than sphagnum peat. Other peats consist of fibers

photo by bob cook

Figure 20. Comparision of Canadian sphagnum peat (top) to Florida peat (bottom).

from sedges, reeds and grasses. These peats are particularly susceptible to decomposition, especially in the presence of fertilizer solutions. Peats that break down rapidly cause media shrinkage and compaction, a condition that hampers plant growth and makes the containerized medium difficult to manage. Many *Florida peats* are derived from sedges, reeds and grasses.

The peat selected as a media component should have some fiber structure and be brown in color when dry. Material that has decayed further, such as that found in muck soils, is black and has a powdery consistency when dry. *Muck* is a very poor component for any potting medium.

Pine bark is recognized as a suitable component for container growth media and in some cases it is a good single-component growth medium. Pine bark is preferred to hardwood bark because it resists decomposition and contains less leachable organic acids than some hardwoods.

Incorporation of a liming material such as dolomitic limestone may be advisable in bark mixes. The pH of pine bark ranges between 4.0 and 5.0 and has a tendency to decrease over time when used in production systems with acidic or neutral irrigation water. Approximately 5 to 9 pounds of dolomitic limestone will normally adjust a cubic yard of bark to between pH 6.0 and 7.0 over a 60-day period. Hydrated lime may be substituted for a portion of the dolomite to raise the pH over a one-week period, while coarse limestone will extend the pH adjustment period.

The large moisture content of fresh bark makes it heavy, a characteristic that limits its shipment over long distances. However, once bark dries below 35% of its total water-holding capacity, it becomes difficult to rewet. Use of a horticultural wetting agent would be helpful for rewetting bark. A moisture adjustment period of several days is required.

Sphagnum moss, which is the whole moss plant collected alive along with connected dead, but non-decomposed moss parts, should not be confused with sphagnum peat. Dried sphagnum moss is not generally used in potting mixes, but may be used shredded as a top dressing over seeds in germination trays. The moss is reported to have some fungicidal activity.

Sphagnum moss is also a source of the fungus *Sporothrix schenckii*, which causes sporotrichosis. Sporotrichosis in humans usually starts as a local skin disease of the hands, arms and legs, but may become generalized. Workers handling sphagnum moss are encouraged to wear gloves to prevent injury to the skin surface and prevent entry of

Figure 21. Shredded pine bark.

Figure 22. Sphagnum moss.

the organism through existing skin lesions.

Hardwood bark from deciduous species is used extensively in many areas of the country as a container media amendment. Hardwood bark differs greatly from pine bark in its chemical and physical characteristics. The pH range of fresh hardwood bark is 5.0 to 5.5. As the bark ages in the presence of water, the pH increases to 8.0 or 9.0, a condition much too alkaline for plant production. Fresh hardwood bark should never be used immediately for potting plants.

Hardwood bark decomposes more rapidly than pine, causing an initially high demand for nitrogen by microorganisms; this higher C:N factor will induce a nitrogen deficiency in plants growing in the fresh bark. A second potential problem in certain hardwood species relates to phytotoxic effects that have been reported on plants grown in fresh bark or plants drenched with extract from fresh bark. After composting, bark-induced nitrogen deficiency problems and phytotoxicity caused by bark from certain tree species are eliminated.

Melaleuca bark or bark and wood of *Melaleuca quinquenervia* (punk tree or paperbark tea tree) has been used successfully by several University of Florida researchers as a soilless growth medium component. Melaleuca was introduced to southern Florida around 1887 from Australia and has become a major invasive plant causing a serious threat to the ecology of many areas in southern Florida, including parts of the Everglades.

Figure 23. Melaleuca bark can be shredded and used in media.

The bark of melaleuca constitutes nearly one half the bulk of its small branches. When properly processed by special hammer mills, the bark and wood together are an excellent component for soilless mixes. Because of the many thin layers that constitute the structure of melaleuca bark, it has an open structure that provides excellent aeration. Another desirable characteristic of this bark and wood is its resistance to decay which provides particle size stability. Processed melaleuca bark and wood is a suitable substitute for pine bark in mixes containing up to one-third pine bark (such as a blend of equal volumes of pine bark, peat and sand).

Sawdust, wood shavings and wood chips constitute a rather broad category of wood particles generated by sawmills and other wood processing industries, often involving a wide range of particle sizes and several tree species. Wood particles are generally less desirable for potting media than bark because wood has a much greater C:N ratio; such as 1:500 for fresh wood compared to 1:120 for bark. Addition of approximately 25 to 30 pounds of nitrogen per ton of fresh sawdust or other relatively fine wood particles will supply sufficient nitrogen for microorganisms to prevent deficiency during plant production. Sawdust of hardwood species ties up nitrogen and breaks down about three to four times faster than sawdust of softwood species.

Coconut fiber or coir is a natural fiber extracted from the husk of coconut. The porous, granular structure of coconut fiber makes an excellent growing media component, especially in combination with sphagnum peat moss. Coconut fiber has a significant amount of pores for every particle, thus providing more pore space and a better water-holding capacity in the root zone when fully hydrated. Coconut fiber has a pH close to 6.0, an excellent wetting and re-wetting ability, high resistance to physical breakdown, and less shrinkage in containers over the life of the crop. Coconut

Figure 24. Shredded coconut fiber (coir).

husks can also be cut into specific sizes for uniform particles.

Coconut fiber or coir products will vary, depending on their origin and how they are processed. Using coir may require some adjustments in the crop management practices including, but not limited to, adjustment in watering practices and fertilizer application rates. Make sure to watch for potential high sodium levels and nutritional imbalances from higher potassium levels.

Inorganic Media Components

Perlite is a light weight, white, expanded, closed-pore mineral of volcanic origin widely used in the horticultural industry as a component to peat-lite mixes. The mineral is crushed and heated to approximately 1800° F causing it to expand.

Perlite is utilized extensively for its light weight, physical stability and ability to provide non-capillary pore space in a mix. Perlite has little water-holding capacity since the internal pore structure is closed. It has extremely low cation exchange capacity, no nutritive value of its own, and no notable influence on pH of mixes in which it is employed.

The bulk density of perlite is approximately 6 to 8 pounds per cubic foot. The fine dust present while handling dry perlite is irritating when airborne and inhaled. Therefore, effort should also be made to minimize the physical movement of loose, dry perlite until it can be moistened or incorporated with moist peat or other amendments. Individuals involved with considerable perlite handling should wear a breathing mask or respirator and goggles. A fine spray of water on perlite as it is being poured from the bag and the use of properly placed exhaust fans in an enclosed media blending area will greatly reduce the perlite dust problem.

Vermiculite is a mica-like mineral that, when heated above 1400° F, expands to an open-flake structure that provides spaces for air and water. Vermiculite particle size is determined by the particle size of the mineral prior to heating. Due to the range of pore spaces in processed vermiculite, it retains considerable moisture upon wetting. The pH of most of the vermiculite used in horticulture falls within a range of 6.0 to 8.9. Although vermiculite contains measurable amounts of potassium, calcium and magnesium available to plants, it should not be regarded as a fertilizer. Vermiculite also has good buffering action and cation exchange capacity.

One of the major shortcomings of vermiculite is its poor physical stability after wetting. Particles that have been mixed, wetted and compressed do not recover physically. Compression of moist vermiculite causes the expanded particle to collapse and frequently slip apart. This is particularly a problem when

photo by bob cook

Figure 25. Horticultural grade perlite.

Figure 26. Professional grade vermiculite.

the mix is handled wet, when vermiculite containing mixes are used in large containers where the pressure is great toward the bottom of the container, and in situations where mixes are used on a second crop such as in a propagation bed or recycled mix.

There are several grades or particle sizes of vermiculite used by horticulturists. Each manufacturer of vermiculite has its own system of grades. The finer grades are generally used in mixes formulated for small pots and plug tray applications, while coarser grades are usually found in mixes designed for larger containers.

Polystyrene foam is a plastic product manufactured from resin beads subjected to heat and pressure. The polystyrene foam used in peat-like mixes is usually derived from scrap generated during the manufacture of polystyrene bead-foam such as sheet insulation. Styrofoam® is one trademarked brand of polystyrene foam.

Figures 27. Polystyrene foam beads.

Polystyrene foam is utilized in potting mixes to improve drainage, reduce waterholding capacity, reduce bulk density and serve as a cost effective alternative to perlite. The closed pore structure of the foam makes it one of the least water retentive components in use. The foam has no appreciable cation exchange capacity, and contains no plant nutrients.

A desirable size range of polystyrene beads for potting mixes is 1/8 to 3/16-inch diameter particles. The extremely low bulk density of the foam beads or chips (0.75-1.0 lbs/ft^3) presents some handling problems. The light-weight material should be handled in areas where there is little air turbulence to prevent particle drift. The drift problem is compounded by the static charge of foam particles that causes them to stick to objects and surfaces in the media handling area. A small amount of water plus a wetting agent applied to the foam will reduce both handling problems.

The light weight and durable nature of polystyrene foam make it an attractive alternative medium component for crops in hanging baskets and a variety of interior plants that must be packaged and shipped long distance.

Rockwool is manufactured from basalt (a mineral) using a heating and fiber extrusion process. Although rockwool is used primarily for insulation, it can be utilized as a rooting

Figure 28. Horticultural rockwool used in potting media.

medium by itself or in combination with other ingredients, such as peat, bark, and perlite to make a soilless growth medium.

Rockwool formulated for horticultural use varies considerably in physical and chemical properties among manufacturers. Some product lines have been treated to make the wool more hydrophilic (attract water), while other lines are essentially hydrophobic (repel water). Blends of the two lines can be used to achieve a specific water-holding capacity.

Rockwool is utilized because it can be manufactured to uniform standards and does not break down from bacterial or chemical action. When protected from excessive compaction, rockwool provides aeration but lacks notable cation exchange capacity and nutrient supply of its own.

Calcined clay results from heating clay to a very high temperature (up to 1800° F) causing it to expand into a highly porous material that is physically and chemically stable. The clay is then crushed into smaller particles that are subsequently graded into specific particle size ranges.

Calcined clays provide non-capillary pore space due to the large void created between particles in the mix, thus allowing for good aeration. Water is also held internally within the porous particle structure. Most calcined clays have good cation exchange capacity, which helps in the retention of nutrients, but the particles have no nutrient value of their own.

Figure 30. Long-term interiorscape plants in quality media.

Calcined clay is again receiving attention by a few commercial soil formulators as an amendment in some better quality peat-like mixes. Although the cost of calcined clay mixtures is still high, the greater cost can be justified in the long term management requirements of tropical plants used in the interiorscape. Potting mixes that decompose and shrink are difficult to manage and often contribute to premature plant replacements. These replacements and the additional labor required to manage interior plants growing in low-quality mixes is far more costly in the

photo by bob cook

Figure 29. Calcined clay particles.

Figure 31. Peat moss, bark, perlite potting mixture.