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Irrigation/Insect Control Part 2

Non-organic amendments can extend media life

With limited breakdown, they're good additions to bark and peat

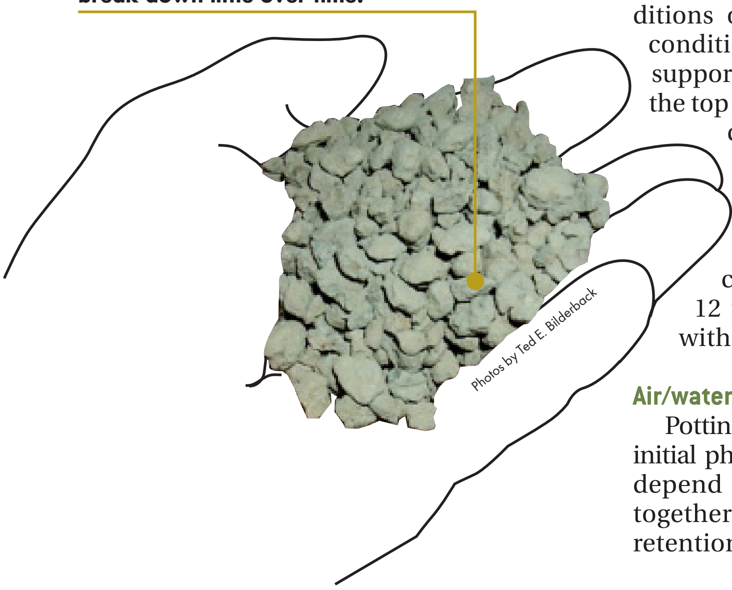
By Ted E. Bilderback, James S. Owen Jr., Stuart L. Warren and Joseph P. Albano

Like people, nursery potting substrates are unique and show signs of physical and biological changes as they age.

Soilless substrates used in container production of nursery crops are predominantly comprised of organic components such as bark and/or peat moss blended with other organic or inorganic components. Inorganic components include perlite, pumice, coarse sand, industrial clays, concrete block particles and plastics like those contained in municipal garbage.

These inorganic components are stable and decompose little when used in potting substrates. Blending these stable components with organic components can decrease changes in physical properties over time by dilution. This, in turn, preserves the number of large pore spaces adjacent to non-decomposing particles, thus helping to maintain structural integrity of the substrate.

Coarse aggregate clay amendments have proven to be useful potting substrate amendments, and they break down little over time.



Nursery crops frequently remain in containers for one or more growing seasons. Decomposition of organic components can create an overabundance of small particles that hold excessive amounts of water, creating limited air porosity.

Changes in air- and water-holding characteristics over extended periods can have significant negative effects on crop health and vigor.

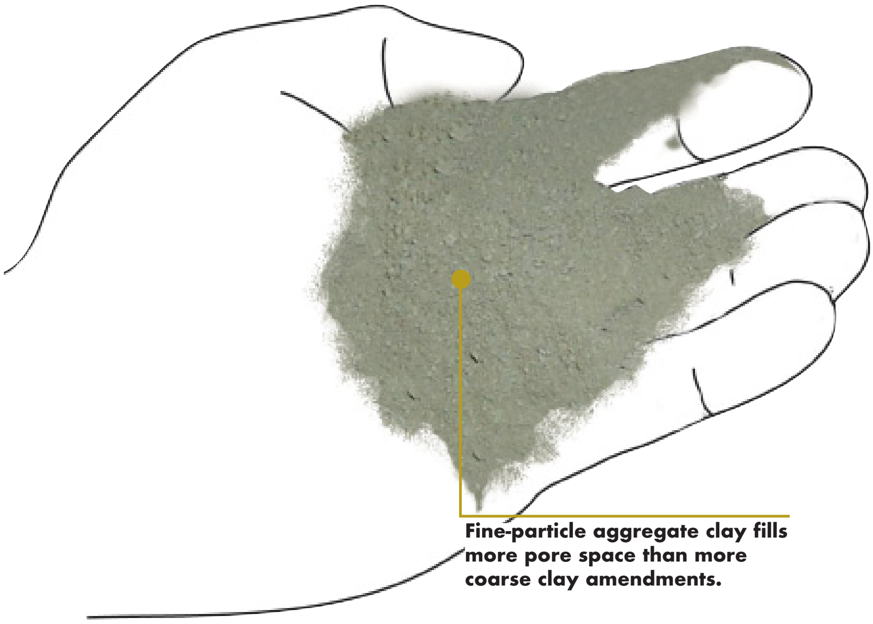
One might argue that the breakdown of organic components is offset as vigorous roots fill containers. Roots are thought to increase air space as they push substrate particles apart, in effect taking control of the substrate's physical properties.

Well-established roots are capable of extracting nearly all the available water held at low tensions. Unfortunately, the Utopian conditions of the rhizosphere cease under two conditions: When airspace is insufficient to support the mass of respiring roots or when the top of the plant demands more water than can be extracted by the roots between irrigation cycles.

The timeframe for plants to outgrow their container or for the container substrate to disintegrate to conditions that limit air and water is 12 to 18 months. Many would disagree with this timeframe, but we have proof.

Air/water balance

Potting mixes can be engineered for optimal initial physical properties. Air and water spaces depend on how all the components work together when combined. Air- and water-retention characteristics are largely depen-



Fine-particle aggregate clay fills more pore space than more coarse clay amendments.

dent on how components fit together initially.

Over time, organic components soften, allowing moisture to fill internal pores. The organic particles decompose to become smaller particles that create tiny pores that hold water.

Therefore, decomposition over time results in more water being held inside and between organic particles.

The 'bark ages'

Very little research has been published on changes in organic container substrates as they decompose over time. However, we can make some pretty strong deductions from research that has been done.

Research in 2004 studied the physical properties of aged versus fresh pine bark in container media. Available water was significantly greater in the aged pine bark.

Just as interesting was how the properties of the fresh and aged pine bark changed over time.

The fresh pine bark substrate decomposed in the container throughout the production cycle to become the aged pine bark substrate over the course of a year. Available water increased from 16 to 22 percent while air space decreased from 36 to 25 percent.

These changes demonstrate dramatic improvements in fresh pine bark physical properties with time. Conversely, the aged pine bark substrate became only marginally acceptable over a year with a decrease in air space from 26 to 17 percent.

Basically, this teaches us that if you don't think you have to adjust irrigation cycles to compensate for aging organic media components, you're fooling yourself.

Beyond bark

Aggregates such as perlite, pumice, concrete block particles, pea gravel, builder's sand, well point sand, screened fly ash, granite shavings and calcined or dried industrial clays can be used as coarse components for potting substrates.

Aggregates used in potting substrates tend to be products nurseries can buy locally.

Some products such as pea gravel, coarse sand, well point sand, pumice and concrete block particles can drastically increase wear on mixing equipment. Other components, such as fly ash, raise pH and alter chemical properties of potting substrates.

Aggregates also grind organic components and can reduce particle size if mixed for too long in mechanical blending equipment.

Adding sand to bark is a common practice throughout the United States. Nurseries add sand to bark to increase the weight of containers to prevent blow over and to slow irrigation water as it flows through the container. This is particularly important with fresh bark.

The slower infiltration rate promotes more thorough wetting of the substrate. With just coarse bark particles, water can channel rapidly to the bottom of the container.

High freight costs mean growers must typically buy sand from a local source. Mortar sand used for laying brick should be used cautiously since it has very fine particles and readily fills pores between larger bark particles. This reduces air space.

Most growers use washed builder's sand, which usually weighs 120 pounds per cubic foot and has approximately 9 percent air space and 36 percent total porosity.

In some areas, well point sand (gravel), which has larger particle sizes, is used by nurseries.

When potting materials have greatly different particle sizes — such as pine bark and fine sand — the final volume is not additive when mixed together. This means that 1 cubic yard of pine bark plus 1 cubic yard of fine sand does not equal 2 cubic yards. You'll likely end up with 1½ or 1¾ cubic yards of the combined ingredients.

In this situation, a great increase in bulk density (weight) of the substrate would be expected. An increase in bulk density results in lower total porosity and decreased air space.

Even coarse builder's sand is much smaller in particle size than pine bark particles. Therefore, adding sand to bark usually increases moisture retention and available water content but reduces air space and total porosity.

Clay saves and pays

Calcined or expanded clays are alternatives to sand or other inorganic components. Clay used as a soilless substrate component has been reported to increase percolation rate, drainage, air space and increase pH buffering capacity and to reduce phosphorus leaching.

Clay is defined as a secondary mineral (weathered primary mineral) with a particle size less than 2 millimeters. Industrial clay aggregates are mined minerals that undergo screening and temperature treatment to create physically uniform and reproducible products.

These clays offer the water- and nutrient-buffering capacities found in soil that are not typically present in organic substrate components due to their relatively inert components.

The most popular size for the agriculture industry is between 0.85 and 0.25 millimeters. Industrial clay minerals are dried and are described as regular-volatile materials (RVMs). RVM products include cat-box materials and garage adsorbents. These are soft and contain low amounts of water by weight. This dried product can be subjected to further heating and classified as low-volatile materials (LVMs), otherwise known as calcined, or fixed.

Testing clays

Clay aggregate amendments have been studied primarily in peat-based substrates. More recently they've been studied with pine bark mixes.

When pine bark was amended with 8 percent mineral aggregate, all physical properties were in the normal ranges. Adding another 24 percent (by volume) Georgiana palygorksite-bentonite mineral aggregate resulted in a 13-percent increase in container capacity and a 13-percent decrease in air space.

With the addition of the clay amendment, the physical properties became more ideal with container capacity increasing to 63 percent and air space decreasing from 34 percent. Available water increased with increasing mineral aggregate rate; unavailable water content decreased.

But weight might be an issue. All mineral aggregate amendment rates were 20 percent less in bulk density than the 8:1 pine bark/sand medium.

In other studies, pine bark amended with a 24/48 calcined Georgiana palygorksite-bentonite dramatically decreased water usage, decreased phosphorus loss and increased water-buffering capacity during container cotoneaster production.

Compared to an 8:1 pine bark/sand substrate, a clay-amended pine bark medium reduced water usage by 6 gallons per 5-gallon container. This would result in a reduction of 200,000 gallons per growing acre per season.

A clay-amended substrate also reduced phosphorus losses in the leachate by 60 percent. This was accomplished without sacrificing growth of the cotoneaster.

Also, in a water-stress study, increased water-buffering capacity allowed a clay-amended pine bark substrate to go 48 hours without irrigation before the plants became water stressed compared to 24 hours for an 8:1 pine bark/sand substrate.

Initial studies were conducted with an 8 percent clay amendment rate. Further studies demonstrated that plant size was maximized at approximately 12 percent (by volume) addition to pine bark. This is approximately 100 pounds of clay per cubic yard of potting mix.

Talking trash

Many alternative substrate components show promise — they're nontoxic to plants and can be successfully used to amend conventional substrates.

But cost, regional availability and a limited supply of uniform and consistent quality reduce their widespread use. Municipal garbage is not one of the first alternatives that come to mind.

The merits of using household garbage were not evident when we began studies with Fluff, a processed garbage product developed by Bouldin Corp./WasteAway Services in McMinnville, Tenn.

However, Fluff could be a value-added component for horticultural crop production. There is certainly an unlimited supply and wide availability. In addition, Fluff could help alleviate demand for pine bark.

The nursery business is growing rapidly and there are projections of bark shortages in the future. Considering that our society has a big problem with disposing household waste, the nursery industry could be part of the solution. Can Fluff

fulfill this role?

Research examining the suitability of Fluff as a substrate amendment is limited. A North Carolina State University study was conducted to evaluate the physical property effects of adding Fluff to pine bark.

The key to engineering substrates for optimal physical properties is maintaining a balance between air space and water content. Air space and available water are the most critical substrate properties related to plant growth.

Air space is critical for root metabolism and growth. Low air space reduces root-nutrient and water-adsorption capacities.

Substrates with low available water may require frequent irrigation to avoid wilting and moisture stress. The ideal range for air space in nursery containers is 20 to 30 percent.

Most organic-based substrates, including pine bark, decrease in air space during production due to decomposition. In contrast, a 15 percent Fluff substrate increased from 31 to 32 percent air space during the test period. A 45 percent Fluff mix was essentially unchanged in air space during a 4½-month test period.

The exception was a 30 percent Fluff mix, which lost air space between 2 months and 4½ months. A possible explanation might be loss of large pores related to the fit of particles between the two components.

Nevertheless, evidence is compelling regarding the possibility that Fluff can provide stability to container substrates throughout a production cycle.

Unlike most composts, which consist mainly of organic materials, we are speculating there is enough inorganic material in Fluff to provide stability. The 45 percent Fluff had the most consistent physical properties, most likely due to the dilution of the pine bark.

In corresponding growth studies, plant growth was equivalent and nutrient content of plants and leachates were within expected ranges.

More information will be available in a few months when 1-year data will be available. Then maybe we can talk more trash.

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