Container Gardening Part 3: The Growing Medium

We've already published a 4-Part series of articles on "Growing Media for Containers" (GNO Gardening August 2021-November 2021). In that series, we go into detail about the different organic and inorganic components commonly found in most container media. We define what they are and list their physical and chemical properties. I suggest you reread those articles for a basic understanding of the components that make up container potting media. All those articles can also be found here: [Joe Willis (www.lsuagcenter.com/profiles/JWillis)](www.lsuagcenter.com/profiles/JWillis).

In most situations, it's faster, easier, and more economical to purchase a commercial potting mix than to make your own. There are a lot of general-purpose potting mix brands available. There are also specialty potting mixes created for a specific type of plant, such as, orchid potting mix, succulent and cacti potting mix, tropical plant potting mix. No single potting mix is ideal for all containerized plants. Most plants will do well in any high-quality potting mix. Often, a general-purpose commercial mix can be improved by adding components. With a little research, you can get information regarding the optimal mix for growing a particular plant species, then adjust your commercially purchased mix accordingly by making additions.

Regardless of what plant you are growing in a container, the role of the growing medium is the same.

- Anchor for the roots and stability of the plant.
- Store inputs such as water and nutrients and make them available to the plant roots.
- Home for soil microorganisms involved in organic matter breakdown, creating nutrient availability, and root-microbe interactions.
- Facilitate gas exchange – oxygen and carbon dioxide
- Buffer soil temperature

To accomplish this, a good growing medium needs:

- **High permeability to water and air.** Soil texture and structure that begets large aggregates and large pore spaces allow rapid air and water infiltration and percolation.
- **High water-holding capacity.** Small particle size and pore space and certain components increase a medium's water-holding capacity. This means more water will be available to the plant on a longer, more continuous basis.
- **Good drainage.** Loose soil with large aggregates and pore spaces allows excess water to drain quickly allowing for good gas exchange.
- **Good aeration.** Large aggregates and organic matter create pore space for gas exchange providing roots with oxygen and removing carbon dioxide.
- **Light weight.** Medium with a low bulk density makes it easier to move the container when necessary but should be weighty enough to maintain containerized plant stability.
- **Good fertility**. Plants need nutrients to survive. They get the majority of these from their soil. A potting mix with a high cation exchange capacity (CEC) can retain nutrients for an extended time. Many commercial mixes also contain organic matter and controlled release fertilizer that provide nutrients for the plants.
- **Disease, insect, and weed free.** Your starting media should be mostly free of

disease, insects, and viable weed seeds. Often, commercial mixes are pasteurized prior to bagging.

- **Plant stability.** The potting mix should provide adequate weight to stabilize the plant as it grows and good structure for roots to grow into and grab hold.

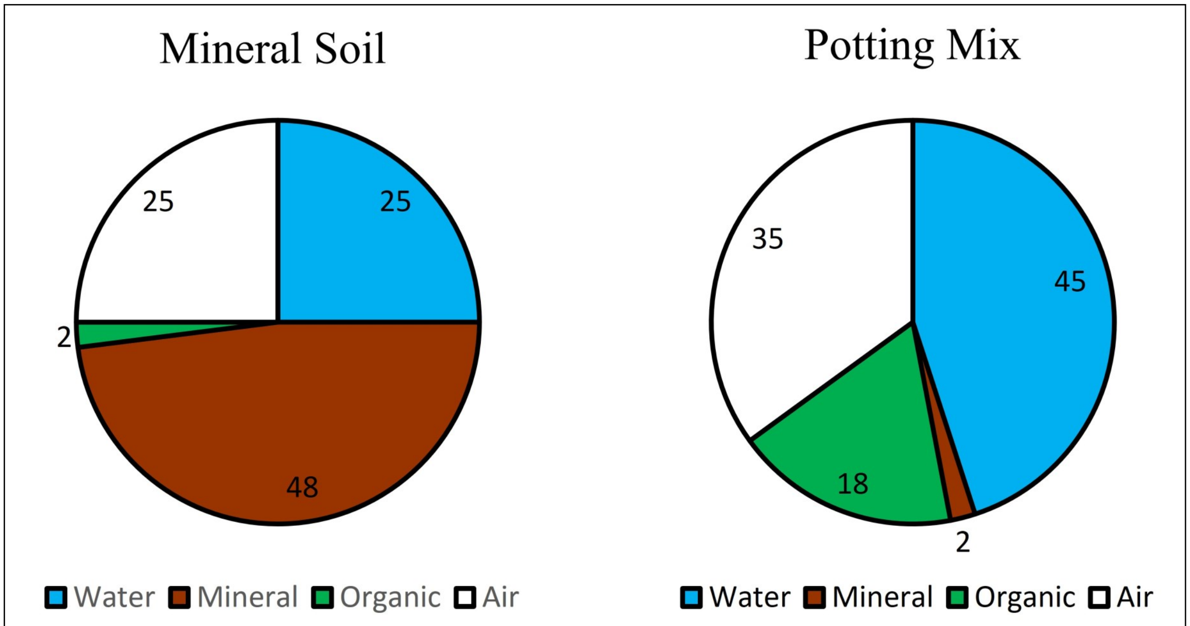

Figure 1: Comparison of components of mineral soil and potting soil. Numbers are percentages.

Let's look at the characteristics of a good potting soil and what influences these characteristics. Good mineral soils are made up of roughly 1-5% organic matter, 45-50% mineral matter (sand, silt, clay) and 50% water/air (pore space). Potting soils on the other hand are 55-85% water/air (pore space), 0-5% mineral matter (usually sand) and 15-45% organic matter. In other words, mineral soils are mostly mineral matter with a small amount of organic matter and half or less pore space. Whereas, potting mixes are mostly pore space, the solid portion is mostly organic matter, and very little if any mineral matter (Figure 1).

Pores exist between soil particles and sometimes within soil particles and the type of particle determines the type and amount of pore space. To illustrate, in pure sand, where sand touches sand there is space/pores between the granules; however, the sand particle itself is smooth and dense with little to no internal pores. Whereas in pure perlite, where perlite touches perlite there is space/pores between the particles and space/pores within the perlite particle itself (Figure 2). An equal volume of Perlite has much more pore space than an equal volume of sand.

The size and percentage of pore space in a growing medium is very important. Pores are where all the action takes place in the soil. Pores are the pathway for water and air movement through the soil. Pores are where gas exchange takes place, where the roots exchange carbon dioxide for oxygen and nitrogen-fixing bacteria take in nitrogen. Pores are where nutrients are attached to or released from soil particles and where nutrients are taken up by plant roots. Pores are where water is stored and taken up by roots and root exudates are released. Pores are where microbes hang out and do their job of breaking down organic matter. Pore size greatly determines the rate and extent at which all this activity occurs. The mixture of different media components determines porosity. The individual particles and how they bind together to create aggregates is what determines soil

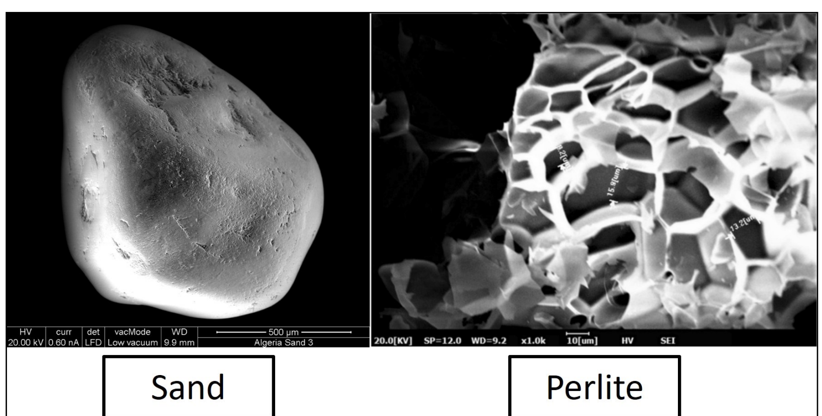

Figure 2: Electron micrograph of sand and perlite. Sand is very solid with almost no internal pore space whereas perlite is mostly internal pore space.

structure and soil structure determines porosity. Large pore spaces give the media high water and air permeability, good aeration, good drainage, and light weight. The small pore spaces give the media high water-holding capacity and good plant stability. Therefore, a good balance of large (macropores) and small (micropores) pore spaces is required for the best container potting soil. The combination of porous components (e.g. perlite and vermiculite) that form aggregates creates both macropores and micropores. The mixture of soil components and microbiota creates microaggregates (<250 µm) that assemble into larger macroaggregates (0.25–2 mm) held together by organo-mineral complexes and organic matter (Figure 3). The formation and breakup of aggregates and organic matter breakdown means the porosity of soils is a dynamic characteristic. Soil compaction is just a change in pore size due to compression; there is no change in soil composition.

We've discussed containers, irrigation, soil and potting mixes. Next, it's time to plant.

~ Dr. Joe W. Willis

Resources:

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Gardner, W.H. 1988. How Water Moves in Soil. https://gsr.lib.msu.edu/1980s/1988/880323.pdf

Hydrophobic Soil: Treatment and Prevention. 2022. https://www.theseedcollection.com.au/blog/hydrophobic-soil-treatment-and-prevention#:~:text=The%20simplest%20way%20to%20do,to%20maintain%20the%20soil's%20condition.

Owen, J.S. and J.E. Atland. 2008. Container Height and Douglas Fir Bark Texture Affect Substrate Physical Properties. HORTSCIENCE 43(2):505–508. https://journals.ashs.org/hortsci/view/journals/hortsci/43/2/article-p505.xml

Soil Compaction. 2018. Uni. Minn. Ext. Soil compaction | UMN Extension

The Science Behind Our Favorite Potting Mix. 2023. Mulhall Nursery. https://mulhalls.com/garden-home/blog/the-science-behind-our-favorite-potting-mix/

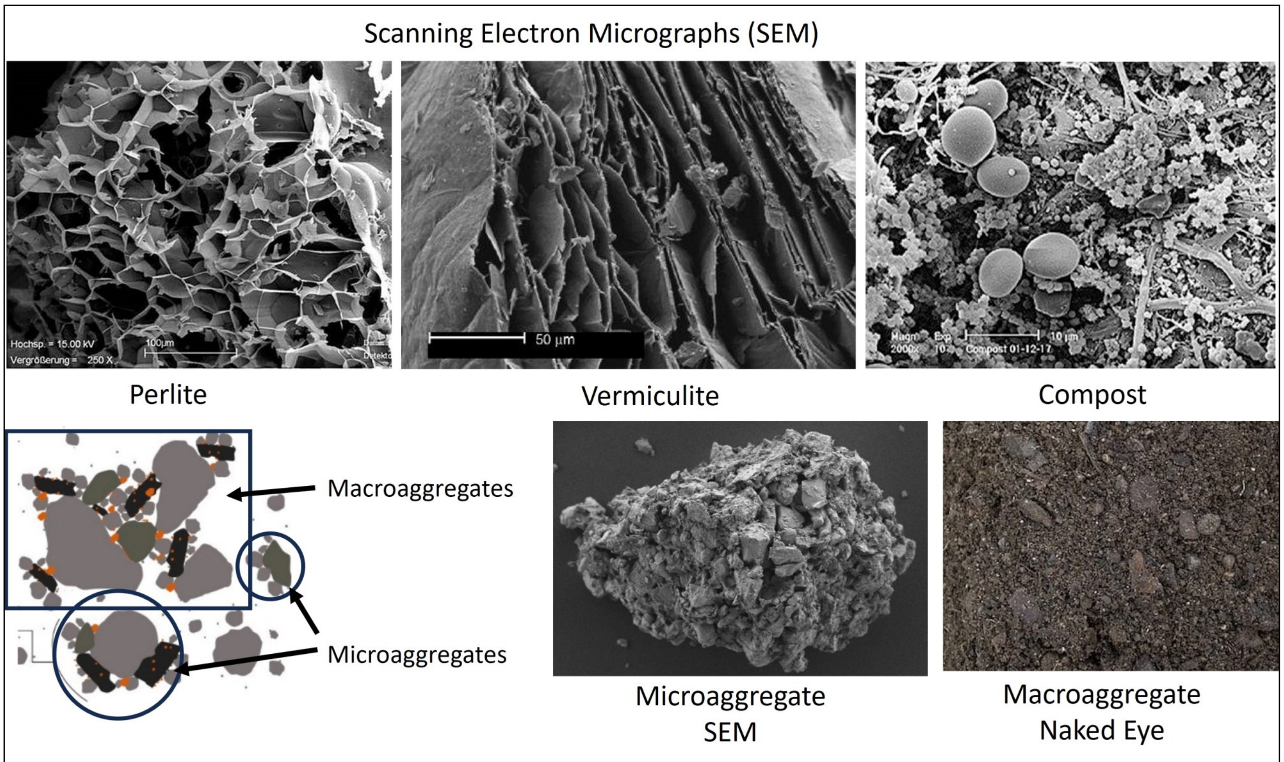

Figure 3: The top row are scanning electron micrographs (SEM) of potting mix components showing their microscopic porous nature. The second row shows an SEM of a microaggregate made up of components from the top row – these are still microscopic particles. The macroaggregates are what we can see with our naked eye as small clumps. The bottom left is an illustration of this and the pore spaces created.