Container Gardening Part 2
Water Movement and Irrigation

Container gardening is certainly different from standard in-ground gardening. One big difference pertains to water movement and irrigation requirements. Let's begin by examining water movement through soil and then take a look at how that impacts container gardening.

Water moves through soil by moving through the soil pores. Standard garden soil is about 50% pore space which is filled with air/water. Potting soil mixes, on the other hand, have a higher pore space percentage; as much as 85%. This space is also filled with air/water. Water movement through soil is due to a combination of forces – gravity, adhesion, and cohesion. Gravity affects water in soil the same way it affects everything – pulling it from a higher elevation to a lower. Adhesion is the force causing two unlike things to stick together. Cohesion is the force causing two identical things to stick together.

Pore size has a tremendous effect on water movement. Pour a volume of water on a container filled with gravel, sand, or clay and it will flow out the bottom of the gravel first, the sand second, and the clay third. This is due to pore size (Figure 1). Practical application – it takes a longer to fully saturate soils with smaller pore size.

Now is a good time to discuss the perched water table. What is a perched water table? Basically, the perched water table is where the gravity force pulling water downward is balanced by the capillary force pulling water upward. Capillary force is the combination effect of adhesion and cohesion; the two forces discussed above. This creates a zone of soil that is saturated (all pore spaces are filled with water) (Figure 2). As shown, pore size affects how high the perched water table forms. Practical application –

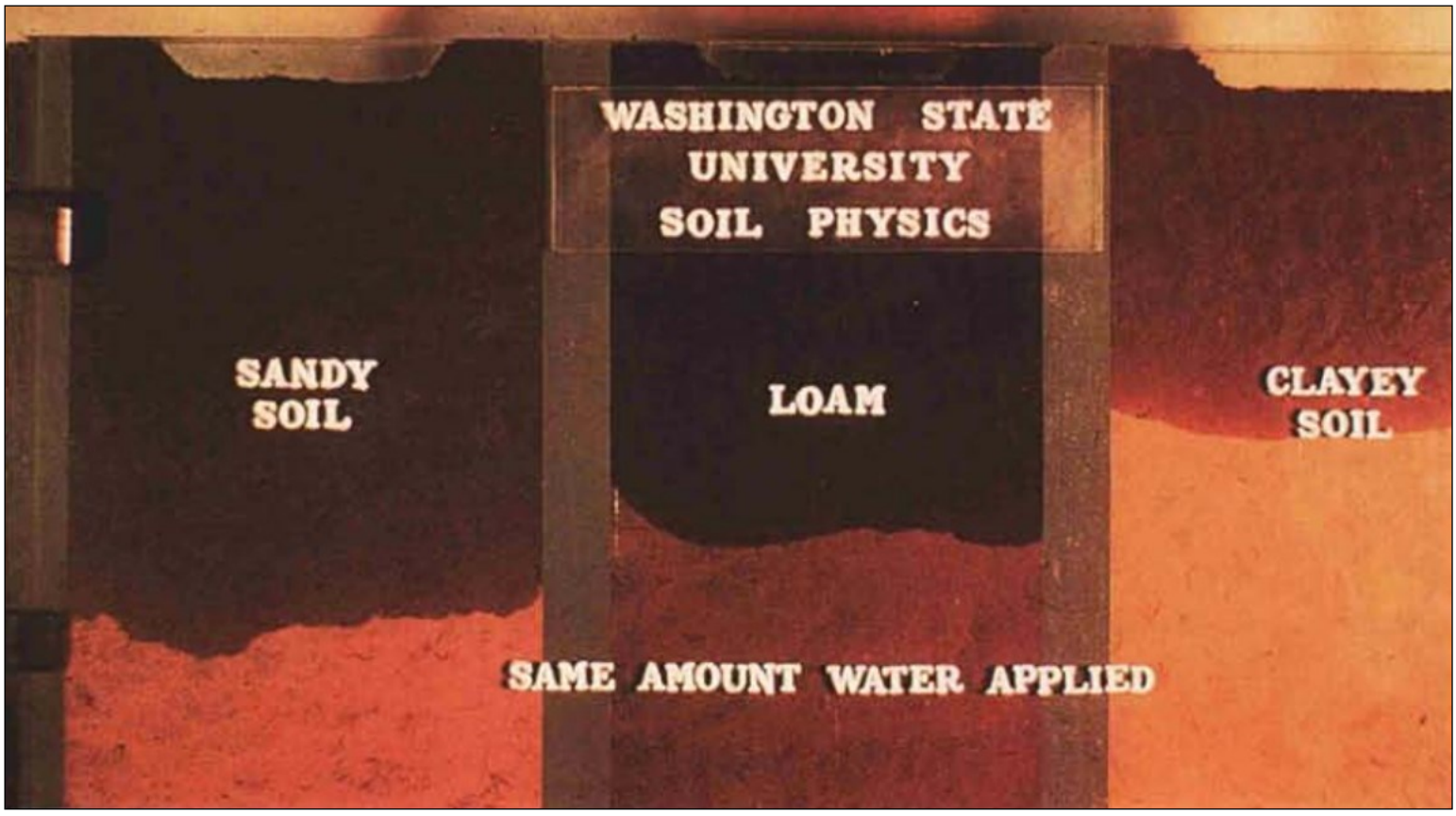

Figure 1: Demonstration of water movement through soils with different pore sizes. Sandy soil has the largest pore size, loam the next highest, and clayey soil the smallest pore size.

a potting mix that contains large and small pores is the best balance.

Now let's look at how water moves through layered (stratified) soil. Research shows that water moves uniformly through uniform soils regardless of their components. However, in layered soils, water tends to move through and saturate one layer before moving into the next. This is true regardless of pore size differential between layers. Figure 3 shows water moving through a layer of soil, encountering a layer of sand, with another layer of soil below the sand layer. Even though sand is more porous than the soil layer, the water tends to spread throughout the soil layer before entering the sand layer. Once it penetrates the thin sand layer, it tends to spread through the sand layer before entering the second soil layer. This type of behavior is due to the forces of adhesion and cohesion. Practical application – putting a layer of stone, gravel, etc. in the bottom of your container does not improve drainage. It actually impedes drainage and raises the perched water table (Figure 4). However, recent research has shown that soil layering in containers (stratified substrates) might be beneficial. Because water tends to fill one layer before moving into the next layer, many plants develop a dense root system in the top layer in addition to the next layer. This results in a more uniformly denser healthy root system throughout the container rather than being concentrated in the lower portion of the container (Figure 5).

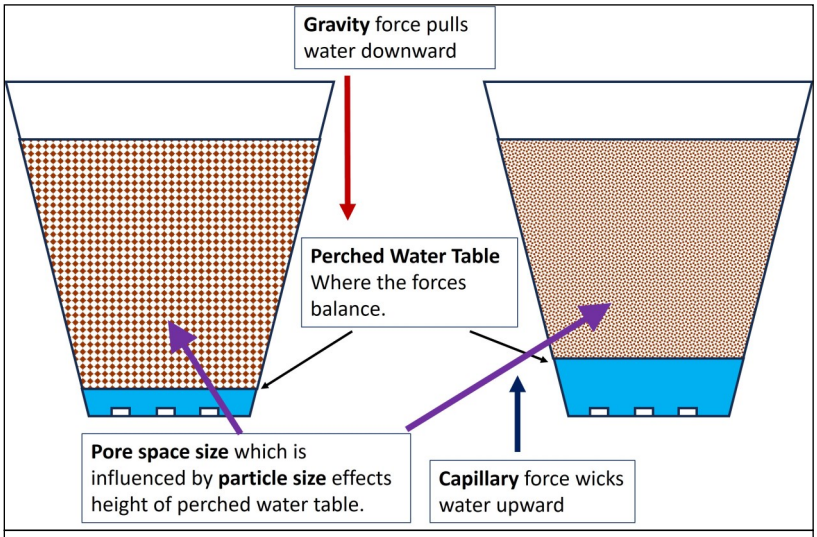

Figure 2: This illustrates how a perched water table forms when the force of gravity is balanced by the capillary force. This also shows that pore size affects how high the perched water table forms.

Water channeling is the movement of water along a narrow path of least resistance rather than uniformly infiltrating a soil. This can happen in containers in several ways and is usually a result of drying. Many components of potting soils are hydrophobic when dry. High organic content potting soils also shrink when they dry out. As the potting mix in a container dries, it will shrink and pull away from the sides creating open channels along the container wall. It may also create vertical cracks in the potting soil creating a channel from top to bottom. Another way channeling can happen in dry potting soil occurs when you attempt to rewet the container. If, for some reason, the water wets a channel of the soil as it moves into the container rather than uniformly infiltrating, it will create a wet channel of soil that the water will tend to follow every time it is irrigated (Figure 6). These are the types of channels we tend

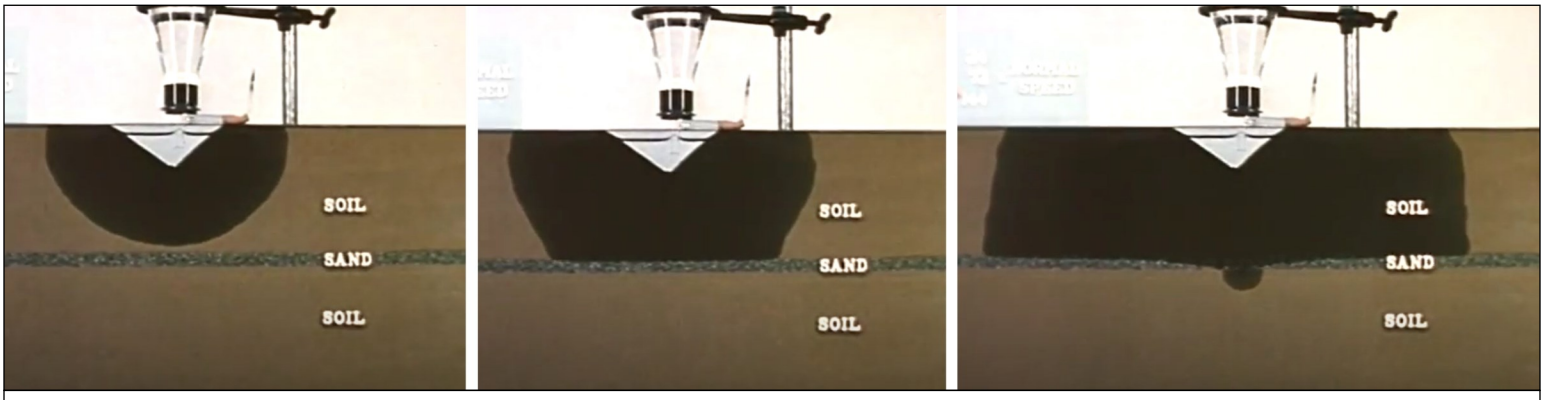

Figure 3: This demonstrates water movement through layered soil. Water tends to saturate one layer before moving into the next layer. Note that the thin sand layer tends to saturate before moving into the soil layer below.

not to notice. To avoid water channeling, uniformly moisten the potting medium before filling the container and adding the plants. Once planted, do not allow the soil to completely dry out. Always water when the top 1-2 inches of soil has begun to dry. If the container of soil has completely dried, using a fork or other similar tool, break up the dried soil to create a uniform mixture with no cracks in the soil or around the container edge. Add a small amount of surfactant to your watering can before watering the container. The surfactant helps to overcome the soil's hydrophobic nature and is sometimes called a wetting agent. After rewetting the soil, you can return to watering without the surfactant. Practical application – never allow your containerized plants to completely dry out.

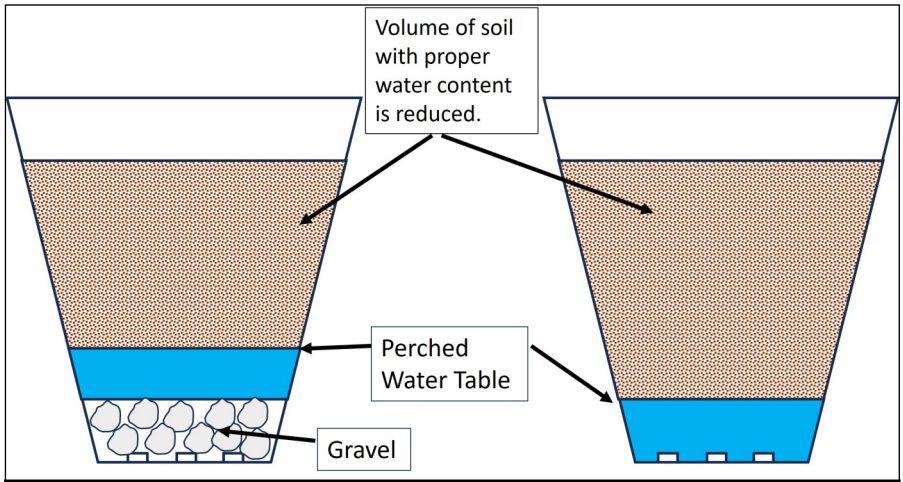

Figure 4: Adding a layer of gravel to the bottom of a container raises the perched water table in the container and reduces the volume of soil with the proper moisture content for plants.

Plant roots are water-seekers. A plant's roots grow through the soil following the path of waterflow seeking the water that the plant needs to survive (Figure 7). Plants develop shallow root systems in containers that are watered frequently but not deeply. The roots grow where the water is. Plants develop deep root systems in containers that are watered infrequently but deeply. The soil dries from the top downward. Therefore, as water becomes unavailable in the upper soil, the plant roots grow deeper into the still moist soil below. Thus, watering deeply and allowing the upper soil to dry somewhat before watering again leads to a deeper more robust root system and a plant that is better adapted to withstand water stress situations.

Figure 5: Comparison of *Hydrangea macrophylla* root and shoot growth in a standard nursery mix versus a stratified substrate approximately 1-year into production.

Irrigating Containers

We've looked at water movement in soils and the factors that affect it. But what we really want to know is what is the best way to water our containers.

- Prewet the potting media before filling containers and planting plants.
- Fill containers with uniformly mixed potting medium unless you are doing stratified substrates.
- Do not put a gravel or similar material layer in the bottom of the pot to increase drainage. This will actually decrease drainage and create an elevated perched water table.
- Once planted, never let the containers dry out completely. This leads to problems with rewetting and can cause channeling.
- Water thoroughly at every watering. This helps to prevent salts building up in the soil. It also encourages development of a deeper, more robust root system (Figure 7).
- Water uniformly over the entire soil surface in the container. This promotes uniform water infiltration.

Figure 6: Water forming channels as it flows through dry soil rather than uniformly infiltrating.

- Water when the top 1"to 2" of soil begins to feel dry.
- When irrigating, water the soil not the plant. Getting water on the plant leaves and stems can lead to increased disease incidence. A plant gets the water it needs by root uptake so put the water where the plant can get it.

One final comment on irrigation of container plants. The only water available to containerized plants is the water in the container's soil. It must be replenished as it is used up. Unlike plants grown inground, rain events don't change the need for watering your containers.

~ Dr. Joe Willis

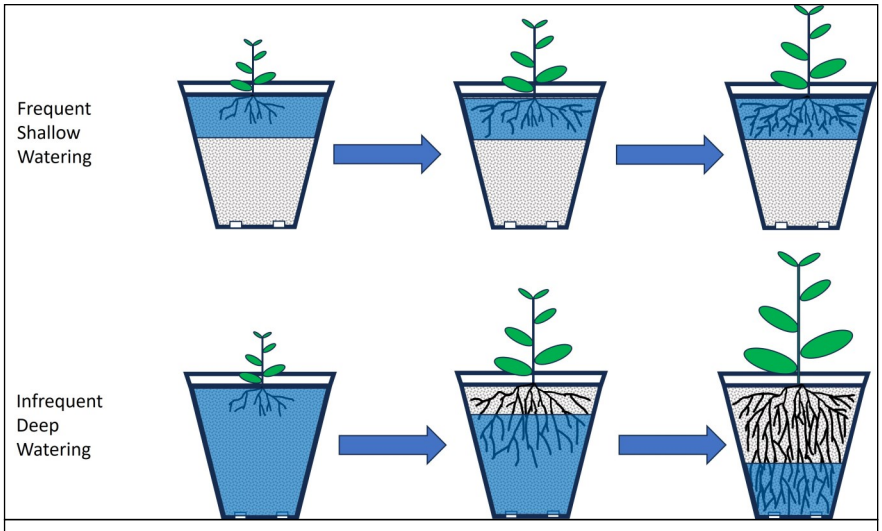

Figure 7: This illustrates the results of frequent shallow watering vs infrequent deep watering. The top plant gets water frequently before the top soil layer dries. The bottom plant gets water infrequently when the top 1" to 2" of soil has begun to dry.

Selected References

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