SOIL FOR CONTAINERS

LAGUNA HILLS NURSERY
Sept 2024

Containers present certain problems not encountered when growing in the ground.

Built-in perched water table.
Soil is normally like an endless sponge with any excess water continuously transferring downward. If it is interrupted by a horizontal layer of gravel some of the water will perch in a saturated zone above the gravel. This is because soil can exert a stronger pull on the water molecules than gravel or gravity. Similarly, if the bottom of a container is made of a non-porous material, gravity cannot, even with plenty of drain holes, relieve the soil at the bottom of a pot from a saturated condition. The height (above the bottom) of this saturated soil is dependent upon the coarseness of the soil. The smaller the particles, the higher the porosity and the higher the saturation after irrigation. To provide good growing conditions, either the pot must be tall, leaving an adequate volume of unsaturated soil above the perched water table, or the soil must be very coarse creating a thinner layer of saturated soil. If the plant uses a tremendous volume of water a high perched water table can be beneficial. Generally low containers are more difficult to manage because the perched water table is closer to the top. Taller containers provide a larger zone of moist unsaturated soil following a thorough irrigation.

Lack of moisture reserve.
Unlike the ground, plants only have access to moisture in the container no matter how hard the roots can suck. Container design (self-watering pots) and irrigation timing can get around this problem.

Poor retention of nutrients.
Clay and charcoal hold nutrients best. The coarse soil in pots allows nutrients to get washed out quickly. Organic or slow release fertilizers help, as well as adding an organic mulch layer or leonardite (a material that resembles charcoal) to the soil.

Lack of insulation.
Exposure to summer sun and to winter cold can cause root damage and death. Pots can be shielded or moved into protected areas.

History of Potting Soils & Organic Amendments
Bonsai, the art of growing miniature but mature looking trees in small pots has been a part of Japan for nearly a thousand years. The traditional methods use natural soil ingredients. The masters considered sand the most vigorous growing medium, but had to curtail vigor (Bonsai plants need to be stunted) by adding certain amounts of loam (with silt and clay). If problems were encountered the soil was changed to pure sand until the plant recovered. During the 19th century Citrus were grown in huge pots in France. The trees spent warm weather outdoors but were moved into Orangeries (primitive heated greenhouses) for the winter. The soil in these pots was about 97% sand.
The Royal Horticultural Society determined that sandy loam was the most ideal soil for containers.
In the late 1950's I played in my father's pile of container soil. The soil was a sandy loam with almost no clay. Local building supply yards carry a similar product called fill sand. This soil gives decent results for 5-gallon and larger containers. My father told me that growing plants was simple. He watered his plants every day and fertilized them every month with excellent results. The number of plant species grown 50 years ago does not come close to what is offered today, however my father seemed to grow Gardenias, Camellias, Avocados, and Citrus with little difficulty.
In the 1950's the University of California developed several soil mixes for containers that would be lighter (more consumer friendly) and even more permeable. Among these are
a. 1 part sand:1 part peat
b. 1 part sand:1 part bark
c. 2 part sand:1 part bark:1 part peat
In the 1960's my father added redwood sawdust to his sandy loam to lighten it. This worked well as redwood decays very slowly. A number of growers still use a redwood/sand mix.

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In the 1970's redwood became quite expensive and fir shavings, fir bark and other materials became quite prevalent. By the 1980's we were having many problems with rotting rots in potted plants. The agricultural agents told my father that he shouldn't be watering his plants every day, even though he had done that for nearly 30 years.

In that same decade, the Ball Seed Company's book, The Ball Red Book, (still a Bible for greenhouse flower growers) warns that while peat, sawdust, and bark are fine for growing annuals, permanent plants require permanent materials for best long term results. "A balance between water-holding capacity and air-supplying power should be sought. Of the two aeration is more important." Apparently few growers listened.

In the 1980's the prominent horticulturalists were pushing the theory that the more compost you incorporate into the soil, the better the results. In those days I followed their lead, but was starting to notice puzzling results. In the late 1980's and early 1990's I did not trust that what we were telling customers worked at all. Plants were rotting and everyone was blaming too much irrigation. I could not predict what our customer's results would be. Growing plants was getting strangely mysterious.

In 1995 I talked to a soil researcher who explained that soil was not organic. The scientist had me slowly strip off the soil from a plant that was growing in a bark and peat-based potting soil. He told me to observe careful. During the purging process the plant quite noticeably "pulled" its leaves up and looked much "happier" as the organic matter was removed. That same year I started growing vegetables (broccoli, strawberry, artichoke) in pure sand and pure pumice and saw incredible results. Growing plants in pumice is a form of Hydroponics.

The European Hothouse industry spent a lot of research money to determine the best materials (substrates) to use in their hothouses for their crops. Greenhouse operations are so costly that it is imperative that the plants grow and produce at the highest levels possible. They recommended sand, perlite, pumice, rock wool, pelletized clay, peat moss, coconut coir and rice hulls as dependable materials.

Perlite and pumice are both silicon dioxide (same material as glass) that have a lot of air pockets. Perlite is a mined ore that is popped in an oven like popcorn. Pumice is made by Nature in volcanoes by gasses blowing through moulten rock. Rice hulls are actually quite similar being about 90% silicon and are used as a perlite substitute. Rockwool is a thick sheet of mineral fibers commonly spun from basalt. Pelletized clay are fired (stable) clay pellets somewhat larger than sand. Peat Moss, which is composed of hair-like plant fibers, will retain its form and character for at least several months. Coconut coir, the fiber from Coconut shells, is similar but not quite as water retentive as peat moss.

All of these materials are available at a reasonable cost, have well-documented characteristics, and are extremely permeable. The high permeability promotes explosive root and plant growth, but the grower has to irrigate and fertilize carefully and constantly. All of these materials are discarded and replaced periodically.

The hothouse researchers determined that the characteristics of wood, bark, green waste and other types of organic products (ground up pallets, etc.) to be unpredictable. This means that they could not get consistent results when using wood, bark or other "bio" materials as a growing medium. The characteristics of wood and bark vary greatly from tree to tree, even from one end of the plank to the other end.

Currently most of the large growers of container plants in the U.S. use lots of partially composted ground bark (either Fir or Pine). These plants can look great initially, although rarely as good as field-grown plants. One university researcher, who recommends fir bark, reminds growers that bark is a good growing medium for a 5-month period following 3 months of initial composting. After 5 months

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the substrate has lost much of its permeability and the lack of oxygen also causes the continuing decomposition to produce toxic substances. He recommends that within 5 months make certain that the plant has been either:
1. Sold
2. Moved into a larger container surrounded with fresh bark, or
3. Discarded.

It appears to me that this researcher considers landscape plants to be the same as florists' plants. Sell and/or discard.

I believe that growers honestly think that organic materials become good soil somehow and/or become replaced by the surrounding soil once installed. When these plants are planted into extremely free breathing soils like the coarse soils found in the inland valleys, the results are decent. However, if these same plants are planted into heavy soils typical of Orange County, they act as if they are growing in a pocket of sewage. I have observed that the fastest growing plants are least affected, probably because their roots have become so large that the comparatively small pocket of sludge has little effect.

In the retail market there are a wide range of nationwide brand name and locally bagged potting soils. A few years ago a UC researcher studied a number of these potting soils. There results showed that most brands killed most of the species of trial plants. Only one plant (Impatiens) survived in all the soils. Among the brands tested the Scott's (aka Miracle Gro) had the best results. The researcher pointed out that these soils are meant to perform for 6 months. The main ingredients in Scott's is peat moss and composted forest products (wood and/or bark pieces)..

Our custom potting soils also contain peat moss. However our 2 soils are 50%:50% peat:pumice and 60%:30%:10% pumice:peat:sand. Our soils perform much better after 1 year than the others primarily because they contain much more material that is permanent.

Pure sand is still the best long term potting soil (for pots taller than 12") but the weight can be a problem. At my home we like a mixture of roughly 50% sand, 25% peat, and 25% pumice. This is essentially mixing plaster sand with our Laguna Hills Nursery Acid Mix Potting Soil in equal parts. The plants that we grow here at our store are grown in a very similar soil.