UF UNIVERSITY of FLORIDA IFAS Extension

Floriculture Research Alliance

Rapid Porosity Test for Container Substrates
(in pots rather than plug trays)

Goal: To rapidly measure dry bulk density, water holding capacity and air porosity of substrate in pots in greenhouse operations. See our other bulletin FRA S13 for a more detailed and precise method.

Substrate porosity and water holding capacity: why is it important?
The space in a pot is filled with solid substrate particles, air, or water. It is essential to have balanced air and water in a substrate for healthy root growth, and high quality plants.

Steps	Procedures
A list of things needed	Choose a pot that has already been filled and irrigated as normal. This pot may or may not have a plant with a root ball, but substrate will have settled out in the container to a stable height through irrigation. You will need an empty pot of the same type as the filled pot. You will also need a plastic beaker, 4 gal (15 liter) plastic bag without holes, waterproof marker pen or tape, weight scale, saucer, scissor, rubber bands, knife and tap water.
Seal the empty pot with a plastic bag & measure the pot volume	Put a plastic bag inside the empty pot, paying attention that both the inside wall and bottom of the pot are fully in contact with the bag. Hold the plastic bag in place on the pot by putting a rubber band or tape around the outside of the pot. Mark a line inside the plastic bag at the same level as would normally be filled with substrate, using tape or a waterproof marker pen. Put the empty pot on a scale, record the pot weight (W0 in grams), then tare weight to zero. Pour water into the pot and fill up to the mark, and record the weight as volume V in mL (The density of water is 1 gram (g) per milliliter (mL)).
Bring substrate to saturation & measure pot weight at saturation	With the pot filled with substrate, cut off the top part of the plant if it is rooted into the substrate, and carefully remove the media and root ball from the pot. Seal the pot by inserting a plastic bag inside the pot as described in the previous step. Gently put the root ball back into the plastic covered pot, making sure the substrate surface is at the original level. Slowly and gently add water to the top of the pot so that the top of the substrate is glistening. Allow the substrate to equilibrate for 5 minutes. Set the scale to zero, then put the filled pot on the scale and record the weight (W1 in grams).
Measure pot weight after drainage (near container capacity)	Take the pot off the scale, and cut the plastic bag through the drainage holes on the bottom of the pot with a knife or similar. Don't cut yourself. Allow the water to drain out until it stops dripping (15 min). Set the scale to zero, then place the pot on the scale and weigh again (W2 in grams). This irrigated and drained pot will be near container capacity.
Weigh the dry substrate, or estimate its weight	Empty the substrate and spread on a tray to air dry. Separate the root from the soil. Air dry the substrate in a warm dry environment for a few days until weight does not change. Then weigh dry substrate again (W3 in g). Change in weight from drained to dry (accounting for pot weight) represents water holding capacity in liters. If you want a very rough and quick estimate before the substrate is air-dried, divide the pot volume V (in mL) by 1000 then multiply by 100 grams/liter for an approximate bulk density of substrates made up of peat, perlite , vermiculite, and coconut coir. For example with a 2L pot filled with a peat/perlite substrate, W3 = V 2000 mL /1000 x 100 = 200 grams.
Calculate air porosity, water holding capacity and dry bulk density	Water holding capacity (milliliters per pot) = (W2-W3-W0) Air porosity (%) = 100 * (W1-W2)/(V) Water porosity (%) = 100 x (water holding capacity)/(V) Solid % by volume = 100% - air porosity – water porosity Dry bulk density (g/L) = 1000*(W3)/(V)





How to interpret it: Example for a coir substrate in a tall thin pot (as shown in pictures): V=2275 mL, W0 = 75 g, W1 = 2275 g, W2 = 1775 g, W3 = 228 g. Calculations would give water holding capacity=1472 mL; air porosity = 22%, water porosity = 65%, solid = 13%, dry bulk density = 100 g/L.
For a 6-inch (15-cm) diameter, 1-liter pot by volume in peat-based substrates: air porosity is typically 10 to 15%; water porosity 70 to 80%; solid 10 to 15%. The large pores (holes or spaces) in growing substrate hold air when the pot is drained. Small pores in a growing substrate hold water. Substrates with coarse particles therefore tends to have a high air porosity and low water porosity (a "dry mix"). Substrates with fine particles have lower air porosity and high water porosity (a "wet mix").

For more information: Contact authors Jinsheng Huang and Paul Fisher, pfisher@ufl.edu. Thanks to our Floriculture Research Alliance at University of Florida sponsors (floriculturealliance.org) including A.M.A. Plastics, Blackmore Co., Fafard et Frères Ltd (Canada), Greencare Fertilizers, Pindstrup, Premier Tech Horticulture, Quality Analytical Laboratories, Sun Gro Horticulture, and leading young plant growers. University of Florida IFAS Bulletin FRA S12. April 11, 2013.