

A New Method for Root Substrate Testing

Experts test the Rhizon Soil Moisture Sampler system and compare it to other common methods of extracting solution from greenhouse root substrate

By Paul Nelson, Kay Jeong and Jonathan Frantz

Three common methods are used for extracting solution from greenhouse root substrate for testing pH, EC and nutrient levels.

In the saturated media extract procedure (SME, also known as saturated paste extract), cores of substrate are taken from the vertical substrate profile. Water is mixed into the collected substrate to the point of a glistening paste, the mix is allowed to sit for about an hour, and then solution is squeezed from the substrate for analysis. The substrate solution is altered because more water is added than it could have held at container capacity — possibly 10 to 15 percent excess water. The pH is usually a little higher and EC and nutrient levels a little lower than the root would experience due to dilution. This system is destructive to the plant root ball. However, the entire substrate profile is represented in the extract.

The second system is the 2:1 extract (two volumes water to one volume substrate). Like SME, it is destructive and alters the substrate solution through excess water addition.

The third system, PourThru (PT), is non-destructive to the plant root ball and, unlike the two previous systems, yields unaltered substrate solution. The PT procedure is conducted one hour after irrigation. A specified volume of water is applied to the surface of the substrate to serve as a plunger that pushes the substrate solution out of the bottom of the container into

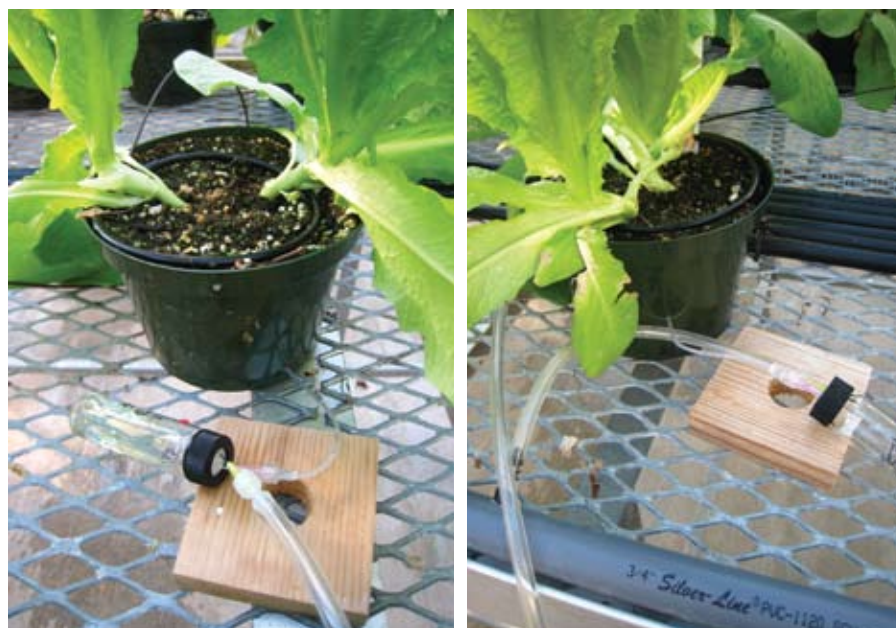
a collection saucer.

A disadvantage is that solution is not obtained from substrate at the top of the container. To obtain solution from all of the substrate profile it would be necessary to apply a volume of water equal to that of the volume of solution in the substrate. If this were done, some of the applied water would find channels in the substrate allowing it to pass through to the collection container, thereby diluting the soil extract. To prevent this, less water is applied, which results in substrate solution being pushed out from the lower profile of the container and not from the top.

Applying a New Method

The Rhizon Soil Moisture Sampler (RS) is a more recent system that offers a fourth means for extracting substrate solution. It is similar to the PT in that it is non-destructive to the crop, fast and easy to use,

and does not alter the substrate solution. The RS consists of a rigid, porous plastic extraction tube that is inserted into the substrate. The extraction tube is typically connected to a hypodermic needle by a short length of flexible plastic tubing. The needle is inserted through the rubber cap on a collection vial. A second tube is also connected to the sample vial through a hypodermic needle. This tube is connected on



Examples of Rhizon Sampler inserted at different depths

its other end to a vacuum line for the purposes of our research. In the commercial setting it would be connected to a hand activated vacuum pump (costing ~\$150). As the handle of the pump is repeatedly squeezed by hand, a vacuum is created in the system that draws substrate solution into the rigid extraction tube and then on into the sample vial where it is trapped.

The micro extraction tube used in this study has an outside diameter of 0.1 inch (2.5 mm) and length of 4 inches (10 cm). An alternative macro extraction tube measures 0.2 inch (4.5 mm) in outside diameter and 3½ inches (9 cm) in length.

The RS can be inserted into the container substrate when it is being filled or later after planting by simply pushing it into the substrate. Pots with the sampler can be placed in

various locations within a crop to give replications of the sample that are representative of the whole crop. The RS can be left in the pot and used repeatedly during the period of crop culture.

The RS Advantage

We undertook our study of the RS to compare its effectiveness to the PT system. The PT system works well for pots that can be lifted to insert a saucer under them. The RS system does not require lifting pots. The sampler can be inserted in beds and benches of soil; the 3- to 5-gallon containers used for vegetable fruit production such as tomato, cucumber and pepper; and large pots used for crops such as cut rose, gerbera and foliage plants.

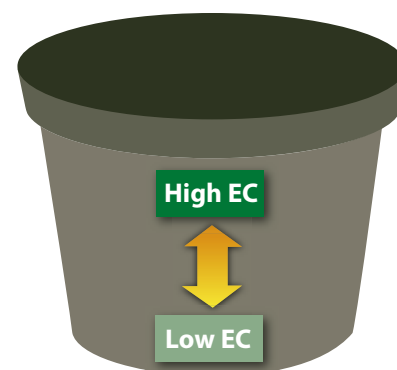
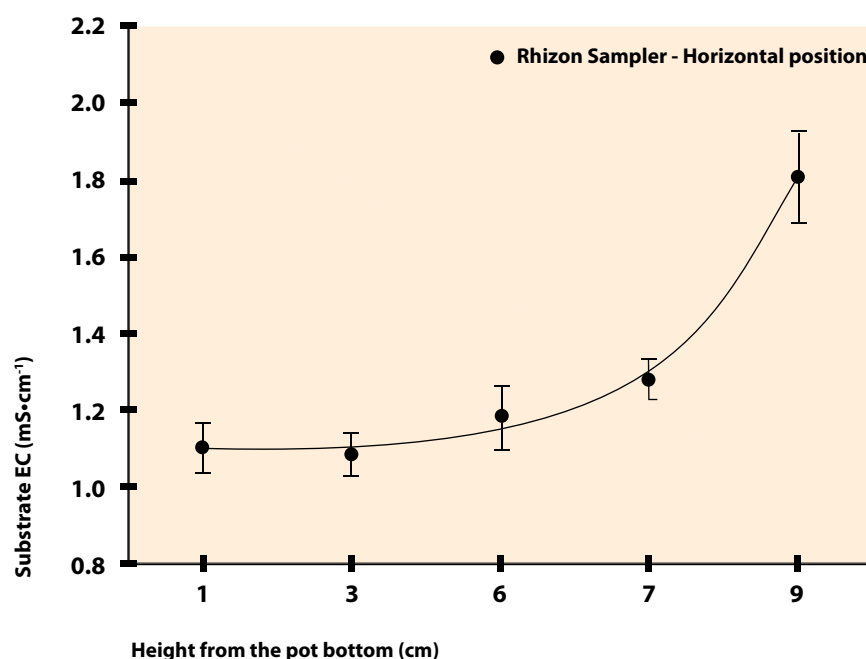
The RS system also lends itself well to long term crops where repeated sampling over time is important. We saw an additional advantage of the RS system for research. During the PT procedure, an extra application of water is made, which does not alter the extracted solution but does

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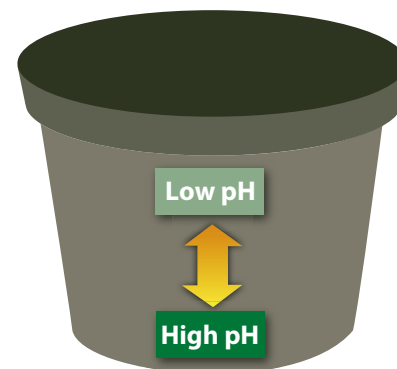
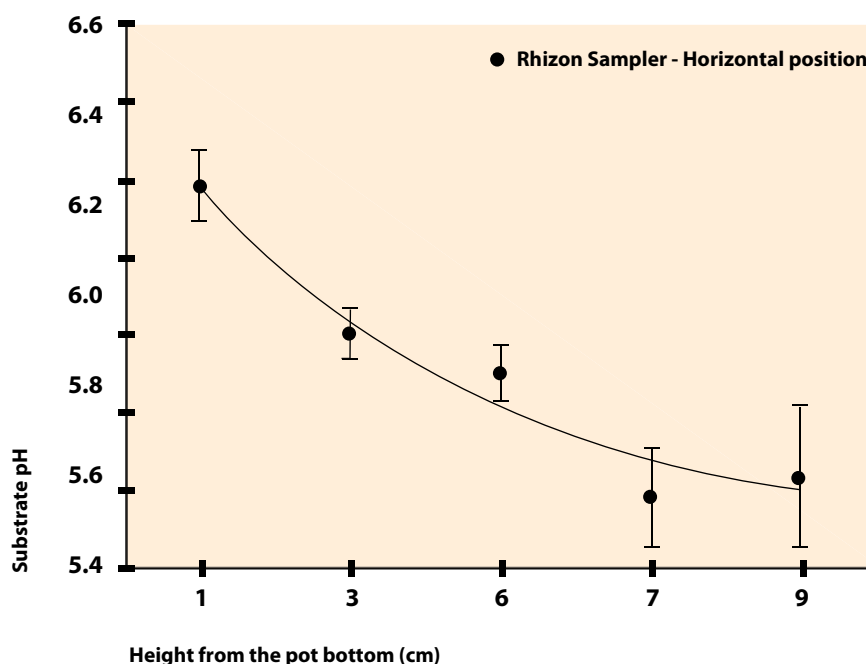


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Rhizon Soil Sampler – Substrate EC



Rhizon Soil Sampler – Substrate pH



alter the substrate for the next irrigation or two. Closely repeated samplings would alter the nutritional status of the substrate and distort subsequent research results.

The PT standards already existing for EC should serve well for the vertical or diagonal RS extract for EC.

More information about the PourThru substrate

extraction system can be found in the booklet *PourThru Nutritional Monitoring Manual* at: <http://floriculture.info.com>. Extract pH levels for PT and diagonal RS

Testing the New Method

Our concerns about the RS were: 1) Could it sample solution far enough out from its small dimensions to represent the whole pot of substrate? and 2) if placed vertically in the pot, would it sample more solution from the bottom than the top of the pot since the water content is always much higher at the bottom than the top of the substrate profile?

To accomplish our objectives, we grew crops of lettuce in 6½-inch azalea-type pots in Fafard Growing Mix 2 and fertilized these at each watering with Green-care 17-5-17 neutral fertilizer at 180-ppm nitrogen. When roots completely filled the pot, sampling comparisons were begun and were repeated at three intervals. Six positions were used for placement of the RS, each in separate pots. For five positions, samplers were placed horizontally at distances of 0.4, 1.2, 2.0, 2.8 and 3.6 inches above the bottom of the pot. For the sixth position, the sampler was inserted diagonally from top to bottom of the pot. The PT extract was obtained by pouring 3.5 ounces of water on the surface of the pot.

Results from the five horizontal RSs showed that 3.2 times more solution was drawn in by the lowest RS compared to the top RS in an equivalent period of time. Also, there were large gradients in pH and EC across the five layers. As seen in the figures (left), pH varied from 6.2 to 5.6 from the bottom to the top layer, while EC varied from 1.1 to 1.8 from bottom to top. This can be explained by increased concentration of the substrate solution at the top of the pot where water evaporates.

Solution extracted by the diagonal RS, that extended from top to bottom of the pot, was expected to have pH and EC values equivalent to the average of the five layers, but this wasn't the case. The pH and EC values of the diagonal RS were similar to the values in the lowest substrate layer. This was due in great part to the disproportionately larger amount of solution picked up in the lower layers compared to the upper layers. We ran additional tests with a diagonal RS that showed the bias toward a greater amount of solution coming from the base of the RS is larger than the 3.2 fold difference predicted by data from the five horizontal samplers.

As discussed earlier, the PT extract also is biased toward the lower layers in the pot. The EC levels found in the diagonal RS and PT extracts were 1.21 and 1.26, which were not significantly different.



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were 6.6 and 6.3. The RS and PT levels are close enough to use the same standards, also found in the PourThru manual.

Overall, the RS and PT extraction systems had similar results. The RS system extends the utility of the PT system to container configurations that do not lend themselves to the mechanics of the PT system. Growers contemplating use of the RS should target their long-term crops and those grown in large containers or beds. For each crop or nutritional zone a minimum of five samplers should be set up across the zone to ensure representation of the whole zone. When inserting a RS in smaller pots, care must be taken to consistently locate the bottom of the Rhizon extraction tubes near the bottom of the plant container. *Author's Note: The Rhizon system and the hand pump are available from Soilmoisture Equipment Corp.; P.O. Box 30025; Santa Barbara, CA 93130; www.soilmoisture.com*

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Diagonally inserted Rhizon Sampler

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