Creating Excellence in Interiorscaping with One Minute Maintenance™

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strung out between visits, this tends to be a finishing touch rather than a major project. The final part of this step is running the pocket sweep over the carpet to pick up leaf sheaths and moss "crumbs" or wiping them off the floor tile with the cleaning mitt on my wrist.

Wipe Off Container With Plant Paws (5 Seconds)

Since I'm already working on the container as I complete the above, I'm in the right place to buff any dust or dirt off the decorative container with the Plant Paws that are (always) on my wrists. And since I have rotated the plant, I only clean the part of the container that is showing during each visit.

Obviously, doing plant maintenance properly and in one minute per plant takes as much practice as learning any new dance. It also makes a lot of assumptions, such as having all my equipment with me and in proper working condition and having the proper training and experience to do the plant maintenance correctly.

Doing the **first step first** is the most important part of being able to complete a service cycle in a minute per plant, yet it is my experience that not every company will actually complete all four steps. If your company is doing two of the first four steps, it's average. Completing three out of four is very good, and any company doing all four steps is able to do exceptional plant maintenance, profitably.

Anyone can spend less than a minute per plant just by walking up to the plant, pouring water on it, and walking away. The real art to plant maintenance is to walk up to each plant and complete each of the remaining six steps on each visit, no matter what.

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ofa Grower

In-House pH and Electrical Conductivity Measurements in Soilless Substrates

by Diane Camberato and Roberto Lopez

It is important to routinely monitor substrate pH and EC levels before nutrition problems arise. Affordable, easy-to-use equipment and simplified monitoring methods make such monitoring easier for greenhouses and nurseries of all sizes.

Growers should also measure alkalinity, a measure of basic ions (bicarbonate and carbonate) dissolved in the water. High water alkalinity can increase substrate pH over time. Having a professional laboratory test irrigation water before beginning any pH and EC monitoring program is beneficial. Additional substrate and/or plant tissue analyses are necessary for determining which nutrients are present and in what quantity. All nutrients are readily available at a pH of 5.4 to 6.2, but each plant species has an optimal pH range. Obtain this information for each crop you are growing when you begin your monitoring program. There is also an acceptable range for soluble salt content specific to plant species. Please refer to the Purdue Extension Bulletin HO-237-W (www.extension.purdue.edu/extmedia/HO/HO-237-W.pdf) for more information.

Monitoring substrate solution pH and EC requires a metering device that will measure both. Portable, affordable units are available and very accurate. Units that feature automatic calibration and temperature compensation are desirable. However, standard solutions for both pH and conductivity are necessary to calibrate instruments. Always store the instruments and solutions properly in a room with low humidity and at room temperature. Never store solutions or meters in the greenhouse or outside.

Onsite pH and EC monitoring programs allow growers to see trends during the crop production cycle and to make adjustments before crop vigor or quality problems, such as chlorosis in *Calibrachoa* induced by high pH, manifest themselves (Figure 1). Measure and record substrate pH and EC over time since they can change. These changes depend on several factors, including the medium, fertilizer, irrigation water quality, alkalinity, and plant species. Data from pH and EC monitoring, together with crop production logs, provide valuable clues if problems arise.

Substrate testing involves extracting a sample of substrate solution with distilled water (no mineral content) and measuring the pH and EC of the extract. There are three accepted methods

Figure 1. *An example of iron deficiency in* *Calibrachoa* *induced by high substrate pH.*

for extracting media solution for testing: the PourThru test, saturated media extract test, and 1:2 dilution test. The sections below describe the steps for each method (simplified for commercial greenhouse or nursery settings), with the advantages and disadvantages of each.

Regardless of method, a good testing program involves taking 5 to 10 samples of each crop type (container volume, etc.) and taking additional samples for each substrate and fertilizer type. Then, measure the samples separately and base management decisions on the average. The target EC range varies by sampling method.

PourThru Test

The PourThru extraction method has several advantages: it samples the solution from the entire root zone, is nondestructive, and can be used with media that contain slow- or controlled-release fertilizers. It also can be used to test the bark, coconut coir, or sphagnum moss media used to grow orchids.

The major disadvantage of this method is that results are variable. Sampling from dry pots may result in greater EC because of higher salt concentration. Adding too much water could dilute the sample and result in a lower EC. Irrigating the crop as usual (see step 1 below) and monitoring the volume of water added (see step 4) will help minimize these sources of variation.

To sample using the PourThru test method:

1. Fertigate or irrigate the crop as usual for your production program and establish a specific testing day if fertigation is conducted once a week.
2. Allow the substrate to drain for 30 to 60 minutes.
3. Place a saucer under the pot.
4. Apply enough distilled water (approximately 100 milliliters or 3.4 ounces) per 6.5-inch pot to collect as close to 50 milliliters (1.7 ounces) of leachate as possible. More than 70 milliliters (2.4 ounces) of leachate can dilute the salt content, while less than 50 milliliters of leachate may not provide enough solution to cover the probe (Table 1 and Figure 2).
5. Measure the pH and the EC of the leachate.

Saturated Media Extract Test

The saturated media extract test has the advantage of being an accurate test. However, it requires removing substrate from the pot, which can be a disadvantage because this disturbs the roots, and care must be taken to avoid breaking any fertilizer prills if the substrate contains slow-release fertilizer.

To sample using the saturated media extract method:

1. Obtain a 200- to 300-milliliter (7- to 10-ounce) sample of substrate from the root zone (avoid sampling from the

Table 1. Estimated quantity of distilled water to apply to various pot sizes to obtain 50 milliliters (1.7 ounces) extract for the PourThru Extraction Method[1].

Pot Size	Estimated Quantity of Distilled Water	
	Milliliter	Ounces
4, 5 or 6 inch	75	2.5
6.5 inch azalea	100	3.5
1 quart	75	2.5
1 gallon	150	5.0
3 gallon	350	12.0
606, 1203 or 1204 flats	50	2.0

[1]Adapted from Cavins, T.J., B.E. Whipker, W.C. Fonteno, B. Harden, I. McCall and J.L. Gibson. 2000. Monitoring and managing pH and EC using the PourThru extraction method. North Carolina State University Horticulture Information Leaflet 590:1–17.

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In-House pH and Electrical Conducitivity Measurements in Soilless Substrates

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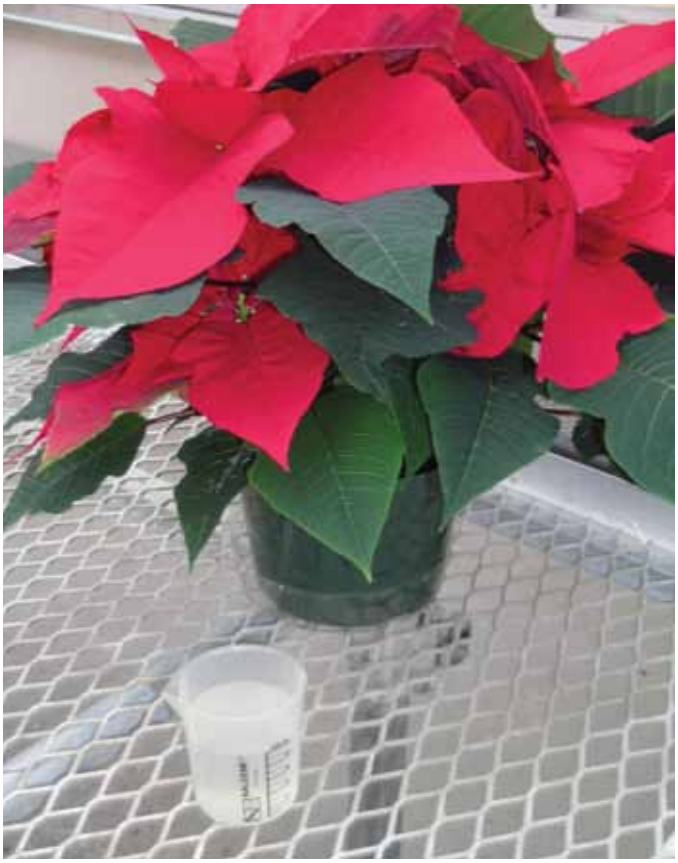

Figure 2. *The goal for the PourThru test is to collect a sample of leachate of approximately 50 milliliters (1.7 ounces).*

top inch and bottom inch of the pot because of the potential for a higher salt content).

2. Place the sample in a 500-milliliter (17-ounce) beaker or container.
3. Add only enough distilled water to wet the sample to saturation – there should be no free water on the sample surface (Figure 3).
4. Let the sample stand for 30 minutes to equilibrate.
5. Pour the mixture into a clean funnel lined with a filter (such as a coffee filter, or a tea or wire mesh strainer) to avoid getting substrate in the solution (Figure 4). Attaching a vacuum line or squeezing the solution through the filter with a spatula or gloved hand, can help obtain the sample more quickly.
6. Measure the pH and the EC of the leachate.

1:2 Dilution Test

The 1:2 dilution test has similar advantages and disadvantages as the saturated media extract test. A significant advantage of the 1:2 dilution test is that the amount of water added to the substrate is defined, rather than left to personal judgment (wet to saturation).

To sample using the 1:2 dilution method:

1. Combine one part (by volume) of substrate with two parts (by volume) of distilled water. For example, combine 4

Figure 3. *When using the saturated media extract method, the substrate should be saturated, but no free water should be visible on the sample surface.*

Figure 4. *For the saturated media extract and 1:2 dilution methods, pour the samples into a clean funnel lined with filter paper or two coffee filters to collect the extract.*

ounces of substrate with 8 fluid ounces of distilled water in a 16-ounce container, or combine 1 cup of substrate with 2 cups of water (Figure 5).

2. Let the sample stand for 30 minutes to equilibrate.
3. Pour the mixture into a clean funnel lined with a filter (such as a coffee filter, or a tea or wire mesh strainer) to avoid getting substrate in the solution (Figure 4). Attaching a vacuum line or squeezing the solution through the filter with a spatula or gloved hand can help obtain the sample more quickly.
4. Collect the extract in a clean container and measure the pH and EC.

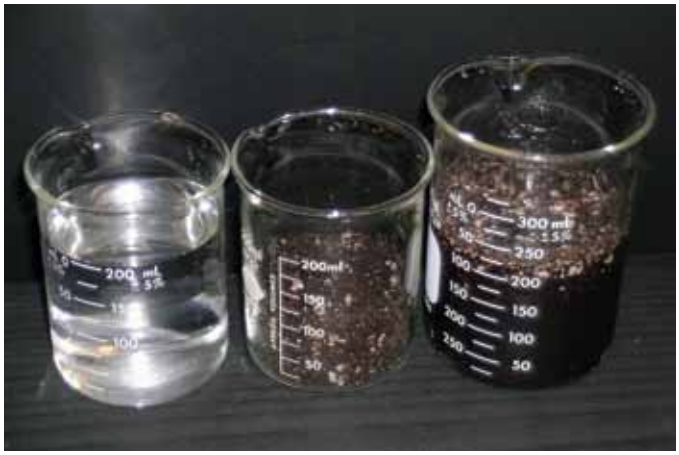

Figure 5. *In the 1:2 dilution method, combine one part (by volume) of substrate with two parts (by volume) of distilled water.*

Important Considerations

Regardless of the sampling method, there are a number of things to keep in mind:

- Calibrate the pH/EC meter with standards to the pH range you are testing. For example, testing peat or bark may require the calibration to be set at 4.0.
- Be consistent. It is better if the same person does the test each time.
- Know the acceptable pH and EC ranges for your crop and monitoring method. The values will be different depending on the sampling method you choose.
- Track your values over time on a graph. This is the real value of testing. The data and graphs will reveal trends and be a critical piece of information to share when seeking advice from diagnostic labs (such as the Purdue Plant and Pest Diagnostic Laboratory: www.ppdl.purdue.edu/PPDL/) or experts about problems only indirectly related to pH or EC.
- Make adjustments to fertilization and water quality in a timely manner based on trends.
- Closely monitor these measurements for crops with long production cycles, such as poinsettias or 2-gallon shrubs.
- Use data when reviewing the growing season to make adjustments for the following year.

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