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Simple Chemical Tests of Potting Mixes Used For Container Crops

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Objectives:

The overall goal of this laboratory is to acquaint you with two procedures used to measure simple chemical properties of container media. These procedures are directly applicable to commercial nurseries and greenhouses. The procedures should be used on a regular basis to provide growers with a rough idea of how plants will grow in potting mixes. Specific laboratory objectives include:

1. Be able to measure pH and electrical conductivity (EC) of a potting mix by using two different analytical techniques.

2. Be able to compare and contrast two methods used to measure chemical properties of potting mixes.

3. Be able to used different types of analytical equipment to measure pH and electrical conductivity (EC) of container media.

4. Be able to compare and contrast different types of analytical equipment for ease of use and accuracy of measurements.

Measuring pH and EC using Two Different Methods

Potting mixes are perhaps the most important factor for producing plants grown in containers. Optimum chemical and physical characteristics of the potting mix will promote plant growth and should decrease the amount of time needed for producing a salable plant. Completing chemical analyses can be expensive, yet a grower or teacher should know two of the most basic chemical characteristics (pH and electrical conductivity) of potting mixes before the plants are planted or seeds are sown. The pH and electrical conductivity of a potting mix can affect the medium's fertility and ultimately plant growth.

Several methods can be used to determine chemical characteristics of potting mixes. Two of the more popular techniques are the Saturation Extraction Method (SEM) and the Pour-through Method (also called the Virginia Tech Method). These methods will be used by you to show how to determine pH and electrical conductivity (EC) of the potting mix. You will experience the different amounts of time and work required to complete these analyses.

This handout is available at: http://extension.ag.uidaho.edu/nursery/potting%20mix%20workshop.htm

I. Measuring Potting Mix Characteristics of a Geranium Crop

Form a group of three people. You will be provided with one potted plant for each group. You will use the potted plants for pH and EC measurement in this laboratory exercise, but you will need to use the plant in a certain order. Please follow the directions below carefully so that you measure the two chemical characteristics in the correct order.

II. Methods of pH and EC Analyses

A. Background
   1. Perhaps the simplest chemical tests that growers can complete are pH and EC determinations. Relatively good equipment needed for each test can cost between $100 and $1,000 with quality meters available for around $200.

   2. pH and EC of the potting mix solution can be measured by the Saturated Extraction Method, and the Virginia Tech Extraction Method (also called the Pour-through Method).

B. Pour-through Method - developed at Virginia Tech
   1. With this method, a container with medium inside is elevated above a collection vessel suitable for collecting leachate from drainage holes. Enough distilled water or good quality tap water is added to the surface of the medium in a 4-inch pot to collect 50 milliliters (ml) (about 2 ounces) of leachate from the pot.
      a. The moisture level of the container medium should be at or near container capacity BEFORE starting this method. For this reason, pots should be watered several hours before testing.
      b. For one-gallon or three-gallon containers, about 150 ml (5 ounces) or 350 ml (11 ounces) of water will need to be added to get enough leachate for analysis.
      c. At least three samples or containers should be tested

   2. In today's lab, you will use the potting mix that is being used for the potted crop in the 4-inch pots. The potting mix was thoroughly watered with tap water several hours before this workshop. Ideally, you should wait 2 to 3 hours for the solution in the potting mix to equilibrate. The idea is to pour in new tap water that will displace the solution that has equilibrated in the rhizosphere (root ball). Please complete the following steps.
      a. First, place the pot over a collection container. Half of a clamshell container will collect the leachate easily. A saucer would also work.
      b. Before watering the pot with the tap water, be sure the container plant is sitting above the bottom of the clamshell container. In other words, place the container on an upside down bottle cap or plastic ring (cut section of pipe) to be sure the pot drains well.
      c. Add 50 to 75 ml of tap water and let it drain for 10 minutes.
      d. Collect the leachate in a small vial or beaker, and place the pH electrode (or conductivity electrode) in the solution so that its tip is submerged at least 2 cm

(almost one inch). Be sure air bubbles have been eliminated from the tips of the electrodes by gently swirling the solution. Take readings with the pH meters, electrical conductivity meters, or combination meters, and record your data.

3. Advantages of the Pour-through Method include:
   a. Extraction and analyses can be done in the field or greenhouse.
   b. Time required for extraction is short, and handling potting mix is unnecessary.
   c. Controlled-release fertilizer is untouched so that prills remain intact.
   d. Specialized equipment for extracting the solution is unnecessary.

4. Liabilities associated with this technique include:
   a. Results from the test must be related to plant growth.
   b. The moisture level in the medium should be similar each time the method is completed for consistent results.
   c. Water may channel in the medium and cause erroneous results.

5. An excellent resource for the Pour-through Method is available on the web.
   a. The web address is: http://pourthruinfo.com/
   b. The site contains PDF files you can download, and the publications describe the method carefully and fully.
   c. At least one publication at the site also describes equipment to use for analyses and managing pH and EC for crops (mainly greenhouse crops) by using the Pour-through Method.

C. Saturated Extraction Method (SEM)
1. With this method, potting mix (about one cup) is taken from a batch of mix or several pots (if testing a growing crop) and just enough distilled water is added to saturate the medium. If you are testing a crop, take about one tablespoon of medium from up to ten pots. The tablespoon of mix should be taken from the bottom center of the root ball, if possible. Once you have one cup (about 150 to 200 ml) of mix, you can start to add distilled water. Slowly add the water. The potting mix is stirred to ensure that water is saturating the entire medium. Add just barely enough water to see the potting mix surface glisten. Free water should be absent from the top of the medium at the saturation point.

2. The saturation point is easier to determine for potting mixes with fine texture (e.g., plenty of peat moss in the mix) than for mixes with coarse texture (e.g., large quantities of coarse bark).

3. Most pH electrodes can be stuck directly in saturated media to take readings. Some EC meters can also be stuck directly in saturated media, but other EC equipment requires the substrate solution to be extracted from the medium to get an EC reading. For most soilless mixes, extracting the water is as simple as putting the saturated medium in gauze or cheesecloth and squeezing the sample to obtain the extract. Vacuum filtration is needed for obtaining extract from saturated field soil.

4. Advantages of this extraction method include:
   a. This method of analysis is widely used, and growers have experience relating analyses to actual plant growth.
   b. Results from this method can be compared between substrates composed of drastically different components.

5. Liabilities of this extraction method include:
   a. Person completing the analysis must get experience deciding on the saturation point.
   b. Medium must be removed from the container and subsequently extracted.
   c. Handling and extraction time may take too long.
   d. Controlled-release fertilizer particles can be ruptured, causing errors.

6. Two excellent resources for the Saturated Extraction Method are available on the web.
   a. The web address is: http://edis.ifas.ufl.edu/EP152
      or: http://www.agf.gov.bc.ca/ornamentals/floriculture/testing.pdf
   b. The sites describe the method carefully and fully.
   c. The sites also describe equipment to use for analyses and references for pH readings and EC readings for general crops when using the Saturated Extraction Method.

D. Data to Take
1. Measure the pH and EC of the potting mix from the potted plants, and record the information on page 6. Be sure to record the data specifying the analysis technique and equipment used.

2. Complete the Pour-through Method first. Start at Step B.2. above.

3. After completing the Pour-through Method, carefully turn the potted plant upside down and remove the pot to expose the root ball. This procedure WILL BE DEMONSTRATED for you.
   a. Remove one to three tablespoons of potting mix from the bottom center of the root ball. Be careful to avoid breaking the root ball/system when taking the sample.
   b. Pool the potting mix from the plants for your group into one plastic cup.
   c. Slowly add distilled water and follow the Saturation Extraction Method procedure starting at Step C.1. above.

4. Use two pieces (or more) of equipment to measure the two chemical properties (pH and EC) of your potting mix. You will be shown the proper method for using the various pieces of equipment.
   a. Try to make at least ONE of your measurements with the laboratory analytical equipment (mainly the pH meter) to compare results from an expensive piece of equipment and an expensive electrode with less expensive equipment.

b. As you use the various pieces of equipment, decide if you like the equipment based on its accuracy, ease of use, and ease of handling.

E. Data Required for This Lab

1. Fill in the data table on Pages 6 and 7. You need to record the information for the chemical properties of your potting mix.

2. Answer the questions on Page 7.

III. When to Use These Tests

A. Once you decide on a testing technique, use it on a potting medium BEFORE you plant into it. Testing potting mixes before planting may help you to avoid crop losses due to a poor potting mix.

B. You can (should) also use these tests after the crop is growing in a potting mix. pH can be checked once a month, and EC can be tested once every two weeks. The interval between testing depends on your schedule, the potting mix, the fertilization program, and the crop (plant species). Testing the potting mix while the crop is growing will provide information about nutrient availability and salt (fertilizer) accumulation in the potting mix, which in turn should help improve crop quality.

Results for
pH and Electrical Conductivity Measurements

I. Chemical Properties of Container Media – **Pour-Through Method**

1. pH Meter name _____ _____ _____

2. EC Meter name _____ _____ _____

3. Measurements

pH _____ _____ _____

EC (write units) _____ _____ _____

I. Chemical Properties of Container Media – **Saturated Extraction Method**

1. pH Meter name _____ _____ _____

2. EC Meter name _____ _____ _____

3. Measurements

pH _____ _____ _____

EC (write units) _____ _____ _____

Comparison of Results

1. Using your data, fill in the table below. This table compares chemical characteristics of the potting mix as determined by the two extraction techniques and equipment used.

Characteristics	Plant Potting Mix					
Chemical properties						
	pH Meter _____		pH Meter _____		pH Meter _____	
	Saturated	Pour thru	Saturated	Pour thru	Saturated	Pour thru
pH	_____	_____	_____	_____	_____	_____
	EC Meter _____		EC Meter _____		EC Meter _____	
	Saturated	Pour thru	Saturated	Pour thru	Saturated	Pour thru
Electrical conductivity	_____	_____	_____	_____	_____	_____

(Note: make sure units are identical for the EC meters)

2. Did both measurement techniques (SEM and Pour-through) yield similar results for chemical properties of your medium? If your answer is no, what were the differences in general?

3. If results differed between the two techniques, speculate on reasons for these differences? Do these differences make sense?

4. Which technique would YOU prefer to use to measure pH and EC? Why? Please be specific.

5. Which equipment would you prefer to use at your business? Why? Base your answer on accuracy, cost, and ease of use of the equipment.