NC STATE UNIVERSITY
Floriculture Research

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1, 2, 3's of PourThru

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The PourThru program is designed for growers to monitor and manage crops. It involves three parts: 1) a simple technique for measuring pH and electrical conductivity (EC), 2) charts for recording pH and EC values, and 3) recommended ranges and procedures for maintaining substrate pH and EC.

pH

The substrate pH is very important to plant nutrition. The pH directly affects plant nutrient availability, especially micronutrients (**Fig. 1**).

Low pH can result in increased micronutrient availability which can lead to phytotoxicities in some plants. For example, a low pH (≤ 5.8) can result in iron and / or manganese toxicity in geraniums and marigolds. In contrast, high pH (>6.2) can lead to micronutrient (iron) deficiencies in petunias and azaleas; and boron deficiency in salvia, petunias, and pansies. Both excessively low and high pH's should be avoided in greenhouse production.

Most greenhouse crops grow best at pH 5.4 to 6.2, but some crops such as azaleas and hydrangeas prefer an acidic substrate while others such as Easter lilies are grown at a higher pH.

Electrical Conductivity

Soluble salts are the total dissolved salts in the root substrate (medium) and are measured by electrical conductivity (EC). A conductivity meter measures the passage of electrical current through a solution. The higher the EC value, the easier it is for electric current to move through the solution. The EC of the substrate provides insight to the nutrient status of the crop. Keep in mind that not all of the salts measured by an EC meter are fertilizer salts. An EC meter measures the sum of all salts in a solution, but does not provide details about the type or amount of each salt present.

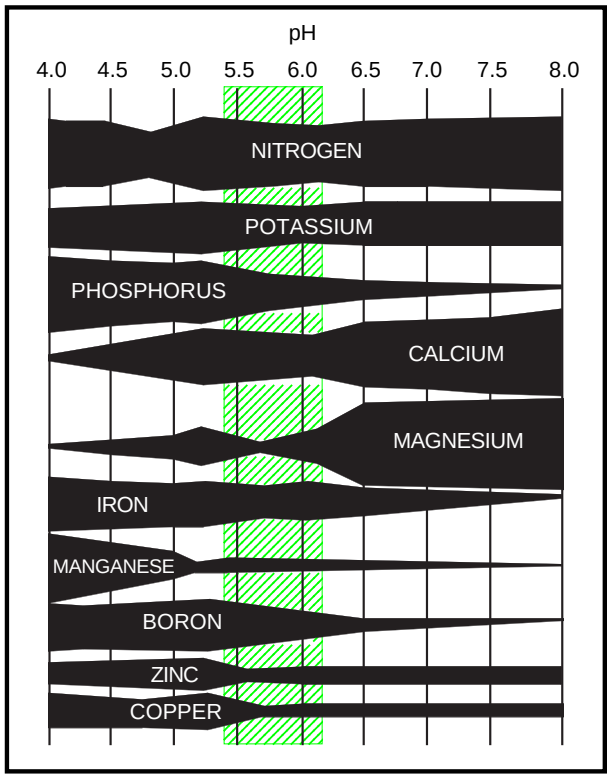

Figure 1. Influence of pH level on the availability of essential nutrients in a soilless substrate containing sphagnum peat moss, composted pine bark, vermiculite, and sand. The pH range recommended for most greenhouse crops is indicated by slashed lines.

Excessively high EC values are associated with poor shoot and root growth. Symptoms often begin on the lower leaves as chlorosis and progress to necrotic tips and margins. If the root substrate is allowed to dry, plants may exhibit wilting symptoms because of dieback of root tips, which further inhibits water and nutrient uptake. High EC has also been linked with the increased incidence of *Pythium* root rot.

In contrast, when EC values are too low, plant growth can be stunted or leaf discoloration can result from the lack of nutrients. Usually nitrogen is the most typical nutrient deficiency (lower leaf yellowing). But lower leaf purpling (phosphorus deficiency), interveinal chlorosis of the lower leaves (magnesium deficiency), or lower leaf interveinal chlorosis and marginal necrosis (potassium deficiency) can also occur.

Sampling Program

Sampling results are only as good as the sampling procedure. How to set up a sampling program, which crops to sample, and the number of samples to collect are all factors to consider.

Crops. Any single crop which makes a large contribution to the "bottom line" should be included. Examples include poinsettia, fall pansies, bedding plants, geraniums, garden mums, or hanging baskets. If it is a major crop, then include it!

The Troublemakers. Some crops are more troublesome than others. Examples include crops which are sensitive to low pH (celosia, dianthus, geraniums, and African marigolds), to high pH (pansy, petunia, salvia, snapdragons, and vinca), to low EC (Easter lily and poinsettias), or to high EC (African violets, begonias, cineraria, impatiens, New Guinea impatiens, pansies, and primula). Consider including these troublemakers in your sampling program.

Other Factors. Consider taking separate crop samples if there are variations in the substrate used (different manufacturers or ingredients), the fertilizer type (acidic or basic) or rates, or planting dates.

Frequency. The speed of PourThru makes weekly sampling possible. Ideally sampling should be done weekly, but in practice it may not be possible. If time availability is a concern consider selecting the "Top 10 Crops of Concern" based on their economic value or if they tend to have nutritional problems. Divide the crops into 2 groups of 5 and alternately sample each group every other week.

Plugs should be sampled every 2 to 3 days. PourThru interpretation standards have not been developed, so consider using the "Squeeze" sampling method. (For additional information, see the Floriculture Information Center, click on the topic: Plugs. Address listed below).

Number of Samples to Collect. For routine analysis, collect and analyze a minimum of 5 individual pots (or for bedding plants a minimum of 5 cell packs). As a general rule, sample 5 pots per 1,000 pots of similarly treated plants. Results can then be averaged for a single "interpretation value".

Other Tips.

- If steps to correct an EC or pH problem have been taken, then resample those plants weekly. If needed, sample as frequently as every other day.
- If results seem atypical, consider resampling before making drastic changes, especially to the substrate pH.

Charts for recording pH and EC values, interpretation values, and corrective procedures are all listed at the Floriculture Information Center, click on the topic: PourThru. That web address is:

http://floriculturein fo.com

PourThru Nutritional Monitoring Manuals are available from the North Carolina Commercial Flower Growers' Assoc. for $15 + postage (919-779-4618).

PourThru Steps

Steps

Below are the 6 easy steps for PourThru sampling.

1. **Irrigate your crop one hour before testing** (**Fig. 2a**). Make sure the substrate is saturated. If the automatic irrigation system is variable, water the pots/flats by hand. If using constant liquid feed, irrigate as usual. If using periodic feeding (weekly, etc.): a) irrigate with clear water, b) test a day or two before you are to fertilize, and c) test on the same day in the fertilizing cycle each time. *Consistency is very important!*

Figure 2a. Irrigate containers thoroughly.

2. **Place saucer under container.** After the container has drained for an hour, place a plastic saucer under the container (**Fig. 2b**). If testing seedlings in bedding plant flats, pull out one cell pack and place it in the saucer (**Fig. 2c**).

Figure 2b. Saucer for pots.

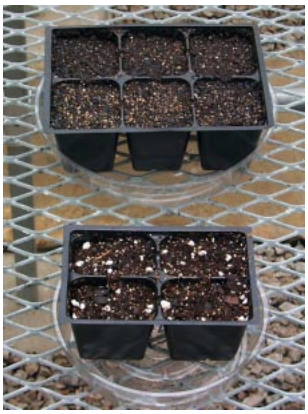

Figure 2c. Saucers for cell packs.

3. **Pour enough distilled water on the surface of the substrate to get 50 ml (1.5 oz) of leachate** (**Fig. 2d**). The amount of water needed will vary with container size, crop and environmental conditions. Use the values in **Table 1** as guides.

Figure 2d. Applying water for extraction.

4. **Collect leachate for pH and EC** (**Fig. 2e**). Make sure to get about 50 ml of leachate each time (**Fig. 2f**). Leachate volumes over 60 ml will begin to dilute the sample and give you lower EC readings.

5. **Calibrate your pH and EC meters prior to testing** (**Fig. 2g**). The test results are only as good as the last calibrations. Calibrate the instruments every day that they are used. Always use fresh standard solutions. Never pour used solution back in the original bottle.

6. **Measure pH and EC of your samples** (**Fig. 2h**). Test the extracts as soon as possible. EC will not vary much over time provided there is no evaporation of the sample. The pH will change within 2 hours. Record the values on the charts specific to each crop.

Figure 2e. Collected leachate for testing.

Figure 2f. Collect 50 ml (1.5 ounces) for testing.

Figure 2g. Calibration standards for testing.

Figure 2h. Testing leachate samples.

Table 1. Amount of water to apply to various containers to obtain 50 ml (1.5 ounces) of extract*.

Container Size	Water to add**	
	milliliters	*ounces*
4 inch 5 inch 6 inch	75	2.5
6.5 inch azalea	100	3.5
1 quart	75	2.5
4 quart	150	5.0
12 quart	350	12.0
Flats 606 (36 plants) 1203 (36 plants) 1204 (48 plants)	50	2.0

**Containers should be brought to container capacity 30 to 60 minutes before applying these amounts.*
***These amounts are estimates. Actual amounts will vary depending on crop, substrate type, and environmental conditions.*

NCSU Floriculture Website:
www.ces.ncsu.edu/floriculture/