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5. Manage water and nutrient management in propagation. Santos, K. and Fisher, P. Greenhouse Management and Production 29(3):30-32. 2009.

By Kate Santos and Paul Fisher

Manage water and nutrient management in propagation

Reduce irrigation and fertilization by applying only the water and nutrients that plants need during propagation.

Table 1: Reported parts per million of nitrogen applied in nutrient solution at each locations over a 4-week propagation cycle.

Grower	Week			
	1	2	3	4
A	200	200	200	200
B	0	200	170	200
C	150	200	200	150
D	0	300	300	300
E	0	0	150	150
F	0	0	1x150; 2x300	1x150; 2x300
G	0	0	200	200
H	100	100	100	100

Table 2: Water volume leached over a 4-week crop cycle in 8 greenhouse locations. Tray size was 10-11 inches by 20-21 inches. CC refers to Container Capacity (the water-holding capacity of a single tray).

Location	Volume leached (Gallon/Tray)	Volume leached (Gallon/Acre)	Water-holding capacity (CC in Gallon/Tray)	CC leached/Tray
A	0.3	8253	0.3	0.8
B	1.6	49249	0.3	4.7
C	0.6	15144	0.4	1.3
D	0.2	4799	0.4	0.4
E	0.3	9334	0.3	1.0
F	0.5	14607	0.4	1.3
G	0.5	15731	0.2	2.2
H	0.7	20801	0.3	2.0
Average	0.6	17240	0.4	1.6

Tray size was 10-11 inches by 20-21 inches. Container capacity is the water-holding volume of a single tray.

Providing adequate fertilization with minimal leaching during propagation has several benefits. Root growth is inhibited when water is overapplied. A water-logged growing medium encourages pathogens and leads to reduced nutrient uptake. Also, overwatering can cause pre-plant nutrients to be rapidly leached out of the medium.

There are environmental benefits to minimizing leaching because excess water either needs to be treated before recycling or leaves the greenhouse as runoff. Fertilization is needed to ensure healthy growth, but overapplication can result in greater top growth and require more growth regulators to produce compact plants. By applying only the water and nutrients that plants need, irrigation and fertilizer costs are reduced.

Current industry practices

We conducted a study that evaluated eight vegetative propagators in Colorado, New Hampshire, New Jersey and Michigan. At each location, an experiment was run for one week on four crops of vegetatively grown liner trays that varied in age from zero to four weeks old. Calibrachoa and petunia were grown, depending on location and availability. Both species have a similar crop time in an 84- to 105-count liner tray. Cultivars were consistent within a given location, but varied between locations.

Within each crop, pH, electrical conductivity (soluble salts), nutrient levels

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and water volume were examined in the applied nutrient solutions, the growing medium, plant tissue and the nutrient solution that leached from the trays.

During the study, each grower recorded the fertilizer applied to each crop age group (Table 1). Growers varied when fertilizer was added to the mist solution (week 1, 2 or 3) and the concentration that was applied (0 to 300 parts per million).

The volume of water leached differed by up to 10 times at the various operations, ranging from 4,799 to 49,249 gallons per acre over a four-week crop cycle (Table 2). Previous research has shown that most of a pre-plant nutrient charge in growing media is lost after leaching about two container capacities from a tray. This loss of nutrient charge holds true across a wide range of growing media.

Nutrients applied to the media can end up in the leachate, substrate (growing medium) or plant tissue. A more efficient grower applies adequate fertilizer to have a healthy and vigorous crop, while minimizing leaching.

On average, 50 percent of applied nitrogen, 49 percent of applied phosphorus and 46 percent of applied potassium were taken up into the plant tissue. The average percent nutrients leached ranged from 23 percent nitrogen, 34 percent phosphorus and 28 percent potassium. Maximum levels measured 45 percent nitrogen, 45 percent phosphorus and 55 percent potassium.

All growers produced salable crops, but resource efficiency varied greatly between locations. Differences were the result of grower management, rather than geographic location.

Grower operations that maintained similar greenhouse temperatures and had similar structures located only 6 miles apart leached very different water and nutrient levels.

How to measure nutrient leaching

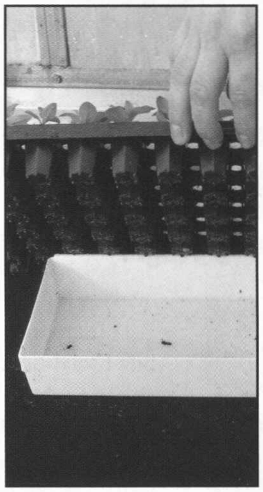
Equipment needed:

A white plastic 6-by 15-inch cutlery tray (i.e., Rubbermaid) that fits beneath most 84- and 105-count plug trays) to be the leachate collector; 1/2-inch wide surgical tape or similar water-resistant tape.

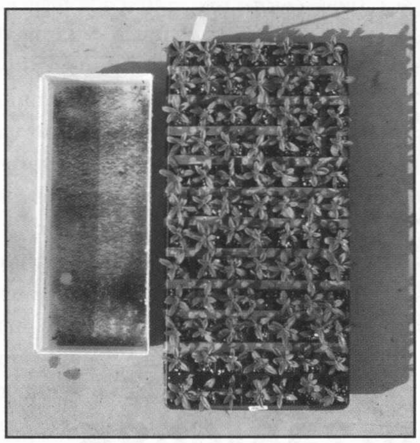
Steps:

1. Select five propagation trays in the greenhouse. Choose trays in different locations to check both volume and variability between trays.

2. Cover the holes on the top of the propagation trays with the tape (this is easier to do before planting).



3. Place a leachate collector beneath each propagation tray. The bottom of the cells in the tray should be at least 1 inch above the leachate collector so that the cells will not be sitting in water by the end of the week.



4. Leave trays in the greenhouse for one week. Irrigate normally.

5. After a week measure the amount of solution in each leachate collector.

6. Check electrical conductivity of the leachate. Low electrical conductivity (near the electrical conductivity of your water source) indicates that most nutrients are leached from the growing medium. Also use a plug squeeze test to check the electrical conductivity of the growing medium.

7. Run this protocol for four weeks to track water and nutrient trends as the crop ages.

Calculate leaching volume per propagation tray

The standard leachate collector is 45 percent of the total surface area of a typical 10-by-20-inch 84-count propagation tray and 39 percent of an 11-by-21-inch 84-count tray. If you use a different collector or propagation tray size, calculate their relative surface area.

To calculate the total volume leached per propagation tray per week: Volume of water in the leachate collector divided by 0.45 (1020 tray) or 0.39 (1121 tray).

For example, 30 ounces leached into the collector from a 1020 tray equals 30 divided by 0.45 = 67 ounces or 0.5 gallon per propagation tray.

High leaching rates

If you have high leaching rates (0.5 gallon or more per propagation tray over four weeks):

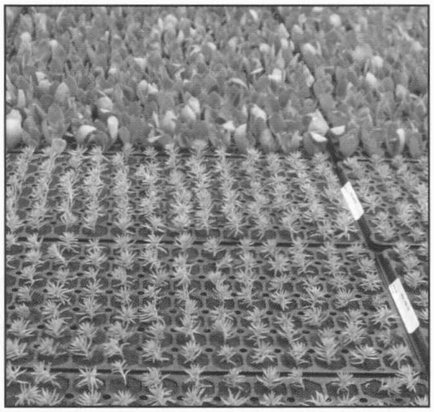
• Check both irrigation frequency and duration.

• Check that the irrigation boom or mist nozzles are providing even coverage. Are all plants being watered heavily to avoid wilting in a few dry spots?

• Train staff to water evenly and moderately.

• Evaluate fogging systems or other ways to increase humidity; or shade to reduce light levels so water application can be reduced.

• Ensure adequate nutrients are being applied, based on plant appearance and tissue nutrient levels.



By applying only the water and nutrients needed, irrigation and fertilizer costs are reduced.

Eliminate nutrient leaching

In follow-up discussions with the growers, the leaching and fertilizer data provided a training tool for their production staffs. You can easily measure the leaching level for your crops at a minimal cost. And check the uniformity of your mist and watering systems.

The greatest potential for leaching occurs during the first two weeks of propagation (or up until root growth occurs) because of the large amount of water applied to maintain plant turgidity. Plant requirements change with temperature and climate. Leaching is likely to be greater if irrigation timing is only based on a time clock rather than light, temperature or vapor pressure deficit.

Our research found that some operations applied adequate nutrition to provide the plant needs while minimizing the amount of water and nutrients leached. This is a feasible goal.

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