Water Management in Propagation©

Paul Fisher
PO Box 110670, University of Florida, Gainesville Florida 32611, U.S.A.
Email: pfisher@ufl.edu

For many plant nurseries, water restrictions are impacting both our landscape customers and also production. Limited access to high quality water has been exacerbated by population growth and climate change, in some cases leading to bankruptcy for growers and retailers who cannot compete for access with other water users. Regulations increasingly require growers to retain and re-use nutrients, pesticides, and stormwater rather than allowing contaminants to run off into the environment.

All of these pressures mean that growers should consider how to conserve water by only applying irrigation as needed by the crop. This article provides some rules of thumb to know if you may be over-applying water in propagation. Efficient watering during propagation involves both management and technology such as climate-controlled mist timing, but we will concentrate here just on monitoring steps that cost very little.

MEASURE AND CONTROL LEACHING

Minimizing leaching (the washing of irrigation water through the growing substrate) combined with adequate fertilization has several benefits. Root growth is inhibited when water is overapplied. A water-logged growing medium encourages pathogens such as *Pythium*, leads to reduced nutrient uptake because roots need air to grow and actively take up nutrients, and pre-plant soil-incorporated nutrients are rapidly leached out. There are environmental benefits from minimizing leaching because excess water either needs to be treated before recycling, or leaves the greenhouse as runoff. Fertilization is needed to ensure healthy plant growth, but over-application can result in greater top growth, requiring more growth regulator chemicals to produce compact plants. By applying only the water and nutrients that plants need, irrigation and fertilizer costs are reduced.

Growers vary widely in how efficiently they use water during propagation. One simple method is to place a water-tight tray underneath the propagation trays, and collect the leachate that runs through the tray. Using this method, the University of Florida (UF) quantified leaching of irrigation water and nutrients during a 4-week propagation cycle with *Petunia* and *Calibrachoa* cuttings in eight commercial propagation greenhouses in the U.S.A. Leachate was collected by placing a collection tray under propagation trays under mist, boom, or hand watering. The liters leached per 25 × 50 cm tray ranged from 0.6 L to 6.0 L, which represented up to 461 m^3 of water per hectare over the 4 week cycle. That is the equivalent of a large swimming pool!

A guideline for water-soluble or granular fertilizer is that once a complete soil volume of water (or about 2 L depending on the tray) is leached through, any pre-plant fertilizer charge has been leached out. Controlled-release (coated) fertilizers are more resistant to leaching, but hard to evenly distribute between small cells in a tray. That means that U.S.A. propagators typically either: (A) do not use a pre-

plant charge because it will be leached away, (B) ensure they leach less than one soil volume during misting, and/or (C) apply an irrigation with water soluble fertilizer (usually around 200 ppm of nitrogen from a complete fertilizer) as soon as plants are off mist and roots can take up nutrients.

You Will Need:

- A tray that fits beneath your propagation tray (we usually use a Rubbermaid™ cutlery tray). This is the "leachate collector."
- 1-cm-wide water-resistant tape or stickers.

Steps:

1) Select five propagation trays in the greenhouse. Choose trays at different spots in the greenhouse to check both volume and variability between trays.
2) If the tray has vent holes on the top of the propagation tray between cells, cover these holes with the tape or stickers so that water won't drip through the top of the tray. It is easier to tape those holes before planting (Fig. 1).
3) Place a leachate collector beneath each propagation tray. The bottom of the cells in the propagation 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 (Fig. 2).
4) Leave trays in the greenhouse for 1 week and irrigate normally under mist, boom, or hand watering.
5) After 1 week measure the amount of solution in each leachate collector (Fig. 3).

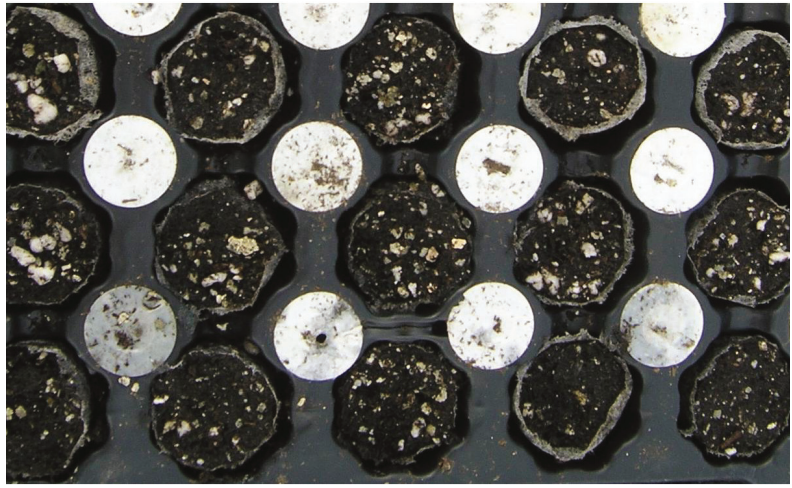

Figure 1. Propagation tray with taped ventilation holes.

6) Check electrical conductivity (EC) of the leachate. Low EC (near the EC of your water source) indicates that most nutrients are leached from the growing medium. Also use a plug squeeze test to check EC in the growing medium.
7) Run this protocol over several weeks, to track water and nutrient trends as the crop ages.

Calculate Leaching Volume per Propagation Tray.

- If the leachate collector is smaller than the propagation tray (Fig. 4), multiply the collected volume by the area of the propagation tray and divide by the area of the leachate collector) to calculate the volume per propagation tray.
- For example, let's say the propagation tray is 25 × 50 cm = 1,250 cm^2, the leachate collector is 20 × 40 cm (800 cm^2), and you collect 1.2 L over 1 week in the leachate collector. The leachate volume per propagation tray would be 1.2 × (1,250/800) = 1.9 L per tray.

If You Have High Leaching Rates (2 L or More per Propagation Tray over 4 Weeks):

- Check both irrigation frequency and duration.
- Check boom or mist nozzles are providing even coverage. Are you watering everything heavily to avoid wilting in a few dry spots? The more uneven your mist system, the more you will have to leach. Set up collection trays or cups over the benches, and run the mist for up to 5 min (Fig. 5). Check volumes in the collection trays. Identify the driest spots and consider changing the number, height, or type of emitters.
- Train staff to water evenly and moderately.
- Evaluate fog or other ways to increase humidity; or shade to reduce light so that water application can be reduced.
- Ensure adequate nutrients are being applied, based on plant appearance (pale leaves often indicate deficiency) and tissue nutrient levels.

Figure 2. Propagation tray sitting above the leachate collector.

Figure 3. Solution in leachate collector after 1 week.

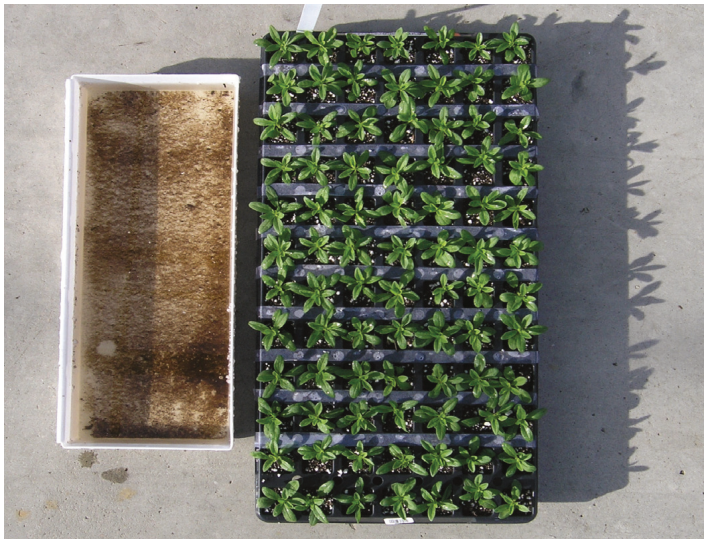

Figure 4. A leachate collector smaller than the propagation tray.

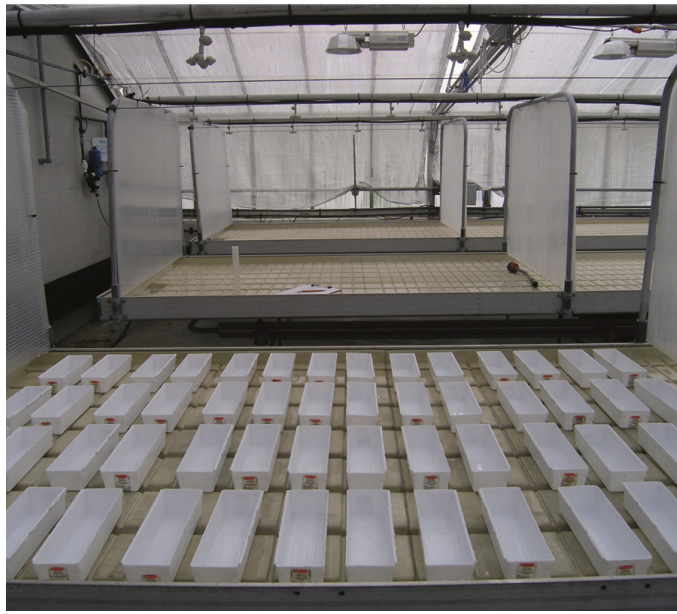

Figure 5. Collection trays set up to check for even mist nozzle coverage.

NIGHT MISTING

The goal during misting at night is to keep plants hydrated, without having excess free water that encourages disease. Hopefully your mist timer allows separate settings for day and night mist schedules, or you have an artificial leaf or similar to adjust mist timing. If you have just a simple clock with one setting, you either have to adjust the timer at morning or night, or you will overwater at night. A simple approach to know whether night misting is about right is to check first thing in the morning.

- Are plants hydrated? (If not, increase mist frequency.)
- Does the plastic on the tray or media surface have pools of water? (If so, there is too much water.)
- If you lift up the tray (Fig. 6) can you see clearly defined drips of water under each hole in the tray (about right), or is there a large puddle (too much water).

WHEN AND HOW MUCH TO WATER

There is no more important growing decision than when to water, and how much water to apply. Some people are "wet growers" and others are "dry." It can be helpful to use a common language when discussing moisture level in propagation, to have the consistent watering practices needed for uniform germination or rooting. This is especially true in larger operations with multiple growers.

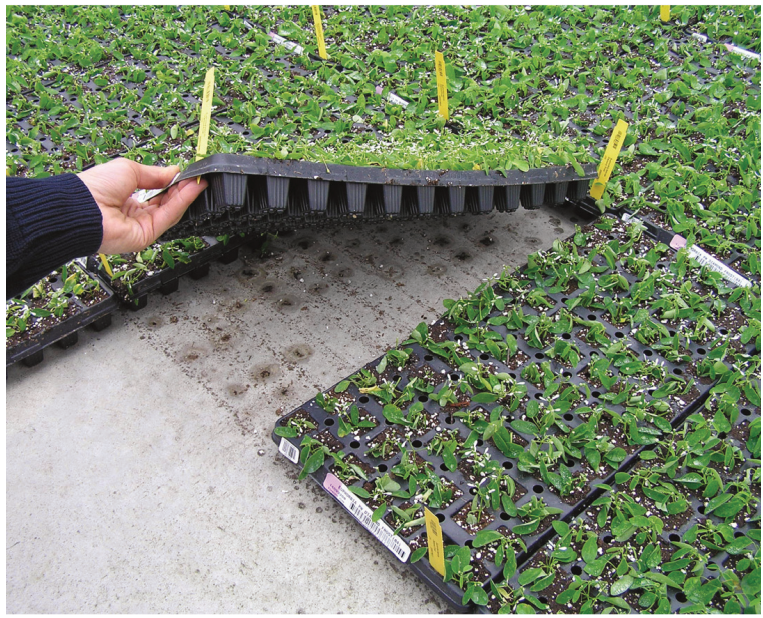

Figure 6. A check for correct hydration after night misting.

Ball Horticulture (Healy, 2008) has developed a moisture index for growing substrate (Table 1). A copy of the article is available for free at: <http://www.ofa.org/pdf/bulletins/08_marchapril.pdf>, with guidelines for different crops. Large-scale propagators train their staff to ensure they can identify the five stages of moisture. For seed germination, crops can be grouped as to the ideal moisture level (for example W4 for pansy and W2 for verbena). Specific seedling plug crops are watered at each stage when they dry down to a specific moisture level (for example, W2) and enough water is applied to reach an optimum level (such as W4). In general, if your crop is consistently at W5 this indicates overwatering. This concept can also be applied to finished plant production.

CONCLUSION

Consider whether your operation could improve watering practices with any of the simple concepts presented here. An old grower saying is that the person holding the hose controls your wallet. Don't just tell untrained new employees to "go out and water." Train them to water to plant needs, and you will see increased rooting success and less waste. Making efforts towards minimizing leaching in our own operations also shows we are doing our part in being a truly "green industry," before regulators enforce a change in grower practice.

Table 1. Growing media moisture levels used by Ball Horticulture (Healy, 2008) for improving irrigation decisions during propagation. (With thanks to Dr. Will Healy and Ball Tagawa, Colorado.)

Level	Class	Sight	Feel	Culture
W5	Saturated	Shiny black; standing water. Soaked	Very heavy; media feels soaked and dripping	No oxygen for roots; few seeds germinate; soak
W4	Wet	Dark brown; no standing water	Heavy; can squeeze out moisture when pressed	Maximum acceptable water level
W3	Medium	Brown	Average weight; media will feel moist; maybe squeeze out droplets	Optimum and transitional level
W2	Dry	Light brown	Light weight; no free moisture	Typically do not dry below level; wet / dry cycle develops roots
W1	Baked	Tan; media may pull away from cell sides	Very light weight; no moisture, almost dusty	Plants desiccate and die rapidly; only cactus survive at this level

LITERATURE CITED

Healy, W. 2008. How wet is wet? Watering terminology. OFA Bulletin March/April 2008:16–18. <http://www.ofa.org/pdf/bulletins/08_marchapril.pdf>.