Young Plant Research Center

Water and Fertilizer Application and Leaching during Commercial Propagation

Preliminary Internal Report for Young Plant Research Center Partners.
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Dr. Bill Argo (Blackmore Co.) and growers at each site assisted with data collection.

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BACKGROUND

Propagation of vegetative cuttings involves considerable application of water for control of humidity, soil moisture, and also as a means to apply water-soluble fertilizer. Fertilizer and water contribute to the overall production costs, but are generally low in cost relative to other inputs. However, from a regulatory standpoint, water use is becoming increasingly heavily regulated, along with control of nutrient runoff.

The proposed goal of this project is to provide growers with the capability to monitor how much water and fertilizer they are applying, and the amount of these inputs that are being used for crop growth or wasted in the form of leachate. Growers can thereby use this information to improve crop health, as well as minimize excessive water and fertilizer use. The preliminary results presented here provides an initial baseline for the inputs required in propagation, allows growers to compare their water and fertilizer use with other leading growers, and also shows the variability between locations and growers.

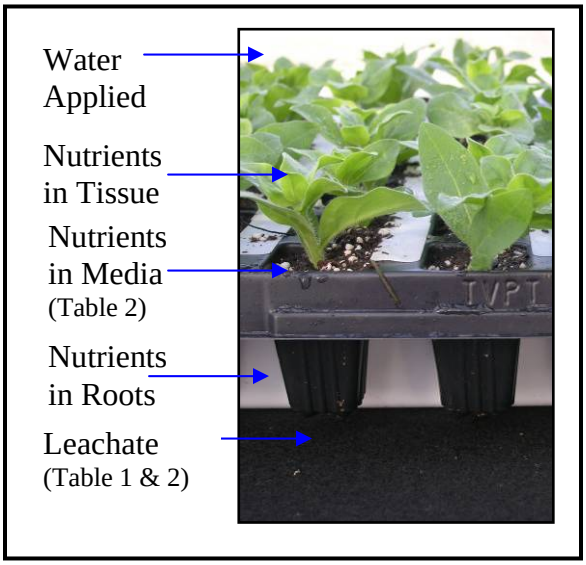
Much of the data are still being analyzed, but our goal here is to provide initial feedback to growers.

INTRODUCTION

The objective of this research project was to quantify current propagation practices with respect to overhead water and/or fertilizer application along with the subsequent leachate produced. Preliminary investigations at the University of New Hampshire of the growing medium in a given plug tray show that the starter charge is depleted after 2 container capacities are leached from a given plug cell. That result is also in line with earlier research at Michigan State University.

This project focused on working with greenhouses across the country to address the following questions:

1. How much water do growers apply at different growth stages of vegetative cuttings?
2. How much fertilizer is applied?
3. How long did it take to leach two container capacities?
4. How does the pH and EC within the media fluctuate over a propagation cycle?
5. How does tissue nutrient content fluctuate within a cutting from just before sticking through to finish? (We do not yet have all tissue nutrient data analyzed)

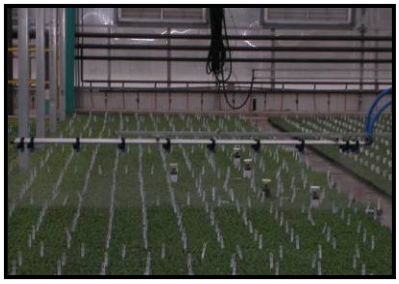


The data for this research was collected through the collaborative efforts of eight greenhouse facilities: Center Greenhouses (Colorado), D.S. Cole Growers (New Hampshire), Four-Star Greenhouses (Michigan), Glass Corner Greenhouses (Michigan), Kube-Pak Corporation (New Jersey), Lucas Greenhouses (New Jersey), Pleasant View Gardens (New Hampshire) and Welby Gardens (Colorado).

RESEARCH PROTOCOL

1. Suitcases were packed with everything necessary to conduct the on-site experiments.

2. 20 collection trays were divided into four groups and placed beneath taped plug trays to measure leachate.



3. 20 mist applicator bottles were also randomly distributed in each site to measure overall water/fertilizer applied.

4. The trays were then left for a week, treated the same as a normal crop.

5. After 1 week we returned to take measurements and samples with some on-site help!

6. The solutions then traveled back to UNH where the pH and EC of each sample was tested before being sent on to Quality Analytical Laboratories for a complete nutrient analysis.

RESULTS

Table 1. The total volume leached throughout the course of an entire propagation cycle at the eight locations.

Company	Tray Size	Species	Growing medium	Total Volume Leached/ Tray/ 4 weeks	
				Gallons	Liters
A	84	Petunia	Peat/Perl	0.27	1.00
B	105	Calibrachoa	Peat/Perl	1.58	5.99
C	105	Calibrachoa	Peat/Perl/Polymer	0.65	2.48
D	105	Calibrachoa	Peat/Perl	0.15	0.58
E	84	Petunia	Peat/Perl	0.36	1.35
F	105	Diascia	Peat/Perl/Soil	0.58	2.19
G	105	Calibrachoa	Peat/polymer	0.51	1.91
H	84	Calibrachoa	Peat/Perl/Rockwool	0.78	2.95

Notes on columns in Table 2 (leachate volume) on the following page.

1. Company (*Each company was given a letter code. See our email on which letter corresponds with your own company).*
2. Tray size (cell count)
3. Plant Species (petunia, calibrachoa, or diascia)
4. Media Type
5. Crop age (weeks after sticking)
   - 1 - (0-1 weeks old)
   - 2 - (1-2 weeks old)
   - 3 - (2-3 weeks old)
   - 4 - (3-4 weeks old)
6. **Volume** leached per week per age group.
   This number was obtained by averaging the amount of solution measured in the five collection trays per age group, and is presented in units of:
   - **LITERS** leached per **TRAY** per week per age group.
   - **GALLONS** leached per **TRAY** per week per age group.
   - **OUNCES** leached per **CELL** per week per age group.
   - **CONTAINER CAPACITIES** leached per week per age group. The container capacity of a given media is the total amount of water present in the container after the medium has been saturated and allowed to drain. This was calculated based upon each of your individual media types.
   - **CUMULATIVE % STARTER CHARGE** leached. To estimate this, we added up the leaching volume over the four weeks of propagation and assumed, based on past research, that after two container capacities are leached the pre-plant nutrient charge was leached out.

Table 2: Volume of leachate at each location over the four week production period. The dark blue and light blue row shows the heaviest or least leaching of all locations for that week of propagation, respectively.

Company	Tray Size	Species	Growing medium	Crop Age	**Liters/** Prop. Tray	**Gallons/** Prop. Tray	**Ounces/** Cell	Container Capacities	Cumulative % Starter Charge Lost
A	84	Petun	Peat/Perl	1	0.36	0.10	0.15	0.29	14%
A	84	Petun	Peat/Perl	2	0.12	0.03	0.05	0.10	19%
A	84	Petun	Peat/Perl	3	0.13	0.03	0.05	0.10	24%
A	84	Petun	Peat/Perl	4	0.39	0.10	0.16	0.31	39%
B	105	Calib	Peat/Perl	1	3.39	0.89	1.09	2.14	107%
B	105	Calib	Peat/Perl	2	1.24	0.33	0.40	0.79	146%
B	105	Calib	Peat/Perl	3	0.34	0.09	0.11	0.21	157%
B	105	Calib	Peat/Perl	4	1.02	0.27	0.33	0.65	190%
C	105	Calib	Peat/Perl/Polymer	1	1.05	0.28	0.34	0.66	33%
C	105	Calib	Peat/Perl/Polymer	2	0.11	0.03	0.04	0.07	37%
C	105	Calib	Peat/Perl/Polymer	3	0.89	0.24	0.29	0.57	65%
C	105	Calib	Peat/Perl/Polymer	4	0.43	0.11	0.14	0.27	79%
D	105	Calib	Peat/Perl	1	0.37	0.10	0.12	0.24	12%
D	105	Calib	Peat/Perl	2	0.01	0.00	0.00	0.01	12%
D	105	Calib	Peat/Perl	3	0.00	0.00	0.00	0.00	12%
D	105	Calib	Peat/Perl	4	0.20	0.05	0.07	0.13	19%
E	84	Petun	Peat/Perl	1	0.15	0.04	0.06	0.12	6%
E	84	Petun	Peat/Perl	2	0.75	0.20	0.30	0.58	35%
E	84	Petun	Peat/Perl	3	0.09	0.02	0.03	0.07	38%
E	84	Petun	Peat/Perl	4	0.37	0.10	0.15	0.29	52%
F	105	Diasc	Peat/Perl/Soil	1	0.40	0.11	0.13	0.25	13%
F	105	Diasc	Peat/Perl/Soil	2	0.02	0.01	0.01	0.01	13%
F	105	Diasc	Peat/Perl/Soil	3	1.18	0.31	0.38	0.74	50%
F	105	Diasc	Peat/Perl/Soil	4	0.59	0.16	0.19	0.37	68%
G	105	Calib	Peat/polymer	1	1.37	0.36	0.44	1.55	78%
G	105	Calib	Peat/polymer	2	0.37	0.10	0.12	0.42	99%
G	105	Calib	Peat/polymer	3	0.04	0.01	0.01	0.05	101%
G	105	Calib	Peat/polymer	4	0.13	0.03	0.04	0.15	108%
H	84	Calib	Peat/Perl/Rockwool	1	0.27	0.07	0.11	0.21	11%
H	84	Calib	Peat/Perl/Rockwool	2	1.48	0.39	0.60	1.17	69%
H	84	Calib	Peat/Perl/Rockwool	3	0.43	0.11	0.17	0.34	86%
H	84	Calib	Peat/Perl/Rockwool	4	0.77	0.20	0.31	0.61	117%

Table 3: pH and EC in the growing medium (plug squeeze) or leachate, along with fertilizer concentration and number of irrigations with spot watering, clear water, or nutrient solution.

									Plug Squeeze		Leachate	
Company	Tray Size	Crop Age (wks)	Days in Trial	Irrigation Type	# Days Spot	# Days Clear	# Days Fert.	Fertilizr [ppm N]	pH	EC	pH	EC
A	84	1	7	Boom	0	6	1	200	5.0	2.5	5.0	2.7
A	84	2	7	Boom & Hand	0	0	4	200	5.1	3.2	5.0	3.2
A	84	3	7	Boom & Hand	1	0	3	200	6.2	0.6	5.7	0.8
A	84	4	7	Boom & Hand	1	0	4	200	6.5	0.4	6.6	0.3
B	105	1	7	Boom	0	7	0	0	5.2	0.2	6.1	0.2
B	105	2	7	Boom	0	5	1	200	5.1	0.6	5.4	0.5
B	105	3	7	Hand	0	0	2	170	5.5	0.3	5.9	0.5
B	105	4	7	Hand	0	0	3	200	5.8	1.0	6.0	1.2
C	105	1	6	Boom	0	5	1	150	6.1	1.8	6.2	2.0
C	105	2	6	Boom	0	3	2	200	6.6	1.3	6.4	1.5
C	105	3	6	Boom	0	0	2	200	6.8	0.9	6.9	1.1
C	105	4	6	Boom	0	0	2	150	6.7	2.3	6.6	3.0
D	105	1	7	Boom	0	7	0	0	5.6	1.8	5.5	3.4
D	105	2	7	Boom & Hand	3	2	1	300	6.0	0.9	5.8	1.5
D	105	3	7	Boom & Hand	4	0	2	300	6.3	0.8	6.3	0.6
D	105	4	7	Boom & Hand	4	0	2	300	6.8	2.0	7.1	1.9
E	84	1	5	Boom	0	5	0	0	5.6	3.2	5.7	1.2
E	84	2	7	Boom	0	7	0	0	6.7	0.7	6.7	1.0
E	84	3	7	Boom & Hand	0	5	2	150	6.4	1.0	6.6	0.9
E	84	4	7	Boom & Hand	0	4	3	150	6.7	0.7	6.9	0.7
F	105	2	7	Boom & Hand	1	5	0	0	6.5	2.5	6.8	2.9
F	105	3	7	Hand	0	2	3	1x150; 2x300	6.6	1.4	6.9	1.7
F	105	4	6	Hand	0	1	3	1x150; 2x300	6.6	2.1	6.7	2.0
F	105	1	6	Boom	0	6	0	0	6.4	3.1	6.7	4.8
G	105	1	7	Mist	0	7	0	0	5.9	0.9	5.9	1.5
G	105	2	7	Mist	0	7	0	0	6.6	0.4	6.6	0.4
G	105	3	7	Hand	0	4	3	200	6.5	0.7	7.5	0.5
G	105	4	7	Hand	0	0	4	200	6.6	1.1	6.9	1.1
H	84	1	6	Boom	0	0	7	100	6.1	2.6	5.9	6.4
H	84	2	6	Boom & Hand	1	2	2	100	6.3	1.0	6.7	0.9
H	84	3	6	Hand	2	0	4	100	6.6	0.7	7.0	1.1
H	84	4	6	Hand	2	0	4	100	6.6	0.9	6.8	1.1

Notes: “Days Spot” refers to the number of days when trays were spot watered by hand. “Days Clear” and “Days Fert” refers to the number of days when trays were irrigated with clear water or fertilizer solution, respectively. “Fertilizr [ppm N]” refers to the fertilizer concentration on occasions when fertilizer was applied.

DISCUSSION

All eight leaching experiments achieved our goal of obtaining quality data (thanks to our collaborators!) and show that this approach could be applied to other locations. These preliminary data present leachate and media results. Results pertaining to the tissue samples and overall water applied will be available in an upcoming report.

Tables 1 and 2 summarize the data that were obtained from the collecting trays placed beneath the propagation trays. The leachate measured in each collection tray was then extrapolated to illustrate how much solution would be leached for an entire tray (not only from the cells over the collection trays). There was great variability between greenhouses. For example, in the first week of propagation leachate volume per tray ranged from 0.15 L to 3.39 L.

Based on the amount of leachate measured, we were able to calculate how much water ran through your media in the course of one week. If more than two container capacities worth of solution were leached, based on previous research, you can assume the starter charge is completely lost from your media. Understanding when in the crop cycle this happens will help you gauge when you should begin supplementing with overhead fertilization to maintain a constant nutrient balance for the growing cutting.

Table 3 shows the fluctuations of pH and EC in both the media as well as in the leachate throughout the crop cycle. Information on overhead fertilization and general clear water application is also provided to further explain how the EC and pH is being maintained each week. Here, again, we are seeing a lot of variability between growers. Using the information from these two columns you can determine when the media nutrient levels are dropping (plug squeeze column) and when the leachate EC levels are rising. It can also help you to determine if you are applying too much fertilizer and therefore leaching out an equivalent amount of fertilizer as is being maintained within the plug cell itself.

Using Table 1 will further explain the fluctuations in pH and EC by looking at how much solution was leached each week. For example, if you find that there was a drop in EC from Week 1 to Week 2, but the fertilizer program appears fairly constant, look at how much solution was leached out that week. If you are nearing one or two container capacities of leachate, it is likely that you leached out most of the nutrients from week 1 which would explain the drop in EC.