COHA 8 RESEARCH UPDATE: Managing PGRs and Pesticides with Hybrid Treatment Systems

Background:

A high quality, consistent water supply is essential for the greenhouse and nursery sectors. Many operations are moving toward recovery and reuse of irrigation water runoff in order to reduce water limitation risks and improve environmental sustainability. However, it is critical that the water supply does not negatively affect crop production. A survey conducted by Clemson University indicated that the top 3 ranked 'contaminants of most concern' regarding recycling irrigation return water were pesticides (herbicides, plant growth regulators (PGRs)), plant pathogens, and nutrients and salts (White et al., 2019)

A recently completed research project (FCO/SRG 2015-2018) demonstrated the capacity of innovative Hybrid Treatment Systems (HTS) to remove nutrients (in particular N, P) from post-irrigation and other operational waters as well as fungal plant pathogens. This finding alleviates significant grower concern regarding the risk of pathogen transfer from an infected zone to the rest of the production areas via recovered and reused irrigation water. However, for full reuse in the greenhouse, growers are also concerned about residual levels of PGRs and pesticides.

The COHA8 project is using two large-scale pilot systems constructed for the previous study to evaluate HTS for the removal of PGRs and pesticides, verifying that the treatment process is managing the major risks in the water intended for recirculation, and to optimize removal to a level that is acceptable to growers.

Permanent HTS Install - 2016

Pilot System Interior

Pilot Systems Installed On-site

Goals

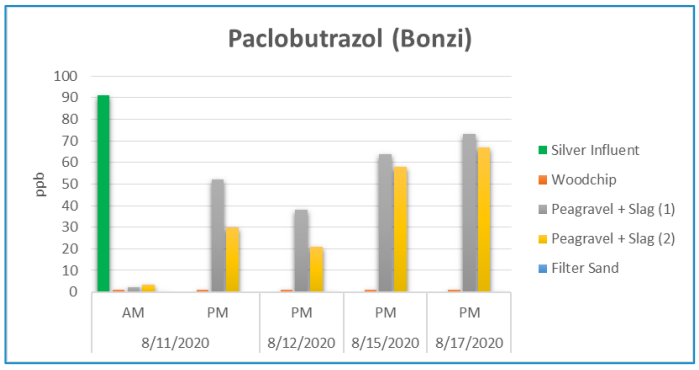
- Evaluate the ability of Hybrid Treatment Systems to remove PGRs and pesticides from irrigation return water by measuring the effect of individual treatment media, media sequence, and operational parameters on performance.
- Increase awareness in the industry of this technology.

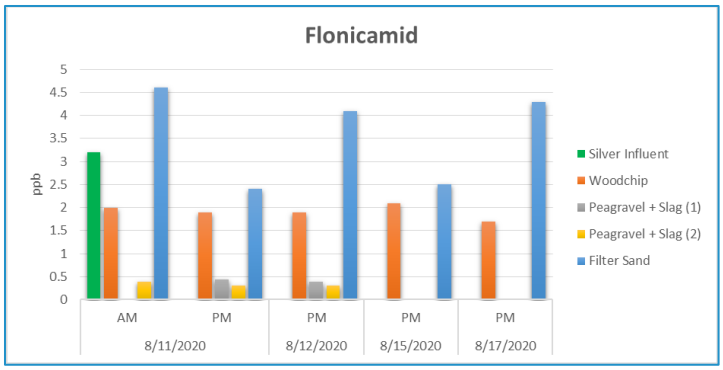
Methods

Testing was carried out on-site using greenhouse irrigation return water spiked with PGRs: Paclobutrazol, 80ppb; Fludioxonil, 20ppb; Chlormequat, 80ppb, Daminozide, 80ppb. Treatment cell media included woodchips (2), pea gravel, pea gravel/slag mix, filter sand, wollastonite, and granular activated carbon (GAC). Removal of PGRs and pesticides was measured in two ways: laboratory analysis which scanned for 400+ pesticides, and broccoli seedling bioassay

Preliminary Results: 2020 evaluation of individual media

All three PGRs measured in the laboratory scans (Paclobutrazol, Fludioxonil, and Propiconazole present at 4ppb) were removed to >99% by the woodchip and wollastonite cells. These treatment cells also removed all of the pesticides detected in the irrigation return water to a similar degree, with the exception of Flonicamid, which was removed to the greatest extent by the pea gravel/slag treatment cells. Granulated activated carbon (GAC), which was added as a "gold standard treatment" in the study removed all the PGRs and pesticides detected. Example results are shown below.





Bioassays were conducted to determine the effect of any residual chemistries on plant growth. The results shown in the Table below indicated a similar pattern to the lab analyses, with growth restored by woodchip and GAC treatment of the PGR spiked irrigation return water. Wollastonite and filter sand were slightly less effective in the fall, which was likely temperature related.

Bioassay

Photo credit: Jenn Sheardown

Percent inhibition of growth by 6 day effluents (hypotocyl length)

	Influent	Wood-chip	PG/Slag	Pea Gravel	Wollas-tonite	Filter sand	GAC layer	GAC tank
August	50%	18%	51%	44%	5%	-4%	5%	
October	56%	-11%	46%	48%	21%	12%		-7%

Next Steps: 2021-2022

- Testing of media sequences to enable full removal of PGRs and pesticides as well as maintaining the original functionality of the HTS to remove residual nutrients if required (e.g. N, P, Al) and fungal plant pathogens
- On-site Demo Day (if possible given COVID-19 restrictions)
- Final report due Feb 2022; factsheets posted to the Flowers Canada Growers website

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