A better way to keep greenhouse water clean
by Kieran Brett

With funding from ACIDF Ltd., scientist Jian Yang and her team have shown that an innovative water filter can greatly reduce the presence of disease in greenhouse water systems.

For an Alberta greenhouse grower, their water management system is nothing less than the bloodstream of the operation. After all, this system moves the water -- drawn from either nearby dugouts or municipal supplies -- that irrigates and feeds the vegetables and flowers that consumers value so highly.

According to Jian Yang, while a water system is essential to growing greenhouse crops, it can also complicate the producer's efforts to manage diseases such as Fusarium and Pythium root rot.

“In a hydroponic system in a greenhouse, growers will re-use the nutrient solution,” says Yang, Vegreville-based Plant Pathology Research Scientist with Alberta Innovates – Technology Futures (AITF). “If a previous crop had been contaminated, the pathogen could still be there and affect the next crop. These are root diseases, so once the pathogen gets into the water, it can spread within the greenhouse very fast.”

One remedy is to change the water more frequently in a recirculated hydroponic system. With producers mindful of using water resources carefully, this is not a preferred option. There are practical issues, too. Drawing municipal water more often will cost the producer more money. Water from dugouts can contain pesticide residues that could harm delicate and valuable greenhouse crops. Discarding water used for fertilization would also mean the loss of nutrients, and thus, a higher fertilizer bill for the producer.

As Yang indicates, greenhouse growers use a variety of methods – from heat treatments to sand filters – to keep their water as clean and free of disease as possible. Most have drawbacks such as cost, energy use or limited effectiveness.

Inspiration from medical technology

Beginning in 2013, with support from the Alberta Crop Industry Development Fund (ACIDF), Jian Yang began work on a proof-of-concept for a new and alternative way to minimize the presence of diseases in greenhouse water systems. Her idea was to develop a filter coated with nanoparticles of silver and to apply the nanotechnology to the greenhouse industry.
“This technology is available now in other applications,” says Yang. “Nanotechnology is being used in many areas in medicine, for example. Dressings can be coated in a micro-coating of silver to control bacterial infection in a wound that’s healing.”

The project team included AITF scientists who had plant pathology and microbiology expertise, as well as the University of Alberta, which contributed its expertise in nanotechnology and engineering.

Yang visited several Alberta greenhouses to obtain disease samples, then brought these back to her lab to test the effectiveness of her prototype silver-coated filter. In two years of lab-scale filtration experiments, she found the filter was over 90% effective at killing fungal and bacterial pathogens.

“By having a small amount of silver ion on the filter material, this is the most efficient way to reduce diseases,” says Yang. “We treat the water instead of spraying the crop. If a producer is using a number of filters, this could be used as the last filter in the system.”

Steps to commercialization

As a proof-of-concept conducted at laboratory scale, Yang’s silver-coated filter has been found effective at controlling key diseases within a greenhouse water system. She believes the next step is to engage greenhouse producers for on-site trials, and work with greenhouse equipment companies on moving toward commercialization.

At this point, Yang’s innovation shows clear potential to lessen or remove one of the biggest production issues greenhouse growers face. It’s a win for the environment and for the economics of greenhouse production.

“If we can treat the water continuously in this way,” says Yang, “we can reduce disease, reduce the use of fungicides and save water.”

Evaluation of silver nanoparticles-coated activated carbon against microbes

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<th>Description</th>
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<tr>
<td><em>Pseudomonas</em> sp. treated with AgNP-coated AC for 24 hours on a shaker at 200rpm at 25°C, 3 days after plating</td>
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<td><em>Fusarium oxysporum</em> treated with AgNP-coated AC for 24 hours on a shaker at 200 rpm at 25°C, 3 days after plating</td>
<td><img src="image2.jpg" alt="Image of Fusarium oxysporum treated with AgNP-coated AC" /></td>
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