Monitoring Pathogens & Algae In Irrigation Water

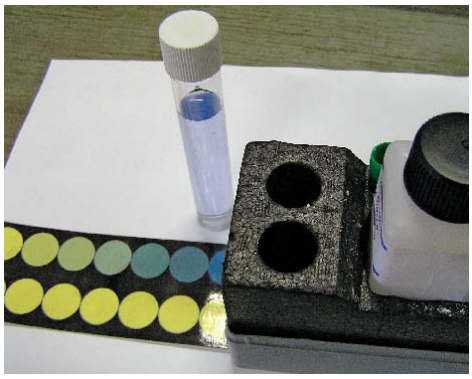
by ***PAUL FISHER*** and ***CHERYL SMITH***

WATERBORNE pathogens, which include quarantine diseases such as Ralstonia, or the more common Pythium and Phytophthora, can cause major losses in young plant production. Water testing is the only way to know whether a plant disease outbreak is being caused by irrigation water, and it helps pinpoint where in your irrigation system the contamination is occurring. Testing also ensures that your water treatment system is working correctly.

As an industry, we are experienced with on-site and laboratory testing of irrigation water for salts, acidity and nutrients. Although water testing for pathogens and algae in horticulture is still an emerging technology, we encourage you to use this tool to help manage pathogens and algae. In this article, we discuss aspects of water monitoring and a trial where we tested water sources at seven leading rooting stations around the U.S. during the January through June growing season.

On-Site Tests

If you have a water treatment system in place, when was the last time you checked if it is working correctly? On-site tests allow you to check the concentration of control agents such as copper, chlorine, hydrogen dioxide, Oxidative Reductive Potential (ORP), pH and electrical conductivity (EC). These tests include manual colorimetric tests, handheld meters or inline controls for continual dosage systems. On-site tests have the advantage of being low cost and rapid, allowing repeat measurements and the tracking of trends over time just as you can track pH or EC.



On-site tests allow growers to check the concentration of control agents. Sample on-site test kits for a copper treatment system (left) and ZeroTol (right).

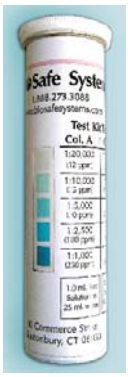
All water treatment systems require maintenance and checking – they are not equipment you can install and forget. For example, copper systems rely on controlled electrolysis to form soluble copper ions, often resulting in corroded connections and plates or rods that require maintenance. Problems with copper systems are sometimes not identified until a rise in algae level is observed – not the best maintenance method!

Powerful oxidizers, such as chlorine, are hazardous to worker safety if the injection system malfunctions. If the manufacturer provides or recommends a test kit, make sure the kit is used regularly (at least once a month) and has not exceeded its shelf life. Because colorimetric tests are inherently subjective, train one person to do the tests.

With in-line control systems, train staff to check that sensors are calibrated and ensure they have a technical and common-sense understanding of the system. For example, in one case a faulty pH sensor led to overdosing and rapid draining of the acid stock tank, which was caught by an observant grower.

Laboratory Tests

More detailed laboratory tests are available from some water treatment companies, university plant pathology laboratories and private microbiology laboratories.



In our study, we sent samples to BioSafe Systems (manufacturer of ZeroTol, contact **info@biosafesystems.com**) and Selective Micro Technologies (Selectrocide, contact Landon Merrill, **lmerrill@selectivemicro.com**), who provide testing of total bacteria, fungi and algae loads free to their customers. In the study samples, the companies quantified biological loads of the water in terms of:

Water samples are cultured on agar or in liquid culture. The number of colonies of bacteria, fungi or algae that grow from one milliliter of water can then be counted.

- Bacteria counts (in colony forming units per milliliter, cfu/mL, both laboratories)
- Fungal and algae counts (cfu/mL, Selective Micro)
- A fungal colony rating scale (BioSafe), or
- The dilution of control product needed to kill these organisms (BioSafe)

Guidelines For Taking Water Samples

WHERE SHOULD YOU SAMPLE?

- Water Source: Sample from the point closest to the source.
- Pre- and Post-Treatment: Sample from a short distance before and after water treatment.
- Outlet: A sample from the farthest point from the source, such as a watering hose or mist-head typically used for irrigation.

HOW SHOULD YOU COLLECT SAMPLES?

- The laboratory will provide guidelines on the water volume required and may provide a water and shipping container.
- 500 milliliters (16 oz.) is adequate.
- Unopened, noncarbonated distilled water bottles from a supermarket are generally adequate, but spring water can sometimes contain organisms. Selective Micro Technologies suggests using Poland Springs brand bottles.
- Run the irrigation line for three minutes.
- Remove the bottle cap at the site, and do not contaminate the sample with your hands.
- Empty and fill three times and then fill samples no more than ¾ full to provide some gas exchange.

SHIPPING SAMPLES

- Do not hold water samples for more than 12 hours.
- Refrigerate if not shipping immediately.
- Insulate the container if possible.
- Inform the laboratory before sending samples.
- Ship overnight and early in the week so the sample does not sit over a weekend.

Sample at the water source (top), before and after water treatment (center), and at the outlet (bottom). Also sample the supply and return tanks in recirculating systems.

Most bacteria and fungi in water samples are likely to be beneficial or benign, rather than pathogenic. Greenhouses are not sterile environments. Attempting to completely sterilize water, all surfaces and the growing medium would require massive doses of chemicals. Removing beneficial organisms can also make it easier for pathogenic organisms to become established. High colony counts do not therefore indicate a pathogen problem, but rather show where biofilm may be building up in the irrigation system.

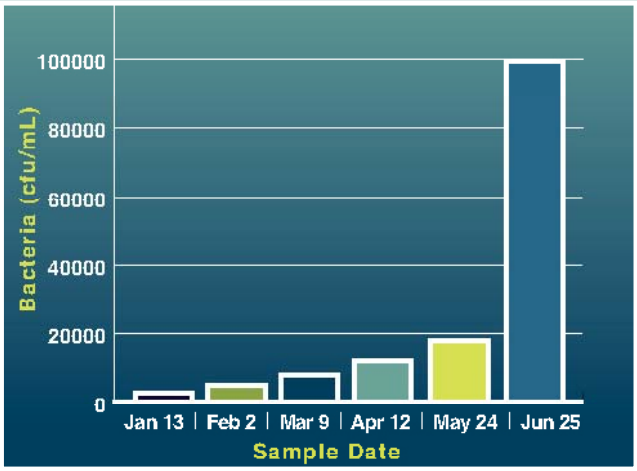
There is currently little standardization across private horticulture laboratories on how samples are processed, and control thresholds have not yet been established. However, total counts can be an indicator of the general efficacy (or failure) of a treatment system.

The UMass Extension Plant Diagnostic Lab (e-mail M. Bess Dicklo at **mbdicklo@umext.umass.edu**) provided presence/absence data on four key waterborne pathogens: Pythium, Phytophthora, Fusarium and Rhizoctonia species. The samples cost $50 each and required one to two weeks for isolation, obtaining pure cultures on semi-selective medium and microscopic examination of reproductive structures of organisms.

Irrigation water may be contaminated with many species of Pythium and Phytophthora although not all these species are pathogenic to floriculture crops. Identification of pathogens to the species level requires mycologists who specialize in particular genera. If a laboratory reports a positive presence of a Pythium, Phytophthora, Fusarium and Rhizoctonia species, it is prudent to assume that a pathogen is present and treat accordingly.

In our trial, we sampled water at the source (well) immediately after treatment (which included three copper, one bromine, one calcium hypochlorite and one reverse osmosis system), and at an outlet in the greenhouse. In one site, Fusarium was cultured from the source and in another location, Rhizoctonia was found at the outlet.

Controlling Biological Load



IN this holding tank, which contained water directly from the well, a rise in overall bacteria counts (and fungi, not shown) over time was an indicator that the copper system was not adequately controlling biological load. Corroded electrodes in the copper system were the culprit. It is important to note that no bacterial or fungal disease was evident on crops in this or the other greenhouses in our study despite some high colony counts.

Treatment And Monitoring In Perspective

In summary, the following factors should guide monitoring of bacteria, fungi and algae in irrigation water:

- Monitoring with university labs to identify pathogens to the genus level is valuable if you have a plant disease issue.
- Monitoring through pesticide companies is currently free and mostly useful for evaluating biofilm and overall biological load and testing the control system.
- All control systems require regular testing, at least monthly.
- Focus on testing in your propagation area, where plants are most stressed and vulnerable.
- Surface irrigation water is more likely to be a problem than well water, which favors regular testing.
- Greenhouses are not sterile. Overall sanitation, and not sterility, is the goal. **GG**

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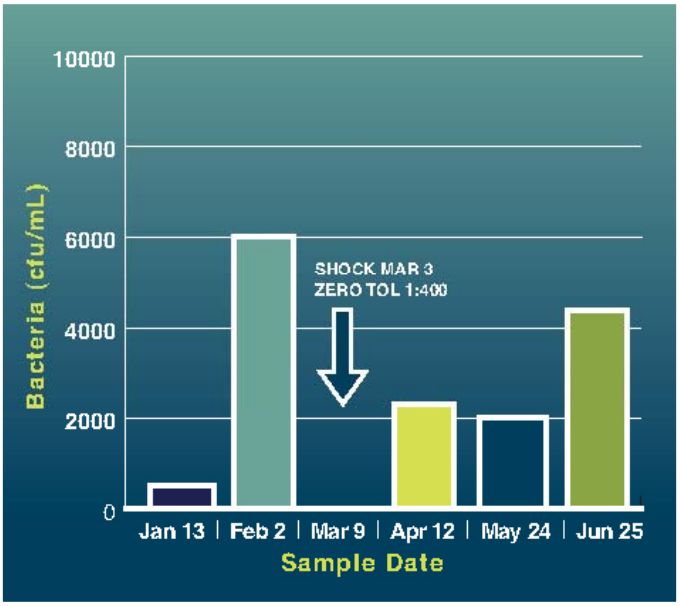
Monitoring Bacteria Levels



BACTERIA levels were monitored over time in a recirculation holding tank with a flood floor irrigation system. An overall rise in bacteria levels from January to February led to a shock treatment with ZeroTol on March 3. The chemical shock of a recirculation tank temporarily reduced bacteria level, which rose again over time.