On-site hands-on microbial water quality monitoring "Tool Kit" for greenhouses

Why monitor microbial water quality?

There are several reasons to monitor the microbial water quality throughout a greenhouse facility, but the overall goal is to **manage RISK** and prevent plant pathogens from getting into production areas. A routine monitoring program enables the operator to monitor **water treatment system performance** and assess changes in water quality throughout the **whole production system** and proactively manage it. For example, deciding when to clean out tanks, which water to use for more (or less) sensitive crops, or what level of disinfectant is needed when switching water sources (from roof water to pond water for example).

What is described below is a **PRACTICAL** "Tool Kit" of methods growers can use in-house to track microbial water quality throughout their system. The methods were evaluated to meet the following criteria: simple and quick to do without requiring specialized skills, cheap enough to be used on a routine basis, provide a fast result relative to a diagnostics laboratory, and give sufficient information for farmers to make good decisions.

When and where to monitor?

The extent and frequency of a water quality monitoring program at a facility is as individual as the facility itself, and has to fit in with the production system. Think about how the water flows in your irrigation system (even draw a diagram), and ask the following questions:

- What are your primary concerns? Plant pathogens from a water source? Pathogens from recycled water? Are there sensitive crops? Is the disinfection system(s) performing to requirements?
- Where are your critical monitoring points? For example: source water, pre- and post-treatment (immediately before and after to test performance), pre- and post-treatment storage tanks or cisterns, and don't forget about the feed tank. Remember, this is your program, so some monitoring points could be for routine monitoring, but others for trouble shooting if required. It may be helpful to do more tests at the beginning and then narrow it down to a routine testing program. You may decide to do more testing in some seasons depending on your crops and expected water quality. It's your Tool-kit – make it fit the job.
- And what are the best (least busy) days to do this – make it part of your routine.

What's in the "Tool Kit"?

Three types of 3M Petrifilms are recommended as being cost and time effective:

- Rapid Yeast & Mold (RYM) – a measure of risk from fungal pathogens
- Total aerobic plate count (bacterial) (AC) – general water quality; risk of biofilm development
- *E.coli* and total coliforms (EC) – for when food safety is important

3M Petrifilms: 1) Total Yeast & Mould, 2) Aerobic Plate Count, 3) *E.coli*/Total Coliform

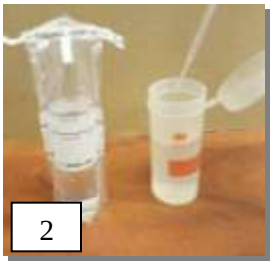
Other useful methods in the tool kit include **ImageJ** – a free downloadable program to help with counting high numbers of colonies on the Aerobic Count plate in particular. **DNA Multiscans®** will identify what fungal pathogens are present, but are much more expensive and do not distinguish between living and dead organisms in the sample. The Clean-Trace **ATP** measurements parallel the AC and RYM plate counts but are real-time measurements, and may be useful in some cases though the system is also more expensive. Your tool-kit should also include test strips or hand-held testers for measuring pH and disinfectants such as chlorine, chlorine dioxide, or hydrogen peroxide peracetic acid etc- whatever fits your system.

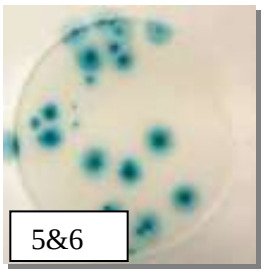
Testing method

Rule # 1: Keep everything clean!

Rule # 2: Once you have figured out your method, do it the same every time!

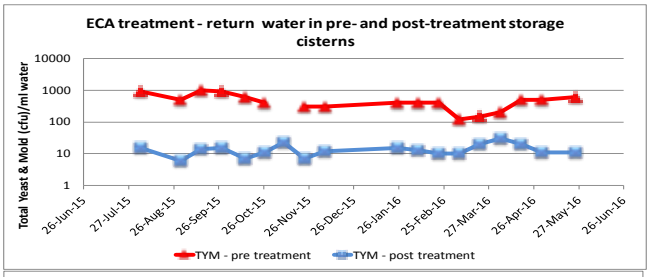
1. Sampling into a sterile sample container or whirl-pak
2. Diluting using sterile phosphate buffer if required (record the dilution factor)
3. Lift top film, drop 1 ml of sample or sample dilution on centre of bottom film
4. Roll top film back down, and use spreader to distribute the sample evenly
5. Incubate in an incubator or at room temperature 2-5 days at 28-20 degrees Celsius (Choose a consistent incubation time and temperature that works best for your schedule. The lower the temp, the longer the incubation period needs to be.)
6. Count colonies (directly for a few, or using Image J or an estimate method if counts are high) and multiply by the dilution factor (if used) to get 'colony-forming units' per milliliter of sample (cfu/ml)
7. Record your data and keep track of water quality along with crop quality observations
8. Refer to the 3M Interpretation guides for Aerobic Count plate, Rapid Yeast & Mold count plate, or E.coli/Coliform count plate for details on procedure and interpretation.

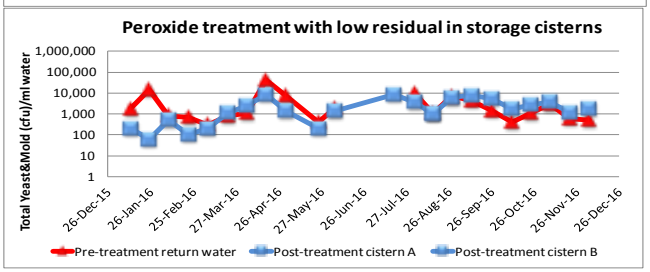


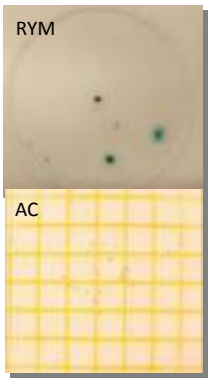


How to interpret your results

Two sets of monitoring data from cisterns holding pre- and post- treatment water are shown below. In the first graph, the results of routine monitoring show that the treatment system is generally removing about 99% of the Yeast & Mold populations. The second graph illustrates a treatment system that is not removing much of the population – this was generally because of low residual peroxide concentrations in the storage cistern.

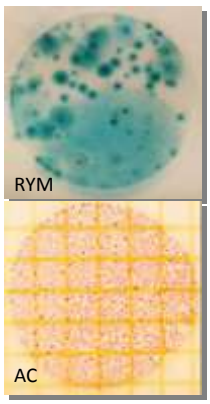






Low counts/Consistent results

- Treatment system OK
- Scouting looks OK
- Routine tracking of changes in levels with water sources changes (e.g. pond versus roof), cisterns, treatment performance etc



High counts/Inconsistent results

- Unusual spikes in data
- Send for DNA multiscan?
- Extra scouting for issues?
- Monitor extra locations to identify potential problem source?
- Check/maintain treatment equipment?
- Clean tanks (including feed)?
- Line clean out when Aerobic Plate Counts (AC) exceed 10,000cfu/ml to prevent line clogging due to biofilm build up

Further Reading & Information

Monitoring Irrigation Water for Floriculture Crops, edited by Paul Fisher, University of Florida IFAS Extension
http://manatee.ifas.ufl.edu/agriculture/nursery/A-ZPubs/Monitoring_Irrigation_Water.pdf

3M™ Interpretation guides

- 3M™ Petrifilm™ Rapid Yeast and Mould Interpretation Guide
  http://multimedia.3m.com/mws/media/1388678O/rapid-yeast-and-mould-interpretation-guide.pdf
- 3M™ Petrifilm™ Aerobic Count Plate Interpretation Guide
  http://multimedia.3m.com/mws/media/236194O/petrifilm-aerobic-interpretation-guide.pdf
- 3M™ Petrifilm™ *E.coli*/Coliform Count Plate Interpretation Guide
  http://multimedia.3m.com/mws/media/236246O/petrifilm-ecoli-coliform-interpretation-guide.pdf

ImageJ download link: https://imagej.nih.gov/ij/download.html

For more information contact

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Supplies can be ordered from:

- Innovative Diagnostics for 3M™ supplies
- Mandel Scientific (Guelph) for dilution tubes
- Amazon.ca for most other supplies

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