

Report on the Use of Quaternary Ammonium Disinfectants for Didygem [Didymo] Disinfection [2007]

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Advantages of Quaternary Ammonium Disinfectants for Didygem Disinfection

There are some compelling reasons for advocating the use of a quaternary ammonium disinfectant (QAD) to control didygem. QADs are:

- reasonably widely available and affordable
- reasonably biodegradable and minimally toxic to humans and critters
- effective against a wide range of unwanted, potentially invasive biological agents including various bacteria, algae, viruses, fungi, and protozoa
- stable in solution for longer duration than oxidizing agents such as bleach
- possessed of mild surfactant properties that make them more able to penetrate absorbent materials than simple, aqueous bleach solutions
- not likely to be damaging to equipment and fabrics
- already in use by F&W for spread prevention of fish diseases, such as whirling disease (which is actually caused by a myxozoan)

Are quaternary ammonium disinfectants effective against didygem?

The only evidence we have about the effectiveness of various products for didygem decontamination comes from New Zealand Biosecurity, who commissioned the *National Institute of Water and Atmospheric Research* (NIWA) to study didygem survivability. NIWA chose to include in its study a product called “303 Clearall” that is sold in New Zealand to control algae growth in swimming pools. I’m fairly mystified about why they focused their intensive study on this product. From their description, it appears that “303 Clearall” is a quite non-standard QAD, and furthermore, it is not possible to determine its precise active ingredients, making it impossible to extrapolate the results to other QADs.

However, in their report (“Studies on the Survivability of the invasive diatom *Didymosphenia geminata* under a range of environmental and chemical conditions”; NIWA Client Report: CHC2006-116), NIWA references a less extensive study that was conducted with another QAD with an apparently more standard formula. These results suggest that benzalkonium chloride, a standard component of QADs, is very effective against didygem. NIWA reports:

“A separate test of a product containing 3% benzalkonium chloride (see Section 4.2.6) (NIWA report DDT06501, also see <http://www.unclejacks.co.nz/4.htm>) showed that a 4% solution (i.e., 0.12% benzalkonium chloride) achieved 100% mortality of *D. geminata* cells in one minute. A diluted solution of 0.0015% benzalkonium chloride was effective after 1000 minutes.

It is difficult to reconcile the difference in response between the two products with no information about the active ingredient concentrations in 303 Clearall. The high concentration of Clearall needed to kill all cells rapidly suggested that the concentration of active ingredient was low. However 303 Clearall’s stated %a.i. of 60% is high.”

A summary of the study referenced in the above paragraphs, documenting the effectiveness of benzalkonium chloride, is available from the “Uncle Jacks Didymo Killer” website. The summary does *not* report the results cited above for a 0.0015% solution of benzalkonium chloride after 1000 minutes. It *does* report the data for a 0.12% benzalkonium chloride solution after 1 minute, which apparently conferred 100% cell mortality.* These results are contingent on the assumption that “Uncle Jacks” contains 3% benzalkonium chloride, so that a 4% solution of “Uncle Jacks” is equivalent to a 0.012% solution of benzalkonium chloride. I have been unable to verify that “Uncle Jacks” contains 3% benzalkonium chloride, as claimed in the NIWA report. No information about the products’ constituents is provided on the “Uncle Jacks” website.

It is unfortunate that NIWA did not choose to further test a standard QAD with a published concentration of benzalkonium chloride and/or other active ingredients. Nevertheless, the results reported suggest that QADs may provide a very effective tool for preventing the spread of didygem.

Is “Sani-Care 128” effective against didygem?

F&W uses the QAD “Buckeye Sani-Care 128” for control of fish diseases. “Sani-Care 128” contains the following active ingredients:

Didecyl dimethyl ammonium chloride (DDAC) 5.07%
n-Alkyl (C14 50% C12 40%, C16 10%) dimethyl benzyl ammonium chloride (DBAC) 3.38%

{Note that “n-Alkyl (C14 50% C12 40%, C16 10%) dimethyl benzyl ammonium chloride” is essentially the same thing as “benzalkonium chloride”, but with specific information about the length of the alkyl groups of the various benzalkonium constituents.}

Based on extrapolating from the results reported by NIWA, at a minimum, soaking in a 4% solution of this product (equivalent to ~ 0.12% benzalkonium chloride) for 1 min should easily achieve 100% didygem cell mortality.† It is quite likely that a more dilute solution would also be effective, since the other quaternary ammonium active ingredient in the product, DDAC, is also likely to be effective against didygem, and is ignored in the above extrapolation.

What should we do?

It seems to me that we have three options:

1. Do not recommend QAD products for didygem spread prevention because we have insufficient evidence for their effectiveness from the minimal New Zealand Biosecurity

* Unfortunately, there is an inconsistency in the report summary about the actual concentration used to provide 100% mortality after 1 minute. In the introduction and in the Results section, the report claims that a 4% solution of Uncle Jacks was used. However in the “Testing procedure” section, the report describes using a 1% solution. I assume that the “1%” is a ‘typo’ because the reports are otherwise consistent in claiming that 4% was used.

† Assuming a non-absorbent item; as discussed extensively in NIWA’s reports, absorbent items such as felt waders will require longer soak times to achieve complete penetration of the disinfectant solution.

commissioned reports (I DO NOT favor this approach because, as I outlined in the previous sections of this document, I believe QADs have many advantages, and are likely to be effective).

2. Recommend Sani-Care 128 or its equivalent at some concentration we think is likely to be effective based on NIWA's report, e.g. a 2% solution.

3. Conduct some experiments of our own in the next 3-4 weeks, using didygem cells collected from the White River, to better document the effective concentration of Sani-Care 128 for didygem disinfection. Feasibility of this approach will depend on there being sufficient population in the White River to conduct some tests. Angela and I are confident that given sufficient cells, we can easily replicate the Neutral Red staining protocol used by NIWA to assess viability.

Note that approaches 2 and 3 are not mutually exclusive. We could go forward with using Sani-Care 128 and at the same time conduct some further testing to fine-tune the concentration requirements.