12TH U.S. SYMPOSIUM ON HARMFUL ALGAE

USING AN ULTRAVIOLET-ENABLED BOAT TO REDUCE MICROCYSTIN AND SUPPRESS CYANOBACTERIAL GROWTH IN HARMFUL ALGAL BLOOM-IMPACTED SURFACE WATERS

SESSION: HAB MANAGEMENT, MITIGATION, & CONTROL II

ABSTRACT: Numerous remediation strategies exist for cyanobacterial harmful algal blooms (cyanoHABs), however most are limited by challenges of scalability and adverse off-target effects on the surrounding ecosystem. Germicidal ultraviolet light (UV-C) has emerged as a promising method for suppressing cyanoHABs in a sustainable, chemical-free manner that is both scalable and results in limited off-target ecological effects. In this study, the US Army Engineer Research and Development Center's (ERDC) CyanoSTUN (Cyanobacterial Suppression Through Ultraviolet-Light-C Neutralization) vessel was deployed to a cyanoHAB to determine whether UV-C could effectively suppress cellular growth, degrade associated cyanotoxins, and inhibit harmful phytoplankton species more readily than beneficial species without the use of chemicals. During a field trial conducted in a HAB-impacted freshwater body exhibiting average cyanobacteria abundance of 3.75x10^5 cells/mL and average total microcystin concentration of 3.5 µg/L, pre- and post-treatment samples were collected and re-grown for 9 days in the laboratory to observe differences in microcystin, chlorophyll, and phycocyanin concentrations, optical density, cell density, and community composition. Results showed that the CyanoSTUN UV-C treatment effectively suppressed the growth of the cyanobacteria community for approximately two days. The CyanoSTUN UV-C treatment also demonstrated a sustained, dose-dependent effect on microcystin concentration; the average reduction in microcystin concentration for 15, 30, and 45 mJ/cm2 treatment doses was 31.6% (or 1.3 µg/L), 45.7% (or 1.9 µg/L), and 49.9% (or 1.7 µg/L), respectively, over the 9-day regrowth period. Non-cyanobacteria were too scarce in this CyanoHAB to conclude whether the CyanoSTUN UV-C inhibits harmful phytoplankton species more readily than beneficial species. The CyanoSTUN UV-C treatment reduced chlorophyll concentrations at a statistically significant level for some of the regrowth period, but had no significant effect on phycocyanin, optical density at 680nm, Ft 450 (in vivo chlorophyll), Ft 620 (in vivo phycocyanin), or quantum yield. Further field studies with the CyanoSTUN are required to validate performance under more severe cyanoHAB conditions, however the results reported herein from the first field study with the CyanoSTUN suggest that this treatment method may offer water managers confronted with a CyanoHAB the ability to rapidly and safely pause a bloom for multiple days and reduce the risks posed by its associated cyanotoxins without using chemicals.

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