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Application of Response Surface Methodology to Assess the Impact of Aqueous and Particulate Phosphorous on Diazotrophic and Non-Diazotrophic Cyanobacteria Associated with Harmful Algal Blooms

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Abstract : Harmful algal blooms (HABs), more notably cyanobacteria-dominated HABs, compromise water quality, jeopardize access to drinking water and are a risk to public health and safety. HABs are representative of ecosystem imbalance largely caused by environmental changes, such as eutrophication, that are associated with the globally expanding human population. Cyanobacteria-dominated HABs are anticipated to increase in frequency, magnitude, and are predicted to plague a larger geographical area as a result of climate change. The weather pattern is important as storm-driven, pulse-input of nutrients have been correlated to cyanobacteria-dominated HABs. The mobilization of aqueous and particulate nutrients and the response of the phytoplankton community is an important relationship in this complex phenomenon. This relationship is most apparent in high-impact areas of adequate sunlight, > 20°C, excessive nutrients and quiescent water that corresponds to ideal growth of HABs. Typically the impact of particulate phosphorus is dismissed as an insignificant contribution; which is true for areas that are not considered high-impact. The objective of this study was to assess the impact of a simulated storm-driven, pulse-input of reactive phosphorus and the response of three different cyanobacteria assemblages (~5,000 cells/mL). The aqueous and particulate sources of phosphorus and changes in HAB were tracked weekly for 4 weeks. The first cyanobacteria composition consisted of Planktothrix sp., Microcystis sp., Aphanizomenon sp., and Anabaena sp., with 70% of the total population being non-diazotrophic and 30% being diazotrophic. The second was comprised of Anabaena sp., Planktothrix sp., and Microcystis sp., with 87% diazotrophic and 13% non-diazotrophic. The third composition has yet to be determined as these experiments are ongoing. Preliminary results suggest that both aqueous and particulate sources are contributors of total reactive phosphorus in high-impact areas. The results further highlight shifts in the cyanobacteria assemblage after the simulated pulse-input. In the controls, the reactors dosed with aqueous reactive phosphorus maintained a constant concentration for the duration of the experiment; whereas, the reactors that were dosed with aqueous reactive phosphorus and contained soil decreased from 1.73 mg/L to 0.25 mg/L of reactive phosphorus from time zero to 7 days; this was higher than the blank (0.11 mg/L). Suggesting a binding of aqueous reactive phosphorus to sediment, which is further supported by the positive correlation observed between total reactive phosphorus concentration and turbidity. The experiments are nearly completed and a full statistical analysis will be completed of the results prior to the conference.

Keywords : Anabaena, cyanobacteria, harmful algal blooms, Microcystis, phosphorous, response surface methodology
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