Effects of inorganic nitrogen on taxa-specific cyanobacterial growth and nifH expression in a subtropical estuary

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ABSTRACT: The potentially toxic, diazotrophic filamentous cyanobacterium *Cylindrospermopsis raciborskii* has recently become a common component in the summer phytoplankton in the St. Johns River (SJR) estuary, Florida, where *Anabaena* spp. historically dominated. Using a microcosm nutrient enrichment experiment, we investigated the ability of *C. raciborskii* and *Anabaena* spp. to compete under a range of available NO_3^- and NH_4^+ concentrations, to test the hypothesis that *C. raciborskii* benefits from increased dissolved inorganic nitrogen (DIN) availability. TaqMan quantitative polymerase chain reaction (PCR) probes were designed, tested, and applied to target the *nifH* gene in one *C. raciborskii* and two *Anabaena* spp. strains from the SJR. N limitation prevailed, as shown by increased N_2-fixation rates if no N was added, increased chlorophyll *a* concentrations when DIN was added, and depletion of added DIN. *Anabaena* spp. and *C. raciborskii* showed rapid growth with no DIN additions and were the main taxa responsible for N_2 fixation. Abundances of *C. raciborskii* increased if NH_4^+ was added, but *nifH* was expressed at low levels, suggesting growth was relying on NH_4^+. *Anabaena* spp. and *C. raciborskii* expressed *nifH* genes when NO_3^- or NH_4^+ were present, but expression was higher with NO_3^-. The *narB* gene sequence was amplified from *Anabaena* spp. and *C. raciborskii* from the SJR, suggesting these taxa are capable of assimilating NO_3^-. However, even small NO_3^- additions blocked the growth of *Anabaena* spp. in the mixed phytoplankton community but not that of *C. raciborskii*. The results suggest that *C. raciborskii* in the SJR is a stronger competitor than *Anabaena* spp. when DIN is present.