Water Hazard: The Effect of Paracoccus Denitrificans-Based Remediation Techniques on the Levels of Nitrate and Oxygen in Freshwater Environments

Shaw, Casey

Nitrate (NO3) is a major component of plant growth and the most common fertilizer ingredient in the world. The extensive use of nitrate-based fertilizers has contaminated countless bodies of water, though, leading to health problems across the world. This experiment's goal was to discover if the denitrifying bacteria Paracoccus denitrificans¬, which is harmless to humans, could be used to reduce nitrate levels in fresh water. The experiment was split into two parts. Part 1 examined the effects of Difflugia lobostoma and Paracoccus denitrificans with glycerin as a carbon source upon oxygen and nitrate levels, while Part 2 examined and refined combinations of Paracoccus with and without glycerin, as well as aeration in some groups. Hypotheses included: 1) Glycerin added to Paracoccus would increase rates of oxygen depletion and nitrate reduction. 2) Aeration would maintain a constant oxygen level and higher rates of denitrification. Each test group consisted of five glass one-quart jars, with three replicates per trial. Jars were established with water, Spirogyra (to help simulate a freshwater ecosystem), plant food and ammonium nitrate, bringing the water's nitrate level to 45 mg/L. Nitrate and oxygen levels were tested using Vernier Dissolved Oxygen Probe and Vernier Nitrate Ion Specific Probe, with data collected daily. Data analysis has indicated that groups with both Paracoccus and glycerin added exhibited rapid rates (~85-95%) of nitrate reduction and similar rates of oxygen reduction, with deoxygenation being proportional to glycerin level; groups with aeration experienced significantly lower deoxygenation rates. Therefore, it is conclusive that Paracoccus is capable of reducing nitrate levels in freshwater, albeit coupled with rapid deoxygenation.

Awards Won: