Medora Corporation

Comparison of "Good" Green Algae & Diatoms to "Bad" Cyanobacteria

This comparison is based on Medora Corporation's experience and research in this field beginning in 2001. Medora Corporation has likely done more water testing on more lakes than any other organization, private or public. Each day of the year, five to ten crews are testing water all over the U.S.

	Green Algae and Diatoms "Good algae"; edible by zooplankton.	**Cyanobacteria** "Bad algae"; not usually edible by zooplankton. This algae is often called blue-green algae (BGA) or harmful algae blooms (HABs).
Number of Common Species	5,000 to 70,000 species? Usually there are 10-50 species present in every water body, all trying to become dominant, and each with its own niche regarding temperature, sunlight, nutrient levels, predators, etc. Most freshwater species have a "close cousin" that lives in the ocean / saltwater.	50 common species? The most common species are Microcystis, Anabaena, Aphanizomenon, Cylindrospermopsis, Plantothrix (formerly called Oscillatoria). Most freshwater species have a "close cousin" that lives in the ocean / saltwater.
Appearance	Diatoms are usually present in all seasons, but prevalent in cold water and give the water a brown tinted color. Green algae give the water a nice green tint. These algae repel each other and spread out; they do not clump together. Individual cells are too small to be visible to the naked eye. They impart a clear tint to the water, green for green algae or brown for diatoms. An exception to the "can't see" rule is filamentous algae, which can be clumps of algae in the spring that detach from the surface and "pop up" to the top. Usually they sink in two weeks or are eaten by fish or ducks. See the technical paper on the jar and stick test to check if you have filamentous algae.	BGA cells are usually green or blue-green. They can clump together to form surface scums or other particles in the water column that are visible to the naked eye. Microcystis looks like green paint spilled on top of the water. Aphanizomenon often looks like small chopped grass blades or cut hair. Anabaena can look like small BBs in the water.
Size	Generally 10-40 µm, so very small.	Much larger; 30-150 µm, and sometimes visible to the naked eye.
Difference in Results During a Jar Test	See the technical paper on www.medoraco.com regarding testing a jar of water. Generally good algae settles to the bottom of the jar in one day or less.	See the technical paper on www.medoraco.com regarding testing a jar of water. Generally BGA floats to the top of the jar in one day or less, and forms a ring at the surface of the water or else spreads out across the surface.

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Susceptibility to Damage from Oxidizing Chemicals	Generally are not damaged by hydrogen peroxide because of firm cell wall.	Hydrogen peroxide is lethal to BGA because it has a slimy bacteria type of cell wall. Peroxide is used worldwide for BGA control except in the U.S. The only peroxide listed with the EPA as a pesticide, and the only one used, is a powdered peroxide called sodium carbonate peroxyhydrate. After peroxide is applied, since it kills all cyanobacteria and other bacteria in the lake, there is a flood of nutrients released, usually leading to a worse bloom two to three weeks later.
Mobility	Good algae is planktonic, meaning no mobility. They go wherever the water takes them. Because they are heavier than water, up to 1.03 specific gravity, they are always sinking. They require wind mixing of the epilimnion (usually the top eight feet or so) to bring them back up into the light. Some species can change their shape a little bit to slow down the sinking rate. One mechanism for SolarBee's success in lakes may be that the SolarBee intake design and mixing constantly takes the later of water from just above the thermocline (say from seven to eight feet deep) and lifts it up and spreads it across the top of the lake. This give good green algae and diatoms a new "lease on life" by putting them back into the light. Then they can out-compete BGA for nutrients since they have very high reproduction rates.	Many species have gas vesicles and vacuoles which then can inflate or deflate to go up or down to get nutrients or light. Speed can range from one inch per day to up to forty feet per hour. They can also add carbon ballast (weight) to increase or decrease upward or downward velocity. As mentioned above, they can adjust their specific gravity to go up in the day to catch sunlight, and down to the bottom to find nutrients such as nitrogen (N) and phosphorus (P) and possibly iron (Fe). It is possible that SolarBee machines kill BGA by bringing them up from the layer that is pulled into the machine (for example, from seven to eight feet deep) to the surface where the sunlight kills them. A BGA cell maintaining the exact buoyancy to be 7.5 feet deep, for instance, when it is popped to the surface, may not be able to get out of the surface film and descend again.
Nutrient Management	There is very little nutrient storage space in the cell; must receive constant new supply of nitrogen (N) and phosphorus (P).	Can store excess P for later use, and many species can "fix" N. Atmospheric N makes up 79% of our air. Nitrogen gas is not very dissolvable in water, but there is enough dissolved in the upper water of lakes for BGA to "fix" it and get around an N limitation. In some lakes, up to 50% of N may be N fixed by BGA. The ability to fix N is a huge competitive advantage.
Food for Zooplankton	These algae are preferred and highly edible by zooplankton, small waterborne animals such as daphnia and others, which in turn are eaten by fish, sending them and P nutrients all the way up the food chain. The result is clear water and large, happy fish.	BGA is generally not edible by zooplankton, because (a) it is too large to fit into the mouth, and (b) it may be emitting toxins that kill the zooplankton. A small amount of BGA may be eaten by large individual zooplankton that have no other food. It is possible that SolarBee circulation creates a huge food crop of green algae, and when that crop is all eaten, there are so many zooplankton that the larger ones will eat BGA to survive if they have to.

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Blooms	Generally these algae can never bloom. Instead the lake will just get a little bit more green or a little bit less green, like a gentle sine wave, as the zooplankton population adjusts the amount of algae in the lake. Standard prey-predator relationships indicate the zooplankton population will grow and shrink as necessary to always crop the good algae down, keeping it from ever becoming an out-of-control bloom. An exception to this rule is that when the water is less than 10° C, the zooplankton are not active and so diatoms can bloom (usually, because they can handle the cold water). Note: the concept that “good” algae can never bloom is a novel and new finding by Medora Corporation based on conducting repeated water testing in over 300 lakes and 500 wastewater ponds since 2001. So far there have been no exceptions to this rule except in cold water as	Out-of-control and semi-permanent blooms typically occur in summer months when there is a lot of light, and long days, warm water, and stagnant conditions that have caused the good green algae to settle out of the light, leaving the lake "up for grabs".
Daughter Cells, Spores	Daughter cells are identical to the parent.	Some BGA species can affect whether reproduced “daughter cells” will have more N fixing heterocysts, or gas vesicles, depending on what is needed to dominate the lake. Daughter cells / spores can be akinetes, which rest on the sediment until a future season, and then all rise up at about the same time to “take over” the lake. It is not known how they communicate the order to rise up at the same time, but it could be related to enzymes.
Attraction to Each Other	These algae have enzymes to repel each other, so they spread out evenly throughout the water. All algae that grows in the water column can also grow as attached algae on bottom rocks, etc.	These cells often attract each other and together form clumps, scum, filaments, or other visible shapes such as “BBs” (Anabaena) or “cut hair” (Aphanizomenon) or “spilled paint” (Microcystis). Thus they can shade out and kill green algae. All algae that grows in the water column can also grow as attached algae on bottom rocks, etc.

About Medora Corporation

Cyanobacteria and their associated toxins continue to be one of the largest threats to water quality across the world.

GridBee® and SolarBee® brand equipment provide solutions for difficult problems across the water quality spectrum including lakes, drinking water, and stormwater applications. Please contact us to discuss how we can help you make water better.