Cyanobacteria (Blue-green Algae) in Our Waters:
Agricultural best management practices (BMPs) to increase resilience to algal blooms

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Figure 1. **Harmful algal blooms (HABs) may give the water a pea soup appearance.**

What are cyanobacteria and harmful algal blooms (HABs)?

Algae are a normal component of most aquatic ecosystems. However, the formation of algal blooms—the excessive proliferation of algae associated with warm summer temperatures—can have significant impacts on water quality. These blooms can damage aquatic ecosystems by blocking sunlight and depleting oxygen that other organisms need to survive. In addition to being unsightly, foul-smelling when they decay, and interfering with recreational activities like swimming and fishing, some blooms, classified as HABs (harmful algal blooms), can produce toxins that are harmful to humans and animals. Outbreaks of some species can lead to poisoning and death of pets, livestock, and wildlife, and should be monitored. The majority of freshwater HAB problems reported in the United States and worldwide are caused by cyanobacteria, also referred to as blue-green algae. Cyanobacteria are not algae, but are actually photosynthetic bacteria that grow in water and rely on sunlight for energy. While there are hundreds of species of cyanobacteria, only some of them are known to produce toxins, and their blooms are often referred to as CyanoHABs.

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What causes algal blooms, and are they increasing in size and frequency?

Algal blooms are the result of a combination of factors: increased solar radiation, warmer temperatures, and an overabundance of nutrients present in the water, particularly phosphates and nitrates. Human activities, such as agricultural runoff, inadequate sewage treatment, runoff pollution from roads, and livestock and wildlife waste, have all led to excessive fertilization of many water bodies. Climate change is believed to be contributing to the increase in size and frequency of excess cyanobacteria or blue-green algal blooms. Warmer water temperatures, higher atmospheric carbon dioxide levels, and increased nutrient runoff due to more rainfall from extreme precipitation events all create favorable conditions for algal blooms.

Appearance

Toxic cyanobacterial blooms (CyanoHABs) can look like foam, clotted mats, or surface scums that look like spilled paint. The color of surface scums is most often light green to dark, brownish green (Figure 1), but can also be red to reddish brown. CyanoHABs are composed of tiny cells clumping together, and unlike green algae they cannot be removed by hand from the water. For more photos of CyanoHABs and how to distinguish them from other non-toxic algal blooms, refer to the following websites:

- https://www.dec.ny.gov/chemical/81962.html
- http://extension.usu.edu/utahwaterwatch/ou-files/HABs/identification_instructions.pdf

Sometimes harmful effects of cyanobacteria can occur even when there are no visible signs of a bloom. The first sign of a CyanoHAB is often a sick dog that has been swimming in an algae-filled pond. The toxicity of any given bloom may change over time and space, and typically lasts only a few days, but may persist for several weeks.

Cyanotoxins and their effects

It is not easy to tell if a bloom will produce toxins harmful to human or animal health. Laboratory analysis of a water sample is needed to confirm the presence of toxins. Furthermore, the mere presence of cyanobacteria in water does not necessarily mean hazardous levels of toxins will be produced. Problems arise when large surface scums and mats develop. Toxins produced by cyanobacteria are a diverse group of chemical substances that are classified according to their toxic effects. The most widespread cyanobacterial toxins are microcystins, which poison the liver, and neurotoxins, which affect the nervous system. The majority of CyanoHAB poisonings are caused by microcystins. It is also possible for an algal boom to produce both microcystins and neurotoxins. The toxins are released when the cells break open, which can happen naturally during die off, when algaecides are applied, or in the stomach when ingested by people or animals.

Routes of exposure to cyanobacteria

People involved in recreational water use may come into contact with cyanobacterial toxins through three routes of exposure: 1) direct contact of exposed parts of the body, including ears, eyes, mouth, and throat; 2) accidentally swallowing water containing cells; and 3) inhaling water aerosol containing cells. The most frequent and serious health effects in humans have been caused by drinking water contaminated with the toxins, or by ingestion during recreational water contact. Known health effects associated with human exposure to toxic CyanoHABs will vary depending on the toxin, and include dermatitis (skin irritation), headaches, allergies, fever, severe gastrointestinal illness, liver inflammation and hemorrhage, tingling and numbness, muscular pain, and, on rare occasions, death (although there are no confirmed deaths in the United States definitively linked to cyanotoxins).

Livestock, wildlife, and pets can be poisoned by drinking water containing toxins or intact blue-green algal cells. In small lakes or large ponds, wind effect tends to concentrate the blooms on one side of the water body. Cattle are usually poisoned when they drink from the windward side of stagnant water bodies where the CyanoHABs have accumulated. Cyanobacteria can also grow in water collection vessels, such as watering troughs. Symptoms of cyanobacterial poisoning will depend on the toxin ingested. Signs of neurotoxin poisoning, which usually appear within 15 to 20 minutes of ingestion, include weakness, staggering, breathing difficulties, convulsions, and death. Signs of liver poisoning may take hours or days to manifest themselves, and include weakness, pale mucous membranes, bloody diarrhea, and death. Symptoms that your dog may have ingested CyanoHAB are similar to those described above, and include diarrhea or vomiting, drooling, weakness, disorientation, seizures, collapse, breathing difficulties, and unconsciousness.

Prevention: Adopting best management practices to reduce nutrient losses

The best way to avoid problems associated with cyanobacteria is to prevent blooms from occurring in the first place. This can be done by reducing nutrient buildup in surface waters, particularly by controlling pollution from fertilizers (including manure) from agricultural and urban use, and by better management of wastewater disposal systems.

Agricultural producers can reduce nutrient losses from their operations by adopting best management practices (BMPs), which are science-based, holistic approaches that reduce or eliminate the likelihood of pollutants and soils moving off of treated areas and into receiving waters. They include the following:

- **Adopt nutrient management techniques:** Practices should be adjusted by utilizing the appropriate rates, timing, placement, and method of applying fertilizer nutrients, including manure.
- **Maintain year-round ground cover:** Cover crops or perennial species can be planted to prevent periods of bare ground on farm fields, during which the soil and its nutrients are most prone to erosion and loss into waterways.
- **Establish and maintain buffer strips:** Buffer strips are vegetated zones between natural areas (streams, ponds) and adjacent areas that have been modified by human activities. Farmers can plant trees, shrubs, and grasses along the edges of fields, particularly those that border water bodies. These buffer strips can be highly effective at reducing or eliminating nutrient runoff by absorbing or filtering out nutrients before they reach the water body.
- **Adopt conservation tillage:** Farmers can adopt one of several conservation tillage practices to help reduce soil erosion, soil compaction, and surface runoff, all of which reduce the likelihood of nutrients reaching waterways.
- **Manage livestock access to streams:** Fences can be installed by farmers and ranchers along streams and other water bodies to block access from animals. This can help restore stream banks and help prevent excess nutrients from entering the water.
- **Participate in watershed efforts:** Reducing nutrient pollution in our waters requires collaboration among stakeholders and groups across entire watersheds. By becoming involved and engaged with state governments, farm organizations, and other conservation and community groups, farmers can play leading roles in these efforts, which have been shown to be highly successful in reducing nutrient inputs into waterways (e.g., South Florida Water Management District, https://www.sfwmd.gov/news/nr_2017_0711_eaa_bmp_program).

Mitigation and control: How to reduce the risk of CyanoHABs poisoning your livestock and pets

If faced with CyanoHABs in ponds used for livestock, farmers and ranchers can take the following steps to help reduce the risk of poisoning of their animals:

- Fence off downwind drinking areas where CyanoHABs accumulate and force animals to drink from areas where cyanobacteria concentrations are less likely to occur.
- Pump water from the pond to a livestock tank or trough, where there is less chance of CyanoHABs. By placing the intake about 2–3 yards below the water surface, the regions where the cyanobacteria and toxins concentrate can be avoided.
- Algaecides, such as copper sulfate, are effective in killing algal blooms and can be used if the site has a history of repeated CyanoHABs. The recommended maximum concentration is 1 ppm, which is 2.7 lb of algaecide per acre foot of water. One treatment is usually good for 2–3 weeks. However, these algaecides can have unintended impacts because they can also kill fish and damage the ecosystem of inland waters. Furthermore, lethal levels of toxins may be released from ruptured algal cells when copper sulfate is used, creating a high-risk situation. For this reason, copper sulfate is better used as a preventive product to be applied before large blooms have built up. If you do apply copper sulfate to an algal bloom, cattle should be held off the treated water for at least 5 days after the last bloom.

Cyanobacteria can also proliferate in livestock troughs unless measures are taken to control algal growth. Take the following measures to reduce the risk of algal blooms:

- The easiest way to reduce algal growth in open troughs is to provide adequate shading from direct sunlight. Cyanobacteria need sunlight to grow, so by shading the troughs you can prevent blooms.
- Clean out your troughs annually to prevent algal buildup. Chlorinating them periodically with household bleach is effective.
- Adding a trace of copper to the water in the trough will also keep it free of algae. However, use caution because too much copper in the diet of animals is toxic.

To protect your pets from exposure and potential health hazards associated with CyanoHABs, take the following precautions:

- Do not let pets swim in or drink from areas where the water is discolored or where you see foam, scum, or mats of algae on the water.
- If pets (especially dogs) swim in scummy water, rinse them off immediately—do not let them lick the algae (and toxins) off their fur.

If any of the symptoms described above arise in your dog after exposure to CyanoHABs, contact your veterinarian immediately because they may be able to flush the toxins if caught early enough.

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