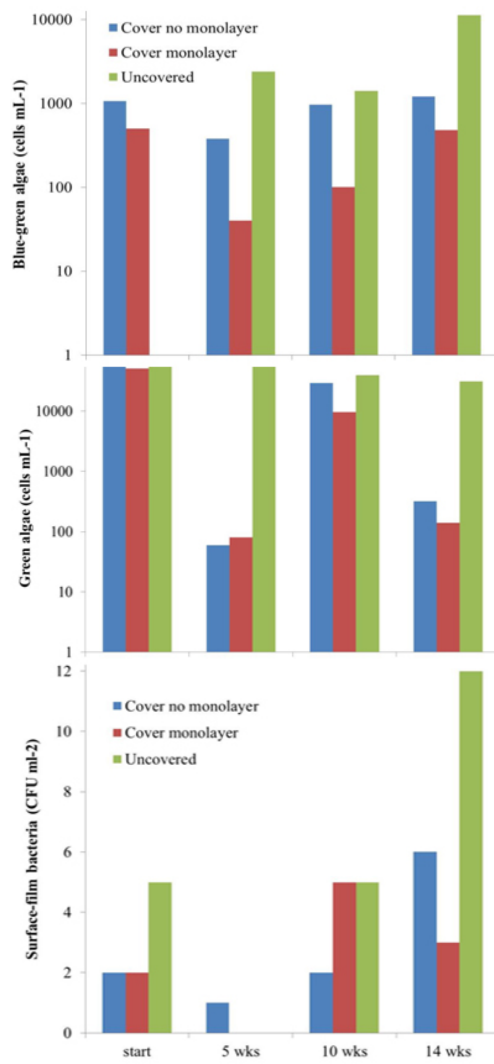
Water-saving microfilm has minimal algal impact

Technologies that reduce evaporation are attractive to water managers, as the annual amount of water evaporating from water storages can be more than the annual consumption of water for domestic and industrial purposes combined. The application of a water-saving, artificial surface film one molecule thick (a monolayer microfilm), permeable to wildlife, non-toxic and biodegradable has been a research goal since the 1960s. Natural surface films formed from decaying leaf litter or from algae lack the orderly, tight molecular packing required to reduce evaporation. Some monolayer microfilms can reduce evaporation by around 40%, but only under calm conditions when turbulence does not beach or submerge the film. The need to re-apply monolayer for days to weeks to save water alarms ecologists, as the water-warming and calming impact of the surface film may increase the risk of toxic algal blooms, and an abundant new food supply may reduce water quality.



In our study, water from a dam in South-east Queensland suffering periodic blue-green algal blooms was added to three 10 m diameter tanks filled with tap water. Fabric covers were used to calm the water surface on two of the tanks, favouring the formation of an artificial surface film. The monolayer octadecanol was applied weekly to one covered tank only, to compare how prolonged calm conditions with and without monolayer affected water quality and the survival of algae and surface film feeding bacteria. After 5 weeks, the light and wind-excluding black fabric was replaced with a more light and wind-permeable white fabric, and after another 5 weeks a black cover was re-installed on the tank that was not treated with monolayer.

Warm, calm, dark conditions should favour blue-green algae. However, over the 14 weeks of our study, there were fewer blue-green algae in the covered tank with the monolayer. Other algal species were not affected, and prolonged monolayer application did not increase bacteria known to feed on surface films. At the start of the study, blue-green algal numbers were lowest and surface film feeding bacteria were highest in the turbulent water of the uncovered, no monolayer tank. We had to replace the liner in this tank, and polyphenol chemicals from the new liner that were toxic to the blue-green algae, must have been food for the bacteria. Surface film feeding bacteria can also feed on slicks from boat engines, which include compounds similar to the polyphenols from the liner.

Over the next 10 weeks blue-green algal numbers recovered in the uncovered tank, but dropped in the covered monolayer tank, and prolonged monolayer application did not increase the numbers of surface film feeding bacteria. A key feature of monolayer technology is very little chemical is needed to maintain the surface film (we applied 30 mg over 14 weeks). Indeed, pollen and dust blown into the uncovered tank increased surface film feeding bacteria more than the monolayer did. Our results suggest even at this low rate of application, the octadecanol monolayer was toxic to the blue-greens, but did not affect other types of algae or bacteria. So this water-saving, octadecanol microfilm may not be as damaging as first feared.

Publication

Impact of artificial monolayer application on stored water quality at the air-water interface.
Pittaway P, Martínez-Alvarez V, Hancock N, Gallego-Elvira B.
Water Sci Technol. 2015