Aquatic Plant Management

Barley Straw for Algae Control

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The use of barley straw for algae control has received a lot of publicity in recent years. It is now common to find small barley bales being sold in nurseries and garden shops for use in water gardens and small pools to control algae. The word-of-mouth reports of success with this method have led many people to suspect that barley might also control algae in ponds and lakes. What has research so far told us about the potential for barley to control algae in these larger bodies of water? And, what does the Environmental Protection Agency (EPA) say about using barley straw as an algicide? These topics will be addressed in this publication.

Where It All Started

The technique of using barley for algae control was developed in the early 1990s in England, where it is widely used in many bodies of water, including large reservoirs and canals. In general, it is thought that fungi decompose the barley in water, which causes a chemical to be released that prevents the growth of the algae. The specific chemical(s) has not been identified (oxidized polyphenolics and hydrogen peroxide are two decomposition products that have been suggested), and it is not clear whether the chemical is exuded from the barley itself or if it is a metabolic product produced by the fungi. The activity of barley straw is usually described as being algistatic (prevents new growth of algae) rather than algicidal (kills already existing algae).

Laboratory studies conducted by English researchers suggest that barley will not control the growth of all species of algae. In fact, some of the studies are contradictory, claiming that certain types of algae are susceptible while other studies claim that those algae are not susceptible. But, the field evidence from England does suggest that, in most cases, water clarity will improve over time and that this is due to reduction in algal populations.

Research in the U.S.

American researchers have been somewhat slow to initiate research on barley. However, some studies have been conducted and will be summarized here.

Results of research at Purdue University have been inconsistent. Our first studies were conducted in the laboratory, and we were able to show that some algal species were indeed susceptible to barley, but others were not. A similar study at the University of Maryland (1) also showed that algal species vary in their susceptibility. We then tried larger studies that were conducted in stock tanks (outdoors) and in plastic cylinders (in the greenhouse). Although a decrease in phytoplanktonic growth (the microscopic algae that color the water green) was sometimes observed, we often noticed an increase in mat-forming algae (the algae that form floating mats on the surface of the water).

A field study was initiated by researchers (2) at the University of Nebraska. In April 2000 they applied barley to a lake that had a history of noxious phytoplankton blooms (blue-green algae). They monitored the lake through September and found no improvement in water quality. In April 2001, they removed the netting and remaining straw and continued to monitor the lake in 2001 and 2002. Water quality remains poor and the lake is still dominated by blue-green algae. No further research is planned with barley at this time.

Plastic enclosures were established in a pond at Iowa State University in the summer of 2001 (3) to compare barley-treated and untreated mat-forming algae. The mat-forming algae were not reduced in the barley-treated enclosures although the experiment had to be prematurely terminated at mid-summer because drought conditions dried up the enclosures.

Additional studies were conducted several years ago at the University of Florida (4) and at North Carolina State University (5). In Florida, a small scale study found that predigestion of the straw (incubation in water) for about a month was necessary for activity. As shown in the English studies, the effect was algistatic rather than algicidal. In other words, the liquor did not reduce existing algal populations but did prevent algae from growing. The conclusion from this study was that the amount of straw needed, if extended to a pond scale, was too large to be practical in Florida, particularly since its ponds and lakes are warm, shallow, and have such a long growing season. Several pond trials conducted there were unsuccessful. In North Carolina, two trials were conducted on farm ponds with no effect on mat-forming algae.

Testimonials from pond or lake owners who have tried barley straw range from success to failure. Without replication (e.g. treating several ponds and not treating others with similar algae and water conditions) and extensive data collection, it is difficult to evaluate these reports. The best user documentation thus far has been obtained by Steve McComas of Blue Water Science (6) who has collected data before and after barley treatment on two lakes in Minnesota. In Valley Lake (Lakeville, MN), 1999 readings for Secchi disk transparency, chlorophyll (a measure of microscopic algae growth), and total phosphorus were 3 ft, 36 ppb, and 71 ppb, respectively. In 2000 and 2001, barley straw was added to the lake at rates of 200 and 240 pounds per acre, respectively. In 2001, Secchi disk transparency had increased to 6 ft, and chlorophyll and phosphorus values had decreased to 7 ppb and 37 ppb, respectively. These data suggest that rather than directly controlling algae, the barley straw may reduce phosphorus concentrations which in turn reduce phytoplankton growth. In either case, it is difficult to rule out normal year to year variation as a cause. Although no data were taken on mat-forming algae, observations suggest that its growth was reduced (but not eliminated).

In summary, results from university research in this country have not been consistent or very positive. Whether we are dealing with algal species, water conditions, climatic conditions, or other factors that differ from those of the typical English water body is simply not known at this time. In some cases, the research has been limited in terms of monitoring and may not have followed the guidelines suggested by English scientists. More research in replicated ponds with ample aeration to ensure that the barley decomposes is certainly warranted, but facilities and funding for this kind of research are difficult to obtain.

Clearly, the use of barley is not a process that is going to produce rapid, visible results like an algicide application would. Algae that have been treated with copper sulfate, for example, can start to turn white within a couple of hours after treatment. Results with barley, according to the English researchers, can take several months. Perhaps we Americans are just too impatient!

EPA's Views on Barley

The Environmental Protection Agency (EPA) has the responsibility of maintaining the health of our nation's bodies of water. It is also the agency that regulates the use of pesticides in the United States. All pesticides must undergo thorough testing for their potential to cause adverse effects on non-target species, human health, and the environment. A pesticide that is approved by EPA for use receives a registration number. Only registered products can legally be used as pesticides.

After the apparently successful Lakeville, Minnesota test, a number of lake associations in that state were anxious to begin using barley straw as an alternative to traditional pesticides. Members of the Minnesota Department of Natural Resources were concerned that not enough was known about the potential effects of barley. They questioned whether it provides consistent control and whether they could approve its use in “public” waters (7). The Minnesota Department of Agriculture asked EPA for guidance on this matter.

EPA’s response is summarized as follows: The EPA defines a pesticide as “any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest.” If a claim is made that barley “controls” algae (a pest), it is legally considered to be a pesticide. However, no company has ever registered barley for use as a pesticide. It has not gone through the testing required for registration. Therefore, barley cannot be sold as a pesticide to control algae. This ruling has serious implications for certified commercial applicators (individuals who have been state certified to apply aquatic pesticides for hire) and lake management specialists. These individuals cannot recommend or apply barley for algae control; this application would be the same as distributing an unregistered pesticide.

Likewise, garden shops and nurseries cannot legally sell barley straw for the stated or implied purpose of algae control. Registration is required for all pesticides before they are sold or distributed, regardless of whether most applications go into larger bodies of water or into water gardens, even though the latter usually are privately owned, very small, and not likely to have an impact on the natural environment.

A homeowner with a “private” pond or lake is in a different situation. For the homeowner who does work on their own pond, barley qualifies as a “home remedy” and does not come under EPA authority. Pond owners who wish to purchase barley and apply it to ponds on their own property themselves are perfectly free to do so. However, a person who lives on a public lake cannot apply barley because public waters are "owned" by the public and managed by state government and therefore would fall under EPA restrictions. EPA does not provide guidance on which ponds/lakes are “private” vs. “public,” and how this distinction is made likely varies among states.

There is also a matter of semantics. EPA acknowledges that some products have multiple uses and that it is legal to advertise, sell, and apply a product based on its non-pesticidal uses, even if the product also has pesticidal uses. In this case, as long as someone does not claim algae control per se, they could sell or apply barley straw. The obvious alternative reason for the application of barley is that it might act as a water clarifier. Although there is little evidence that barley acts like typical clarifiers such as alum (which causes the precipitation of phosphorus or removes particles from the water), this is one way in which the direct claim or implication of "algae control" can be avoided. Is this a legitimate way to justify the use of barley? Until further clarification is obtained from EPA, this is a matter for the individual to decide.

For a copy of EPA's written response to questions about barley, please contact me by e-mail (lembi@purdue.edu) and send your FAX number.

If You Do Choose to Use Barley, How Should You Do It?

General Considerations

Recommendations for the use of barley straw to control algae have been distributed through several media, mostly derived from the English experience. If, given the preceding information, you decide to use barley as a home remedy, you should consult your state Department of Agriculture to determine the legal status of using barley straw for algae control in your state.

Some of the most important considerations are as follows:

(1) Do not just toss barley bales or handfuls of barley into the water. The bales must be broken apart and the barley loosely placed into netting so that water and air can circulate through the straw. The decomposition process is aerobic; in other words, it requires oxygen. Tight bales prevent the thorough distribution of oxygen. Anything that increases aeration in the body of water, like an aerator, may help in the decomposition process.

(2) A commonly recommended dosage is 225 pounds of barley per acre of water (about 5 bales). The water should be relatively shallow, perhaps 4 to 5 feet in depth. Barley may work in deeper waters as well, but maximum depths have not determined.

(3) Do not expect immediate effects. If barley works as an algistat rather than as an algicide, it will prevent new growth, but it may not kill off what is already present. Presumably, early treatments, perhaps in March or April, applied before the algae start to grow, will help this situation. The other alternative is to control existing algal populations, either manually or chemically, and then to apply the barley to prevent new growth. According to Dr. J. Newman, who has conducted some of the research in England, the activity of barley builds up to a maximum at about 6 months after treatment and then ceases. At that time, new barley should be introduced into the system.

Printed below are specific use instructions published by the University of Nebraska that are based on English recommendations.

Guidelines from the University of Nebraska

These guidelines are modified from those supplied by the Lake Water Quality Extension Program, University of Nebraska, at http://www.ianr.unl.edu/PUBS/wildlife/NF429.htm. Much of the information was obtained from English recommendations (Centre for Aquatic Plant Management), and more detail can be obtained from the CAPM at http://www.exit109.com/~gosta/pondstrw.sht.

When to Apply the Straw

The decomposition process is temperature dependent and occurs faster in warmer water. When the water temperature is below 50ºF, it takes approximately 6-8 weeks for the decomposing straw to produce enough of the growth inhibiting chemical to effectively control algae. However, it only takes 1-2 weeks when the water temperature is above 68ºF. Once the straw begins to produce sufficient amounts of the chemical, it is likely to control algae for about 4-6 months. Therefore, straw should be applied in mid-to-late April in order to control summer algal growth in ponds and lakes in Nebraska (or sites at similar latitudes).

Amount of Straw to Apply

The amount of straw required to control algal growth is primarily dependent on the surface area of the lake. Lakes with a history of algae problems should be treated at a rate of 225 pounds of barley straw per surface acre. This rate is equivalent to about 0.8 ounces of straw per 10 square feet of surface area. Lower doses can be tried, but should not fall below 90 pounds of straw per acre or 0.3 ounces per 10 square feet.

The effectiveness of the straw is reduced by sediments suspended in the water (i.e. "muddy" water). Therefore, a higher dose may be required in "muddy" lakes or lakes with extremely severe algae problems. In these types of lakes, apply 450 pounds per acre (1.7 oz. per 10 square feet), but do not exceed 900 pounds per acre (3.3 oz. per 10 square feet). The decomposition of the straw requires oxygen, and the application of excessive amounts (greater than 900 lbs. per acre) of straw could reduce the oxygen content of the water to levels that stress or kill fish.

Example: Determining the amount of straw required to treat a 5 acre lake.

(1) The surface area of the lake is 5 acres.

(2) The selected dose is 225 lbs of straw per acre.

(3) Multiply the area of the lake (in acres) by the amount of straw required per acre to calculate the total amount of straw required to treat the whole lake (5 acres x 225 lbs/acre = 1125 lbs).

(4) To calculate the number to bales needed to treat the lake, divide the total amount of straw required to treat the whole lake by the weight of a single bale of barley straw. For this example, assume one bale weighs 45 pounds. However, the size and weight of bales can be highly variable. It is recommended that the approximate weight of the bales be determined at the time of purchase (1125 lbs ÷ 45 lbs/bale = 25 bales).

How to Apply the Straw

(1) The straw bales must first be broken apart. Bales are packed too tightly and do not allow adequate water movement through the straw.

(2) The loose straw should be placed in some form of netting. In larger lakes and ponds, CAPM suggests wrapping the straw in the cylindrical netting commonly used for wrapping Christmas trees (Figure 1). This netting can be used to construct straw-filled tubes (Figure 2) up to 65 feet long that contain about 110 pounds of straw. Loose woven sacks (e.g., onion sacks) can be used in small ponds that require low doses (Figure 3).

Figure 1. For treatments of larger ponds, barley straw can be repacked using a Christmas tree baler to feed the straw into a mesh bag. Photo courtesy of Steve McComas, Blue Water Science, St. Paul, MN.

Figure 2. A large barley bag being anchored into a lake. Photo courtesy of Steve McComas, Blue Water Science, St. Paul, MN.

Figure 3. For treatments of small ponds, barley straw can be repacked into 50-lb onion mesh bags. These bags hold about 7 pounds of barley straw. Photo courtesy of Steve McComas, Blue Water Science, St. Paul, MN.

(3) Use floats to suspend the straw-filled netting in the upper three to four feet of the lake. The straw will lose its effectiveness if it sinks below this depth. Water movement near the surface will keep the straw well oxygenated and distribute the growth inhibiting chemical throughout the upper portion of the lake. This ensures that the chemical is produced where the majority of the algae are growing and away from the bottom sediments that will inactivate the chemical. Therefore, it is recommended that floats be inserted inside the netting at the same time the netting is filled with straw. The netting is then anchored into place using rope attached to bricks or concrete-filled buckets.

Where to Apply the Straw

In order to improve the distribution of the growth inhibiting chemical, CAPM recommends placing several small quantities of straw around a lake. Place each net of straw roughly equidistant from other nearby nets and the shore. The placement of the nets does not need to be exact and practical considerations such as corridors for boating and angling may influence the location of the nets. In small ponds, where only one net of straw is required, place the net of straw in the center of the water body.

Sources of Netting

Aquatic Eco-Systems, Inc. (standard netting) Apopka, FL 407-866-3939	The Campbell Company, Inc. (Christmas tree netting) Wautoma, WI 1-800-242-2019
Kelco Industries (Christmas tree netting) Milbridge, ME 1-800-343-4057	

Sources of Cited Research/Information:

(1) Daniel E. Terlizzi, Maryland Sea Grant Extension Program, E-mail: dt37@umail.umd.edu

(2) John C. Holz, University of Nebraska, E-mail: jholz@unl.edu

(3) Joseph E. Morris, Iowa State University, E-mail: jemorris@iastate.edu

(4) Kenneth Langeland, University of Florida, E-mail: kal@gnv.ifas.ufl.edu

(5) Stratford Kay, North Carolina State University, E-mail: stratford_kay@ncsu.edu

(6) Steve McComas, Blue Water Science, St. Paul, MN, E-mail: mccomas@pclink.com

(7) Steve Enger and David Wright, Minnesota Department of Natural Resources, St. Paul, MN, E-mail: steve.enger@dnr.state.mn.us and dave.wright@dnr.state.mn.us

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