THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

Agriculture and Natural Resources

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Chemical Control of Aquatic Plants

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Aquatic plants are an important element of any aquatic ecosystem, whether it be a stream, pond, lake, or reservoir. Most naturally occurring aquatic ecosystems have been impacted by human activity, resulting in increased nutrients or sediments from various land uses. Many more aquatic ecosystems have been created by human efforts through the construction of ponds, lakes, and reservoirs. One result of these artificially created bodies of water is the development of aquatic plant communities. Excessive plant growth often interferes with the uses for which these water bodies were created. Recreation (swimming, boating, fishing), aesthetic values, and domestic uses often necessitate the active management of aquatic plants. This management is accomplished with either preventative measures or control measures. Vegetation control may be accomplished with biological, mechanical, or chemical methods. The focus of this fact sheet is chemical control of aquatic plants with approved herbicides and algaecides. However, pond owners will be most successful in managing aquatic plants by using a variety of methods. No single control strategy is likely to provide long-term satisfactory results.

Considerations in Using Aquatic Herbicides

Identify the Plant

Chemical control efforts will not be successful unless the aquatic plants to be controlled are properly identified. This can be accomplished several ways: (1) review the picture guides of aquatic plants that are produced by many of the aquatic herbicide manufacturers; (2) review pictures of aquatic plants available on many aquatic plant and/or pond management web sites; (3) collect samples of the plants and take them to your county Extension or Soil & Water Conservation District office for assistance in identification; (4) collect samples and send them to: The Ohio State University, C. Wayne Ellett Plant and Pest Diagnostic Clinic, 2021 Coffey Road, Columbus, OH 43120. There is a nominal fee for identification and control recommendations (the clinic will bill you); or (5) hire a commercial pesticide application firm to identify the plants and make the proper herbicide/algaecide application.

When collecting the plants for identification, every effort should be made to collect samples of each of the different kinds of plants present. Plant specimens should be covered with wet paper towels, placed in a sealed plastic bag, and then transported, shipped, or mailed.

Choosing an Appropriate Herbicide

Once a plant is identified, the pond owner can then review the herbicides labeled to control the problematic plant(s) and then choose one that best fits his or her individual situation. Factors to consider are cost, spot control versus whole system treatment, ease of application, water use restrictions, and safety considerations. Table 1 provides a list of common aquatic plants in Ohio and what federally labeled chemicals will control them. Nearly all herbicide labels are available on the Internet for review, allowing the pond owner to easily compare products and then make a selection.

Table 1. Aquatic herbicides labeled for control of common aquatic plants and algae in Ohio. "x" = control, "p" = partial control as indicated by manufacturers, and "–" = no control or unknown. Check product labels for additional species controlled.

Common Name	2,4-D	Copper Chelate	Copper Sulfate	Diquat Dibromide	Endothall Amine Salt	Endothall Potassium Salt	Fluridone	Glyphosate	Imazamox	Imazapyr	Sodium Carbonate Peroxyhydrate	Triclopyr
EMERGENT PLANTS												
Arrowhead	x	–	–	x	–	–	x	x	x	x	–	–
Bulrush	–	–	–	–	–	–	–	x	–	–	–	–
Cattails	–	–	–	x	–	–	p	x	x	x	–	–
Purple loosestrife	–	–	–	–	–	–	–	x	–	x	–	x
Smartweeds	x	–	–	x	–	–	x	x	x	x	–	x
Spike-rush	–	–	–	x	–	–	p	x	–	x	–	–
Willows	–	–	–	–	–	–	–	x	x	x	–	–
ALGAE												
Algae—filamentous	–	x	x	p	x	–	–	–	–	–	x	–
Algae—planktonic	–	x	x	–	x	–	–	–	–	–	x	–
Chara (muskgrass)	–	x	x	–	x	–	–	–	–	–	-	–
FLOATING-LEAVED PLANTS												
American lotus	x	–	–	–	–	x	–	x	x	–	–	x
Duckweed	–	–	–	x	–	–	x	–	–	x	–	–
Watermeal	–	–	–	–	–	–	x	–	–	–	–	–
Water-shield	p	–	–	–	–	–	x	x	x	x	–	x
White water lily	p	–	–	–	–	–	x	x	x	x	–	x
Yellow water lily	p	–	–	–	–	–	x	x	x	x	–	x
SUBMERGED PLANTS (SOME MAY HAVE FLOATING LEAVES)												
American pondweed	–	–	–	x	x	x	x	–	x	–	–	–
Bladderwort	x	–	–	x	–	–	x	–	x	–	–	–
Brittle naiad	–	–	–	x	x	x	x	–	–	–	–	–
Coontail	x	–	–	x	x	x	x	–	–	–	–	–
Curly-leaf pondweed	–	–	–	x	x	x	x	–	x	–	–	–
Eelgrass	–	–	–	x	x	–	–	–	–	–	–	–
Elodea, waterweed	–	–	–	x	–	–	x	–	–	–	–	–
Eurasian watermilfoil	x	–	–	x	x	x	x	–	x	–	–	x
Floating pondweed	–	–	–	x	x	x	x	–	x	–	–	–
Horned pondweed	–	–	–	–	x	–	–	–	–	–	–	–
Large-leaved pondweed	–	–	–	x	x	x	x	–	x	–	–	–
Leafy pondweed	–	–	–	x	x	x	x	–	x	–	–	–
Sago pondweed	–	–	–	x	x	x	x	–	x	–	–	–
Small pondweed	–	–	–	x	x	x	x	–	x	–	–	–
Southern naiad	–	x	–	x	x	x	x	–	–	–	–	–
Watermilfoils	x	–	–	x	x	x	x	–	x	–	–	x

Water Uses

How the water in the pond or lake is used is an extremely important consideration in selecting a herbicide or algaecide. Many products require waiting periods (hours or days) depending on whether the water is used for domestic or agricultural purposes, irrigation, swimming, or fishing. Table 2 provides a summary of water use restrictions and waiting periods for federally labeled aquatic chemicals. Always consult the aquatic herbicide label on the container to determine what restrictions apply.

Application Rate

The amount of herbicide to be applied varies with the product used as well as the plant species to be controlled. The application rate on the label is usually described on the basis of area (acres of surface water) or volume (acre-feet of water). In order to apply the proper amount, these measurements of the pond or lake must be known (see *Pond Measurements*, Ohio State University Extension Fact Sheet A-2). If more than one herbicide will suit the pond owner's needs, the treatment cost should be calculated by determining the total amount of herbicide needed (application rate multiplied by area or volume), and then determining the cost of purchasing that amount of herbicide. The cost of a container of any herbicide should not be confused with the actual cost of the treatment.

Downstream Use of Pond Discharge

Ponds that have a periodic or constant discharge should not be treated with an algaecide or herbicide that will negatively impact the immediate downstream uses of the water. A number of aquatic herbicides have restrictions on their use if potable water intakes are 1/4 to 1/2 mile downstream. Consult the label on the product container for information about pond and lake discharges.

Legal Aspects

Only chemicals federally approved to control the aquatic plants of interest are legally permissible to be used. The active ingredients that are used in some of the labeled and US EPA approved aquatic herbicides are sometimes formulated into other products with different uses. Do not use materials that are not labeled for aquatic uses even though the active ingredient may be the same. Unless the product is labeled for aquatic use, the label will not contain the proper information necessary for safe use in aquatic ecosystems.

Chemical labels are legally binding, and any use contrary to what is written on the label is unlawful. Some states have imposed additional regulations on aquatic herbicide use, so it is important to check with your state for specific regulations pertinent to your state. Some states only allow certified commercial pesticide applicators to treat aquatic plants, while other states allow the pond or lake owner to treat the plants. In Ohio, the Ohio Environmental Protection Agency (OEPA) may need to be notified prior to any pesticide application to a pond or lake. Notification is not required when the aquatic pesticide is applied consistent with label instructions *and*:

1. The application is to a pond or lake with a surface area equal to or less than five acres; *and*
2. The application is not within one mile upstream of a public water supply intake or within one mile of a reservoir public water supply intake; *and*
3. The application is not to any wetland, borrow pit, quarry, or water body used for public swimming.

For more information on notifying the Ohio EPA, consult *Notifying the Ohio EPA Prior to Applying Aquatic Herbicides in Ponds* (Ohio State University Extension Fact Sheet A-13), which is available from county offices of Ohio State University Extension or at http://ohioline.osu.edu.

Timing the Application

When to Treat

Proper timing of herbicide/algaecide applications is extremely important for both effective control and to avoid potential problems. Timing involves knowing the water temperature, and waiting until vigorous plant growth is present. However, do not wait too long in the summer, when a late application could result in large quantities of plants decomposing, thereby creating conditions conducive to a fish kill by suffocation. Some herbicides and algaecides require minimum water temperatures of 60°F in order for there to be enough biological activity in the plants for the active ingredient to be effective. Unlike some terrestrial herbicides that can be used as pre-emergents (applied prior to the germination of plant seeds or the regrowth of sprouts), aquatic herbicide and algaecide use must be delayed until the plants are present and growing.

Table 2. Aquatic herbicides and algaecides for aquatic plant control and water use restrictions. Always check labels for additional or updated restrictions.

Chemical Name	Waiting Period Before Water Used For:						
	Human			*Animal*	*Irrigation*		
	Drinking	Swimming	Fish Consumption	Drinking	Turf	Forage	Food Crops
2,4-D (note 1)	Do not use	1 day	0 days	do not use	do not use	do not use	do not use
Copper chelate (many types)	0 days	0 days	0 days	0 days	0 days	0 days	0 days
Copper sulfate	0 days (note 2)	0 days (note 2)	0 days	0 days (note 2)	0 days	0 days	0 days
Diquat dibromide (notes 3 and 4)	1–5 days	0 days	0 days	1 day	1-5 days	5 days	5 days
Endothall amine salt (note 5)	7–25 days	24 hours	0 days	7–25 days	7–25 days	7–25 days	7–25 days
Endothall potassium salt (note 5)	7–25 days	24 hours	0 days	7–25 days	7–25 days	7–25 days	7–25 days
Fluridone	note 6	0 days	0 days	0 days	30 days	30 days	30 days
Glyphosate	note 7	0 days	0 days	0 days	0 days	0 days	0 days
Imazamox	note 6	0 days	0 days	0 days	note 8	note 8	note 8
Imazapyr	note 7	0 days	0 days	0 days	120 days	120 days	120 days
Sodium carbonate peroxyhydrate	0 days	0 days	0 days	0 days	0 days	0 days	0 days
Triclopyr	note 9	0 days	0 days	0 days (note 10)	120 days	120 days	120 days

Notes:

1—Do not apply to waters used for irrigation, agricultural sprays, watering animals, or domestic water supplies.

2—No required waiting period. 24-hour waiting period recommended to allow for dissipation of metallic odor.

3—Controls some species of filamentous algae: Spirogyra and Pithophora.

4—Actual waiting period dependent on commercial product used and application rate.

5—Actual waiting period dependent on formulation type and application rate.

6—Do not apply within 1/4 mile of a potable water intake if pond or lake has a discharge.

7—Do not apply within 1/2 mile upstream of a potable water intake if pond or lake has a discharge.

8—Do not use for irrigation purposes until tests indicate levels are under 50 ppb; do not use for greenhouses and nurseries.

9—Label provides setbacks from water intakes if applied to ponds and lakes.

10—No restrictions on animal drinking water consumption although label provides restrictions for lactating animals consuming hay treated with this chemical.

Summer Oxygen Depletion from Decomposition

Aquatic plants that are killed with an algaecide or herbicide will decompose in the pond. Decomposition is an oxygen-using process and the source of oxygen is that which is dissolved in the water. Fish require sufficient dissolved oxygen, otherwise they will suffocate. When aquatic plants have accumulated to the point at which large amounts are present (typically mid-June or later), the decomposition that occurs after a whole pond or lake is treated with a herbicide/algaecide could result in an oxygen demand so great that there is not enough oxygen to sustain fish life. This problem can be avoided if chemical plant control efforts are carried out before there is a large accumulation of aquatic plants.

Summer water temperatures enhance the risk to aquatic life associated with controlling large amounts of aquatic plants. As water temperature increases, less oxygen can be dissolved in the water at saturation. Decomposition rates increase as water temperatures increase, meaning dissolved oxygen is consumed quicker. These factors increase the risk to aquatic life once water temperatures exceed 70–72°F.

Spot Treatments

Small, partial treatments are an effective method to manage aquatic plants and reduce the risk of a fish kill due to oxygen depletion from decomposition of plants killed by an algaecide or herbicide. The surviving plants can continue to produce oxygen to meet the demand imposed by decomposition of the smaller amounts of plants killed. Also, spot treatments allow the pond owner to maintain some underwater habitat for aquatic life while maintaining "plant free zones" for swimming and fishing. Pond owners can treat 20–25% of the aquatic plants every three weeks. In hot summers, the interval should be three weeks and maybe increased to four weeks. Many algaecides and herbicides have granular formulations that more easily facilitate spot treatments.

Retreatments

Regrowth of aquatic plants, particularly algae, during the growing season is frequently a problem for the pond owner who is using aquatic algaecides or herbicides. Regrowth, or what appears to be regrowth, may be simply the late-season development of other plants species not previously noticed, the result of an improper application, or the natural ability of the plant to reproduce throughout the growing season (e.g. algae). Retreatments at the same rate as the initial treatment and during the same growing season may be financially unwise. Aquatic algaecides and herbicides are expensive. Therefore, every effort should be made to control as many of the treatment variables as possible (proper plant identification, application, and timing) to ensure adequate control with the initial treatment.

Algae growth can be explosive in warm water and in ponds with high levels of nutrients. Regrowth is common in these situations, causing many pond owners to re-treat at some point during the summer. Fortunately, regrowth of submerged and emergent aquatic plants is limited and often does not occur until late summer when recreational activities have ceased. It is probably wise financially and biologically not to re-treat at that point. Retreatments of algae are best accomplished by periodic walks around the water body, and applying a granular algaecide product on the small patches of algae as they appear.

Aquatic Herbicides Approved for Use

2,4-D (Navigate, AquaKleen, Aquacide)

While 2,4-D is widely used to control many species of terrestrial plants, it has limited uses on aquatic plants. It is most often used to control water lilies and Eurasian watermilfoil. Because of significant water use restrictions and limited efficacy on aquatic plants, it is not widely used in Ohio.

Copper sulfate (numerous trade names)

Most species of algae can be controlled with low concentrations of copper sulfate. It is available in crystalline nuggets the size of rock salt or as finely ground "snow" grade. Whichever form is purchased, best results are obtained by dissolving the copper sulfate in water and spraying it directly on floating algae mats or on the water surface above submerged algae. Snow grade copper sulfate dissolves more easily than crystal nuggets. Because copper is corrosive to galvanized metal, mixing and application equipment should be made of plastic or stainless steel.

Plastic garden sprayers (2–5 gallons) work well in treating ponds less than an acre in size. For larger ponds or when spray equipment is not available, the required amount of crystal nuggets can be placed in a burlap bag. The bag is towed from a boat through the water until all of the crystals have been dissolved in the area to be treated.

There are no water-use restrictions associated with the use of copper sulfate. When applied at the proper

rate, the water may be used immediately for swimming, drinking, fishing, irrigation, and watering livestock. However, since copper sulfate has a metallic odor, pond owners may want to suspend drinking, swimming, and watering livestock for a day.

Copper sulfate applied at recommended rates is often lethal to various trout species, ornamental goldfish (particularly koi), and white amur. This is particularly true in low alkaline water or soft water (less 50 parts per million of hardness). It is recommended that alternative algaecides be used in ponds containing these sensitive fish species. Copper sulfate applied at recommended rates can be lethal to fish eggs and some species of newly hatched fish fry. Recommended rates of copper sulfate can kill the eggs and fry of largemouth bass and bluegills. Its use during the spawning season of these species is discouraged. The presence of male largemouth bass and bluegills guarding saucer-shaped nests in shallow water is a good indicator of spawning activity.

Copper chelate (Cutrine Plus, Cutrine Ultra, Clearigate, K-tea, Algimycin, Komeen, Nautique, Captain)

Copper is also available in a chelated, or buffered, formulation, which is manufactured as a liquid or granule. This provides some advantages during application. The liquid form needs only to be mixed with water and sprayed out over the pond surface; there are no crystals to dissolve. The granular formulation consists of clay or organic granules impregnated with copper chelate. As the granule breaks down, the copper is released into the water. This formulation is especially useful when spot treatment is desirable.

Copper chelate products are primarily used for algae control, although some submerged plants are susceptible. There are no water-use restrictions associated with either formulation of copper chelate. Copper chelate products are less toxic than copper sulfate to fish, but should be used cautiously in the presence of trout or ornamental goldfish.

A number of the chelated copper products have surfactants/penetrants added to them that enhance their efficacy in controlling problematic algae, such as those with thick cells wall or gelatinous coatings. These surfactants are labeled for use in aquatic ecosystems and are safe to aquatic life. If you choose to add a surfactant on your own, it must be labeled for use in aquatic ecosystems.

Diquat dibromide (Reward, Weedtrine-D)

These products are formulated as liquids and are applied directly to the pond surface to control submerged plants and a few species of filamentous algae. They can also be mixed with water and a surfactant to control cattails. The active ingredient will quickly bond to suspended soil particles, and therefore should not be used in muddy waters. There are water-use restrictions associated with these diquat products.

Endothall amine salt (Hydrothol 191)

This product is formulated as both a liquid and a granule. In addition to a number of submerged plants that are controlled, endothall amine salts will also control most filamentous algae and muskgrass (*Chara*). Fish are extremely sensitive to this active ingredient. To reduce the potential for killing fish, start applications at the shoreline and move outward so that fish can escape from treated areas. There are significant water-use restrictions associated with this product.

Endothall potassium salts (Aquathol K, Aquathol Super K)

This herbicide is produced both as a liquid and granular. This contact herbicide will control a wide variety of submerged aquatic plants, but will not control algae like the amine salt of endothall does. Also, fish are less sensitive to this formulation of endothall than the amine salt formulation. There are significant water-use restrictions associated with this product.

Fluridone (Sonar, Avast!)

This product is available both as a liquid and as pellets. The pellets come in a variety of time release formulations to allow for more precise application depending on site factors. Fluridone will control a broad range of submerged and floating aquatic plants, and some emergent plants as well. It is particularly effective for control of Eurasian watermilfoil, duckweed, and watermeal. In 30–90 days after application, the target plants will be controlled, often for the entire season. The slower kill of aquatic plants lowers the risk of a post-application fish kill due to oxygen depletion by decomposing plants. Significant water use restrictions are associated with fluridone, primarily the use of treated water for turf, forage, and food crops. It should also not be used within a quarter mile of a potable water intake, which makes it not usable in ponds and lakes used for drinking water.

Glyphosate (Accord, Rodeo, Accord, Eagre, Glyfos, GlyPro, Shore-Klear, Aquamaster, AquaPro)

This chemical is formulated as a liquid, and is mixed with water and a surfactant to control emergent aquatic plants and water lilies. It is not effective on algae or submerged plants. Glyphosate is a broad spectrum systemic herbicide that is absorbed through the leaves and is then transported throughout the plant, including the roots. Do not apply when rain is likely within six hours. Plants can take several days to weeks to die or show damage, at which point a follow-up application can be made to the plants missed during the initial application. Aquatic glyphosate products should not be used around water bodies used as potable water supplies or within a half mile of such water bodies.

Imazamox (Clearcast)

This herbicide is a broad spectrum, slow-acting systemic herbicide used to control a wide variety of emergent, floating, and submerged plants. There are significant water-use restrictions associated with this herbicide, particularly for irrigation uses.

Imazapyr (Habitat)

This herbicide is a broad spectrum, slow-acting liquid herbicide to control aquatic emergent plants and water lilies. Imazapyr does not control submerged aquatic plants. There are significant water-use restrictions associated with this herbicide, particularly for irrigation uses. As with glyphosate products, follow-up applications may be needed once it can be determined if any target plants were missed. Imazapyr should not be used around water bodies used as potable water supplies or within a half mile of such water bodies.

Sodium carbonate peroxyhydrate (GreenClean, Phycomycin)

This is a fast-acting algaecide with results noticeable within several hours in the form of algae discoloration from green to a whitish or cream color. Its mode of action is oxidation, producing 100 times its volume of oxygen as it eliminates chlorophyll in the immediate application area. It completely biodegrades into naturally occurring compounds, and is non-toxic to aquatic life if used as specified by the manufacturer. There are no water use restrictions. Sodium carbonate peroxyhydrate is very corrosive and should not come in contact with other pesticides, cleaners, or other oxidizing agents.

Triclopyr (Renovate, Garlon 3A)

This chemical is a fast acting, systemic liquid herbicide that is selective for a variety of broadleaf aquatic plants. It is particularly useful for controlling Eurasian watermilfoil and purple loosestrife. There are significant water-use restrictions associated with this herbicide, particularly for irrigation uses.

Surfactants

Surfactants are chemical additives that increase the efficacy of herbicides by enhancing the spread of the chemical over the plant's surface and penetration of the chemical into the plant. If the herbicide label states that a surfactant is needed or recommended, then an aquatic registered surfactant should be used. Typically, surfactants are used with aquatic herbicides that control emergent and floating plants. There are many surfactants available that can be used in aquatic systems.

Safety

Critically important safety information is on all federally approved pesticide labels and should be read carefully prior to any application. By law, copies of the applied product must be in the possession of the applicator at the application site at the time of application. This is easily accomplished by having the product container with you by the pond as the application is made.

The label will provide information on protective clothing and equipment that should be worn, potential physical and chemical hazards to the applicator, and proper storage of any unused product. Additionally, the label provides medical information on required steps should exposure to a product occur.

Disposal of pesticide containers should occur as follows:

Empty liquid containers must be triple rinsed with the rinse water being added to the spray tank prior to application. If no spray tank is used, the rinse water should be applied to the water body being treated. After application, spray tanks should also be triple rinsed with rinse water being applied to the pond. Empty bags that contained dry formulations of aquatic pesticide products should be triple-rinsed with the rinse water being applied to the pond. All containers or bags should be rendered unusable, either by puncturing the containers or cutting up the bags.

Additional Pond Management Information

Placing Artificial Fish Attractors in Ponds and Reservoirs, Ohio State University Extension Fact Sheet A-1.
Pond Measurements, Ohio State University Extension Fact Sheet A-2.
Controlling Filamentous Algae in Ponds, Ohio State University Extension Fact Sheet A-3.
Muddy Water in Ponds, Ohio State University Extension Fact Sheet A-6.
Understanding Pond Stratification, Ohio State University Extension Fact Sheet A-7.
Winter and Summer Fish Kills in Ponds, Ohio State University Extension Fact Sheet A-8.
Planktonic Algae in Ponds, Ohio State University Extension Fact Sheet A-9.
Fish Species Selection for Pond Stocking, Ohio State University Extension Fact Sheet A-10.
Cattail Management, Ohio State University Extension Fact Sheet A-11.
Algae Control with Barley Straw, Ohio State University Extension Fact Sheet A-12.
Notifying the Ohio EPA Prior to Applying Aquatic Herbicides in Ponds, Ohio State University Extension Fact Sheet A-13.
Duckweed and Watermeal: Prevention and Control, Ohio State University Extension Fact Sheet A-14.
When to Apply Aquatic Herbicides, Ohio State University Fact Sheet A-15.
Dyes and Aquatic Plant Management, Ohio State University Extension Fact Sheet A-16.
Benefits and Disadvantages of Aquatic Plants in Ponds, Ohio State University Extension Fact Sheet A-17.
Ohio Pond Management, Ohio State University Extension Bulletin 374

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