ISU Fisheries Extension

Managing Iowa Fisheries

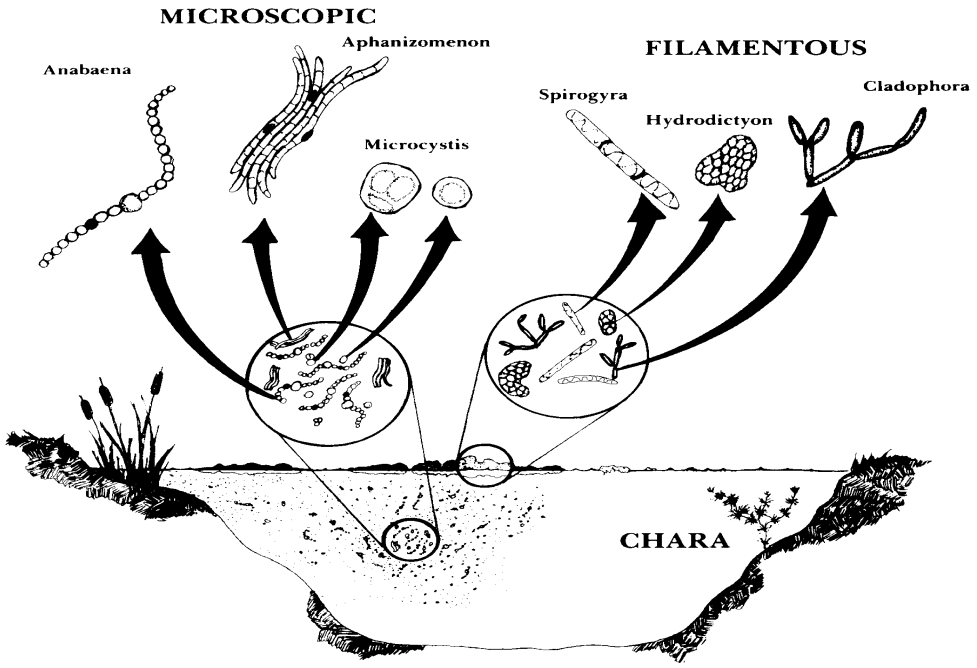
Aquatic Plant Management

Many different aquatic plants can be found in ponds. These plants range from microscopic organisms, known as plankton algae that drift suspended in the water, to larger plants rooted in the pond bottom. Moderate plant growth is essential to water bodies because plants produce oxygen, food, and cover for fish and other aquatic organisms. Nutrients and fish feeds introduced into the water (often from the surrounding watershed) can create an ideal habitat for aquatic weed growth. In ponds that have too many weeds, it may be difficult to harvest fish using seines and/or fishing tackle. Aquatic plants that interfere with sport fishing and commercial fish production may be considered weeds to be controlled.

Aquatic Plants

Aquatic plants that cause weed problems may be placed into four groups: algae, floating weeds, emergent weeds (foliage above water), and submersed weeds (majority of foliage below water).

Algae are the most common plants in ponds. Shape and size of algae vary from microscopic single- or multiple-celled plants to branched plants that resemble submersed aquatic plants. Unlike other aquatic plants, algae do not produce flowers or seeds. Algae are divided into three groups: plankton algae, filamentous algae (pond moss), and the stoneworts (*Chara* spp. and *Nitella* spp.).



Algae habitats

IOWA STATE UNIVERSITY
Extension and Outreach

PM 1352J Revised August 2009

American pondweed

Plankton algae produce most of the dissolved oxygen in a pond and are essential to fish survival. In the presence of sunlight, green plants release oxygen as a byproduct of photosynthesis. At night, plants and other pond organisms consume oxygen. Because of this diurnal cycle, oxygen concentrations are lowest at dawn and highest in the mid-afternoon. Cycle imbalances can lead to oxygen depletion and subsequent fish death.

Floating weeds float in or on the surface of the water and obtain their nutrients from the water rather than from soil. Duckweed (*Lemna minor and Spirodela polyrhiza*) and watermeal (*Wolffia spp.*) are examples of common floating weeds.

Emergent weeds are rooted to the pond bottom, but have stems, leaves, and flowers that extend above the water surface. They primarily grow on the shoreline and in shallow water up to 10 feet deep. Common emergent weeds are cattails (*Typha spp.*), rushes (*Juncus spp.*), and arrowhead (*Sagittaria spp.*).

Submersed aquatic weeds grow under and up to the water surface. Most submersed weeds have flowers and seedheads that extend above the surface of the water. Examples of common submersed weeds include coontail (*Cerato-phyllum spp.*), pondweed (*Potamogeton spp.*), and water milfoil (*Myriophyllum spp.*).

Management Methods

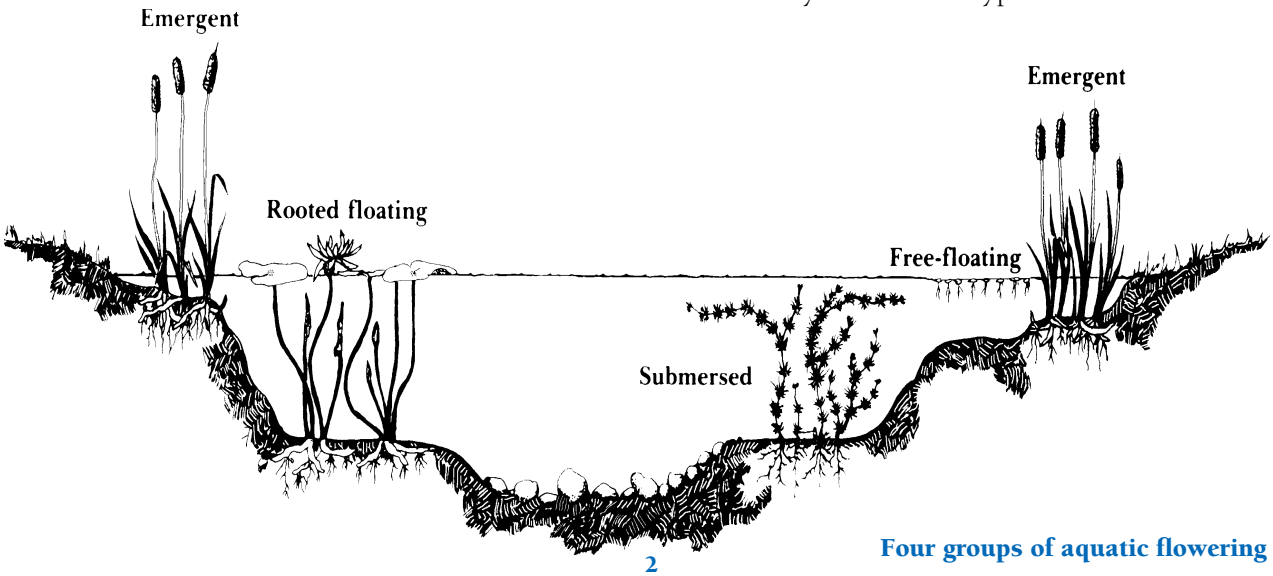
Aquatic plant control is a management plan that incorporates preventive methods (proper pond construction and maintenance), biological methods (grass carp [*Ctenopharyngodon idella*]), mechanical (physical removal), cultural methods, and the use of labeled aquatic herbicides. Developing an aquatic weed management plan depends on correctly identifying the problem weed(s) and selecting control methods that are compatible with efficient pond usage, e.g., sport fishing, aquaculture, animal watering, or swimming.

Preventive Methods

It is easier and less costly to prevent weed problems than it is to control them once they develop. Careful pond site selection, proper pond construction, and watershed practices are the first steps in preventing aquatic weed problems.

For example, rooted aquatic weeds and algae usually begin growing in shallow water (less than two feet deep). Edges of new and existing ponds should be deepened so shallow water areas are minimized. However, families with young children should be cautious about increasing these depths.

Decreasing the pond water level exposes shallow areas to freezing temperatures and drying that can effectively limit certain types of submersed weeds. For



Four groups of aquatic flowering plants

a drawdown to be effective, the water level should be lowered in the late fall and not allowed to refill until the early spring. Some plants, e.g., cattail (*Typha* spp.), are tolerant to drawdown and cannot be controlled by this method (table 1).

Biological Control Methods

The grass carp is a practical and economical way to control certain types of pond weeds. Grass carp effectively control submergent weeds with tender, succulent vegetation, such as coontail and water milfoil. They are, however, ineffective in controlling weeds that have tough, woody vegetation, e.g., water lily and cattail. The current stocking recommendation for Iowa ponds is four to five fish per surface acre. This number may need to be increased in ponds that have a rich and productive plant fauna. Initial plant control should be noticed 18 months after initial stocking. If the pond already has a large prey base, such as largemouth bass, the landowner should stock eight-inch long or longer grass carp to enable them to escape predation. Biologists have noted that the complete control of aquatic plants by grass carp may result in a pond with intense plankton algae population—intense green coloration.

Mechanical Methods

Various types of aquatic weed cutters and harvesters have been developed for canals and large reservoirs. Use of these machines is not practical in small fish ponds. Early manual removal of weeds by seining or raking can prevent some weed problems.

Cultural Control

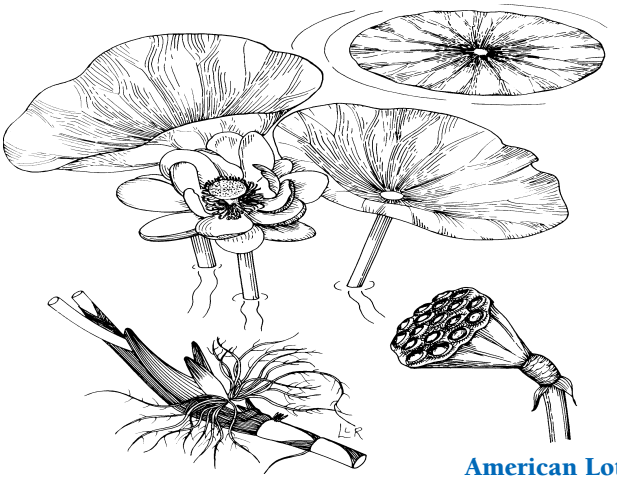
Altering the environment, or cultural control, can be used to manage aquatic weeds. Examples of cultural control for aquatic weeds include the following:

1. Shorelines can be lined with rocks or other riprap to prevent both erosion and the establishment of aquatic weeds.
2. Winter drawdowns control many submersed and rooted floating weeds (table 1). This technique involves removing water to expose shallow areas to drying and freezing conditions. Drawdown is achieved with structures built to control water flow into the pond, lake, or ditch; the installation of siphoning systems to lower the water level; or naturally as a result of receding shorelines during periods of low rainfall. Winter drydowns also dry and compact sediment, which deepens the body of water.
3. Covering bottom sediments with black plastic can control submersed weeds on a small scale. Black plastic works well with boat docks and swimming

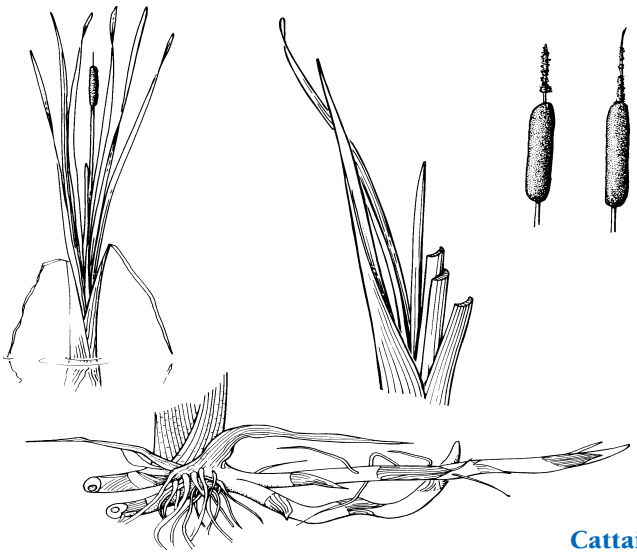
Table 1. Effect of winter drawdown on aquatic plant species.

Susceptible to drawdown:
Arrowhead (*Sagittaria heterophylla*)
Bladderwort (*Utricularia vulgaris*)
Largeleaf pondweed (*Potamogeton amplifolius*)
Pickerelweed (*Pontedaria cordata*)
Spikerush (*Eleocharis acicularis*)
Water lily (*Nymphaea tuberosa*)
Watershield (*Brasenia schreberi*)
Tolerant to drawdown:
Bulrush (*Scirpus validus*)
Cattail (*Typha latifolia*)
Leafy pondweed (*Potamogeton foliosus*)
Richardson's pondweed (*Potamogeton richardsonii*)
Water smartweed (*Polygonum natans*)

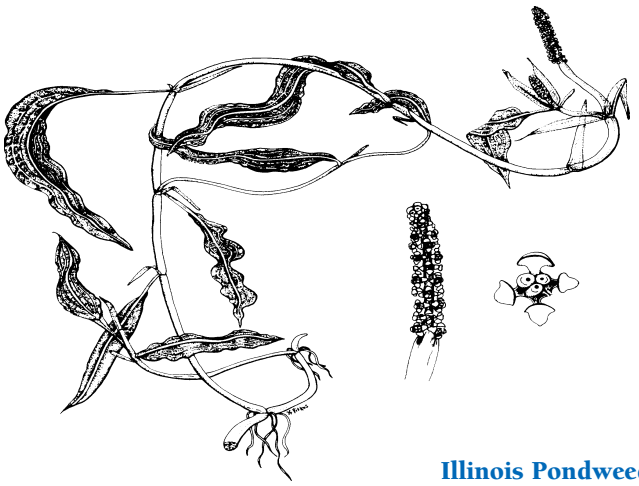
From Illinois Pesticide Applicator Training Manual 39-6



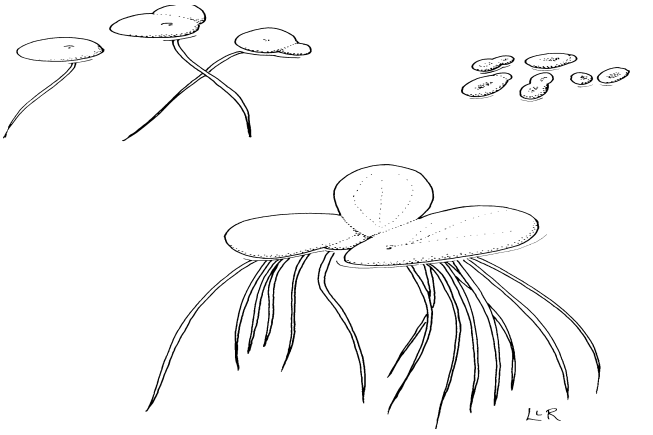
American Lotus



Cattail



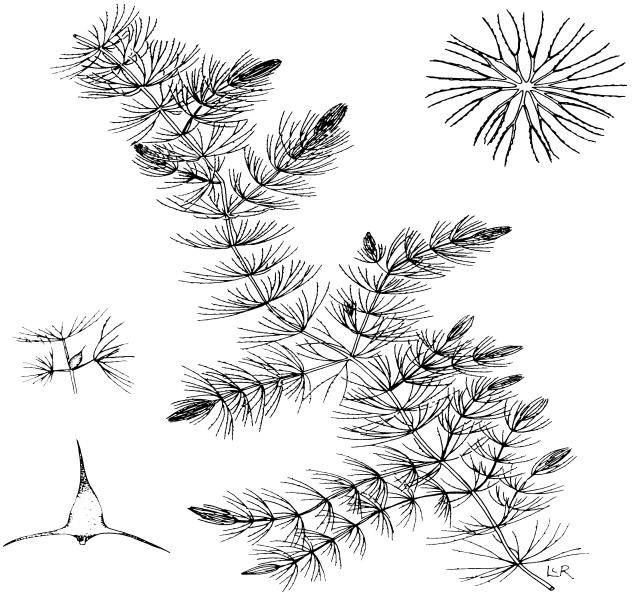
Illinois Pondweed



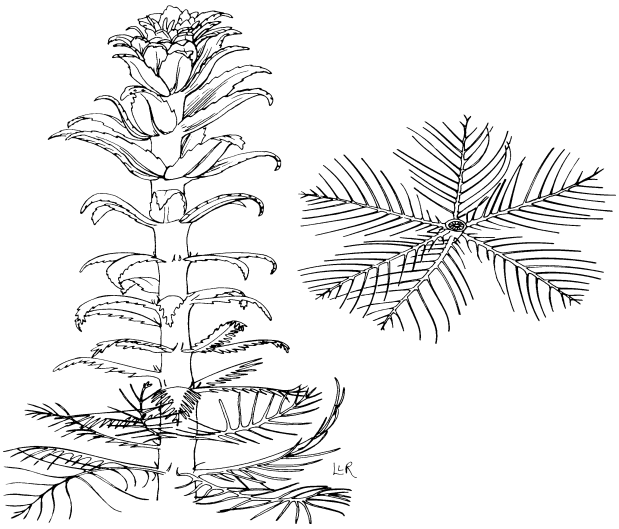
Watermeal

beaches. Plastic usually is installed during impoundment construction, drawdown, or ice cover and is weighted with sand or gravel.

4. Nontoxic dyes, which act as light screens, inhibit submersed plant growth. For example, the blue dye Aquashade absorbs light that otherwise would be used for photosynthesis. Aquashade is applied easily, disperses readily, and reduces growth of plants at depths greater than two feet. Dye concentration must be maintained throughout the growing season, so its use is limited to ponds with no outflow. Also, it must be applied before weeds emerge in the spring; once weeds reach the water surface, the dye has little effect. In this region, an initial application and a midseason application are suggested.
5. Aeration can be beneficial to water bodies, but its effects in controlling aquatic plants (algae and vascular) has not been demonstrated adequately. Two types of aerating equipment exist. One injects air into anaerobic (oxygen-depleted) water or pumps bottom water to the surface where it is mixed with air and reintroduced to the bottom of the lake. Simpler aeration devices agitate surface waters and are used to maintain levels of dissolved oxygen. Aeration benefits deep lakes with anaerobic bottom waters by opening up new water areas for fish and preventing the lake from becoming completely anaerobic in the summer or winter.



Coontail



Water milfoil

Chemical Control Methods

Herbicides may be used to control plants in commercial fish ponds. The first step in successful chemical control is accurately identifying the problem plant. Plant identification assistance is available through Iowa State University Extension and Iowa Department of Natural Resources offices. After the plant has been identified, a herbicide that is labeled for

aquatic use may be selected (tables 2 and 3). However, the user must read and fully understand the herbicide label **before** applying the herbicide to the pond.

Choosing an application method

The herbicide application method depends on the herbicide formulation and target weed species. Many herbicides are applied directly from the container (ready for use); others need to be diluted with water before application.

Treatment of large areas requires mechanical sprayers or spreaders and a poser boat to ensure adequate distribution of the chemical. Sprayable herbicide formulations can be applied with hand-held or mechanical pressurized sprayers or a boat bailer. Injecting the chemical near the outboard motor propwash aids in dispersion. Hand-operated or mechanical rotary spreaders can apply granular or pelleted formulations. Soluble crystals, e.g., copper sulfate, may be placed in burlap bags and dragged or suspended in the water until they dissolve.

Surfactants enhance the spreading, wetting, and penetrating characteristics of selected foliar-applied herbicides, e.g., diquat, glyphosate. Add them according to individual product label directions. Surfactants are not recommended for submersed weed control treatments.

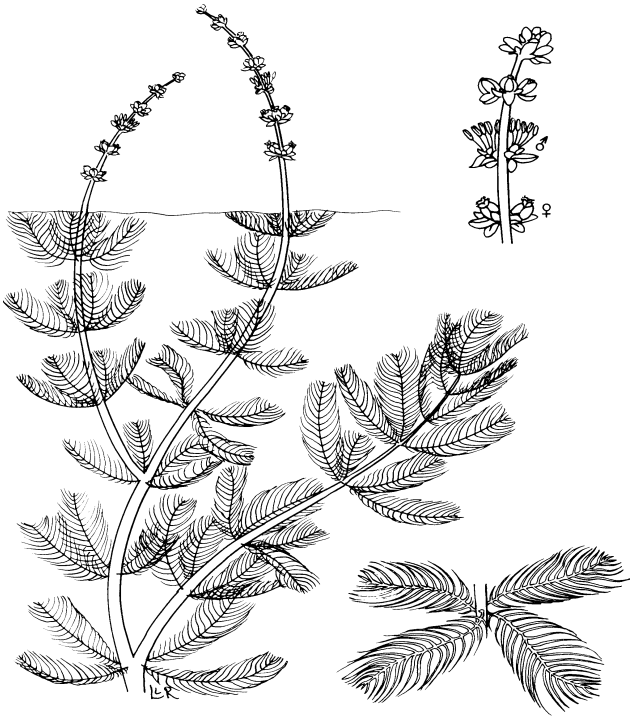
Calculating herbicide dosage

Always apply an aquatic herbicide at the rate suggested on its label. Applying excessive herbicide **does not** improve weed control. It does, however, increase treatment costs and may increase the risk of injury to fish. Conversely, applying less than the recommended rate usually does not offer adequate weed control.

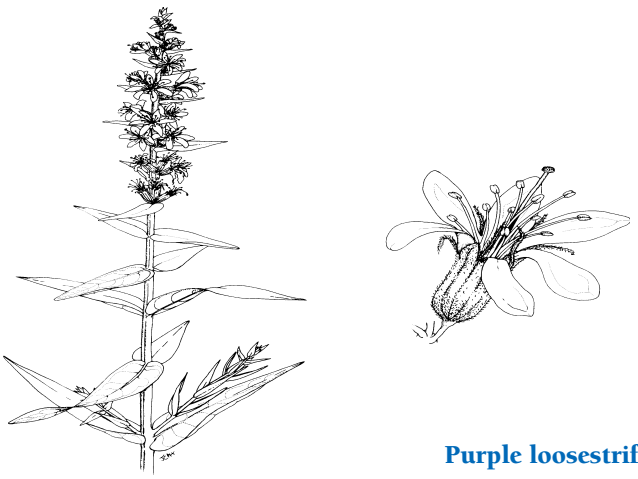
Prior to herbicide application, the size of the body of water, and often the average water depth, must be determined. Some herbicides are applied per surface acre, some per acre-foot, and some as a total water volume treatment.

Considerations before selecting a herbicide

Aquatic herbicide use is complicated by water entering and leaving an impoundment caused by springs, streams, run-off, overflow pipes, and emergency spillways. Fresh water that enters an impoundment may dilute the chemical until it is no longer effective, and overflow of treated water may kill plants in nontarget areas or pollute streams and other ponds or lakes.



Eurasian water milfoil



Purple loosestrife

Also consider the projected use of the treated water when selecting chemicals. Restrictions on the use of treated water for human and livestock consumption, swimming, turf irrigation, and food and forage crops, as well as on the consumption of fish from treated water, are specific to each herbicide. Table 4 lists restrictions on the use of water treated with aquatic herbicides. Because restriction listings for specific herbicides may change, always read label instructions prior to use.

Table 2. Response of common aquatic weeds to herbicides.

Aquatic group and weed	Aquatic Herbicides: copper complexes	copper sulfate	2,4-D	diquat	endothall	fluridone	glyphosate
Algae							
planktonic	E		P	P	P	P	P
filamentous	E		P	E	G[1]	P	P
chara (musk grass, musk weed)	E		P	G	G[1]	P	P
nitella	E		P	G	G[1]	P	P
Floating Plants							
bladderwort	P		G[2]	E		E	
duckweeds	P		G[3]	G	P	E	
water hyacinth	P		E	E		P	G
watermeal	P		P	P-F		F-G	
Emergent Plants							
American lotus	P		E	P	P	F	G
arrowhead	P		E	G	G		E
buttonbush	P		E	F	P	P	G
cattails	P		G	G	P	F	E
water lily	P		E	P		E	E
maidencane	P		P	F		F	E
pickerelweed	P		G	G		P	F
pond edge annuals	P			G	P	F	E
sedges and rushes	P		F	F		P	G
slender spikerush	P			G		G	P
smartweed	P		E	F		F	E
spatterdock	P		E	P		E	G-E
watershield	P		E	P	P	G	G
water primrose	P		E	F	P	F	E
willows	P		E	F		P	E
Submersed Plants							
broadleaf water milfoil	P			E	E	E	P
coontail	P		G	E	E	E	P
elodea	P			E	F	E	P
eurasian water milfoil	P		E	E	E	E	P
fanwort	P		F	G	E	E	P
naiads	P		F	E	E	E	P
parrotfeather	P		E	E	E		F
pondweeds (*Potamogeton*)	P		P	G	E	E	P

E = excellent control; G = good control; F = fair control; P = poor control

[1] Hydrothol formulations only
[2] Granular 2,4-D formulations
[3] Liquid ester formulations only

Table 3. Aquatic herbicides.

Copper sulfate (various trade names)
Copper sulfate is primarily used to control algae. It is a contact herbicide and quickly kills sensitive algal species. However, copper can interfere with gill function and if improperly used can be toxic to fish. But the majority of fish kills due to copper sulfate treatment are primarily caused by a massive algae kill and subsequent oxygen depletion problems.

The effectiveness and safety of copper sulfate is determined by water alkalinity and temperature. In waters with an alkalinity less than or equal to 50 ppm, the rate of copper sulfate needed to control algae can be toxic to fish. Treatment at water alkalinities of less than or equal to 20 ppm is extremely risky. In high alkalinity waters (less than or equal to 250 ppm), copper sulfate quickly precipitates out and is not effective for algae control. The toxicity of copper sulfate to fish increases as water temperature increases and pH decreases. Avoid copper sulfate applications during hot summer months.

Chelated copper (Komeen, K-Tea, others)
Copper that is held in an organic complex is known as chelated copper. Chelated copper formulations do not readily precipitate in high alkalinity waters, but stay in solution and remain active longer than copper sulfate. Chelated copper is less corrosive to application equipment than copper sulfate. Due to its enhanced solubility, chelated copper generally is used at rates slightly lower than copper sulfate. Chelated copper formulations are slightly less toxic to fish than copper sulfate. However, in waters with low alkalinity (less than or equal to 20 ppm), or in water with an alkalinity of less than or equal to 50 ppm that contains trout, chelated copper use is extremely risky, particularly during the hot summer months.

2,4-D (various trade names)
2,4-D is a translocated herbicide that is available as a granular or liquid formulation. Granular 2,4-D controls submersed plants such as coontail (*Ceratophyllum demersum*) and emergent plants such as water lily (*Nymphaea* spp.). Liquid formulations of 2,4-D are used to control floating plants, such as water hyacinth (*Eichhornia crassipes*), and several emergent plants. 2,4-D is available as ester or amine formulations, which are slightly better for aquatic applications. However, the liquid ester formulation is more toxic to fish than the amine. The granular ester form is safer to use in aquatic applications. There are numerous uses for 2,4-D, but only those labeled for aquatic systems use are legal to use.

Diquat (Weedtrine-D, Diquat, Herbicide-H/A)
Diquat is a contact herbicide that can be used as a "pour-in" treatment for submersed plant and filamentous algae control, or as a foliar application for duckweed (*Lemna minor* and *Spirodela polyrhiza*) control. An approved nonionic surfactant is required when diquat is used as a foliar application. Diquat is tightly bound to clay micelles and is not effective for plant control in muddy water. Diquat quickly kills plants and should be used as a partial pond treatment for dense vegetation.

Endothall (Aquathol, Hydrothol)
Two different salts of endothall are used for aquatic weed control. A dipotassium salt is available as a granular or liquid formulation by the trade name of Aquathol. Hydrothol is available as a liquid or granular formulation and is a mono (N,N-dimethyl-alkylamine) salt of endothall. Aquathol and Hydrothol vary considerably in their safety to fish and plant control spectrum. Hydrothol is more toxic to fish. Consequently, Aquathol generally is used in fish ponds. Hydrothol controls algae (filamentous and stoneworts) and many submersed plants. Aquathol controls many submersed plants, but is not effective for algae control. Both Aquathol and Hydrothol are contact herbicides and may be used on a spot or partial pond treatment basis.

Fluridone (Sonar)
Fluridone controls most submersed and emergent plants and is available as a liquid or pelleted formulation. Liquid formulations also may be used to control duckweed. Fluridone is a translocated herbicide that slowly kills plants over a 30- to 90-day period. The slow action of fluridone generally prevents the occurrence of plant decomposition-induced oxygen problems. Floridone is not effective as a spot treatment. The entire pond must be treated to control the target plant species.

Glyphosate (Rodeo, Pondmaster)
Glyphosate is a foliar applied, translocated herbicide that is used to control most shoreline vegetation and several emergent plants, such as spatterdock (*Nuphar luteum*). Glyphosate translocates from the treated foliage to underground storage organs such as rhizomes. Applications at the flowering or fruiting stage of perennial plants are generally more effective than earlier applications due to better translocation to underground plant parts. An approved nonionic surfactant should be used with glyphosate (Rodeo formulations only). Rainfall occurring within six hours of application will reduce the effectiveness of glyphosate.

Table 4. General aquatic weed control water use restrictions[1] (number of days after treatment before use)

Common Name	Human drinking	Human swimming	fish consumption	Animal dairy	Drinking livestock	turf	Irrigation crops	agricultural sprays
copper sulfate[2]	0	0	0	0	0	0	0	0
copper complexes	0	0	0	0	0	0	0	0
2,4-D	*	*	*	*	*	*	*	*
diquat	*	*	*	*	*	*	*	*
endothall	7-14	1	3	7-14	7-14	7-14	7-14	7-14
fluridone[3]	0	0	0	0	0	30	30	30
glyphosate[4]	0	0	0	0	0	0	0	0

[1]Algae control may result in fish kill due to oxygen depletion if herbicides are applied to large areas, if dissolved oxygen levels are low or, if fast acting contact herbicides are used (diquat, copper sulfate, etc.). Similar hazards exist when large masses of vascular plants or floating weeds are rapidly killed with herbicides.
[2]If water is used for drinking, the elemental copper concentration should not exceed 1.0 ppm (e.g., 4.0 ppm copper sulfate).
[3]Do not apply within 0.25 mile of any potable water intakes.
[4]Do not apply within 0.5 mile upstream of potable water intakes.
*Water restrictions vary with formulation and rate. Read the label.

Note: Labels change periodically. The end user must read the label at the time of purchase and before using the product.

When to treat aquatic weeds. Herbicides do not affect aquatic weeds when water is cold and weed growth is slow. Do not treat water until its temperature has risen to at least 65°F. Treat for algae control before vegetative growth is great. Treatment works best when only 5 to 10 percent of the water surface is covered with algae. Treat emergent and submersed plants when they are growing rapidly, up to early bud stage. Optimum application dates for most emergent and submersed plants and algae lie between May 1 and June 15 in Iowa, depending on the year. Spray cattails when they are in the flowering or fruiting stage.

Complete control of weeds with aquatic herbicides during the summer may cause fish kills due to decreased oxygen levels associated with decomposing plants. It is best to treat only 25 to 30 percent of a pond's area at one time, waiting three to four weeks between applications. Applications made during the late spring, while water temperatures are relatively cool (the cooler the water, the more oxygen contained), will reduce this risk.

What to expect from herbicide control.
Herbicide control may last longer than other weed control methods, but do not expect a weed-free condition the year after it is applied. Retreatment the same year may be necessary for aquatic plants that are difficult to control, such as duckweed, brittle, and slender naiads. Herbicide also may remove predominate species, eliminating the competition for other tolerant species that consequently flourish in the open environment.

Common reasons for herbicide failure.
1. Not reading herbicide label.
2. Misidentification of weed species.
3. Rate miscalculation.
4. Adverse weather—rainstorms or high winds that dilute herbicides.
5. Water conditions—high turbidity, low water temperatures, and high calcium can chemically or physically interfere with herbicide action.
6. Weed regrowth or appearance of new weeds.
7. Improper timing of application—too late or too early.
8. Rapid water exchange causing chemical dilution.

If used correctly and according to label restrictions, aquatic herbicides pose little threat to the environment or the public. However, these materials may become toxic to humans, livestock, and nontarget organisms if applied at excessive rates. Herbicides may be toxic if taken internally. Avoid direct contact with chemicals. If herbicide comes in contact with skin, immediately wash it off with water. If it is taken internally, consult the product label for first-aid information and immediately see a physician. Carefully read and follow all pesticide label directions.

Integrated Plant Management

Consider herbicides a temporary control method. Depending on the herbicide selected and the weed species, duration of control can range from a few weeks to several months. To achieve long-term weed control, use a combination of recommended aquatic weed control methods. For example, using the proper herbicides followed by stocking grass carp will effectively control and prevent the reoccurrence of most submersed weed problems. The best long-term control is to intercept the flow of nutrients into the pond through modifications of land-use practices or through the use of small wetlands to filter runoff.

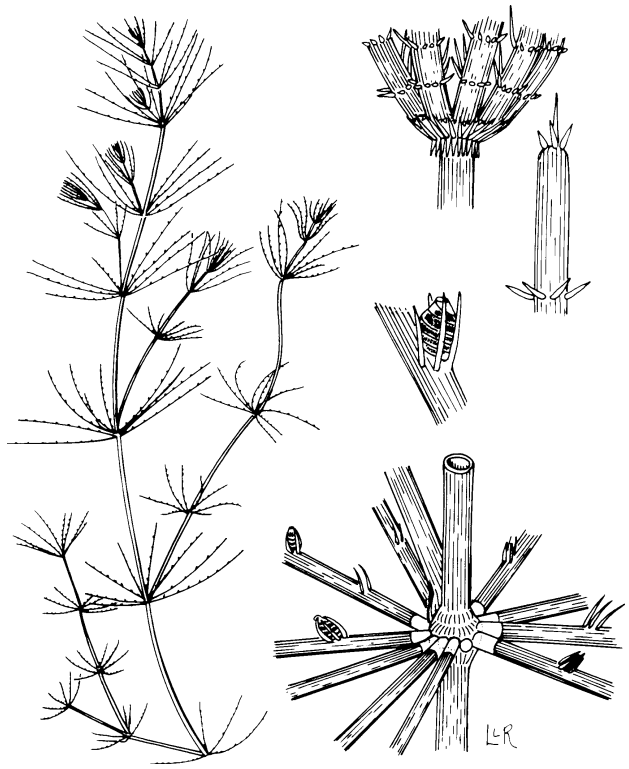
About This Publication

The information and suggestions included in this publication reflect the opinions of extension fisheries specialists based on field tests and use experience. Management suggestions are a product of research and are believed to be reliable. However, it is impossible to eliminate all risk. Conditions or circumstances which are unforeseen or unexpected may lead to less than satisfactory results, even when suggestions are used. The Cooperative Extension Service will not assume responsibility for such occurrences. Such risk shall be assumed by the **user** of this publication.

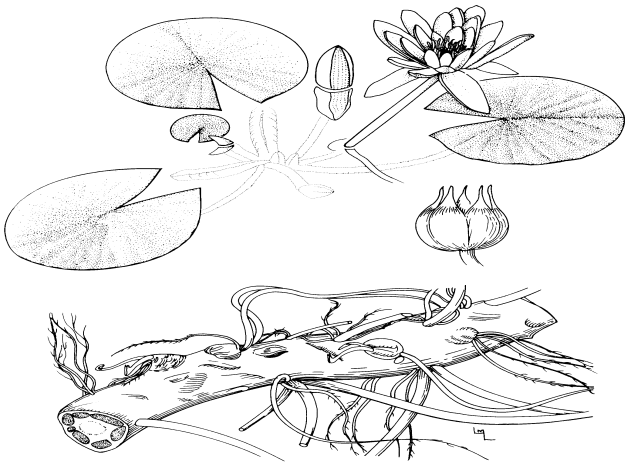
Suggested herbicides must be registered and labeled for use by the Environmental Protection Agency and the state Department of Agriculture. The status of herbicide label clearances is subject to change and may have changed since this publication was printed. County extension staff and appropriate specialists are advised of changes as they occur.

The **user** is always responsible for the effects of herbicide residues on livestock and crops, as well as problems that could arise from drift or movement of the herbicide from his or her property to that of others. Always read and carefully follow the instructions on the container label.

The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.



Musk grass



Water lily

Additional information concerning aquatic herbicides may be found in the following Iowa State University Extension publications: PM 1352A, *Managing Iowa Fisheries: Water Quality*; PM 1352D, *Managing Iowa Fisheries: Calculations and Conversions for Fisheries*; PM 1352I, *Managing Iowa Fisheries: Use of Copper Compounds in Aquatic Systems*; and CS 17, *Aquatic Pest Control, Category 5: A Guide for Commercial Pesticide Applicators*.

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Illustrations of algae habitats and four groups of aquatic flowering plants were used with permission from the Cooperative Extension Service, University of Illinois at Urbana-Champaign, *Illinois Pesticide Applicator Training Manual 39-6 Aquatics*. The illustrations of American pondweed and spatterdock were reprinted from a previous ISU Extension publication, *Control of Aquatic Plants in Ponds and Lakes*. All other illustrations of aquatic plants were used with permission from the Information Office of the University of Florida, IFAS, Center for Aquatic Plants, Gainesville.

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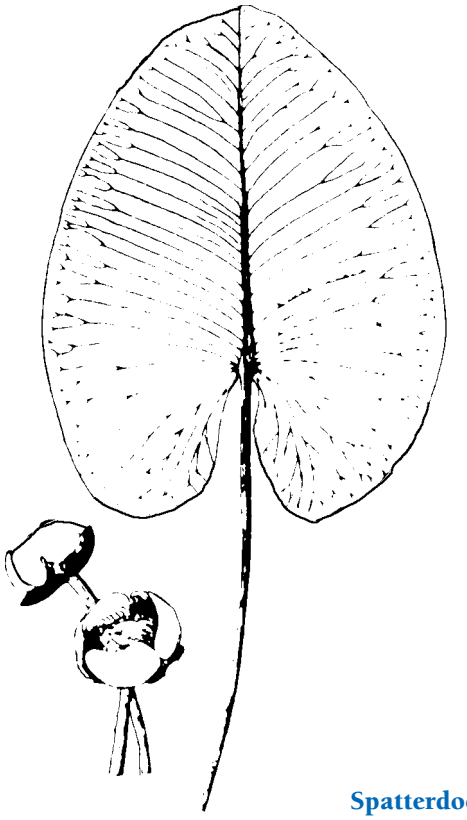

Spatterdock