SRAC Publication No. 361

Southern Regional Aquaculture Center

February 2001
Revision

AQUATIC WEED MANAGEMENT
Herbicides

Michael P. Masser,[1] Tim R. Murphy[2] and James L. Shelton[2]

Managers can quickly and economically control problem weeds in commercial fish ponds with aquatic herbicides. However, herbicides are just one method of managing aquatic weeds. There are also: 1) preventive methods such as proper pond site selection and construction, fertilization and periodic draw-downs; 2) biological methods such as grass carp (*Ctenopharyngodon idella*); and 3) mechanical methods such as cutting, seining and raking. Using a combination of methods, within a comprehensive plan, is the most cost effective and environmentally safe way to manage aquatic weeds. SRAC Publication No. 360, *Aquatic Weed Management - Control Methods*, contains additional information on the various methods used to control undesirable weeds in fish ponds. Once undesirable weeds are eliminated, applying fertilizer periodically will stimulate planktonic algal blooms that suppress the growth of submerged weeds.

Herbicide selection

The effectiveness of herbicides varies (Table 1). The first critical step in selecting an appropriate herbicide is identifying the weed. The herbicide selected must be labeled for use with food fish. It is important to note any water-use restrictions that may prevent the application of a herbicide in a particular situation on a specific body of water (Table 2). Restrictions on secondary water uses (i.e., swimming, livestock watering, and irrigation) also must be considered before a herbicide is applied.

Application timing

The best time to apply herbicide is in the spring when water temperature is between 70 and 80 °F. At this time of the year, weeds are small and easier to control than during the summer, and levels of dissolved oxygen in the water are usually higher.

Aquatic herbicides are not toxic to fish when applied according to label directions. However, after aquatic weeds are killed the decomposition process consumes oxygen and can reduce the amount of dissolved oxygen in the water. If large quantities of aquatic weeds are killed, their decomposition can reduce the dissolved oxygen concentration to such a low level that fish die. It is important to observe fish closely for 1 week after treatment. Have emergency aeration equipment handy and aerate the pond if fish seem stressed. Treating a pond with herbicides during the hot summer months is risky, because at this time of year dissolved oxygen concentrations tend to be lower and weed biomass higher. Treating only one-fourth to one-third of the total surface area of a pond at one time can minimize the risk of depleting dissolved oxygen. However, some herbicides cannot be used for partial pond treatments. During the summer, even partial treatments may be risky in some ponds.

Application methods

The herbicide formulation and the weed species determine the application method. Many herbicides can be applied directly from the container, while others must be diluted with water first.

To treat large areas you will need a mechanical sprayer or spreader and a power boat to ensure adequate distribution of the chemical. Sprayable herbicide formulations can be applied with hand-held or mechanical pressurized sprayers or with a boat bailer. Injecting the chemical near the outboard motor propwash will help it disperse. Hand-operated or mechanical rotary spreaders can be used to apply granular or pelleted formulations. Soluble crystals, such as copper sulfate, can be dissolved in water and sprayed over the pond;

[1]Texas A&M University
[2]University of Georgia

or, the required amount can be placed in burlap bags and dragged behind a boat, or suspended in the water near an aerator, until the herbicide dissolves.

If herbicide will be applied to emergent weed foliage, adding a surfactant to the chemical may help it wet and penetrate the foliage. Use only registered aquatic surfactants and follow product label directions. Surfactants are not recommended when treating submerged weeds.

Herbicide dosage

Aquatic herbicides must be applied at labeled rates. Application rates were developed from extensive research and provide effective, yet safe, weed control. Applying an excessive rate of a herbicide does not provide better weed control but does increase the cost of the treatment and may increase the risk of injury to fish and other organisms. Applying less than the recommended rate usually results in poor weed control.

Some herbicides, such as those for control of emergent plants, are applied on the basis of the area to be treated. Others, such as those used to control certain submerged weeds, are applied on the basis of the volume of water to be treated. Read the label instructions carefully, because mistakes in calculating treatment rates can be costly and dangerous. For information on calculating the area and volume of ponds see SRAC Publication No. 103, *Calculating Area and Volume of Ponds and Tanks*.

Surface acre treatments:

The amount of herbicide needed for a surface acre treatment is determined by the following formula:

F = A x R

F = Amount of formulated herbicide product.

A = Area of the water surface in acres

R = Recommended rate of product per surface acre

Acre-foot treatments:

An acre-foot of water equals 1 surface acre of water that is 1 foot deep. The number of acre-feet of water can be found by multiplying the number of surface acres times the average water depth. The amount of herbicide needed for an acre-foot treatment is determined by the following formula:

F = A x D x R

F = Amount of formulated herbicide product

A = Area of the water surface in acres

D = Average depth of water in feet

R = Recommended rate of product per acre-foot

PPMW treatments:

Some treatment rates are given as the final concentration of the chemical in the water body on a part per million by weight (ppmw) basis. The amount of herbicide needed for a ppmw treatment is determined by the following formula:

F= (A x D x CF x ECC) ÷ I

F = Amount of formulated herbicide product

A = Area of the water surface in acres

D = Average depth of the water in feet

CF = 2.72 pounds/acre-foot (the conversion factor—CF—when total water volume is expressed on an acre-foot basis; 2.72 pounds of a herbicide per acre-foot of water is equal to 1 ppmw)

ECC = Effective chemical concentration of the herbicide's active ingredient that is needed in the water to control the weed

I = The total amount of active ingredient divided by the total amount of active and inert ingredients.

For liquid products, I = pounds of active ingredient ÷ 1 gallon

For dry products, I = percent active ingredient ÷ 100%

Aquatic herbicides

The herbicides discussed in this section are labeled for use in commercial fish production ponds. Before using any herbicide, read and understand the label.

Copper Sulfate

(Various trade names)

Copper sulfate, often called "blue stone," is primarily used to control algae. It is a contact herbicide. However, it does not control algae such as *Pithophora*. Copper can interfere with gill functions and, if improperly used, can be toxic to fish and zooplankton. Trout and koi are particularly sensitive to copper. However, most fish kills after copper sulfate treatment are related to a massive algae kill and the subsequent depletion of dissolved oxygen.

The effectiveness and safety of copper sulfate are determined by pH, alkalinity, hardness, water temperature, and several other environmental factors. In water with an alkalinity ≤ 50 ppm, the rate of copper sulfate needed to control algae can be toxic to fish. Copper treatment at water alkalinities of ≤ 20 ppm is extremely risky and should be avoided. In high alkalinity (≥ 250 ppm) water, copper sulfate quickly precipitates out and is not effective for algae control. The toxicity of copper sulfate to fish increases as water temperature increases. Avoid copper sulfate applications during hot summer months.

For additional information on treating with copper, see SRAC Publication No. 410, *Calculating Treatments for Ponds and Tanks*.

Chelated Copper

(Cutrine®, Komeen®, K-Tea®, others)

Copper that is held in an organic complex is known as chelated copper. Chelated coppers are used to control planktonic and filamentous algae. Chelated copper formulations do not readily precipitate in high alkalinity waters, but stay in solution and remain active longer than copper sulfate. Chelated coppers are sometimes mixed with other aquatic herbicides (e.g., diquat) to better control algae as well as certain species of submerged plants (see labels). Chelated copper is less corrosive to application equipment than copper sulfate. It is also slightly less toxic to fish. However, in water with low alkalinity (≤ 20 ppm), or in water with an alkalinity of ≤ 50 ppm that contains trout, it is extremely risky to use chelated copper, particularly during the hot summer months.

Diquat

(Reward®, Weedtrine-D®)

Diquat is a contact herbicide that can be sprayed on or injected into water to control submerged weeds and filamentous algae; or, it can be sprayed on duckweed *(Lemna minor* and *Spirodela polyrhiza*) or emergent vegetation. Repeated applications on surface mats of algae (e.g., *Pithophora*) may be necessary. An approved non-ionic surfactant is required when diquat is used as a foliar application. Diquat binds tightly to clay particles and is not effective in muddy water or on mud-coated weeds. Diquat quickly kills plants and should be used as a partial pond treatment for dense vegetation.

Endothall

(Aquathol®, Hydrothol®)

Two salts of endothall are used for aquatic weed control. A dipotassium salt (trade name Aquathol®) is available as a granular or liquid formulation. Hydrothol® is available as a liquid or granular formulation and is a mono-(N,N-dimethylalkylamine) salt of endothall. Hydrothol® is more toxic to fish and aquatic invertebrates, so Aquathol® is generally used in commercial ponds. Hydrothol® controls algae (filamentous and stoneworts) and many submerged weeds. Aquathol® controls many submerged weeds but is not effective for filamentous and macro-algae control. Both Aquathol® and Hydrothol® are contact herbicides and may be used for spot or partial pond treatments.

Fluridone

(Sonar®)

Fluridone controls most submerged and emergent weeds and is available as a liquid or pelleted formulation. Liquid formulations also control duckweed and watermeal. Fluridone is a translocated herbicide that slowly kills plants over a 30- to 90-day period. Its slow action generally prevents the depletion of dissolved oxygen. **Fluridone is not effective as a spot treatment.** The entire pond must be treated to control the target weed.

Glyphosate

(Rodeo®)

Glyphosate is a foliar-applied, translocated herbicide used to control most shoreline vegetation and several emergent weeds such as spatterdock (*Nuphar luteum*) and alligatorweed (*Alternanthera philoxeroides*). Glyphosate translocates from the treated foliage to underground storage organs such as rhizomes. It is most effective when applied during the weed's flowering or fruiting stage. An approved non-ionic surfactant should be used with glyphosate (Rodeo® formulations only). If rain falls within 6 hours of application, the effectiveness of glyphosate will be reduced.

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 submerged weeds such as coontail (*Ceratophyllum demersum*) and emergent weeds such as water lily (*Nymphaea* spp.) and water shield (*Brasenia schreberi*). Liquid formulations of 2,4-D are used to control floating weeds such as water hyacinth (*Eichhornia crassipes*) and several emergent weeds. 2,4-D is available as an ester or amine formulation. Amine formulations are slightly better for aquatic applications because they are less toxic to fish, although the granular ester form is safe to use. Only those formulations of 2,4-D that are labeled for aquaculture are legal to use in culture situations.

The information and suggestions included in this publication reflect the opinions of Extension fisheries specialists based on field tests and treatment experience. Management suggestions are based on research and are generally effective. Conditions or circumstances which are unforseen or unexpected may lead to less than satisfactory results even when best management practices are used. Neither the Cooperative Extension Service nor the Southern Regional Aquaculture Center assumes responsibility for such occurrences. **All risk shall be assumed by the applicator.**

Table 1. Treatment response of common aquatic plants to registered[1] herbicides.

Aquatic group and vegetation	Aquatic herbicides[2]					
	Copper and copper complexes	2,4-D	Reward® (diquat)	Aquathol® Hydrothol® (endothall)	Rodeo® (glyphosate)	Sonar® (fluridone)
Algae						
planktonic	E	P	P	G[3]	P	P
filamentous	E	P	G	G[3] - P[4]	P	P
Chara/Nitella	E	P	P	G[3] - P[4]	P	P
Floating plants						
duckweeds	P	F[5]	G	P	P	E
salvinia	P	G	G		G	E
water hyacinth	P	E	E		G	P
watermeal	P	F	F			G
Submerged plants						
coontail	P	G	E	E	P	E
elodea	P		E	F	P	E
fanwort	P	F	G	E	P	E
naiads	P	F	E	E	P	E
parrotfeather	P	E	E	E	F	E
pondweeds	P	P	G	E	P	E
Emergent plants						
alders	P	E	F	P	E	P
arrowhead	P	E	G	G	E	E
buttonbush	P	F	F	P	G	P
cattails	P	F	G	P	E	F
common reed	P	F	F		E	F
water lilies	P	E[6]	P		G	E
frog's-bit	P	E	E			
pickerelweed	P	G	G		F	P
sedges and rushes	P	F	F		G	P
spike rush	P		G		P	G
smartweed	P	E	F		E	F
southern watergrass	P	P			E	G
water pennywort	P	G	G		G	P
water primrose	P	E	F	P	E	F
willows	P	E	F	P	E	P

[1] Registered as of 4/99 by the U.S. Environmental Protection Agency (EPA).
[2] E = excellent control, G = good control, F = fair control, P = poor control, blank = unknown or no response
[3] Hydrothol® formulations.
[4] Aquathol formulations.
[5] Liquid 2,4-D formulations.
[6] Granular 2,4-D formulations.

Table 2. Restrictions on the use of water after treatment with aquatic herbicides[1] (number of days after treatment before use in private waters only).

	Human use			Livestock	Irrigation	
Common name	Drinking	Swimming	Fish	Watering	Turf	Crops
copper sulfate[2]	0	0	0	0	0	0
copper complexes	0	0	0	0	0	0
2,4-D	*	*	*	*	*	*
diquat	2-3	0	0	1-3[3]	2-3	5
endothall[4]	7-25	1	3	7-25	7-25	7-25
glyphosate[5]	0	0	0	0	0	0
fluridone[6]	0	0	0	0	7-30	7-30

[1] Aquatic vegetation control (particularly algae) can cause low dissolved oxygen, which can stress and/or kill fish. It is best to treat most aquatic vegetation early in the growing season, when the plant is rapidly growing. Treating small areas (e.g., one-fourth of the pond at a time) at 10- to 14-day intervals usually prevents serious oxygen depletion.

[2] If water is for drinking, the elemental copper concentration should not exceed 1.0 ppm (i.e., 4.0 ppm copper sulfate).

[3] Depends on formulation. **Read the label.**

[4] Length of use restriction for endothall varies with the concentration used. **Read the label.**

[5] Do not apply within 0.5 mile of a functioning potable water intake.

[6] Do not apply within 0.25 mile of a functioning potable water intake.

* Water restrictions on 2,4-D vary with formulation, rate and time of year. **Read the label.**

Precaustions

All aquatic herbicides must be registered and labeled for use by the Environmental Protection Agency and the Department of Agriculture. The status of herbicide label clearances is subject to change and may have changed since this publication was printed. County Extension agents and appropriate fisheries/aquaculture specialists are advised of changes as they occur. Please check with your Extension Service if questions arise.

The applicator 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 herbicide from his/her property to that of others. Always read and follow carefully the instructions on the container label. For additional information on aquatic vegetation information and management see the following Web site: *http://wildthings.tamu.edu/aquaplant.*

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 Southern Regional Aquaculture Center or the Cooperative Extension Service is implied.

The work reported in this publication was supported in part by the Southern Regional Aquaculture Center through Grant No. 98-38500-5865 from the United States Department of Agriculture, Cooperative State Research, Education, and Extension Service.