Chemical Weed Control for Lakes & Ponds

Lakes and ponds can develop dense stands of aquatic vegetation that interfere with intended uses and destroy the natural beauty of the water. Most aquatic weed problems result from poor planning and poor management. Manipulating factors such as water, light, and nutrients can help prevent weed growth.

If weed problems develop, you must take measures to reduce the plant population to manageable levels.

Preventive Measures

Pond Construction. Construct ponds to reduce habitats that are favorable to undesirable aquatic plants. Design ponds so that enough water is available year-round to maintain water levels close to the maximum.

Divert excess water, when possible, around rather than through the pond to prevent the loss of added nutrients. Nutrients are important in maintaining a plankton bloom that shades out less desirable plant species. Water entering a pond should not contain excessive nutrients such as from sewage or from runoff from feedlots or barnyards.

It is difficult for aquatic weeds to become established in deep water. However, once established in shallow areas, they gradually invade deeper water. Build your ponds with steep banks that have a 1-to-1 or 1-to-1.5 slope until the water depth is at least 2.5 feet.

Fertilization. Fertilization of farm ponds is a practical and inexpensive way to prevent the establishment of aquatic vegetation and to increase fish production. Fertilization during spring, summer, and fall stimulates the growth of desirable plankton algae (tiny plants suspended in the water) which shade the pond bottom, preventing the establishment of rooted aquatic weeds.

For more information on fertilizing ponds, see Extension Circular ANR-249, "Fertilizing Fish Ponds."

Water Level Control. Controlling the water level is another practical way to manage some aquatic weeds. As much as 90 percent of the submerged vegetation can be reduced by drawing down the water level during three consecutive winters. Also, the number and size of harvestable game fish have been shown to increase following drawdowns.

For a small farm pond, a drawdown every 3 or 4 years exposing at least one-half of the bottom may be helpful in controlling submerged vegetation. Conduct the drawdown in late fall, and do not allow the pond to refill until early spring.

Drawdown may spread needlerush, southern watergrass, and Florida elodea *(Hydrilla)* to new areas of a 'pond. Do not use drawdown where these weeds are present.

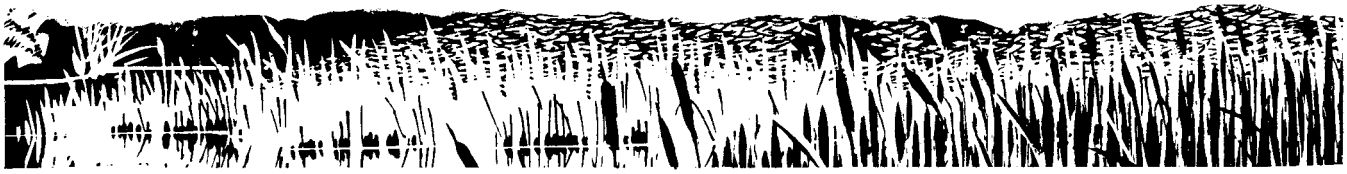
Mechanical Control. Manual removal is practical only for small quantities of plants near the shore. Techniques such as cutting, mowing, raking, digging, and pulling can remove small isolated areas of cattails, sedge, and grasses.

Aquatic weed cutters and harvesters are available for removing aquatic weeds, but they usually are too expensive for most landowners. Aquatic habitats vary greatly from site to site, and equipment that works well in one situation may not be effective in another.

Plant fragments left in water may deplete dissolved oxygen if they die and decompose. Often, they form roots and colonize new areas if they live. Harvesting the plant material is costly; it presents disposal problems; and it is usually the most expensive weed control practice available.

Biological Control. The cost of herbicides, coupled with the concern surrounding the continued use of pesticides, has caused interest in the development of biological controls for aquatic weeds. Biological weed control, strictly defined, means the use of natural enemies (parasites, predators, and pathogens) for the control of weeds. Although there is considerable research underway, there are few proven biological control agents now available.

One potentially important biological control agent for alligatorweed is the alligatorweed flea beetle, Agasicles *hygrophila.* This beetle is a parasite on alligatorweed that naturally occurs in South America. The beetle feeds exclusively on alligatorweed and completes its life cycle on the host plant. Where environmental conditions are favorable, the beetle population multiplies rapidly, and all alligatorweed above the waterline is consumed. Beetles then move to other alligatorweed-infested areas.



The alligatorweed flea beetle has been used to control alligatorweed in Louisiana, Georgia, and northern Florida. Freezing, excessively high temperatures (90 °F+ /, insecticides, and flooding have hindered successful establishment of the beetles.

The grass carp or white amur, *Ctenopharyngodon idella,* is another important biological control agent. This fish, a native of Russian and Chinese rivers, was imported into the United States in 1963 and evaluated as a potential food fish and aquatic weed control agent. It was evident from the start that grass carp showed potential to control most submerged and some floating aquatic weeds in ponds.

Grass carp are related to the common carp but differ significantly in several important characteristics. Grass carp feed on aquatic plants and, unlike common carp, do not disturb bottom sediments which muddy the pond. Grass carp will not disrupt the spawning of bass and bream. Also, grass carp require running water to spawn and will not spawn in ponds or other standing waters.

Grass carp are capable of eating two to three times their own weight in aquatic plants each week and may gain 5 to 10 pounds in a single year. Stocked in the correct numbers in ponds, they control filamentous algae, submerged plants, floating duckweeds, and water fern. Compared to commonly used mechanical and chemical systems of aquatic weed control, the use of grass carp is relatively inexpensive and provides long-lasting control.

Grass carp are spawned artificially and sold by commercial fish dealers throughout the state. Fingerlings (8 to 12 inches/ for stocking ponds are usually available year-round. For more information on grass carp use, see Extension Circular ANR-452, "Using Grass Carp For Controlling Weeds In Alabama Ponds."

Watermeal has been successfully controlled using a tropical African fish called tilapia. Tilapia die at water temperatures below 50 °F, so their use is restricted to May through October. Stock 15 pounds of male and female tilapia per acre during May or June. Reproduction usually adds sufficient numbers to control watermeal during one season. A Diquat herbicide application in combination with tilapia helps to control more serious problems. Stocking tilapia in successive years may also be necessary. In ponds with bass, stock tilapia larger than 5 inches so the bass will not eat them.

Chemical Control. Several herbicides are effective in controlling aquatic weeds. Before using a herbicide, identify the weed correctly so that the proper herbicide is matched to the particular weed problem. Aquatic plants which cause weed problems are divided into four groups: algae, floating, submersed, and emergent.

Algae are small, usually microscopic plants lacking leaves, roots, and stems. These plants consist of only one cell, a group of cells called a colony, or a chain of cells called a filament. Algae may grow freely suspended in the water (plankton), floating at the water surface (pond scum, or attached or unattached to the bottom.

Floating weeds such as duckweeds and water hyacinth have leaves and stems above the water surface and roots suspended below. They are usually free-floating.

Submersed weeds are usually rooted to the bottom and often extend up to the water surface. Common weeds in this group are pondweeds, coontail, and watermilfoil.

Emergent weeds, such as cattails, alligatorweed, and smartweed, usually occur on or near the shore and in shallow water areas. They are rooted in the bottom and their leaves and/or stems extend above the water surface. This group includes weeds growing around pond or lake margins.

Responsible and effective use of aquatic herbicides requires careful consideration of many factors. The most important factor is the safety of the people using the treated water.

Contamination of domestic water supplies or a failure to observe proper precautions in water-use restrictions may result in health hazards. Consider water use by farm animals, wildlife, fish, and waterfowl before using a herbicide (Table 1). The label on the herbicide container can provide you with specific information on the proper use of the chemical.

As dead aquatic plants decay, dissolved oxygen in the surrounding water is used in the process. If large quantities of plants are killed with one treatment, dissolved oxygen in the water may be reduced so severely that fish and other aquatic organisms die. It is usually desirable to treat only a portion of a weed problem at a time and allow the body of water to recover lost oxygen before continuing with subsequent treatments.

The possibility of low oxygen becomes more serious during the summer when the water is warm. If possible, deal with weed problems in the spring when water temperatures are between 70 IF and 800E

Herbicides Used In Water

The following is a brief description of herbicides that can be used to control aquatic weeds. More information on these herbicides can be found in Tables 1 and 2. Always read the product label for application methods, specific rates, and weeds controlled.

Chelated Copper Compounds tCutrine Plus)

Chelated copper compounds are materials that contain copper complexed with organic molecules. Compounds of this type are more stable in water and generally provide longer-lasting weed control. Chelated copper compounds are contact materials that are especially effective on algae.

There are several advantages to using chelated compounds; they are somewhat less toxic to fish, less corrosive to application equipment, and have almost no water-use restrictions. Liquid and granular formulations are available which allow the use of different types of application equipment. However, they are considerably more expensive than copper sulfate.

Copper Sulfate (Various Trade Names)

Copper sulfate is an inorganic material which controls most algae. Copper sulfate is a contact herbicide. Its effectiveness is determined by the alkalinity of the water. This material is frequently available in "snow" or powder form; it is very corrosive to steel; and it is irritating to the eyes.

In water of low alkalinity (less than 50 parts per million/, the treatment rate needed to kill algae may be toxic to fish. On the other hand, treatments in water of high alkalinity (more than 200 parts per million) may not be effective. A good rule of thumb is to use 0.1 ppm copper sulfate for every 10 ppm alkalinity and reduce this amount by 20 percent.

Using copper sulfate to kill algae will reduce the amount of oxygen in a pond, and this could kill fish. Eliminating the source of nutrients or managing the oxygen problem with aeration is often better than killing algae. If algae continue to be a problem, look for a source of excess nutrients that feed the algae.

Diquat (Diquat Herbicide H/A, Weedtrine-D)

Diquat is a contact herbicide that is available only in a liquid formulation. It is effective in controlling the top growth of submerged weeds when it is injected uniformly below the water surface. Free-floating weeds such as duckweeds can be controlled when treated with diquat and an approved non-ionic surfactant.

Because diquat is rapidly tied up by clay particles or organic matter in water, use this herbicide only in clear, non-muddy water. Diquat is frequently mixed with copper chelated compounds or endothall (Aquathol) to broaden the variety of aquatic weeds controlled. See Table 1 for the water-use restrictions associated with the use of diquat-treated water.

Endothall (Aquathol, Hydrothol)

Endothall is a contact herbicide that is available in a liquid or granular form. This herbicide is effective in controlling many submerged weeds when uniformly injected below the water surface or applied over the water surface. This herbicide works best in the spring after weed growth develops and the water temperature is about 65 ° F. See Table 1 for the appropriate water-use restrictions.

Fluridone (Sonar)

Fluridone is a translocated herbicide that controls many submerged and emerged aquatic weeds. The liquid form of this herbicide can be sprayed on the water surface or injected below the water surface. The granular form is spread on the water surface.

Apply fluridone during the spring or summer to still bodies of water with little or no outflow. Fluridone has some irrigation water restrictions and may injure marginal shore plants or trees.

Glyphosate (Rodeo, Pondmaster)

Glyphosate is a translocated, foliar-applied herbicide that controls many rooted, floating, and emerged aquatic weeds. Glyphosate used in aquatic situations requires the addition of an approved non-ionic surfactant. The use rate of glyphosate and the time of application depends upon the target weed species.

Simazine (Aquazine)

Simazine is a non-selective translocated herbicide that controls most algae and some submerged weeds. Make applications in the spring when the weeds are actively growing. Make the applications to bodies of water with no outflow. Simazine can injure or kill trees along the shore. This herbicide has some lengthy water-use restrictions associated with its use.

All aquatic uses of simazine (Aquazine) have been voluntarily cancelled by the manufacturer. Existing supplies of Aquazine can be used according to label directions. When supplies are exhausted, using simazine in aquatic sites will constitute an illegal (unlabeled) treatment. See Table 1 for additional water-use restrictions.

2,4-D (Various Trade Names)

The herbicide 2,4-D is a selective, translocated material that is effective in controlling some aquatic broadleaf weeds. Many different products contain 2,4-D, but only a limited number of them can be used in aquatic situations.

This herbicide is available in granular and liquid forms. The granular form is relatively non-toxic to fish and controls many submerged aquatic weeds. The liquid forms of this herbicide generally control plants with aerial or submersed plant parts, and the liquid ester forms are generally **more toxic** to fish than the other forms.

Read the herbicide label carefully for all appropriate water-use restrictions.

Application And Calibration Methods

Proper application of herbicides is just as important as selecting the correct chemical to control the weed problem. Apply most aquatic herbicides in the spring when plants are young and growing rapidly. Herbicide penetration and translocation are usually at a maximum before the plant reaches maturity. Information on proper herbicide application is usually given on the product label.

Acre-feet. Most aquatic herbicide labels give their application rates in terms of the amount to apply per acrefoot of water. To determine the number of acre-feet in a lake or pond, first determine its average depth by measuring depth at regular intervals in an imaginary line projected along the long axis (shallow end to deep end) of the pond. Multiply the area of the pond (in acres) by the average depth (in feet) to find the total number of acrefeet to be treated.

PPM. Some aquatic herbicides list the quantity to be applied in the final concentration of the pond water in parts per million. This quantity may refer to the commercial product or the active ingredient within the product. Consult the product label for this information. To find ppm on a weight basis, the following formula can be used:

W = A x D x C x 2.72, where

W = number of pounds of herbicide product required.

A = area of the water surface in acres.

D = average depth in feet.

C = final concentration desired in ppm.

The method for applying an aquatic herbicide depends on the material being used and the weed to be controlled. Apply liquid herbicides by injecting or metering into the water behind a boat. Apply granular products by hand or a hand-cranked spreader from the bank or from a boat.

Soluble crystals (copper sulfate) can be put in burlap bags and either suspended or dragged through the water until they dissolve. Some of the suggested treatments require spraying the herbicide directly over the plant or on the water surface. Herbicides can be applied with pump-type backpack sprayers or motorized sprayers operated from boats.

Surfactant And Carriers. The leaves of many floating and emerged aquatic plants have thick, waxy coatings that cause water-soluble herbicides to bead on the surface and reduce the exposure of the plant to the herbicide. Adding a small amount of a detergent-like substance, called a surfactant, to the herbicide-water solution promotes spreading of the solution and provides better coverage of the plant surfaces.

When oil-soluble herbicides (such as 2,4-D esters or oil-soluble amines) are mixed with water, use an emulsifying agent and constantly agitate the mixture to prevent separation of the oil and water. This mixture (emulsion) should have a milky appearance.

Integrated Management Systems

Frequently, two or more recommended methods of weed prevention or control used together will provide more effective results at a lower cost than any of the methods used alone.

For example, the combination of a water drawdown and a herbicide application on exposed submerged-type vegetation followed by a refilling and introduction of grass carp at a low stocking density may rid a pond of a serious weed problem and prevent its reocurrence.

The management systems possible for any given pond are too numerous to discuss here. Therefore, to arrive at the best system for a specific situation in a pond or lake, seek advice from an aquatic weed specialist.

Table 1. Water-Use Restrictions For Various Herbicides.

	Number of Days Restricted After Application				
Herbicide	Drinking	Fishing	Stockwatering	Swimming	Irrigation
Copper sulfate	0	0	0	0	0
Chelated copper compounds	0	0	0	0	**
Simazine	365	0	365	0.25	365
Diquat	14	0	14	0	14
Endothall	25	3	25	3	25*
2,4-D	*	*	*	*	*
Fluridone	Not within ¼ mile of intake	0	0	0	30
Glyphosate	Not within ½ mile of intake	0	0	0	0

*Varies with formulation and rate used; read label.
**Restricted for some plants; read label.

Table 2. Herbicides And Treatment Rates For The Control Of Some Common Aquatic Weeds.

Weed Type And Specific Weeds	Herbicide	Active Ingredient Or Rate Of Concentration	Remarks
Algae			
Planktonic Algae	copper sulfate	0.25-1 ppm	Use 0.1 ppm copper sulfate per 10 ppm alkalinity minus 20 percent. Use low rates in acid water (low alkalinity) and high rates in alkaline water (high alkalinity). Apply snow or powder at early stages of growth on a clear day. Apply by any method which gives rapid and uniform dispersion. **EXCESS COPPER IS TOXIC TO FISH.**
	chelated copper compounds	See label.	Use-rate depends on the alkalinity of water. Dilute concentrate with water in ratio of at least 9 to 1 and apply uniformly. Make application on a clear day. **EXCESS COPPER IS TOXIC TO FISH.**
	simazine AQUAZINE 80W AQUAZINE 90WDG	0.5-1 ppm 1.7-3.4 lb./A. ft. 1.5-3 lb./A. ft.	Use only in ponds which have little or no outflow. Treat between April 1 and May 15. Treatment may kill shoreline trees. Make slurry of powder and water and apply with a bucket at several locations around pond. See Table 1 concerning water-use restrictions.

Weed Type And Specific Weeds	Herbicide	Active Ingredient Or Rate Of Concentration	Remarks
Filamentous Algae *Pithophora,* *Rhizoclonium,* *Chadophora,* *Hydrodictyon,* *Oedogonium,* *Spirogyra*	copper sulfate	0.5-2 ppm	Use 0.5-1 ppm in water of low alkalinity and 1-2 ppm in water of high alkalinity. Break up floating mats of algae prior to treatment. **EXCESS COPPER IS TOXIC TO FISH.**
	chelated copper compounds	See label.	See remarks for chelated copper compounds above. Break up floating mats of algae prior to treatment. **EXCESS COPPER IS TOXIC TO FISH.**
	simazine AQUAZINE 80W AQUAZINE 90WDG	1.3 ppm 4.25 lb./A. ft. 3.8 lb./A. ft.	See remarks for simazine above. Retreatment may be necessary. This herbicide may kill or seriously suppress desirable plankton algae.
	diquat HERBICIDE H/A WEEDTRINE-D	0.5-1.5 ppm	Controls *Pithophora* and *Spirogyra.* Make application to ponds or lakes with little or no outflow of water. See Table 1 for water-use restrictions. Check the label for application instructions.
Chara and *Nitella*	copper sulfate	1-3 ppm	Same as for planktonic algae. **EXCESS COPPER IS TOXIC TO FISH.**
	chelated copper compounds CUTRINE PLUS	See label.	Distribute granular formulation uniformly over infested area when plants are young. When applying the liquid form, dilute with water in ratio of at least 9 to 1. **EXCESS COPPER IS TOXIC TO FISH.**
	simazine AQUAZINE 80W AQUAZINE 90WDG	1.3 ppm 4.25 lb./A. ft. 3.8 lb./A. ft.	See remarks for simazine under planktonic algae section. See Table 1 concerning water-use restrictions. This herbicide may kill or seriously suppress desirable plankton algae.
Submerged Plants			
Pondweed Naiad Coontail Elodea Watermilfoil	diquat HERBICIDE H/A WEEDTRINE-D	2-4 lb. ai/s.A. 1-2 gal./s.A. 5-10 gal./s.A.	Apply early in season by pouring directly into water in strips 40 ft. apart. Late in season when weeds have reached water surface, pour in strips 20 ft. apart or inject. Diquat will not work in muddy water. Also controls bladderwort.
Pondweed Naiad Coontail Watermilfoil	endothall AQUATHOL K AQUATHOL 10G	0.5-4 ppm 0.3-2.6 gal./A. ft. 13-108 lb./A. ft.	Inject below surface of standing water or broadcast over weed-infested area. Rate depends on weed species and method of application. Spot treatment requires higher rates.
	simazine AQUAZINE 80W AQUAZINE 90WDG	1-2 ppm 3.4-6.8 lb./A. ft. 3-6 lb./A. ft.	See comments for simazine under planktonic algae section. Fanwort control requires 8.5 lb./A. ft. This herbicide may kill or seriously suppress desirable plankton algae.
Watermilfoil Bladderwort Coontail	2,4-D granular AQUA-KLEEN	20-(30) 40 lb. ai/s.A. 100-200 lb./s.A.	Broadcast over weed-infested areas when plants are actively growing. Rate depends on weeds to be controlled, depth of water, and species.
Watermilfoil Coontail Elodea Bladderwort Fanwort Naiad Pondweed Hydrilla	fluridone SONAR 4AS SONAR 5P	0.5-4 lb. ai/A. 1-8 pt./s.A. 10-80 lb./s.A.	Use rate is dependent upon water depth and type of reservoir. See Table 1 for water-use restrictions.

Weed Type And Specific Weeds	Herbicide	Active Ingredient Or Rate Of Concentration	Remarks
Floating Plants			
Duckweed Water hyacinth	diquat HERBICIDE H/A WEEDTRINE-D	1-2 lb. ai/s.A. 0.5-1 gal./s.A. 2.5-5 gal./s.A.	Use low to medium rate for all labeled floating weeds except duckweed in spray volume of 150 to 200 gal. of water plus 1 pt. of surfactant. Use the high rate in a spray volume of 50 to 150 gal. of water per acre.
	2,4-D (amine or ester)	See label.	Apply with good coverage of foliage while plants are actively growing.
Duckweed Watermeal	simazine AQUAZINE 80WP AQUAZINE 90WDG	1-2 ppm 3.4-6.8 lb./A. ft. 3-6 lb./A. ft.	Apply as a slurry at several locations in pond. Control is slow (5 to 9 weeks). Treatment may kill shoreline trees and desirable plankton algae.
Duckweed	fluridone SONAR AS	See label.	Apply Sonar AS as a surface application at the labeled rate.
Emergent Plants			
Alligatorweed Arrowhead	fluridone SONAR 4 A.S. SONAR 5P	0.25-4 lb. ai/s.A. 1-8 pt./s.A. 10-80 lb./s.A.	See comments for fluridone under the submerged plants section.
Alligatorweed Spatterdock Waterlily Waterwillow Buttonbush	glyphosate RODEO 4 lb. ae/gal. PONDMASTER 3 lb. ae/gal.	3 lb. ae/s.A. 6 pt./s.A. 1 gal./s.A.	Apply when most plants are in full bloom. Repeat application will be required for alligatorweed control.
Waterprimrose Watershield Arrowhead Waterlily Spatterdock Waterwillow Buttonbush	2,4-D (ester, amine, granular)	See label.	Apply when leaves are fully developed above the water line and plants are actively growing. Thorough wetting of foliage is essential when applying the liquid spray. Use low pressure, large nozzle, and spray thickener. Granules are more effective on waterlilies.
Marginal Plants			
Cattails	diquat HERBICIDE H/A WEEDTRINE	2 lb. ai/100 gal. spray 1 gal./100 gal. spray 5 gal./100 gal. spray	For top kill, apply 100 gal. of spray solution plus 1 pt. Ortho X-77 surfactant per acre. Thorough wetting of foliage is essential. Make application before flowering and repeat treatment as necessary.
Willowtree Buttonbush Cattails Cutgrass Torpedograss Maidencane Phragmites	glyphosate RODEO PONDMASTER	See label.	Rates vary according to target weeds and method of application. Generally, weeds should be treated when they are in full bloom. See appropriate application instructions.

Table 3. Response Of Common Aquatic Weeds To Herbicides.

Aquatic Group And Weed	Aquatic Herbicides						
	Copper Sulfate, Complexes (various)	Aqua-Kleen, Others (2,4-D)	Diquat H/A (diquat)	Aquathol K, Aquathol G (endothall)	Sonar (fluridone)	Aquazine (simazine)	Rodeo, Pondmaster (glyphosate)
Algae							
Planktonic	E	P	P		P	E	P
Filamentous	E	P	G	P	P	E	P
Chara	E	P	G	P	P	E	P
Nitella	E	P	G	P	P	E	P
Floating Weeds							
Duckweeds	P	G[2]	G	P	E	E	P
Water hyacinth	P	E	E		P		G
Emerged Weeds							
Alligatorweed	P	F	P	P	G	P	E
American lotus	P	E	P	P	F	P	G
Arrowhead	P	E	G	G			E
Buttonbush	P	E	F	P	P	P	G
Waterlily	P	E	P	P	E	P	E
Frogbit	P	E	E				
Other grasses	P	P	F	P	F		E
Pickerelweed	P	G	G		P		F
Sedges & rushes	P	F	F	P	P	P	G
Slender spikerush	P		G		G		P
Smartweed	P	E	F		F		E
Spatterdock	P	E	P	P	E	P	G-E
Southern watergrass	P	P			G		E
Watershield	P	E	P		G		G
Water pennywort	P	G	G	P	P		G
Water primrose	P	E	F		F		E
Submerged Weeds							
Coontail	P	G	E	E	E	E	P
Egeria	P	P	G	F	E	P	P
Elodea	P		E	F	E		P
Eurasian watermilfoil	P	E	E	E	E	G	P
Hydrilla	F[3]	P	G	G	E	P	P
Naiads	P	F	E	E	E	E	P
Parrotfeather	P	E	E	E		P	F
Pondweeds	P	P	G	E	E	E	P
Marginal Weeds							
Cattails	P	G	G	P	F	P	E
Maidencane	P	P	F		F		E
Torpedograss	P	P	P		F		G
Willows	P	E	F	P	P	P	E

[1]E =excellent control; G = good control; F = fair control; P = poor control (70%); a blank space indicates weed response not known.
[2]Ester formulations.
[3]Copper complexes only.
Adapted from Aquatic Weed Control, Tim R. Murphy, *Extension Agronomist-Weed Science,* in *The Georgia Pest Control Handbook,* Cooperative Extension Service, University of Georgia, Athens, Georgia.

Abbreviations

ppm - parts per million
A. ft. = acre foot of water
s.A. = surface acre of water
ai = active ingredient
ae = acid equivalent
gal. = gallon
lb. = pound
A. = acre
pt. = pint
G = granules
P = powder

CIRCULAR ANR-48

John W. Everest, *Extension Weed Scientist*
John Jensen, *Extension Fisheries Specialist*
Michael Masser, *Extension Fisheries Specialist*
David R. Bayne, *Professor of Fisheries and Allied Aquacultures*

For more information, call your county Extension office. Look in your telephone book under your county's name to find the number.

Use pesticides **only** according to the directions on the label. Follow all directions, precautions, and restrictions that are listed. Do not use pesticides on plants that are not listed on the label.

The pesticide rates in this publication are recommended **only** if they are registered with the Environmental Protection Agency or the Alabama Department of Agriculture and Industries. If a registration is changed or cancelled, the rate listed here is no longer recommended. Before you apply **any** pesticide, check with your county Extension agent for the latest information.

Trade names are used **only** to give specific information. The Alabama Cooperative Extension Service does not endorse or guarantee any product and does not recommend one product instead of another that might be similar.

The Alabama Cooperative Extension Service
AUBURN UNIVERSITY

Issued in furtherance of Cooperative Extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. The Alabama Cooperative Extension Service, Auburn University, Ann E. Thompson, Director, offers educational programs and materials to all people without regard to race, color, national origin, sex, age, or handicap and is an equal opportunity employer. UPS, 8M14, 4:92, ANR-48