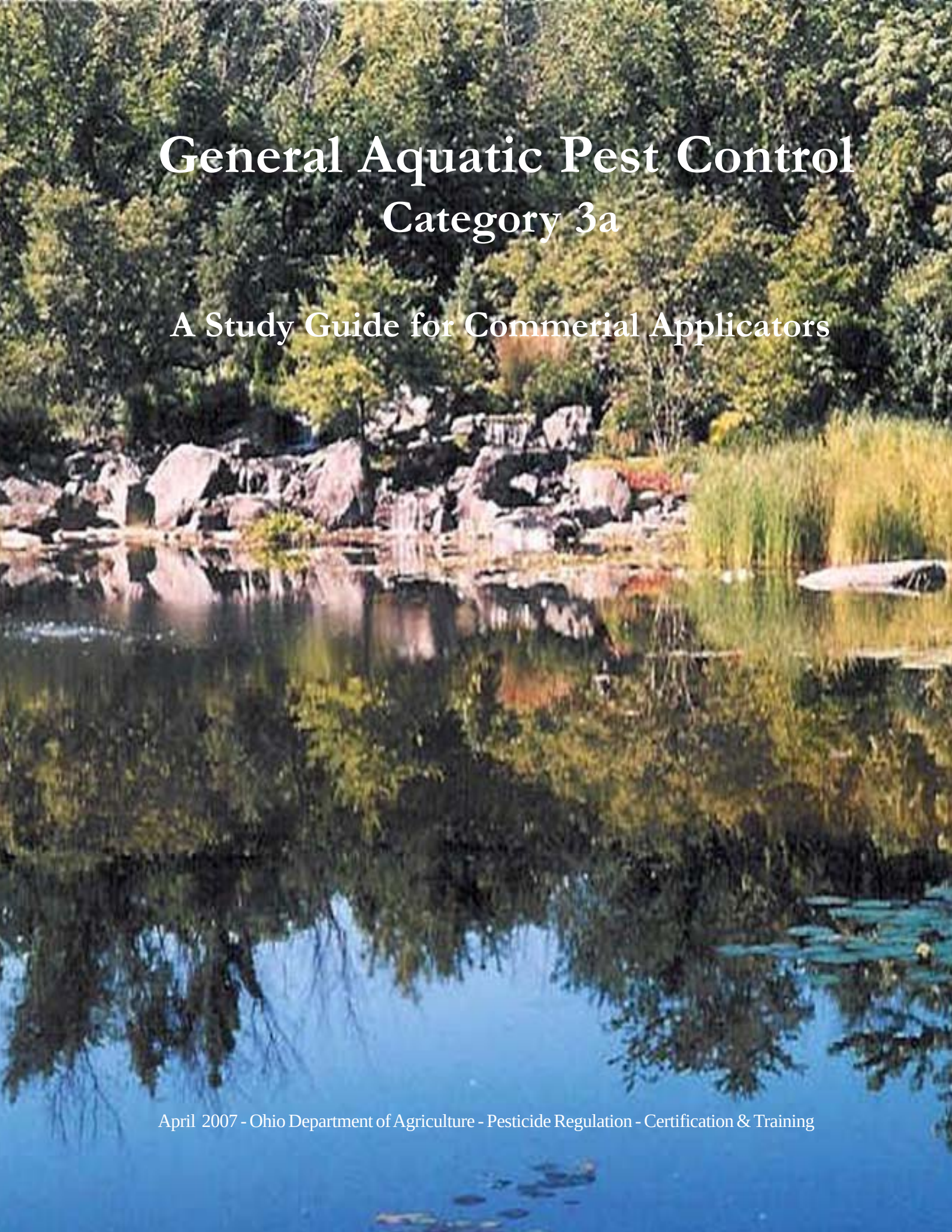

# General Aquatic Pest Control

## Category 3a

### A Study Guide for Commerial Applicators

April 2007 - Ohio Department of Agriculture - Pesticide Regulation - Certification & Training

# Aquatic Pest Control


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# Preface

This manual was developed to help the person or persons applying for an Aquatic Pest Control license to pass the exam. This manual is the collaboration of a number of universities, private companies and associations. The Ohio Department of Agriculture is mandated by the Governor of the State of Ohio and the Ohio Administrative Code to test for the competency of the Ohio licensed pesticide applicators. This is achieved by examinations given to each person who wishes to become a licensed Private applicator (using Restricted-use chemicals on their own property) or Commercial applicator (applying pesticides general-use or restricted-use on another's property).

# CHAPTER 1
# Laws and Regulations

## Learning Objectives

You should learn:

- What federal and state laws govern aquatic pest control?
- Definition of category
- The State Plan for Ohio
- Standards of competency
- Pesticide license information

**STATE AND FEDERAL LAWS**

The Core training manual discusses federal laws. The Supplemental Core Study Guide discusses the state laws that govern the handling and use of pesticides. Review these two publications to understand how laws and regulations affect pesticide practices and uses. These laws include federal laws such as the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Occupational Safety and Health Act (OSHA), the Endangered Species Act, and the Federal Migratory Bird Treaty Act. Pesticide applicators should keep up-to-date copies of the laws and review their contents periodically. Copies of these laws can be obtained from the Ohio Department of Agriculture.

**FEDERAL LAWS FIFRA**

This is the basic federal law administered by the Environmental Protection Agency (EPA) that regulates pesticides (their use, handling, storage, transportation, sale, disposal, etc.) The Ohio Department of Agriculture (ODA) has a cooperative agreement with the EPA to enforce some provisions of FIFRA in Ohio. Some of the provisions of FIFRA are that the EPA must register all pesticides before they can be sold or used. The pesticides must be classified as either "*general use"* or *"restricted use."* General-use pesticides are those that can be purchased without restriction. Restricted-use pesticides are those that can be used only by or under the direct supervision of a certified applicator. FIFRA also stipulates that persons who misuse pesticides (in a way that is "inconsistent with the pesticide labeling") are subject to penalties.

**OSHA**

The U.S. Department of Labor (DOL) administers OSHA. OSHA governs the record-keeping and reporting requirements of all work-related deaths, injuries, and illnesses of businesses with 10 or more workers.

**ENDANGERED SPECIES ACT**

This act requires the U.S. EPA to ensure that endangered or threatened plant and animal species are protected from pesticides. This requires each pesticide label to limit its use in areas where these species could be harmed. Category 3a applicators must consider the possibility that the pesticides they apply may affect endangered or threatened species. The Ohio Department of Natural Resources (ODNR) Wildlife and Fisheries Management divisions maintain the federal and state endangered or threatened species lists. Ohio applicators that want to be sure they are complying with the act must take the initiative and consult with the ODNR to be sure that there are not endangered or threatened species in their area. One of the goals of pest management is to protect off-target plants and animals from pesticides, whether they are endangered or not.

**THE OHIO PESTICIDE LAW**

The Ohio Pesticide Law is the law that governs the pesticide applications in the State of Ohio. The Ohio Department of Agriculture is the state agency that regulates these laws and the pesticide applicators that are licensed by the state. If you have any questions or concerns, please contact the Ohio Department of Agriculture, Pesticide Regulation Section at 614-728-6987.

**DEFINITION OF CATEGORY**

The definition for General Aquatic Pest Control as stated in the law is as follows: Category **3** is **"Aquatic Pest Control"** which means the application of pesticides to standing or running water, for the control of undesirable vegetation or animals, but does not include uses covered by commercial pesticide-use category 10(D), as defined in paragraph (N) of this rule.

The subcategory **"a " - General Aquatic Pest Control** means the application of pesticides to standing or running water, other than swimming pools, for the control of aquatic pests.

**THE STATE PLAN FOR OHIO**

**The State Lead Agency**

The state lead agency for the plan is the Ohio Department of Agriculture (ODA). The Governor assigned the responsibility of the plan to the Division of Plant Industry on March 12, 1973.

## The Training Establishment

An agreement with ODA, USEPA and OSUE was made for training of pesticide applicators. Ohio State University Extension (OSUE) does certification and recertification training of private pesticide applicators. OSU Pesticide Applicator Training and Industry does commercial recertification training for commercial pesticide applicators.

## The State Plan Document

The plan is the document by which the Ohio Department of Agriculture, Pesticide Regulation Section and The Ohio State University share the responsibilities for the certification and training of the Ohio pesticide commercial and private applicators. The Ohio Department of Agriculture is responsible for the testing and licensing of the pesticide applicators. The Ohio State University Extension is responsible for the continuing education credits for those applicators that wish to recertify and not retest.

The plan sets forth the standards by which the Ohio Department of Agriculture and the Ohio State University Extension develop study materials, pesticide exams, and pesticide training. These standards are called, "Standards of Competency."

## Standards of Competency

Commercial applicators are required to demonstrate their knowledge and understanding of the handling and use of pesticides by means of written, closed book examinations; based on the standards of competency set forth in the Federal Code of Regulation (CFR) 171.4. Standards are set forth for the Core exam and for all the categories. The additional "Standards of Supervision" of non-certified applicators must be met, such as availability related to the hazard of the situation. Also needed are instruction and guidance when presence of a supervisor is not required.

## Core Standards

- Commercial applicators shall demonstrate practical knowledge of the principles and practices of pest control and safe use of pesticides. The general examination will stress those areas common to pest control work, including: injury through accidents or misuse, symptoms of pesticide poisoning and first-aid treatment
- Adverse environmental effects, such as water or soil pollution and injury to non-target organisms and drift
- The recognition of common types of pests, their damage symptoms, basic developmental stages and optimum periods of pesticide susceptibility (specific pests to be covered under category)
- Types and formulations of pesticides (both chemical and functional), their modes of action, persistence, and compatibility with various other compounds
- Comprehensive knowledge of labeling format and terminology together with an understanding of permitted uses, classification, and associated warnings, precautions, or other restrictions, such as reentry
- Safety factors related to handling, storage, and disposal of pesticides, particularly those pertaining to the prevention of personal injury trough accidents, misuse, symptoms of pesticide poisoning and first-aid treatment.
- Types of equipment, maintenance and calibration
- Application techniques for greatest effectiveness with minimal adverse side effects
- Appropriate state or federal laws pertaining to the production, distribution, sale or use of pesticides, and to the supervision of non-licensed applicators
- Potential of contaminating well and ground water by pesticides
- Areas in the state where endangered animals and plants are to be protected from pesticides

## General Aquatic Pest Control: Commercial applicator shall demonstrate a practical knowledge of:

- The common aquatic pests to be controlled
- Using pesticides registered for aquatic conditions
- Chemical and physical properties of water affecting the efficacy of pesticides
- Resultant effects on fish and other aquatic organisms
- Potential problem areas as influenced by drainage patterns, etc.
- Methods of pest control other than pesticides
- OEPA laws and regulations regulating the waters of Ohio
- Information necessary for safe and adequate application of pesticides
- Calculating proper rates

**PESTICIDE LICENSE INFORMATION**

### Application Process

The application and fee are only valid for the licensing year noted on the application and cannot be extended to the next licensing year once it is submitted. If all requirements are not met within the license year listed on the application, the application and fee are voided and the fee is NON REFUNDABLE.

License fees cannot be transferred from one company to another. When a first time applicant submits the application and fee, study material will be sent to assist in preparation for the examinations. Categories are listed on the application.

## Exams

Examination requirements are: the General Core examination which covers the laws, regulations, safety disposal and related topics, and an examination for each category in which you need to be certified and licensed. The categorical examinations are specific to what area you will be applying the insecticide, herbicide, fungicide, etc. All examinations consist of multiple choice, photo identification and true/false questions. The exams are not open book exams.

Exam results are mailed two-three weeks after the test date; they are not given over the phone. If you fail the exams, you must wait at least five days to retest. If you need to retest, there is no additional fee required. Exams are ONLY VALID FOR ONE YEAR from the day you pass the exam. If you do not meet the other qualifications for a license to be issued within the year, the exams will expire and you will need to retest. There are several Pesticide Applicator New Schools for new applicants conducted by the Ohio Pesticide Applicator Training Section for The Ohio State University Extension. These classes are held throughout the year. Their web site is http://pested.osu.edu. This site also offers the licensing information: test sites, recertification sites and study material.

Please call the Pesticide Regulation Section at (614) 728-6987 or 1-800-282-1955 to schedule your appointment to take the exams or register online at www.ohioagriculture.gov.

The application is only valid for the licensing year in which you have applied (The year is listed on the application.) If you do not meet requirements within the year that you have applied, then a new application and fee will be required, and no refund is given. The Ohio Department of Agriculture website is: www.ohioagriculture.gov - Look under “Pesticides and Fertilizer Regulation.”

## Commercial Renewal and Recertification Information

Once you have passed the applicable exams for the license and a license has been issued, you are certified for three years. The license MUST be renewed continuously every year in order to keep the three-year certification valid. You need to renew the license every year (at the end of September), which consists of submitting a renewal application and fee. You need to recertify every three years (the recertification due date is printed on your license) by retesting or attending recertification programs. Your recertification is based on the first year you obtained your license, which is based on the license year you passed exams and met all other requirements. Once you have been issued a license, you may begin obtaining your recertification credits at any time during the three-year recertification cycle. You must obtain the following requirements for recertification: **TOTAL MINIMUM OF FIVE HOURS OF TRAINING CONSISTING OF 1 HOUR OF CORE TRAINING AND 1/2 HOUR IN EACH CATEGORY YOU ARE LICENSED - HOWEVER, IT MUST BE A TOTAL MINIMUM OF FIVE HOURS.** If you have met your category requirements, you must still make sure you meet the time requirement by attending approved classes whether they are in your licensed category or not.

If you do not meet the recertification requirements of 1-hour minimum in Core, and at least 1/2 hour in your licensed category or categories with a total minimum time of 5-hours before the recertification expiration date listed on your license, then you must retest to maintain a license.

# CHAPTER 2

# The Ohio EPA Aquatic Notification

**THE OHIO STATE UNIVERSITY EXTENSION FACT SHEET**

## School of Natural Resources

**2021 Coffey Road, Columbus, Ohio 43210-1085**

# Notifying the Ohio EPA Prior to Applying Aquatic Herbicides in Ponds

**A-13-04**

**William E. Lynch Jr.**
Extension Associate, Aquatic Ecosystem Management

Chemical control (herbicide) is a commonly used method to control algae, submerged plants, as well as emergent plants. What may not be commonly known is that whenever an herbicide is applied to some Ohio surface waters, notification to the Director (or his designee) of the Ohio Environmental Protection Agency (Ohio EPA) may need to be done prior to application. The purpose of this fact sheet is to provide a better understanding of what situations require notification to the Ohio EPA and to provide guidelines and an example for submitting a notification form. Please note that the example form is not an official form of the Ohio EPA.

### Who Needs to Submit an Application?

OEPA statute 3745-1-01(E) (1) states that "Whenever chemicals are applied for control of aquatic plants or animals, notice must be given to the Director of Ohio EPA before chemicals are applied. The Director, upon receiving such notice, may order that chemicals not be applied if he/she concludes that the proposed application would pose an unreasonable danger to human or aquatic life." The application of pesticides registered under the Federal Insecticide, Fungicide, and Rodenticide Act are permitted *without notification* to the Director when:

The pesticide is applied consistent with label instructions, and:

i. The application is to a pond with a surface area equal to or less than five acres; and

ii. 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
iii. The application is not to any wetland; borrow pit, quarry, or water body used for public swimming.

Thus, the only aquatic herbicide applications exempt from the notification process are ponds less than five acres, provided they are not within one mile upstream of a public water supply intakes, are not borrow pits or quarries, and where no public swimming occurs. It is important to note that individuals applying herbicides to stream or riverbanks and township or county maintained drainage ditches must continue to notify the Ohio EPA. They are not exempted from this statute as it only applies to ponds.

Some pond owners may not be comfortable with applying herbicides to their ponds themselves and decide to commercially contract the application. The commercial applicator should file the notification form with the Ohio EPA. Remember, choose a commercial applicator that is licensed by having gone through the pesticide application certification program offered by the Ohio Department of Agriculture.

**Where is the Notification Sent?**

In most instances, your form will be sent to Ohio EPA, Water Quality Planning and Assessment, Lazarus Government Center, P.O. Box 1049, Columbus, Ohio 43216-1049. The exceptions are if the planned treatment may affect public drinking water supplies (i.e, herbicide will be applied directly to waters used for public water supplies, within 1 mile of a river/stream public water supply intake, or along the shore of a public drinking water supply reservoir). If these apply, the applicator will need to request the form "Application for Approval of Pesticide Materials for Use in or Near a Potable Water System" from the Ohio EPA's Division of Public Drinking Water. Provide the requested information and return to the Division of Public Drinking Water.

**When to Apply**

Because developing the form and having it reviewed takes time, it is advisable that the applicators consider their needs well in advance and submit the form sometime before May 1st of each year. In ponds with annual vegetation problems, the owner (or applicator) can easily anticipate the plant control needs, submit the notification early, and thereby be ready to apply at the proper time. *Remember, noting the Ohio EPA does not obligate you to apply herbicides.* If for some reason no herbicide application is needed, simply do not apply the product.

It is not unusual for a pond or lake that has had no prior aquatic plant problem to suddenly develop an excessive plant assemblage that may require chemical control for the first time. In this instance, it is recommended that an herbicide application notification form be submitted as soon as possible. The applicator should wait several weeks to give the Ohio EPA time to review and contact you if need be.

**Pre-Application Considerations**

Prior to submitting an herbicide notification form, it is wise to educate oneself on aquatic vegetation control. Items to be considered are what plant(s) need to be controlled, what the water uses of the pond or lake are, what the effective application rate is, and when will the application be performed. The Ohio State University (OSU) Extension program has three fact sheets available that may be useful: Fact Sheet A-3-98 Controlling Filamentous Algae in Ponds, Fact Sheet A-4-98 Chemical Control of Aquatic Weeds, and Fact Sheet A-2-98 Pond Measurements. These are available from each county extension office as well as downloadable at http://ohioline.osu.edu. OSU Extension conducts pond management clinics throughout Ohio and can be an effective venue to get answers to questions as well as learn of alternatives to chemical use. Another important source of information is the labels on the labels on the containers of the various aquatic herbicides legally approved for use. A visit to the local store handling these products is time well spent. Pay special attention to all safety recommendations and usage restrictions associated with product being considered for use. With these materials in hand, the applicator or pond owner can develop the herbicide notification form.

**What to Submit**

The Ohio EPA currently does not have a standard form for notification of administering pesticides to ponds. The following guidelines have been developed to assist the pond owner or applicator in submitting a clear, effective notification form to the Ohio EPA. Also, the question is frequently asked, "If I own multiple ponds requiring notification, do I need to submit multiple notification forms?" The answer is yes because they are distinct bodies of water. However, feel free to send them all in together as a packet.

**A. The Cover Letter**

It is recommended that a cover letter accompany the notification. The purpose of the cover letter is to assure the Ohio EPA that (1) all products labeled safety requirements and water use restrictions will be followed and (2) Ohio EPA's post-application posting requirements will be followed. The cover letter also provides a return address and e-mail address with which the Ohio EPA can contact the applicator if need be. It is encouraged that commercial applicators include their license number in the cover letter. An example cover letter is provided in Figure 1.

**Figure 1. Example Cover Letter to Accompany Pesticide Application Notification Form.**

John Doe
9999 Harriott Road
Marysville, OH 43040
Phone & email

July 31, 2003

Dr. John Estenik
Ohio EPA, Division of Water Quality Planning
Lazarus Government Center
P.O. Box 1049
Columbus, OH 43216-1049

Dear Dr. Estenik:

Enclosed is my notification form to apply aquatic herbicides to a private pond located on my property for the purpose of controlling excessive submerged vegetation and algae. All safety instructions provided on the product labels will be followed. Additionally, the pond will be posted using the Ohio EPA guidelines provided in The Ohio State University Extension Fact Sheet A-13-04 *Notifying the Ohio EPA Prior to Applying Aquatic Herbicides in Ponds*. Posted information will include names of chemicals used as well as restrictive information on drinking, water contact, fish consumption, and irrigation. Please do not hesitate to contact me at 614-333-5432 if you need additional information. Thank you for your time in considering my request.

Sincerely,

John Doe

**B. The Notification Form**

Figure 2 is an example of a suggested notification form
Filled out with data from a fictitious pond

**Figure 2. Sample Herbicide Application Notification Form.**

## Aquatic Herbicide Notification Form

**Submitted to:**
**Ohio Environmental Protection Agency**
**Division of Water Quality Planning and Assessment**

| | |
|---|---|
| Applicator Name and Address: | Pond Management Inc. (License # 111111)<br>3456 State St.<br>Cityville, OH 44444<br>614-333-5432 |
| Client Information: | Mr. John Doe<br>9999 Harriott Rd.<br>Marysville, OH 43040<br>614-873-xxxx |
| Location: | Doe Pond. 1 mile north of US42 and US 33 Intersection |
| Site Information: | 2.5 acres. Pond formed by damming of intermittent tributary to Mill Creek. |
| Target Aquatic Species: | Filamentous Algae, Curly Pondweed, Watermilfoil |
| Non-target Aquatic Organisms: | No known threatened or endangered species within 300 ft of treatment area. |
| Surface Water (Potable Drinking) Intake: | Yes ( ) No ( X ) |
| Primary Contact Usage: | Yes ( X ) No ( )<br>If yes, list types of contact: Swimming and canoeing |

| Requested Chemical(s) | Application Rates | Desired Concentrations |
|---|---|---|
| Copper Sulfate | 2.7 lbs / acre-ft | 0.25 ppm or less |
| Aquathol K | 2 gal / acre –ft | 2.0 – 3.0 ppm |

| Water Use Restrictions: | Copper Sulfate | Aquathol K |
|---|---|---|
| Drinking | 0 days | 25 days |
| Swimming | 0 days | 1 day |
| Fish Consumption | 0 days | 3 days |
| Irrigation / Livestock | 0 days | 25 days |

| | |
|---|---|
| Approximate Application Date (s): | Copper Sulfate: Periodically during June 1 – Sept. 30<br>Aquathol K: June 15 – July 15 |

Additional Information: Small map is attached.

A***pplicator Information***

- Provide the name and address of the applicator that will apply the herbicides. This can either be the pond owner or the name and address of the commercial applicator. If a commercial applicator, again include the license number provided by the Ohio Department of Agriculture.

***Client(s) Address(es)***

- If a commercial applicator is submitting the notification request, the pond owner's name and address appears here. If the form is submitted by the pond owner, simply provide his/her name.

***Name /Location***

- Provide the name of the water body. If unnamed, simply list it as "pond located on the property of 91." Describe the location as an estimated distance from a nearby road intersection (Figure 2). This allows Ohio EPA to check topographic maps for watershed locations should they so desire.

***Site Description***

- Describe your pond in terms of size and how it was constructed (dam or simple excavation). If dammed, provide the name of the stream/river that pond overflow flows into.

***Target Aquatic Species***

- Provide either common or scientific names of plant species to be controlled.

***Non-Target Aquatic Organisms (threatened and/or endangered species)***

- Identify any known Ohio or Federal threatened or endangered species within 300 feet of the proposed treatment area. If none, simply state so. A list of Federal endangered and threatened species can be obtained at http://endangered.fws.gov/wildlife.html. Simply click on the region three index icon. A list of Ohio endangered and threatened species can be obtained from any of the five Ohio Division of Wildlife District headquarters. District headquarters are located in Columbus, Findlay, Xenia, Akron, and Athens.

***Surface Water Intake***

-Indicate whether there is a potable drinking water intake within one mile downstream of the treatment area. If the answer is yes, you need to obtain the appropriate form from the Ohio EPA's Division of Public Drinking Water.

***Primary Contact Usage***

- Indicate whether there is primary contact usage (swimming, canoeing etc.) within the treatment area. If yes, list the human activities that have occurred in the treatment area in the past. This information should be critical in selecting an appropriate herbicide to use in each situation.

***Requested Chemical(s)/Application Rate/Desired Concentration***

- List all the aquatic herbicides that may be used, the application rate and the desired concentration. The product labels can provide this information. Express application rate as gal. or lbs. per surface acre or acre-ft.

***Restrictions***

- List all restrictions associated with each product to be used. This information can be found on product labels. Manufacturers of herbicides are required to include this information on their labels.

***Approximate Application Dates***

- For each product, indicate the approximate application dates. If a product is to be used periodically throughout the growing season, please indicate as so. The application and concentration rates provided on the form are to indicate the rates for each periodical application, not the combined amount to be used for the entire year.

*Additional Information*

- Provide any information the applicator feels needs to be included in the application. The Ohio EPA requires a map illustrating treatment areas be included, so indicate that a map is attached. In small ponds where the entire water area is to be treated, provide a map showing the location of the pond to nearby properties (including owner) and state

entire pond to be treated. In larger lakes where small areas will be treated, indicate on the map the areas to be treated. A neatly hand-drawn map will suffice. County maps are excellent for showing pond locations.

*Posting Requirements*

The Ohio EPA requires that any body of water treated with herbicides be posted for as long as use restrictions provided on the product label are in effect.

Signs- can be made of any material, but it is recommended they be able to withstand typical weather conditions.

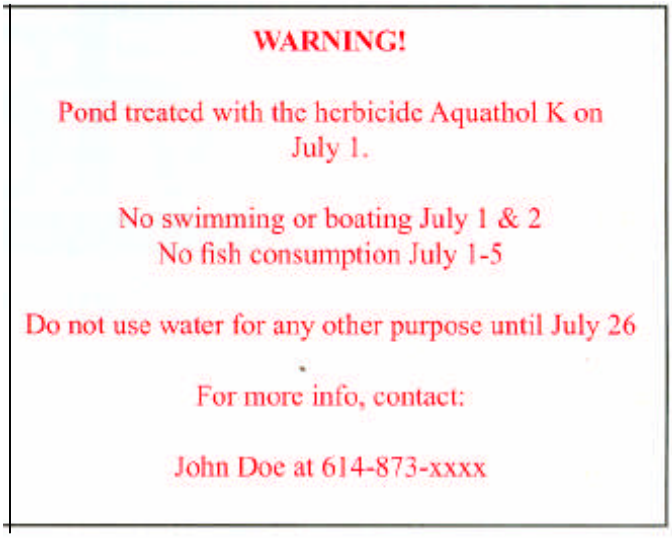
They need to be at least 9 inches by 12 inches in size and should be at a height of 4 to 5 feet off the ground for easy reading. They must be made of highly visible colors with the written information in a contrasting color. A good choice is red lettering on a white background. Be sure the written information is waterproof, such as a permanent marker.

***Posted Information***

- The following information is required by Ohio EPA on the sign:

- Warning that water has been treated with an herbicide
- Chemicals used
- Treatment date
- Days for restricted contact, e.g. swimming
- Days for restricted water use (watering, etc.)
- Days for restricted fishing
- Other information required by the product label
- Name and telephone number of owner

An example sign is illustrated in Figure 3.




***Where to Post***

- For multi-owner private waters treated with herbicides having time-related use restrictions, the area must be posted once on each private lot adjacent to the treatment area and any other private lots within 150 feet of the treated area. For

a pond completely contained within a single property and with no nearby private property, a single posting is sufficient. It is recommended this posting be placed facing the direction in which people typically see or approach the pond. In situations where there are adjacent properties within 150 feet, place additional signs on the property line facing the direction of the other properties.

In small lakes with many property owners (homeowner association lakes), notification signs must also be posted at the usual points of public entry, such as beaches, boat docks, parks, and picnic areas. If only small areas within the lake are treated, signs must be placed (in addition to general access areas) at the treatment area and at 150 feet either side of the treated area. If the entire lake is treated, it is recommended each property owner receive written notice of the application, including the same information provided on posted signs.

## Summary

The Ohio EPA requires prior notification before the application of aquatic herbicides, a regulation which many pond owners are unaware. The only aquatic herbicide applications exempt from the notification process are to ponds less than five acres, provided they are not within one mile upstream of public water supply intakes, are not borrow pits or quarries, and no public swimming occurs. The obligations of the pond owner are simply (1) notify Ohio EPA prior to application, (2) apply the herbicide in a safe manner, following the product label guidelines, (3) and post the treated area until all use restrictions expire. This fact sheet is intended to help the pond owner achieve steps 1 & 3. We have provided samples of a cover letter, an herbicide application notification form, and a warning sign. We encourage applicators and pond owners to follow these samples as it will allow Ohio EPA to quickly review the request and determine if they need to contact the applicator / pond owner prior to application.

Notifying the Ohio EPA Prior to Applying Aquatic Herbicides in Ponds, A-13-04 *Farm Pond Safety;* Ohio State University Extension Fact Sheet AEX-390
*Ohio Pond Management;* Ohio State University Extension Bulletin 374 *Controlling Weeds in Ohio Pond. 41* minute videotape. VT50
Visit your county office of Ohio State University Extension for copies of these resources.

# CHAPTER 3
# Pond Information and Water Measurements

## Learning Objectives

You should learn about:

- What a watershed is
- Pond requirements
- How to measure ponds
- How to measure moving water
- Formulas for herbicide applications

### CONSIDER THE WATERSHED

The water source for most ponds in Ohio is **surface runoff** from the surrounding land. That area of land is the watershed. A ***watershed*** is a region of land where water flows into a specified body of water, such as a pond, river, lake, sea or ocean.

Many activities that occur throughout the watershed will affect the quality of the runoff water, which, in turn, will affect how successful you are in your pond management efforts. Common water quality problems of surface runoff come from improperly maintained septic tanks; industrial pollution; excessive nutrient runoff from crop and livestock production areas and intensively managed turf areas such as golf courses; acid mine drainage; and sedimentation from construction sites, cropland, and timber harvests.

Landowners who own or control the entire watershed for the pond are best able to ensure good quality surface water runoff. When possible, divert poor quality runoff from entering the pond. If diversion is not possible or practical, place grass filter strips between the runoff and the pond.

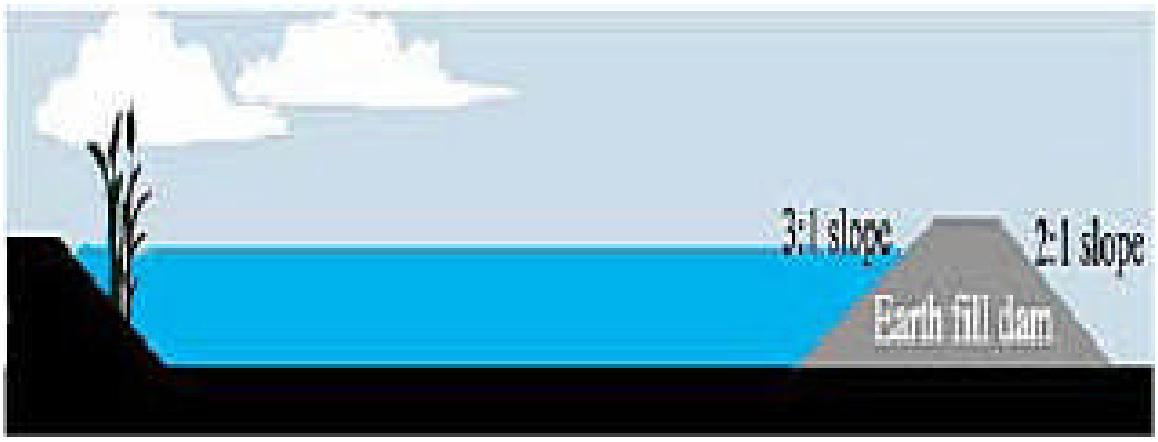
Watershed size is also an important consideration. Because most of the water for the pond will come from runoff, a general rule of thumb is to have about three acres of watershed for every acre-foot of pond storage capacity. Watersheds that are too large may result in high sedimentation rates, turnover, and storage problems, while watersheds that are too small may not provide sufficient runoff, particularly during drought conditions. The local Soil and Water Conservation District (SWCD) office can assist you with watershed size and land-use determinations.

### REQUIREMENTS FOR A GOOD POND

Proper ***site selection***, ***design***, and ***construction*** are essential to the success of a small impoundment. The USDA Natural Resources Conservation Service (NRCS), working with the county Soil and Water Conservation District (SWCD), can provide valuable information on pond construction. The county SWCD office is usually located in the county seat and should be your first stop as you begin to plan for a pond or small lake. Many county engineering offices have aerial photos of the entire county. Many can be accessed via the web.

Ohio ponds should be at least eight feet deep if fish are to be stocked, and banks should be built with 3:1 slopes. A properly built pond, when full, will have a minimum of water less than three

feet deep to discourage growth of aquatic vegetation. Water flowing into the pond should be free of pollution and sediment, and the pond banks should be protected with a good sod cover. Also, you may wish to allow adequate space around your pond for landscaping, wildlife cover, and a picnic shelter. If you intend to stock the pond, remember that ponds one acre or larger usually produce better fishing than smaller ponds.




**MEASUREMENTS**

Proper management of your pond requires that you know its surface area in acres and its volume. Fish stocking and some chemical applications are done using surface area; however, pond volume is often used to determine the amount of chemicals to be used.

If an **NRCS** conservationist or civil engineer designed and supervised the construction of your pond, that person should be able to provide you with these measurements. Your local **USDA** Farm Service Agency (**FSA**) office may have an aerial photo of your pond from which the surface area can be measured. The surface area of an existing pond may also be determined by a survey.

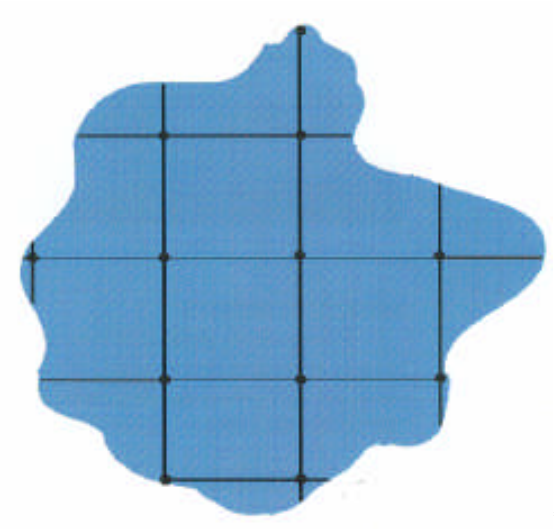
You can determine the surface area by making measurements and using one of the formulas given here. If your pond is **rectangular**, **the surface acreage equals the length in feet times the width in feet, divided by 43,560.**

You can usually regard an irregular-shaped pond as a rectangle or square and compute the area from straight boundary lines that approximate the actual shorelines.

If your pond is **circular**, **measure the total distance in feet around the edge of the pond. Multiply this number by itself and divide by 547,390.** The result is the surface area in acres.

This formula also works for ponds that are almost round. However, if your pond is more egg-shaped than round, this formula will give you a much larger acreage and will introduce errors in other computations.

Next, you will need to determine the average depth of your pond in feet. Make soundings or measurements uniformly spaced over your entire pond surface. This can be done from a boat by using a weighted rope marked off in one-foot increments and lowered to the bottom of the pond. Average at least 30 such readings - this will be the average depth of your pond.



*NOT DRAWN TO SCALE

Now you have the measurements necessary to determine the volume of your pond in acre-feet. Simply multiply the surface area in acres by the average depth in feet (surface area in acres x average depth in feet - volume in acre feet.) **One acre-foot equals 325,850 gallons.**

**Average Depth:**
Take soundings at intervals along transects. Add the measurements and divide by the number of soundings to determine average depth.

**Circular:**
Surface acres = (total ft. of shoreline)2 / 547,390

**Square of Rectangular:**
Surface acres = length (ft.) x width (ft.) / 43,560

**FORMULAS FOR HERBICIDE APPLICATION TO CHANNEL OF MOVING WATER (SEE BELOW)**
**cfs** = cross section area in active ingredient feet x average velocity in feet per second (**fps**)
Cross section area of rectangular channel in sq feet = average width in feet times the average in feet
**ai** = active ingredient
**min** = minutes
**ppmv** = parts per million volume
**ppmw** = parts per million weight

**PPMV** Formula below

$$\frac{\text{gal of chemical} \times 1{,}000{,}000}{\textbf{cfs} \times 450 \times \text{minutes applied}}$$

**Gal of chemical per cfs** Formula below

$$\frac{\text{ppmv} \times 450 \times \text{minutes applied}}{1{,}000{,}000}$$

**Total gal of chemical required** Formulas below

$$\frac{\text{ppmv} \times 450 \times \text{cfs} \times \text{minutes applied}}{1{,}000{,}000}$$

**PPMW** = $\frac{\text{lb. of chemical} \times 1{,}000{,}000}{\text{cfs} \times 3744 \times \text{minutes applied}}$

**PPMW** = $\frac{\text{total gal} \times \text{lb of ai per gal} \times 1{,}000{,}000}{\text{cfs} \times 3744 \times \text{minutes applied}}$

**lb. of chemical per cfs** = $\frac{\text{ppmw} \times 3744 \times \text{minutes applied}}{1{,}000{,}000}$

**Total gal per cfs** = $\frac{\text{ppmw} \times 3744 \times \text{minutes applied}}{\text{lb ai per gal} \times 1{,}000{,}000}$

**FORMULAS FOR HERBICIDE APPLICATION TO PONDS OR LAKES**

The correct amount of formulated herbicide to use per acre-foot of water in order to give the required parts per million is usually provided in a table on the herbicide label. The amount can also be calculated easily if the following relationship is used. Since an acre-foot of water weighs approximately 2.7 million (2,718,144) pounds, 2.7 pounds of any material dissolved in 1 acre-foot of water will equal 1 part per million by weight. Therefore, pounds required = 2.7 lb x ppm desired x acre-ft, if the water volume is less than an acre-foot calculate the amount required using the following formula.

**L =** length in ft **W** = width in ft **D**=depth in ft

$$\frac{\text{average L} \times \text{average W} \times \text{average D} \times 62.4}{1{,}000{,}000}$$

It is necessary to know that one cubic foot (length x width x depth) of water weighs 62.4 pounds. If you find, for example, that the weight of water is 2,718,144 pounds (220 ft x 198 ft x 1 ft x 62.4), you should divide by 1,000,000 to convert the amount to 1 part per million. Thus, 2.7 pounds of active ingredients introduced into that volume of water will give a rate of 1 part per million, or 1 pound of active ingredient per million pounds of water.

*Example 1*. How much copper sulfate pentahydrate (CPS) is required to treat 2.8 acre-feet of water at a recommended dosage of 2 parts per million?

Amount of CSP = 2.7 lb x 2 ppm x 2.8 acre-ft = 15.1 lb

It should be noted that dosage can be calculated on the basis of total chemical material or on the basis of active ingredients. For example, the active ingredient of copper sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$) is the copper which represents only 25 percent of the total weight of the compound.

*Example 2*. If the recommendation calls for the treatment of 2.8 acre-feet with copper sulfate pentahydrate at a rate of 2 parts per million of copper (25 percent of CSP is elemental copper), how much copper sulfate pentahydrate is required to achieve a final concentration of 2 parts per million of copper in water?

Amount = 2.7 lb x 2 ppm x 2.8 acre-ft = 15.1 lb of copper

Amount of CSP = 15.1 lb Cu
25% (or .25) CU by weight
= 60.4 lb

*Example 3.* Aquathol K liquid is labeled at a rate of 2 parts per million active ingredients for coontail control. Aquathol K contains 0.23 pounds of active ingredient (dipotassium endothall) per gallon. How many gallons of Aquathol K are required to treat 2.8 acre-feet at a rate of 2 parts per million active ingredients?

Pounds of active
ingredient required = 2.7 lb x 2 ppm x 2.8 acre-ft
=15.1

Gallons of Aquathol K = 15.1 lb a.i required
4.23 lb a.i per gal
= 3.57

Liquid formulations that are recommended for floating and emergent weeds usually require surface application. The spray mixture may be applied directly to the plants to the point of runoff. When using a liquid herbicide to make a spray solution for a particular number of pounds per acre of active ingredient, use the following formula. Since 100 gallons of water weighs approximately 834 pounds, you can determine the number of pints needed per 100 gallons of solution. Therefore,

$$\text{Pints required} = \frac{\text{lb a.i. per acre x 834 .b}}{\text{gal spray per acre x lb a.i. per 1gal of product}}$$

*Example 4.* If a 2,4-D formulation containing 4 pounds active ingredient per gallon is to be applied at the rate of 5 pounds active ingredients in 120 gallons of solution per acre.

$$\text{Pints needed per 100 gal solution} = \frac{5 \times 834}{120 \times 4} = 8.7$$

When using solid (dry) herbicides to determine how many pounds are needed per 100 gallons of solution, use this formulation:

$$\text{Pounds required} = \frac{\text{lb a. ai. per acre x 100}}{\text{gal spray per acre x percent a.i.}}$$

State or federal recommendations or guidelines may vary about whether the information is give as total formulated material or active ingredient. In all cases, the label must be consulted for proper dosage information.

# Chapter 4
# Aquatic Weed Pest

## Learning Objectives

You should learn about:

- Why treatment is necessary
- The most common aquatic weed pests in Ohio
- How to ID them
- How to manage or control them

**WHY IS AQUATIC WEED CONTROL NECESSARY?**

Plants are natural and important parts of the aquatic setting. Microscopic plants (algae) form the base of the aquatic food chain. Larger algae and plants provide habitat for fish and food organisms. All plants produce oxygen as they photosynthesize during the daylight hours. However, excessive growths of these plants can have a harmful effect on a body of water and its inhabitants. Many shallow, nutrient-rich ponds, lakes, and drainage ditches provide ideal conditions for abundant aquatic weed growth.

**Some of the problems caused by aquatic weeds are as follows:**

- Interfere with or prohibit recreational activities such as swimming, fishing, and boating.
- Detract from the aesthetic appeal of a body of water.
- Stunt or interfere with a balanced fish population.
- Fish kills are due to removal of too much oxygen from the water. Oxygen depletion occurs when plants die and decompose.

Photosynthetic production of oxygen ceases, and the bacteria, which break down the plant material, use oxygen in their own respiration.

Fish kills in summer are frequently caused by die-offs of algae blooms. Fish kills can also result from poorly-timed chemical applications when the weeds are very dense in the pond. When large amounts of weeds die at one time, the result is a reduction in oxygen available to fish from the decaying plant material.

Fish kills in winter occur when there is ice cover on the pond. Oxygen levels remain higher when the pond is open or partially open. The air and wind agitate the water, increasing oxygen levels. Ice cover on the entire pond doesn't allow this exchange and fish kills may result. Decomposition of plants that died in the fall can cause further oxygen depletion.

Fish kills also can be caused by insecticide runoff, ammonia runoff from feedlots, and diseases.

- Certain algae can give water bad tastes and odors.
- Impede water flow in drainage ditches, irrigation canals, and culverts, causing water to back up.
- Decomposition of weeds, sediment, and debris, can cause bodies of water to fill in.

## WATER USE SITUATIONS

The demand for water resources used for recreation, agriculture, and industry is increasing. Many kinds of plant and animal aquatic pests can interfere with water uses. Control of aquatic pests must be done without harm to people and the environment.

Habitats for aquatic weeds involve different proportions of water and soil, including occasionally wet ditches, ditches which always hold standing water, streams, stock ponds, farm ponds, lakes, ornamental ponds, and intermediate habitats. This manual considers three types of water situations - static, limited flow impoundments, and moving water.

### Static Water

Static water is confined for considerable periods of the year, or totally confined within a known area, with no downstream movement. Dugout ponds are examples of this. However, even totally enclosed bodies of water often have appreciable water movement because of wind and changes in water temperature. Weeds commonly grow in static water up to 12 feet deep. Weeds may grow in very clear water that is more than 20 feet deep. If an herbicide is applied for weed control, there is no reason to expect that any appreciable downstream effect may occur, unless there is overflow resulting from unusual storm conditions.

### Limited-flow Water Ditches or Streams

Ditches may be occasionally wet or dry, depending upon climatic conditions. However, herbicides applied to these habitats may move downstream following an arrival of water from surrounding areas. The purpose of the ditch is to drain the surrounding land area so considerable amounts of water must pass through it.

Many farm ponds, including embankment ponds, may be characterized as having limited flow because they usually have an overflow pipe. This overflow pipe is usually an emergency overflow channel that leads to an emergency spillway. The overflow pipe is designed to permit passage of a continuous and relatively well-defined amount of water at all times. The emergency spillway is provided to release excessive amounts of water from storms that raise the levels of the ponds in a short time.

In these situations, small amounts of pesticides may be carried downstream from the application site. Larger amounts may be found downstream after sudden rain storms, which interrupt or come immediately after pesticide application.

### Moving Water

Moving water is found in small streams, creeks, streams, and rivers where there is always some detectable downstream current. Applied pesticides may be found in downstream locations in varying amounts away from the area of original application. Such situations present the greatest potential for concern as an environmental hazard.

## AQUATIC WEED IDENTIFICATION

Identification is the first step in managing aquatic weeds. Most control methods are aimed at specific weeds or groups of weeds with similar growth habits. Aquatic weeds can be divided into two botanical groups; algae and flowering plants. Algae are usually very simple in structure with no apparent leaves or stems. However, some (for example, *Chara*) can resemble flowering plants. For effective chemical control, it is essential that you distinguish between algae and flowering plants.

**Algae**
Microscopic algae form scums and/or color the water green or yellow-green. Sometimes they cause red,black, or oily streaks in the water called “blooms.” Blooms usually occur where abundant nutrients are reaching the water. They should be treated with chemicals before they cause a noticeable color but a sudden die-off of these algae can cause fish kills.

Fig 3.1 Filament Algae (Picture courtesy of OSU)

Filamentous algae (also known as moss) form floating, mat-like growths which usually begin around the edges and bottom of ponds in the early spring. Moss is probably the most common in lakes and ponds in the Midwest. Often, repeated chemical treatments during the summer season are necessary for effective control.

**Chara**
Chara**,** or stonewort usually grows in very hard water and is often calcified and brittle. The plant leaves are arranged along the stem in whorls. It grows completely underwater and has a musky smell. Chara can be difficult to control once it has become established and has a heavy coating of calcium carbonate. Use copper-based algaecides when the plants are still young and not heavily calcified. Although this plant resembles some flowering plants, it is an alga.

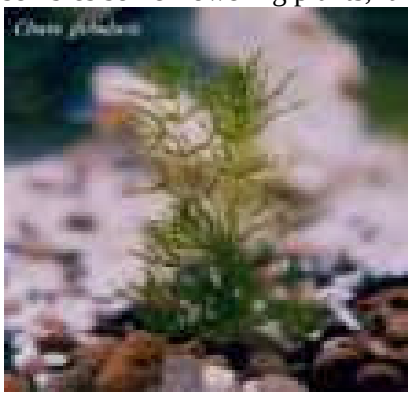
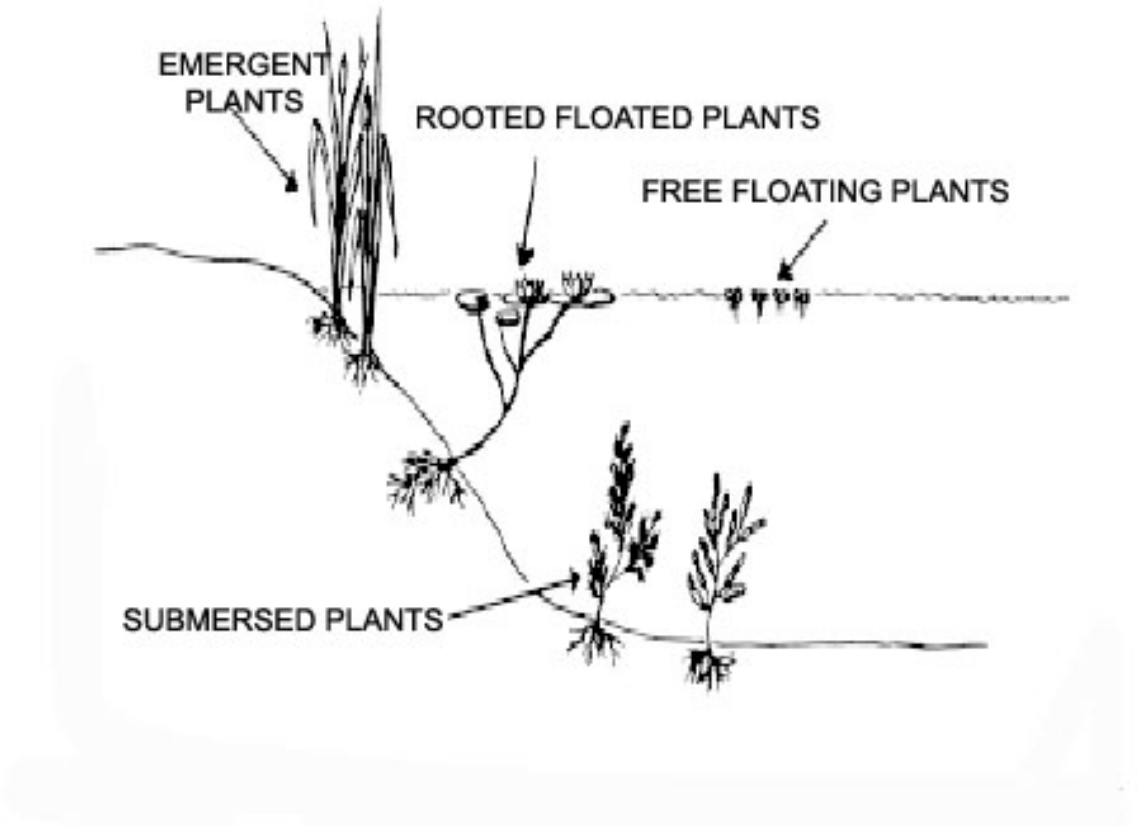


Fig 3.2 Chara

**Flowering Plants**
Flowering Plants can be grouped into broad categories according to where they are found in a body of water.




**Submersed Plants**
Submersed plants are rooted in the bottom sediments and grow up through the water. Flowers or flowering spikes sometimes emerge above the water surface. The main criteria for identification are leaf arrangement and leaf shape.

**Common underwater weeds are**:
**Bushy Pondweed**
Bushy Pondweed is a rooted, underwater plant with slender, branching stems. The leaves are narrow and ribbon-like, 1 to 2 cm long and 0.4 to 0.8 mm wide. The leaves are opposite or in twists of three and leaf margins have coarse fine spines. Generally, it is found in alkaline waters but it can tolerate a wide range of chemical and physical factors. Bushy Pondweed can become abundant in shallow water, forming dense mats. It can cause severe problems in commercial and sports-fishing ponds.

Fig 3.3 Bushy Pondweed (Photo courtesy of MSU)

## Coontail

The leaves of coontail are twisted around the stem. Each leaflet is forked with toothed edges. The leaflets are more densely crowded around the tip of the stem giving the appearance of a raccoon tail. The plant may be anchored to the bottom or may be free-floating beneath the surface. Coontail prefers ponds with hard water. Coontail can tolerate low light conditions in deep water.


Fig 3.4 Coontail (Photo courtesy of Broad Waters)

**Floating-leaf Pondweed**

Floating-leaf Pondweed has two types of leaves. The under water leaves are narrow and grass-like. The floating leaves are oval to heart-shaped with a notched base. Flowers appear on a terminal spike. It can tolerate many different growing conditions in ponds.

Fig 3.5 Floating-leaf Pondweed (Photo courtesy of Aquatic Weed Control Inc.)

**Leafy Pondweed**
Leafy Pondweed has very narrow (about 1/16 inch wide) grass-like leaves with an alternate arrangement. The sides of the leaf are generally parallel but form a pointed-tip. These are not floating leaves. Leafy Pondweed grows in many pond environments but it prefers deep sediments in shallow parts of the pond. It is more common in ponds than in large lakes. It can grow very dense and may interfere with swimming, fishing and boating on the pond.

Fig 3.6 Leafy Pondweed (Picture courtesy of Tesaslanscaper.com)

**Eurasian Water Milfoil**
Water Milfoil usually has four feather-like leaves at a node. This serious, rapidly spreading invader is found in lakes and ponds throughout the Midwest. This exotic plant usually has a dark, reddish appearance with very long stems. Flowers develop on a terminal spike with very short leaves surrounding them; however, it usually reproduces through fragmentation. It grows in a variety of conditions and can quickly grow to intolerable levels in a pond. It often competes with and replaces native pond plants.

Fig 3.7 Water Milfoil (Photo courtesy of Bright Waters)

**FLOATING PLANTS**
## Duckweed and Watermeal
Free-floating plants, such as duckweed and watermeal are seed-bearing plants which float free on the water's surface. They never become rooted in the soil, and are propagated by sexual and asexual means. They can completely cover the surface of a pond. Both are extremely small. Duckweed is no more than 1/4 inch in diameter, and watermeal is even smaller. Both plants prefer static, quiet water with minimum wind exposure. Both plants are found in nutrient-rich

waters. Input of waste water from sources such as livestock feedlots and septic tank fields should be eliminated.

Fig 3.8 Duckweed (Photo courtesy of My Aquaira.com)

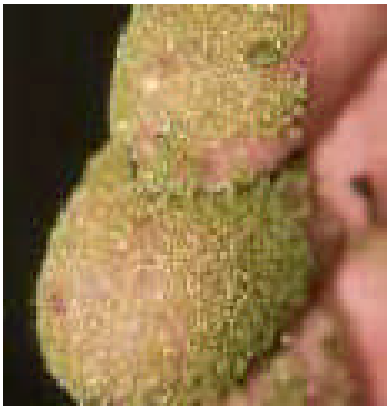


Fig 3.9 Watermeal (Courtesy of Texas A&M)

**ROOTED FLOATING PLANTS**

**Water Lily and Spatterdock**

Rooted floating plants include waterlily, spatterdock, and water lotus. Spatterdock is usually the weediest of the three and completely fills in shallow areas less than 3' or 4' deep. Spatterdock is a massive, difficult to kill underground rhizome from which new plants sprout. It differs from waterlily in having heart-shaped leaves that come above the surface of the water and a yellow flower. Waterlily has round leaves.

Figure 3.10 Spatterdock
(Photo courtesy of Maine center of Invasive Aquatic Plants)

Figure 3.11 Water Lily (Photo courtesy of NC State University)

**Emergent (shore or marginal) plants**

**Cattails**

Emergent plants commonly include cattails, are probably the most familiar of all wetland plants. Their swaying brown flower cluster can be seen at the edges of ponds, rivers, lakes, or just about any place where there is shallow, standing water for at least part of the year.

One of the more obvious things about these plants is their size. The common cattail can grow up to nine feet in height. Their height, linked with their capacity to withstand saturate soil conditions, seems to have been their real tickets to success.

Figure 3.12 Cattail (Photo courtesy of Broadwaters)

# CHAPTER 5
# Managing Aquatic Weeds

## Learning Objectives

You should learn about:

- The types of aquatic control
- Application techniques
- Formulations
- Water zones

**THE BASIC CONTROL APPROACHES ARE**

**1.** Preventive Measures

Proper design and construction of ponds is an important factor in preventive control of weeds. Shallow water at the margins provides an ideal habitat for emergent weeds, such as cattails. These weeds can spread then to deeper water. Banks should be sloped steeply so that very little water is less than 2' to 3' deep.

Proper design and construction of ditches and channels makes weed control easier in the future. If the banks are leveled and smoothed, hard-to-reach places will be eliminated. Lining canals will help to alleviate water weed problems, too.

**2.** Mechanical Control

Even with preventive measures, many ponds still have severe waterweed infestations. In some cases, use of an herbicide may not be possible if the water is used for livestock, drinking, or fish. Hand-pulling the weeds or dredging the pond are possible methods of control. But often the infestation is so severe that these methods are impractical or uneconomical.

Motor-driven underwater weed cutters are available and can be used for the control of such plants as waterlilies and water milfoil. Some mowers simply cut the weeds loose beneath the water surface. Aquatic weed harvesters collect weeds for removal. Disposal of harvested weeds can be a problem. Most mechanical control methods fragment weeds. Many weed species can spread and reproduce from these pieces. Mechanical control is usually slower and more expensive than use of herbicides. Underwater weed cutting must be done continuously during the summer and usually represents a long term financial investment.

**3.** Cultural Control and Habitat Alteration

Certain methods of manipulating or altering the aquatic environment can be effective in controlling aquatic weeds. One of the more successful methods is the drawdown technique in which water levels are lowered over the winter. Exposure of the sediments in the shallow areas of a lake or pond to alternate freezing and thawing action will kill the underground rhizomes of many aquatic weeds (the majority of aquatic weeds are perennial and come from rhizomes).

Many aquatic weeds or their seeds are carried into a pond by wind, birds, fish introduction, fishermen, etc. These weeds infest a pond only if the water conditions are just right. This usually means that nutrients are entering the pond from runoff or stream inflow. To help prevent serious weed infestations you can do the following things:

- Most waters in Ohio are sufficiently rich in plankton and other food organisms to support large fish without the need for supplemental fertilization. In fact, excessive nutrients can greatly increase aquatic plant abundance.
- Maintain a good sod and grass cover around your pond. This will help prevent runoff and erosion. Do not fertilize the turf directly around the pond.
- Do not allow livestock access to a pond except under conditions of extreme heat. If the water is used for livestock, fence the pond and water the animals from a stock tank below and outside the fence. Animals will increase turbidity and fertility and tear down the banks.
- Check septic tanks for possible leakage or seepage into the pond.
- Do not permit runoff from chicken coops, feedlots, etc., to enter your pond. If this kind of runoff is occurring up-stream from your pond, you should check with your county Board of Health to see if anything can be done about it.
- All of these measures will help prevent weed growth, particularly in a new pond. In older ponds these measures will probably aid in reducing infestations of floating plants such as algae and duckweed.
- Do not allow large flocks of Canada geese to reside or visit the pond. Their feces can greatly increase nutrient levels and enhance plant production to nuisance levels.

Other types of habitat manipulation include riprapping shorelines and anchoring screens (e.g., Aquascreen) or black plastic sheets on the bottom sediments to prevent rooted plant establishment. Dyes such as Aquashade, Hydroblock, or Algae Blocker are used to inhibit light penetration through the water. This blue dye can be applied right out of the bottle along the shoreline. It mixes throughout the body of water within 24 hours. The dye intercepts light normally used for photosynthesis by underwater plants. The dye can only be effective if its concentration is maintained.

Some general rules for using dyes are as follows:

1. Do not apply where water outflow will reduce the concentration.
2. Apply in March or April before weeds reach the water surface. Midsummer reapplication is usually necessary. It is effective only on rooted underwater plants growing at depths greater than 2 to 3 feet.
3. Do not use in muddy water.

Aeration has been publicized as another method of weed control. Although aeration is definitely beneficial for fish life and can help prevent fish kills, there is no evidence that aeration inhibits weed growth.

4. Biological Controls

Biological controls for aquatic vegetation have received considerable publicity. Several species of fish are herbivorous in that their principal diet is aquatic vegetation. One such

species, the grass carp (also known as the white amur or Chinese carp), is being used in various parts of the United States and is legal in several states. However, it is illegal to introduce these fish to the ponds, lakes and streams of many states. Check with your local or state fisheries department for regulations regarding the grass carp.

5. Chemical Control Methods

## CONTROL WITH HERBICIDES

Chemicals used in aquatic weed control are classified as herbicides. Herbicides used primarily to control algae may be called algicides, even though they also kill other aquatic plants. For most aquatic weed problems, properly-used herbicides control vegetation without harming the fish. Aquatic herbicides are effective and commonly used means of controlling aquatic vegetation.

**Surface**

Generally, only 1/4 to 1/3 of the surface area of the water should be treated at a time. This helps to protect fish from a possible shortage of oxygen. The surface area (in acres) of a rectangular body of water equals length in feet times width divided by 43,560 (the number of square feet in an acre).

**Timing**

Proper timing of herbicide/algaecide applications is extremely important for both effective control and to avoid other potential problems. Timing involves knowing what the water temperature is, waiting until vigorous plant growth is present, but not waiting too late in the summer when an application results in large quantities of weeds decomposing (an oxygen-using process) and creating conditions conducive to a fish kill by suffocation. Some algaecides require minimum water temperatures of 60 degrees F in order that there is enough biological activity in the plants for the material to be effective. Cattails are best controlled with an herbicide when they reach their most vigorous growth stage which corresponds to the beginning stages of seedhead (catkins) development. Unlike other herbicides that can be used as pre-emergents (applied prior to the germination of plant seeds or the regrowth of sprouts), aquatic herbicide use must be delayed until plants are present and growing.

**Total Water Volume**

The whole body of water from the surface to the bottom is treated or you can treat 1/4 to 1/3 of the water volume (based on the surface acres) at a time. Calculate the volume of the body of water and add chemical to obtain the required dilution.

The concentration of chemical needed to control aquatic plants is often very small and is stated in parts per million (ppm). For example, if the toxic concentration for a particular plant is 2 ppm, that the chemical should be applied at the rate of 2 parts of active ingredient to one million parts of water (2:1,000,000) in the area to be treated.

First calculate the acre-feet of the body of water. * Note: 1 acre foot water - 2.7 million pounds so 2.7 pounds = 1ppm in 1 acre foot-water.

The correct amount of formulated herbicide to use per acre-foot of water in order to find the required parts per million is usually provided in a table on the herbicide label. The amount can also be calculated easily if the folling relationship is used. Since an acre-foot of water weighs approximately 2.7 million (2,718,144) pounds, 2.7 pounds of any materials dissolved in 1 acre-foot of water will equal 1 part per million by weight. Therefore,

Pounds required = 2.7 lb x ppm desired x acre

The following calculation shows how to calculate the number of pounds of active ingredient needed to treat a body of water containing 10 acre-feet at the rate of 0.5 ppm.

2.7 x 0.5 x 10 = 13.5 pounds of active ingredient

**Bottom 1 to 3 Feet Layer of Water**
Treating the bottom 1 to 3 feet of water is especially useful in deep lakes where it is impractical to treat the entire volume of water. Treatments are generally made by attaching several flexible hoses at 3 to 5 foot intervals along a rigid, weighted boom. Each hose has a nozzle at the end. The herbicide is applied as a blanket in the lower 1 to 3 feet of water surface for best results.

**Bottom Soil Surface**
Herbicide application may be made to the bottom soil of a drained pond, lake, or channel.

**AQUATIC HERBICIDES**
Aquatic herbicides generally are available in sprayable or granular formulations.

**Sprayable formulations**
Most herbicide formulations must be mixed with water and applied so that they disperse evenly. These include:

- WSP - water soluble powders that dissolve and form true solutions in water.
- WP - wettable powders from suspensions in water. The particles do not dissolve.
- EC - emulsifiable concentrates form milky white “oil-in-water” emulsions.

**Granular Formulations**

- G - are small clay-based pellets that carry the active ingredient on or in the product. They are usually distributed by some sort of slinger-spreader and sink to the bottom. Slow-release granules or pellets release the pesticide active ingredient over an extended period of time.

**WEED CONTROL IN STATIC WATER**
**Floating and Emergent Weeds**
Floating and emergent weeds can be killed with direct sprays on the foliage applied from a boat or the shore.

**Submersed Weeds and Algae**
Submersed weeds and algae can be treated using sprays or granular formulations.

Sprays are applied as water surface treatments, particularly in shallow water. The herbicide is then dispersed by diffusion (flow), thermal currents, and wave action. Good control depends on good dispersion of the chemical in the water. Subsurface injection is very effective.

Granules are used primarily to control algae or submersed weeds. They sink to the bottom and work about the same manner as bottom soil treatments. Application rates for granules are given as amount per unit of surface area or as a concentration in ppm.
**Advantages to granular formulation include**

- treatment is confined to the bottom where submersed weeds are
- slow-release formulations can provide extended control
- low concentrations of herbicides can be used

- toxicity to fish may be reduced
- allows for spot treatment of high use areas, like swimming areas in front of boat docks

**WEED CONTROL IN LARGE IMPOUNDMENTS (RESERVOIRS)**
Herbicides that work well in small bodies of water may perform poorly in large bodies of water because of much greater water movement by thermal currents and wave action. In these cases, weed control may be improved by:

- using maximum recommended rates
- treating relatively large areas at one time
- apply when winds are at a minimum
- select herbicides that are absorbed quickly by the plants

**WEED CONTROL IN LIMITED-FLOW WATERWAYS**

Flood drainage canals, slough (mud filled or swampy) agricultural or field ditches and drains are good examples of limited-flow waterways. Weed control methods in these systems are very similar to those for static water. Evaluate the possibility of contamination when planning herbicide use. In some areas, drainage water may flow onto cropland or into drinking water supplies.

**SECONDARY AND ENVIRONMENTAL EFFECTS OF AQUATIC PESTICIDE APPLICATIONS**
Incorrect applications of herbicides in water may pose serious hazards to humans, wildlife, fish, and desirable plant life. Select the correct herbicide and apply it at the proper rate. Follow all restrictions on the label. Read the label. Water has many uses and herbicides will not always remain where they are applied. Know the water use restrictions for the herbicide you have chosen.

Improper applications can kill fish directly or deplete the oxygen concentrations excessively if the plants die too quickly. Decomposition of dead fish can contaminate downstream water supplies. Water may be unsuitable for humans, animals, or irrigation.

If application rates are too low in a static water situation, weed control may be unsatisfactory. Excessive application rates may kill fish or exclude livestock from use of the water for a period of time. Use of water supplies for irrigation may not be possible for an indefinite period of time. However, little effect would probably be observed as far as downstream hazards are concerned, since little or no outflow normally occurs.

**In Limited-Flow Water**
Improper application rates could result in contamination of downstream water used by municipalities or communities for domestic water supplies. The hazardous condition would exist whether limited-slow water sources were treated with an application rated too low to accomplish a desired kill of vegetation or if the rate were excessive. Use of excessive rates might result in a fish kill that could affect downstream water supplies through bacteria from decay and decomposition of dead fish.

**In Moving Water**
Application of pesticides to moving waters may lead to at least temporary contamination of downstream water supplies which may be utilized for domestic consumption. In addition, the

pesticide, though applied locally for pest control, is certain to move to other areas of the stream and affect various aquatic organisms.

**Faulty Application**
There are two major hazards involved in faulty applications of pesticides: (1) damage to non-target organisms (2) unsatisfactory control. For example, it would be hopeless to apply granular herbicides in fast moving water, whereas they might work quite well in static water impoundments and even in limited-flow water situations. All currently registered herbicides employed for aquatic weed control are rated as slightly toxic, or non-toxic to fish, birds, insects, and other aquatic organisms so long as proper application rates and techniques are employed. Pesticide labels should be carefully observed to ensure that the aquatic environment is not contaminated during pest control efforts.

**Limited Area Application**
Aquatic weeds may occur in the whole body of water as submersed weeds, or may appear to cover the whole surface of the water as floating weeds. Conversely, the same weeds or other pests may occur only in limited areas within a body of water, whether it is a static, limited-flow, or moving body of water. "Limited area application" implies the advantage of improved safety to aquatic species, specifically the fish population. If pesticides that are potentially toxic to the fish population are applied to a limited area, the fish population can move to untreated water areas and escape potential toxic effects. Also implied in this concept is that a minimal amount of pesticide is applied. This tends to reduce the potential effect upon downstream environments in the event of spill over from the treated body of water.

**WHAT YOU NEED TO KNOW BEFORE USING A CHEMICAL**
The most important considerations before buying and applying an herbicide for aquatic weed control are these:

1. ***Identity of the weed***. This can save you a lot of money because certain chemicals will work only on certain weeds and not on others. Identification help can be obtained from your county Ohio State University Extension Service and/or Soil & Water Conservation District Office.
2. ***Restrictions on use of water treated with herbicides***. Although most aquatic herbicides break down readily and rapidly in water and pose no threat to human or animal health, there are waiting periods on the use of water treated with most herbicides. These restrictions—usually on fishing, swimming, domestic use, livestock watering or irrigation—dictate which herbicides will be appropriate for your pond or lake. Always check the herbicide label for possible restrictions.
3. ***Dosage***. Calculate carefully, and don't overdo it. Most aquatic herbicide labels give dosages on the basis of acre-feet (volume measurement). Acre-feet is calculated by multiplying the surface area by the average depth. For example, a pond with a surface acreage of l/2 acre and an average depth of 4 feet contains (4 feet x 1/2 acre) 2 acre-feet. The herbicide label can then be checked for the amount of chemical to apply per acre-foot.

***Timing*.** Late spring is usually the best time to apply aquatic herbicides. The plants are young and actively growing and most susceptible to herbicides. Do not wait until July or August! If you wait until late summer to treat, you are running a serious risk of killing fish. By that time, the vegetation is usually extensive and thick. Also, the water is warm and still. Killing all vegetation at once under these conditions could seriously deplete the water of its oxygen and cause a fish kill. If you must treat this late in the summer, treat only a portion of the weed growth at a time.

1. ***Temperature***. Aquatic weeds are not affected by herbicides when the water is too cold. The water temperature should be in the 60's, preferably the upper 60's (in the area to be treated) and will stay in the 60's for a week or so. These temperatures usually occur from late April to early June. This means that as soon as the plants are up and actively growing, and if the water temperature is right, the herbicide should be applied.
2. ***Water Hardness***. Some herbicides can be affected by water hardness. Hardness is caused by compounds of calcium, magnesium, and by a variety of other metals. Lower herbicide rates may not work as well at controlling weeds. The herbicide rates may have to be doubled in water that is very hard (more than 180 mg/L) to maintain control.
3. ***Retreatment.*** More than one treatment may be required for adequate control, particularly true for algae. Retreatment is usually required in succeeding years. Plants can regenerate each spring from seeds, spores, and underground rhizomes. These structures generally are not affected by aquatic herbicides. Also, new plants can sprout from seeds.

1. Do not apply where water outflow will reduce the concentration.

2. Apply in March or April before weeds reach the water surface. Midsummer reapplication is usually necessary. It is effective only on rooted underwater plants growing at depths greater than 2 to 3 feet.

3. Do not use in muddy water. Aeration has been publicized as another method of weed control. Although aeration is definitely beneficial for fish life and can help prevent fish kills, there is no evidence that aeration inhibits weed growth.

4. Biological Control
   Biological controls for aquatic vegetation have received considerable publicity. Several species of fish are herbivorous in that their principal diet is aquatic vegetation. One such species, the grass carp (also known as the white amur or Chinese carp), is being used in various parts of the United States and is legal in several states. How ever, it is illegal to introduce these fish to the ponds, lakes, and streams of many states. Grass carp in Ohio must be sterile, triploik grass carp. No diploid fish are allowed.

5. Chemical Control Methods

# CHAPTER 6
# Aquatic Herbicides

## Learning Objectives

You should learn about:

- The types of aquatic active ingredients used for making aquatic pesticides.

**AQUATIC HERBICIDES**

Many chemicals may kill aquatic weeds; however, select only those approved for aquatic use by the U.S. Environmental Protection Agency and labeled for this use. Brief descriptions of several chemicals follow. These are identified by their chemical names. See the table on page 24 for trade names and manufacturers.

**Copper**

This is the least expensive and most widely used material for the control of algae (except Chara). It has little or no effect on other aquatic plants. Copper is a contact herbicide, so direct contact is required. In highly alkaline waters (greater than 250 ppm CaCO3), copper forms an insoluble precipitate and becomes unavailable for algae control. Therefore, a higher concentration of copper must be used. Copper sulfate is toxic to fish eggs, so its use should be suspended during spawning periods. There are no restrictions on the use of the water following treatment, but it is desirable to wait 24 hours to let the metallic smell dissipate from the water.

**Chelated Copper**

Chelated copper compounds are also very effective algicides, whose copper is contained within an organic molecule. This prevents the copper from precipitating out of the water, and thus provides for longer lasting results than copper sulfate. Effective on all types of algae, including Chara. No water use restrictions.

**Diquat Dibromide**

This is a contact aquatic herbicide and is available in liquid form. It will kill most submerged weeds. It is applied by pouring directly from the container or by diluting with water and injecting below the water surface. For best results, it should be applied before weed growth has reached the surface. When sprayed on emergent weeds, the herbicide is mixed with water and a nonionic surfactant. Diquat dibromide should not be used in muddy water.

**Endothall**

This herbicide is available as an amine salt or a potassium salt and is available in both liquid and granular formulations. Fish are sensitive to the amine salt, but not the potassium salt. Endothall is a contact herbicide and is most effective in waters 65 degrees F and above. It will control most of the common submerged weeds that grow in Ohio. The liquid form is mixed with water and sprayed on the water surface or injected below the surface. The granular form is best applied with a cyclone-type spreader. Tables for determining amounts required, application instructions, precautions, and restrictions are on the product label. **Read the label!**

**Sodium Carbonate Peroxyhydrate**

This is a new fast-acting algicide, which produces a strong oxidation reaction and bleaches out the algae of its chlorophyll. It is completely biodegradable into naturally occurring compounds. There are no water use restrictions other than not to apply to drinking water ponds and lakes.

**Erioglaucine & Tartrazine**
These herbicides are inert dyes that control the growth of plants by reduced light. Plants need light to grow; when light is reduced plants can not grow. These products are commercially available and the color is usually blue. They are suspended in the water to reduce light penetration and help control both filamentous algae and submerged weeds. These products will not be effective in water less than two feet deep or if weeds are on or above the water surface.

**Glyphosate**
Glyphosate is a systemic herbicide that moves through the plant from the point of foliage contact into the root system. It is a liquid and produces the best results when applied after emergent plants have reached full growth. It gives good control of cattails and other emergent aquatic plants as well as woody plants growing on the shorelines.

**Granular 2,4-D**
This systemic aquatic herbicide is easily applied using a cyclone-type spreader. It should be applied to coincide with rapid growth of the root systems of submerged weeds for best results. Effective on most submerged weeds found in Ohio ponds, granular 2,4-D also may be used to control some emergent weeds. **Read the product label carefully for application rates, precautions, and restrictions.**

## Warning!

Aquatic herbicides recommended for submerged weed control are safe for use in ponds stocked with fish unless otherwise stated on the label. Each has different restrictions on water use following treatment, so **read the entire label** on the product you select before applying it.

Although non-injurious to fish when applied at the recommended rate, an herbicide application can still contribute to a fish kill. If large amounts of floating or submerged weeds are killed at one time, their subsequent decomposition can result in oxygen depletion and the death of fish from suffocation. To reduce the hazard of such a fish kill, treat weeds early in the growing season. When more than half of the pond is covered with weeds, treat half the pond and wait 10 to 14 days before treating the other half.

When applying herbicides along shorelines or spot-treating weed beds, it is best if applications are started along the shoreline or in the shallowest area and applied out to the deeper water. This will enable fish to move into deeper water to escape the chemical.

# CHAPTER 7
# Equipment Selection and Methods of Application

## Learning Objectives

You should learn about:

- Types of equipment
- How to use them
- Types of formulations
- How to apply them

**AQUATIC APPLICATION EQUIPMENT**

Most of the equipment used in aquatic herbicide applications is similar to that used in agricultural applications. There are a few modifications made to adapt the equipment to unique situations. They are, applying herbicides from boats and injection of herbicides into deep water. This chapter discusses the use of conventional application equipment and how it is adapted for use with aquatic herbicides.

**Liquid Formulations**

The majority of aquatic herbicides are formulated as liquids. The equipment needed for applying liquids depends on two methods below and which one is used:

1. ***Spraytank.*** The herbicide and the substance (used to dilute, usually water), are mixed in a tank, and the mixture is applied to the weeds.
2. ***Direct metering into pump suction.*** The herbicide is metered into the suction side of the pump at the rate needed to apply the correct amount per acre. The substance needed to ensure adequate coverage is **drawn directly from the body of water being treated.**

***The spraytank method is suitable for treating relatively small areas or when mixing several herbicides. When large areas are treated, it may be more efficient to use the direct metering method to reduce the time spent refilling the tank.***

Aquatic weeds can be treated from boats with outboard engines, fixed-wing aircraft and helicopters. The type of application equipment used is dictated to some degree by which vehicle is used.

**Spraytank Applications**

Figure 6.1 shows a typical sprayer used to apply herbicides from a boat. Features of the sprayer components are described below.

**Tank**

The boat-mounted tank, usually made of fiberglass, has a capacity of 50-100 gallons. Usually the tank will have graduations on the side that indicate the volume at that level. The tank should have a large opening for easy filling and cleaning.

Fig 6.1 Typical boat mounted tank sprayer

**Agitation system**

Most spraytanks are equipped with some type of agitation system. **Good agitation is important for maintaining a uniform spray mixture and for mixing of adjuvants such as inverting oil or polymers.** Figure 6.2 shows hydraulic and mechanical agitators. Some tanks are equipped with both types of agitators.

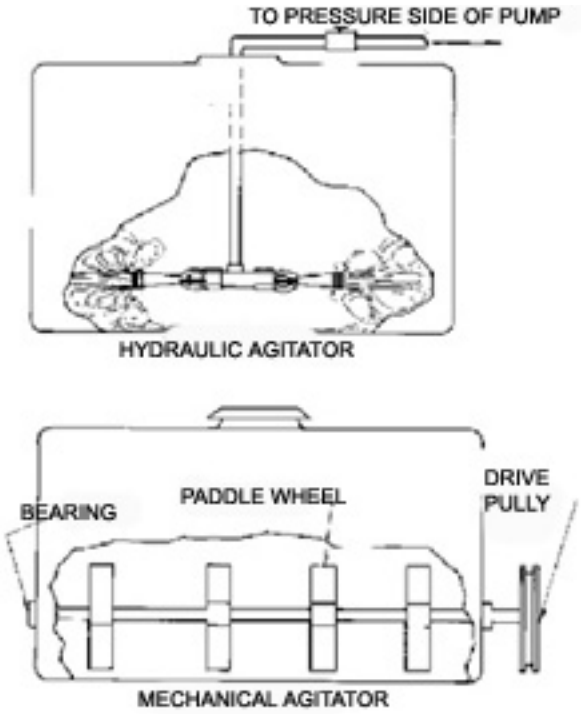



Fig 6.2 Agitation systems for keeping aquatic herbicides and adjuvants in suspension

A well-designed hydraulic agitation system that uses a venturi device for stirring is adequate for keeping wettable powders in suspension. However, this type of agitator will not stir the mixture enough to form invert emulsions or mix polymers. To function properly, the hydraulic agitation line must be tapped into the high-pressure side of the pump (Figure 3). When using a hydraulic agitator, the pump must have the capacity to simultaneously deliver the required flow to the boom or handgun and the agitator. If the maximum pressure that can be achieved after completely closing off the pressure regulator is lower than the pressure needed, the agitator orifice size must be reduced. Mechanical or paddle wheel agitators are probably the best type of agitator. Well-

designed mechanical agitators stir the mixture vigorously and allow the use of both polymers and invert emulsions. Sometimes a clutch is added to the agitator drive, and the operator can keep the mixture at the desired consistency by agitating only when needed.

**Hoses**

The inner and outer layers of all hoses should be resistant to the chemicals used. Check with the chemical and hose supplier if there is any doubt; a hose weakened by chemicals might leak or burst unexpectedly. Two materials widely used for hoses are ethylene vinyl acetate (**EVA**) and ethylene propylene dione monomer (**EPDM**). Check hose monthly for excessive wear and tear.

A pressure hose must be strong enough to withstand the maximum pressure within its length without bursting. Pressure varies at different points along the hose, with the greatest pressure occurring at the pump. Hose size is important because the pressure loss in the hose depends on the hose inside diameter (ID), length and flow rate (Figure 6.3). For example, a 1/2 in. ID hose loses 1 psi per foot at a flow rate of 10 gal per/min.

Pressure loss in relatively short hoses is not very important, but it is important to choose the proper hose size when extremely long hoses are used, such as in some handgun spraying work.

Suction hoses are under a partial vacuum; they will not burst but they can collapse. Choose a suction hose that is reinforced to prevent collapsing. A collapsed suction hose can restrict flow of liquid and starve a pump. This will cause decreased outflow and greatly accelerated wear. As a rule of thumb, suction hose diameters should be at least as large as the pump inlet port.

Polyvinyl chloride (PVC) pipe works well for rigid plumbing; however, caution should be used in selecting the valves. For example, a 1 in. valve can be plumbed to a 1 in. pipe, but the opening inside the valve may be restricted to 0.5 in. in diameter.

**PUMPS**

Most pumps used for applying liquid herbicide formulations are of five general types: roller, piston, centrifugal, diaphragm and gear. Each type has certain capabilities and limitations that determine when it should be chosen. Characteristics of the various pumps are listed in Table 1.

## Roller Pumps

*Roller pumps* have the advantage of being relatively inexpensive. They are widely used in agriculture on general-purpose crop sprayers. However, roller pumps are not often used for aquatic weed control work because they do not produce the high pressures needed for handgun spraying. While a pressure capability of 300 psi is stated for a roller pump, which is adequate for handgun spraying, the pump would not be able to sustain high pressure very long because the rollers wear and fluid leaks back past the rollers. Figure 6.3 shows how to plumb a liquid application system using a roller pump. The system has a hydraulic agitator that would only be suitable for systems not used to apply invert emulsions or sprays containing polymers.

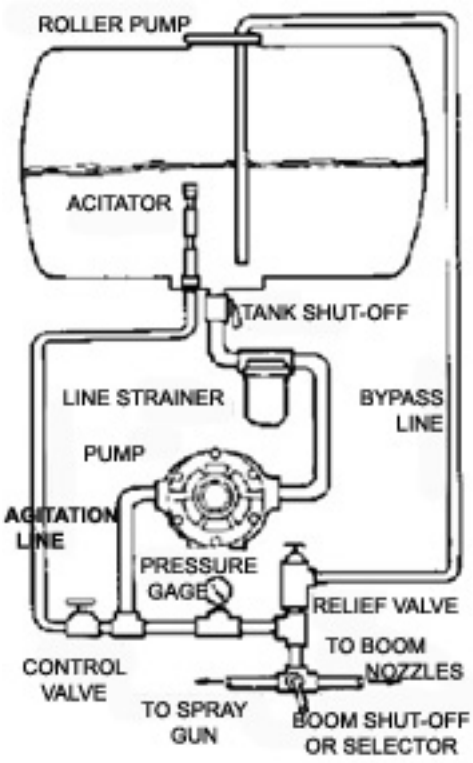



Fig 6.3 Basic plumbing for a roller pump system

**Piston Pumps**

*Piston pumps* are often used in aquatic weed control because they can deliver high pressure for handgun spraying. These pumps are dependable, long lived, and highly adaptable to most types of service. Their primary disadvantages are that they are expensive and deliver relatively low volume, although the volume is usually sufficient for aquatic applications.

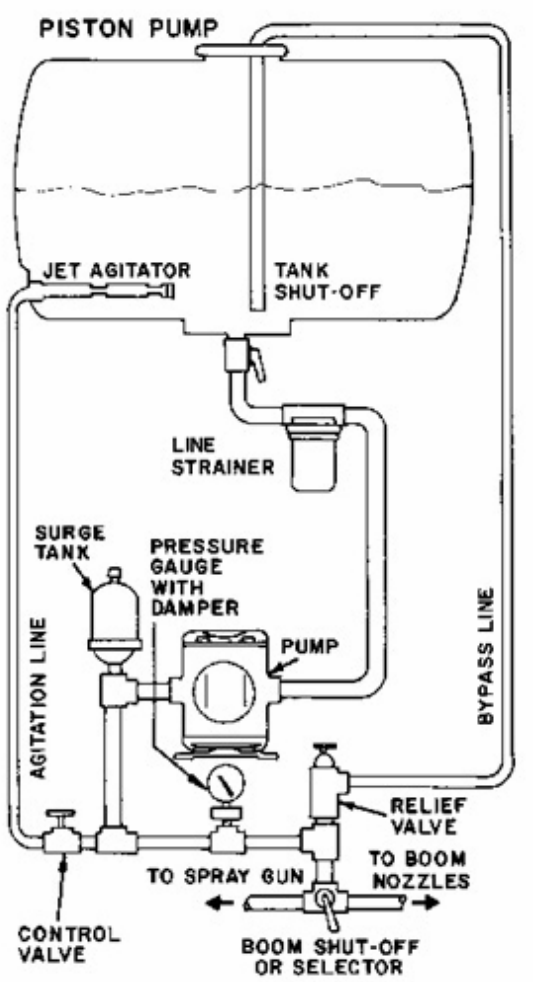


Figure 6.4 Basic plumbing for a piston pump system

A *piston pump* is a positive displacement pump, which means that the output depends on the displacement of the piston in the cylinder. Output is proportional to speed and virtually independent of the pressure needed to force the flow through the orifice area on the system.

Output from a piston pump is not steady. It comes in spurts because the distance that the piston travels in the pump cylinder varies with time. This problem can be eliminated through the use of a surge dampener. Pulsation is especially noticeable for pumps with a small number of pistons (small pumps often have two pistons). The pulsing nature of the flow makes a surge tank desirable. The system should also be equipped with a glycerin filled pressure gauge (glycerin dampens movement of the gauge needle). These gauges last longer and can be read more easily than nondampened gauges on piston pump-equipped systems.

Figure 6.4 shows how to plum a system equipped with a piston pump. The system includes an unloader valve that is especially useful when spraying with a handgun. When the gun is shut off, the system pressure rises until it is sufficient to overcome the spring force on the unloader valve. The valve will crack open and bypass fluid back to the tank. Without the unloader valve, the pressure would continue to rise until a hose bursts. The system shown in Figure 6.4 is appropriate for all of the positive displacement pumps, including diaphragm and gear pumps, as well as the piston type.

**Centrifugal Pumps**
*Centrifugal pumps* deliver high flow rates when working against a low pressure. These pumps are especially useful for transferring fluids from one tank to another or from the body of water into the tank when refilling.

Centrifugal pumps are not suitable for most systems used in aquatic weed control because of the inability to generate high pressures. Small centrifugal coupled to a small two-stroke cycle engine are sold by some manufacturers and are particularly useful for tank refilling.

**Diaphragm Pumps**
*Diaphragm pumps* are now used in many applications instead of piston pumps. Benefits of diaphragm pumps include relatively low cost, low maintenance and small size compared with other pumps with similar flow and pressure ratings. Like piston pumps, diaphragm pumps are positive displacement pumps so the pump output depends on pump speed and remains constant regardless of the pressure it is working against.

**Gear Pumps**
Gear pumps are used in a number of applications and are positive displacement pumps capable of high pressure. The corrosive chemical comes in contact with the pumping gears, so maintenance can be a problem. Gear pumps are becoming less popular and are being replaced by diaphragm and piston pumps in many installations.

**SPRAYERS AND NOZZLES**
The spray and nozzle forms the spray pattern, determines the droplet size and meters the flow rate. Nozzle selection is based on a balance of these three functions. Many types of nozzles are used in a wide range of weed control. However, because of the nature of aquatic weed control, the variety of nozzles used in aquatic applications is much less. The method of application (submersed or surface) determines the nozzle type selected.

***The four primary application methods and nozzle considerations in aquatic weed control are:***

**1. Handgun spraying of surface, water banks and ditch banks species:**
*Handgun sprayers* are entirely manual and are carried as a backpack or hand held. A typical empty weight is about 12 pounds. With four gallons of water, the weight is approximately 45 pounds.


Fig 6.5 Handgun sprayer (Backpack)

The parts of the handgun spray are the same as those found on most sprayers, a tank to hold the spray, a pump to product pressure and flow, a regulator to control the flow, and at least one nozzle to atomize the spray mix (see Fig 6.5). Tanks on the handgun sprayer typically are made of plastic or steel and hold three to five gallons. Some sprayers have a mechanical agitator that moves when the pump is used, other have jet agitation.

The sprayers have a built-in piston or diaphragm pump that is operated by hand. Some models can be adapted to either right or left hand pumping. The other hand is needed to operate the flow control valve and the wand. The pumps are capable of relatively high pressures.

**2. Subsurface injection just below the water surface for submersed weed control:**
Usually short hoses are spaced at approximately 2 ft. intervals on a short, bow or stern-mounted boom. Hoses are just long enough to place the nozzle at the water surface or just below it (Figure 6.7). The nozzle body contains a disk that meters the flow into the water.

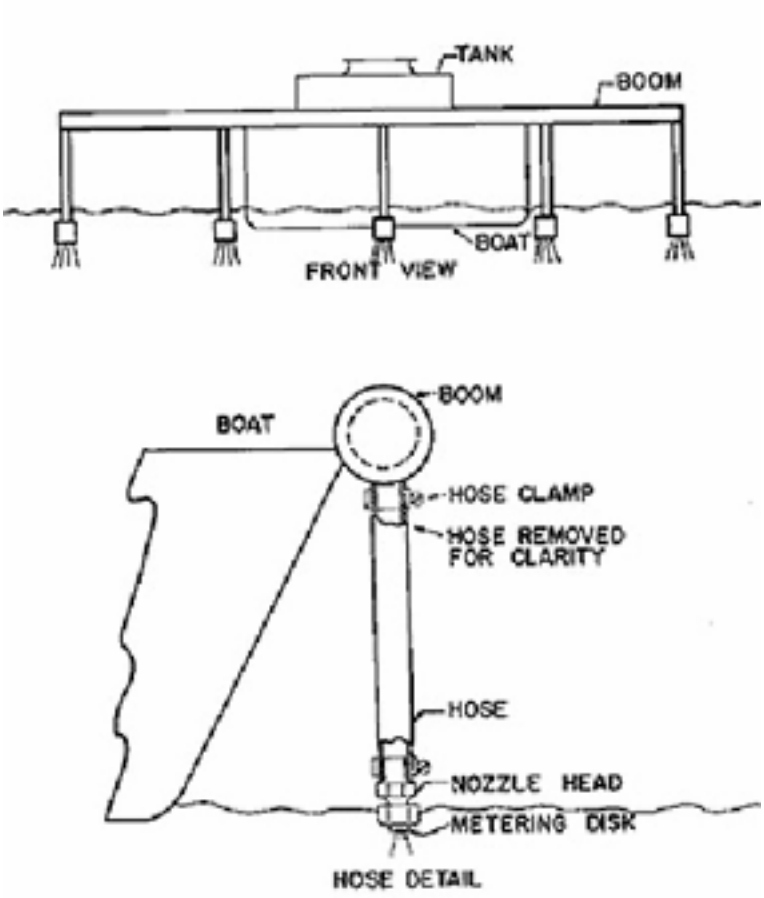



Fig 6.7 Subsurface injection just below the water surface for submersed weed control

### 3. Bottom placement or deep-water injection:

Nozzles are located at the end of long hoses that trail from a boom on the bow of the boat. Hoses are usually weighted to keep the herbicide placement deep within the weed mat or near the bottom (Fig 6.8). A common arrangement involves constructing a nozzle by drilling small holes in a piece of galvanized pipe. The length of the pipe depends on how much weight is needed to lower the hose to the desired depth. Pipe length varies from 9 to 30 in. The pipe is capped on one end and attached to the hose on the other. Deep-water injection hoses must not have any clamps or protrusions that will catch and hold plants.

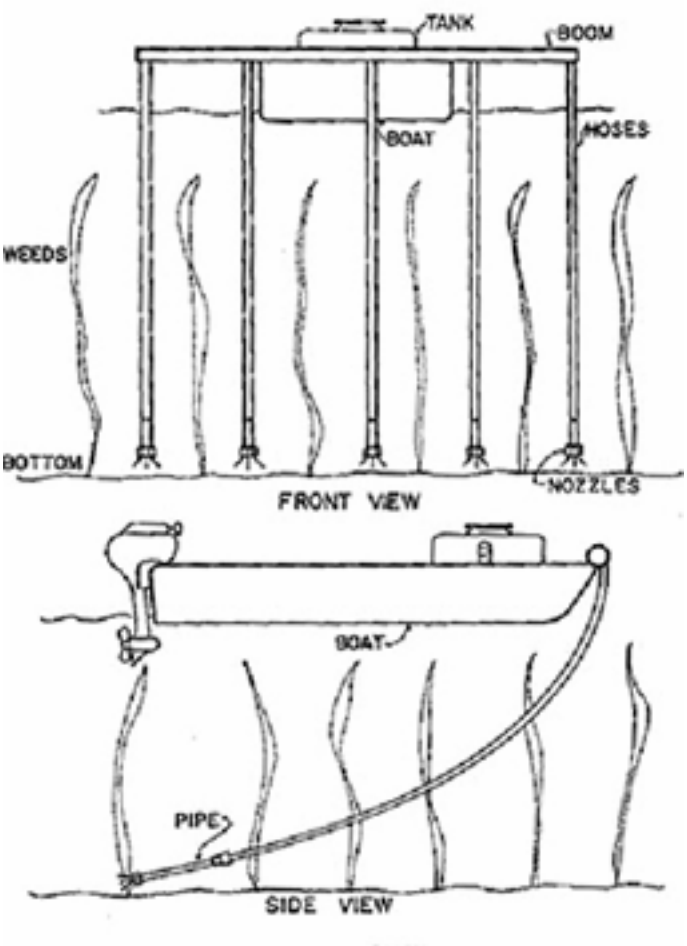



Fig 6.8 Hoses for deep injection of aquatic herbicide

**4. Aerial applications:**

Aerial applications normally use hollow cone or flat fan nozzles to improve coverage with the smaller volume of spray solution applied per acre. A specialized aerial boom designed to produce a large droplet size at low pressure and low volume is the microfoil boom.

Fig 6.9 Aerial application

**Direct Metering into Pump**

***When large areas are treated, it is often more efficient to meter the herbicide into the suction side of the pump and eliminate the time spent filling and mixing tanks.*** Water is drawn into the pump through "water boxes" built into the bottom of the spray boat (Fig 6.11). Normally, one or more plastic tubes are tapped into the pump suction line. Each tube has a valve for opening and closing the lines. Tubes have an in-line orifice used to meter the correct amount of herbicide into the system. Fig 6.11 shows how a typical herbicide withdrawal hose is constructed.

A number of suction hoses can be used so application can continue without interruption. When the herbicide in the container being used is depleted, the applicator opens a valve in the hose in a second container and closes the valve of the empty one.

Other than not using a tank and having the previously described equipment on the suction side of the pump, equipment used for spraying in this manner is very similar to tank-mix units

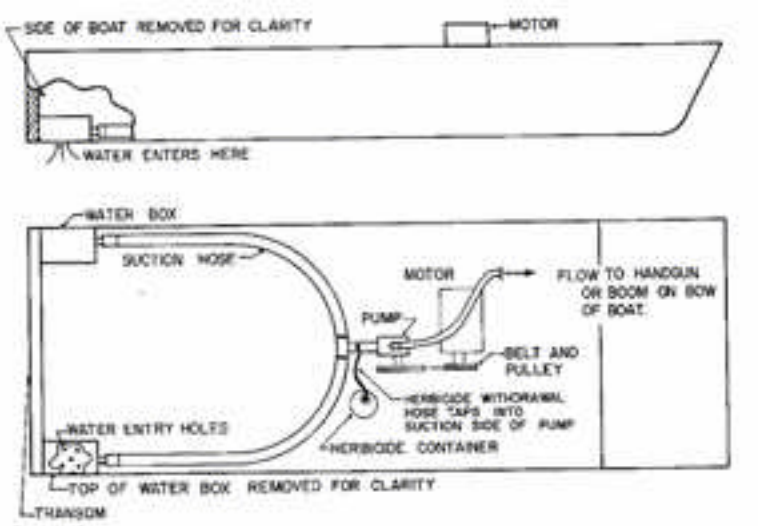



Fig 6.10 Basic system for withdrawing herbicide directly from container and water from boat intakes

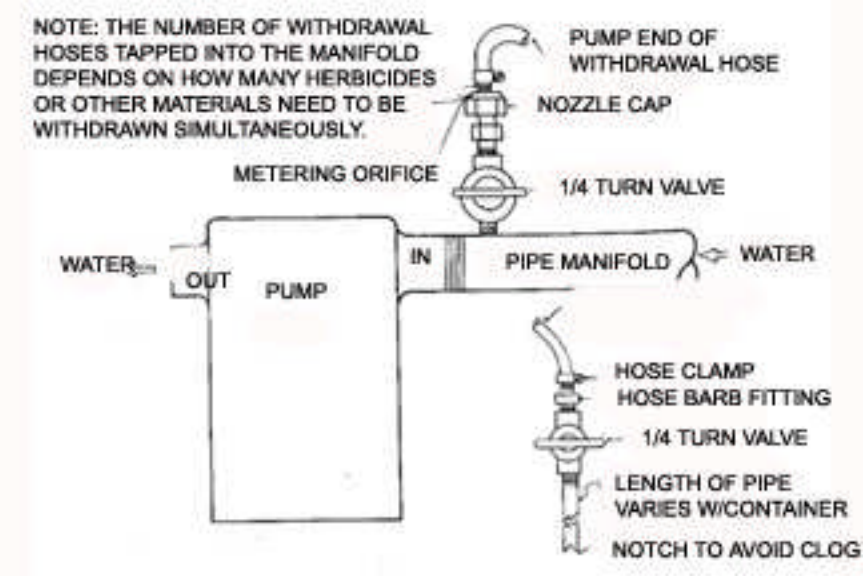



Fig 6.11 Plumbing for herbicide withdrawal hose

**INVERT EMULSIONS**

***An invert emulsion contains water droplets dispersed in a continuous oil phase. This is contrasted to a normal emulsion, which is oil droplets dispersed in a continuous water phase.*** Invert emulsions, which are a thick mayonnaise-like material, do not generate as many fine droplets as water-based sprays, and the emulsion adheres to the target vegetation. ***Invert emulsions are often used as a carrier for herbicide sprays when working in areas where spray drift would be especially detrimental.***

Suction-side metering equipment is usually used for invert emulsion applications but tank-mix inverts can also be made. Various proportions of diesel fuel or xylene and an emulsifying agent were used in the past for making invert emulsions; special lighter oils are usually used now.

When mixing the invert in a tank, the ingredients are added to the tank and the vigorous stirring of a good mechanical agitator causes the formation of the emulsion. If there is no tank, a mixture of the oil and emulsifier is metered into the pump's suction line in the right proportion. Water, oil, and emulsifier then pass through the pump and into a mixing unit that vigorously agitates the mixture and forms the invert emulsion. There are at least two types of mixing units. One is a power-driven unit that does the mixing in a manner similar to household mixers. The other type unit has baffles similar to an exhaust muffler. Ingredients mix because of the turbulence caused by changing directions as the liquid flows through the unit.

This description simplifies the procedures of using an invert system. Invert pumps and systems are generally expensive, must be kept airtight and experience is required to set up, operate and maintain a trouble-free system. Expertise from a manufacturer or agency familiar with inverting systems should be sought before setting up a system.

**APPLYING SPRAYS CONTAINING POLYMERS**

***Polymers are long-chain carbon molecules which, when united with water, thicken the solution and increase the number of large droplets. They are often used when spraying surface weeds with a handgun.***

Applicators may find that the output from their sprayer will diminish greatly when spraying with one or two percent polymer. The reason often given for the flow reduction is that the water-polymer mixture flows less readily, and the pump is unable to force the material through the nozzles, however, this is not the reason for the reduced flow.

Positive displacement pumps normally used in aquatic weed spraying have the capability to force any amount of material that enters the pump out of the pump. If the engine speed (rpm) is set by a governor (as are most small gas engines that power sprayer pumps used in aquatic weed spraying) the output will be the same for a viscous liquid as it would be for water, as long as the same amount entered the pump. The difference is that the pressure required forcing the viscous liquid through the discharge hose would have to be greater. More pressure means the engine has to deliver more horsepower.

Output reduces when using these high concentrations of polymer because the amount entering the pump suction is reduced. Flow rates of water and water-polymer mixture through a given nozzle at a given pressure vary little. Most of the flow reduction is because the pump is starved on the suction side. ***A system used to apply water-polymer mixtures should have extra-large suction lines with a minimum of fittings between the tank and pump inlet.***

**GRANULAR FORMULATIONS**

Granular herbicides are normally applied with a bow-mounted centrifugal or blower-type spreader (Fig 6.12). Centrifugal spreaders can treat a wide swath when relatively large granules are used. ***The ability to treat a wide swath (30 to 40 ft.) without requiring any type of structure extending beyond the sides of the boat makes granular application attractive. The disadvantage is the large quantity of material (20 to 400 lb/acre) that must be handled.*** The rotor that slings the granules is driven by a 12 volt DC motor. Normally, the spreader is purchased as a complete unit except for the mounting system. Because boats used to treat aquatic weeds are normally used to apply both sprays and granular applications from the bow, the spreader is usually mounted so that it can be quickly removed.

Blower-type spreaders use air pressure generated by a low pressure high speed 2 cycle blower, with a venturi discharge nozzle to propel the granules. ***An advantage of blower type spreaders is that little dust is created as compared to that created when the mechanical rotor of centrifugal spreaders strikes pellets or granules.***

Fig 6.12 Blower type spreader for granular aquatic herbicide formulations

## SUMMARY

There are many different types of application equipment and products available on the market today. The equipment and product you choose will depend on the type of weeds to be controlled and the application equipment needed.

# CHAPTER 8
# Other Potential Pond Problems

## Learning Objectives

You should learn about:

- What types of problems there can be
- What causes the problems?
- How to manage them
- What pesticides are available?

**POTENTIAL POND PROBLEMS**

**Crayfish**

Crayfish are important food organisms in the pond. They are on the food lists of birds, mammals, and most species of pond fish. Some species of crayfish may present a problem. These are the burrowers, which make vertical burrows two to six feet deep and pile the mud from their excavation in a "chimney" around the mouth of the burrow. Burrows in moist areas may have connecting tunnels, and in rare cases such tunnels have perforated the dams on ponds.

There are currently no effective long-term control methods - cultural, chemical, or mechanical - for controlling these burrowers. High densities of largemouth bass will help keep a crayfish population in check.

Fig 7.1 Crayfish

**Fish**

When a pond is overpopulated with fish and they are not reproducing, removal of some of the fish population sometimes will not solve the problem. Complete elimination of all fish and restocking the pond is recommended.

You can accomplish this elimination by commercial available fish toxicants. Rotenone is a common ingredient in fish toxicants. **Read and follow label directions for proper use of fish toxicants. Rotenone is a *restricted-use* pesticide. You must be *licensed* to purchase and use it. The information provided here is intended to clarify and supplement that which is found on the product label.**

Small ponds can be treated from the shoreline. Ponds larger than 1/2 acre should apply the fish toxicant from a boat to get better misting and distribution. An outboard motor will be helpful on large ponds. Collection and disposal of larger fish killed in population eradication is recommended to reduce odor problems.

A pond that has had the population eliminated with a fish toxicant usually can be restocked in ten days to a month. To make sure all of the toxicant has decomposed, place some live minnows in a screen wire cage or minnow bucket liner in the water. If the minnows live for four days, the water is safe for restocking.

**Ducks and Geese**

Ponds and small lakes are attractive feeding and loafing areas for migrating waterfowl. The more natural-looking ponds may even attract nesting pairs of ducks and geese. In addition, many pond owners may keep domestic ducks and geese. Such waterfowl provide viewing pleasure, and their feeding habits may help to control some weed problems; however, they also can create problems. They add nutrients to the water, enhancing plant growth. Coliform bacteria thrive in water enriched with waterfowl droppings, especially when the ducks and geese use the pond year-round. For ponds used for swimming, maintenance of more than one pair of domestic ducks or geese per surface acre of water is discouraged. Domestic ducks or geese are not recommended for ponds used for domestic drinking water supplies.

**Management**

Methyl anthranilate meets the needs of the environmental industry for a natural, nontoxic food grade control tool that works on all species of birds.

It controls birds by eliminating their food source at the problem areas, which encourages them to return to their natural food environment.

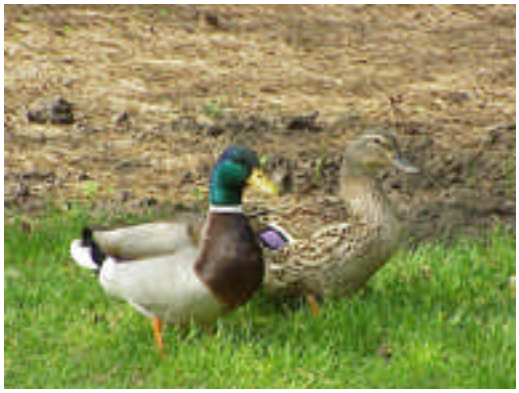


Fig 7.2 (Photo courtesy of DuPage College)

Fig 7.3 (Photo courtesy of deebeedee)

**Muskrats**

Muskrats often invade a pond, especially if it is near a creek or a ditch and there are areas of emergent and submerged weeds in the pond for food. Unlike muskrats found in marshes, which build houses from vegetation, muskrats in ponds usually dig a burrow into the bank as a den. Such burrows may present problems, especially if dug into the dam of a pond. If your pond was designed according to NRCS recommendations, the dam should be wide enough so that a burrow is not harmful. However, if the dam lacks adequate width or height above water level, a problem may develop. Since muskrats are furbearers and are protected by wildlife laws, the recommended method of control is to trap them heavily during the legal trapping season. As mentioned earlier, large areas of cattails and other aquatic plants also will encourage muskrat activity. Get rid of this vegetation, particularly near the dam, if you expect to reduce muskrat populations. Lining the shoreline with coarse stone (at least six inches in diameter) to a depth of three feet below the water level and two feet above will discourage muskrat burrowing.

Fig 7.4 (Photo courtesy of Paradise Hill School)


DEPARTMENT OF AGRICULTURE
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