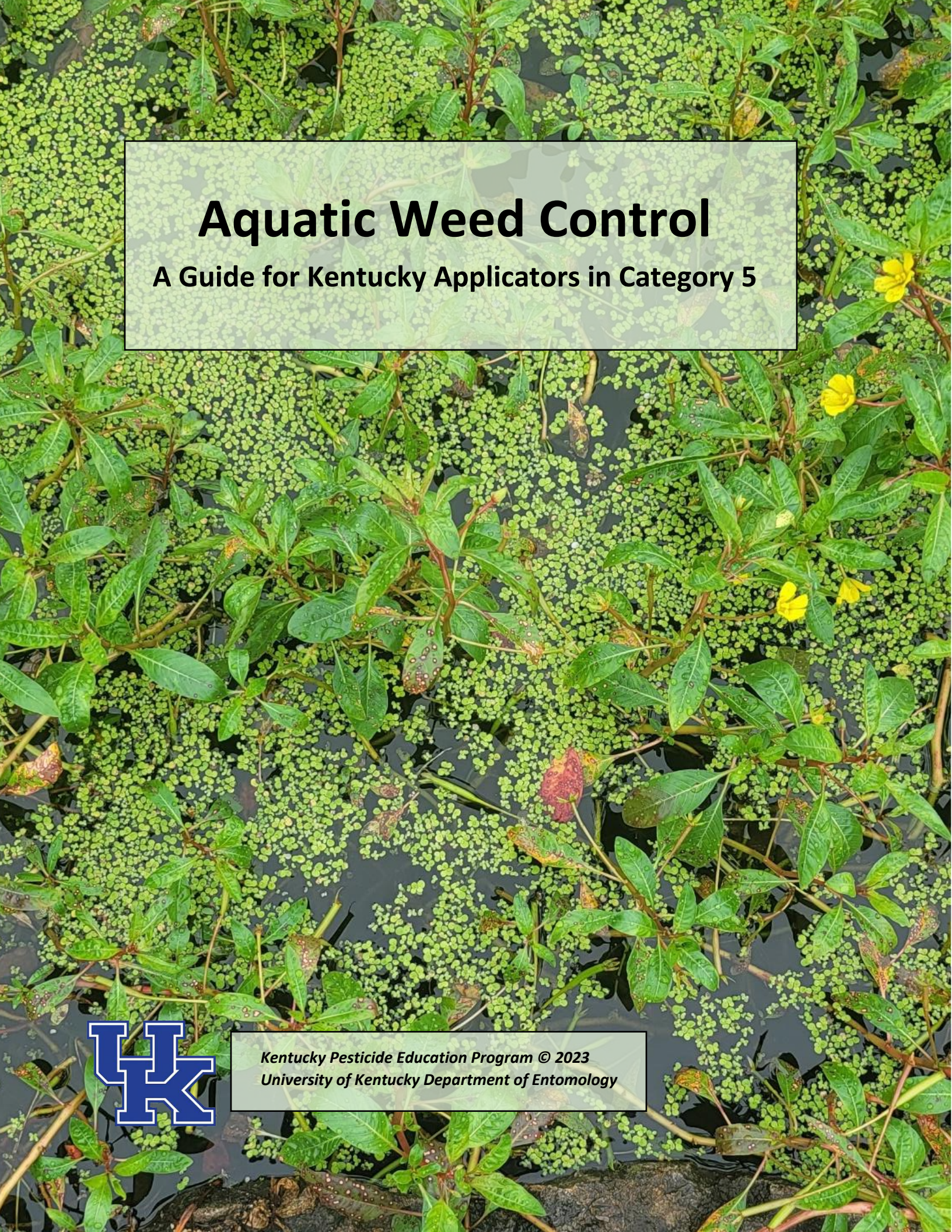


Aquatic Weed Control

A Guide for Kentucky Applicators in Category 5

University of Kentucky Department of Entomology

Laws and Regulations

Federal Authority

Pesticides provide important benefits when used correctly. However, they can cause serious harm if used improperly. The **Federal Insecticide, Fungicide, and Rodenticide Act (*FIFRA*)** is the most important law regulating the registration, distribution, sale, and use of pesticides in the US. However, the Endangered Species Act and Migratory Bird Treaty Act also impact pesticide regulation, application, and pest management. FIFRA gives the Environmental Protection Agency (EPA) the authority to oversee the sale and use of pesticides. Commercial applicators can be fined as much as $5,000 for FIFRA violations. Criminal penalties can be as much as $25,000 and/or 1 year in prison. In addition, Kentucky can enact legal requirements that may be more restrictive than federal law. In Kentucky, the Kentucky Department of Agriculture administers the EPA-approved certification program and enforces FIFRA regulations.

FIFRA give EPA Authority to:

- Impose civil and/or criminal penalties on anyone who misuses a pesticide or commits any other listed unlawful acts. Fines can be up to $1,000 for each offense. However, you have the right to ask for a hearing in your own city or county.
- Stop the sale or use of any pesticide.
- Issue removal orders and seize products to keep them out of the market if it determines the products pose an unreasonable risk.
- Reevaluate older pesticides to ensure that they meet more recent safety standards.
- Protect agricultural workers and pesticide handlers from occupational pesticide exposure.

Exceptions to Pesticide Labeling

Unless the label specifically prohibits it, you can apply a pesticide

- To control a pest that is not on the label as long as the specific crop or site is listed
- By any method that is not prohibited. For example, some pesticides cannot be applied by air.
- At a lower dosage, concentration, or less frequently than specified on the label
- In a pesticide-fertilizer mixture.

All pesticides are classified according to their potential hazards under the circumstances in which they are to be used. The two main classifications are **Restricted Use (RUP)** and **unclassified or general use.** The EPA has officially classified very few pesticides as general use. Most that might be expected to fit into the general-use category currently are unclassified. Normally, general-use pesticides have a lower toxicity than RUPs so they are less likely to harm humans or the environment. The general public can buy general-use pesticides without special permits or restrictions. Restricted Use Pesticides can only be purchased and used by a certified applicator in Kentucky.

Endangered Species Act

Plants and animals classified as endangered or threatened must be protected, and this includes from the effects of pesticides. Some pesticides may have specific restrictions on their use in areas of endangered species habitat. This may include special label instructions to check with an EPA website to determine if there are specific precautions to take when using the product in their area.

Kentucky Laws and Regulations

The Division of Environmental Services of the Kentucky Department of Agriculture (KDA) regulates federal and state pesticide laws and regulations, including the Kentucky Fertilizer and Pesticides Storage, Pesticide Use and Application Act of 1996 (KRS 217b) which was revised in 2022. The Kentucky Department of Agriculture implements the provisions of KRS 217b through the administrative regulations, 302 KAR 026. It is responsible for regulating the registration, sale, distribution, proper use, storage, disposal, and application of pesticides in the Commonwealth. The Division strives to educate the pest control industry and consumers about the proper use of pesticides through education and training programs.

KDA personnel give exams to certify and license qualified citizens who wish to apply or to sell pesticides. Field inspectors from the Agricultural Branch inspect facilities of the businesses which sell and/or apply pesticides and review their records. They can impose fines on businesses and/or individuals who neglect to follow federal and state laws concerning the proper storage, containment, sale, distribution, application, record keeping, or disposal of federally registered pesticides. They also investigate potential pesticide application complaints and violations.

You are responsible for learning about and complying with pesticide laws and regulations before making any applications. In addition, you are responsible for any consequences of actions that result from an application. ***Ignorance of the law is never an excuse for noncompliance or violations.***

Important Definitions

- **Application** - placing of a pesticide or pesticide impregnated fertilizers for effect, including mixing and loading.
- **Certification** - recognition by the KDA that a person has demonstrated a minimum level of competence by

examination and continuing education units and is authorized to use or supervise the use of pesticides in the area of certification.

- **Commercial Pesticide Applicator** - any individual employed by an operator to apply pesticides. Applicators must be certified in the appropriate category and must have a valid license issued by the KDA. The annual applicator license expires on December 31, the license fee is $25.
- **Commercial Pesticide Operator** - owns or manages a business that applies pesticides on the lands of another for hire. Operators must be certified in the appropriate category and must have a valid license issued by the KDA. A licensed commercial pesticide operator also must be registered as a pesticide dealer or must be employed by a registered dealer. The annual operator license expires on December 31, the license fee is $100.
- **Customer** - a person who makes a contract, either written or verbal, with an applicator for hire to make an application.
- **Dealer** - stores bulk fertilizer or a restricted use pesticide for redistribution or direct resale, OR is in the business (for compensation) of applying any pesticide to the lands of another.
- **Direct on-the-job supervision** - when a licensed operator or applicator is physically on site and is directly supervising or training an individual to apply a pesticide.
- **Lawn chemicals** - fertilizers, pesticides, or defoliants applied or intended for application to lawns.
- **License renewal** - There is a 25% fine for license holders who do not pay renewal fees before January 31. The licensee must take a new certification examination if the license is not renewed before November 30.
- **Noncommercial applicator** - an employee of a golf course, municipal corporation, public utility, or other governmental agency certified and licensed to apply pesticides to lands owned, occupied, or managed by his or her employer. The annual non-commercial applicator license expires on December 31, the license fee is $10.
- **Pests** - any animals (insects, snails, slugs, rodents, etc.); plant pathogens (nematodes, fungi, viruses, bacteria, or other microorganisms) or plants normally considered to be a pest, or which are declared to be a pest by the KDA.
- **Pesticide** - any substance or mixture of substances intended to:
  - prevent, destroy, control, repel, attract, or mitigate any pest;
  - be used a plant regulator, or a spray adjuvant, after being mixed with an EPA registered product;
  - be used as a plant regulator, defoliant, or desiccant.
- **Restricted Use Pesticide** -any pesticide classified as such by the EPA administrator, or by administrative regulation of the KDA. Only certified applicators can purchase and use them. Generally, the EPA classifies a pesticide as restricted use if:
  - it exceeds one or more human health toxicity criteria;
  - it meets certain criteria for hazards to non-target organisms or ecosystems, or the EPA determines that a product (or class of products) may cause unreasonable harm to human health and/or the environment without such restriction;
  - then the restricted-use classification designation must appear prominently on the top of the front panel of the pesticide label.
- **Structural pest** - a pest which commonly invades or attacks dwellings or structures.
- **Trainee** - an individual employed by a dealer and working under the direct on-the-job supervision of a licensed operator or applicator. Trainees must be registered with the Kentucky Department of Agriculture with the registration valid for 90 days and cannot be renewed. The fee for trainee registration is $25.

Recordkeeping Requirements

State law requires that any certified applicator keep records of all applications of general and restricted use pesticides. **Keep the records for at least 3 years** from the date of application. USDA and/or KDA representatives have legal access to the records. Pesticide application records must be recorded within 14 days from the date of application. These records must include:

- name and address of person receiving application services;
- location of application;
- size of area treated;
- crop, commodity, stored product, or type of area treated;
- time and date of application;
- brand name or product name of pesticides applied;
- EPA registration number;
- total amount of each pesticide applied per location per application;
- name of person making the pesticide application;
- if application is made by a trainee, the name of the trainee;
- if application is made by a trainee, name and license number of the supervising applicator;
- records required related to trainee supervision;
- purpose of application; and
- any other record as required by the label.

Pesticide applications records:

- are invaluable documentation in the event of a complaint or lawsuit.
- can help determine which pesticide treatments work, which do not work, and why
- help you to plan purchases so that you buy only the amount needed
- provide information needed by medical staff

- document the steps taken to protect farmworkers and the environment
- are used for federal and state surveys

Certification and Licensing

Commercial and non-commercial pesticide applicators must be both certified and licensed. Both are accomplished by passing a written test (minimum score 70%) administered by the KDA. The test is based on information in this manual.

Evidence of Financial Liability

Pesticide dealers who apply pesticides to the lands of others must show evidence of financial responsibility. This can be a surety bond or a liability insurance policy of at least one million dollars ($1,000,000) that would protect persons who may suffer legal damages as a result of the applicant.

How To Remain Licensed and Certified

1. Return the annual license renewal form before January 31. There is a 25% penalty added to the original fee for license holders who do renew and pay their fees before January 31. Failure to renew a license by November 30 of each year, will result in the former license holder being required to retest as an initial applicant, after any applicable fines are paid.
2. Pay any required fees.
3. Earn Continuing Education Units (CEUs) in educational meetings approved by the KDA. Twelve CEU credits, with at least one related to each category of license held by the person within the three-year period prior to each annual license renewal application.

The Kentucky Cooperative Extension Service provides training materials and educational programs for certification and continuing education of commercial and non-commercial applicators through the Pesticide Safety Education Program.

Penalties

Anyone who uses a pesticide in a manner inconsistent with its labeling directions and restrictions may be subject to civil and/or criminal penalties. Generally, any applicator in violation of FIFRA may be assessed a civil penalty. However, the EPA may issue a warning instead of assessing a penalty. An intentional violation by a private applicator is a misdemeanor and will result in a fine and/or up to 30 days imprisonment. You must use all pesticides exactly according to labeling directions—the label is the law!

Practice Questions

1) The _____ is the most important law regulating pesticides in the US.

1. KRS 217b Ky Fertilizer and Pesticides Storage, Pesticide Use and Application Act of 1996
2. 1996 Farm Bill
3. Federal Insecticide, Fungicide, and Rodenticide act (FIFRA)
4. Ky Department of Ag Regulation 1262

2) Commercial and non-commercial pesticide operator and applicator licenses are good for ____ year(s).

1. 1
2. 3
3. 5
4. 10

3) Commercial and non-commercial pesticide applicator certifications are good for ____ year(s).

1. 1
2. 3
3. 5
4. 10

4) A pesticide is categorized as general use if it can harm humans or the environment even if it is used according to label directions.

1. True
2. False

5) A minimum score of ___ % is required on the test to become a commercial or non-commercial pesticide applicators.

1. 60
2. 70
3. 80
4. 100

6) According to state laws and regulations, anyone who is in the business of applying any pesticide to the lands of another is considered to be a pesticide dealer.

1. True
2. False

7) _____ applicators are people who apply pesticides to lands owned, occupied, or managed by a golf course, municipal corporation, public utility, or other governmental agency.

1. Certified commercial
2. Registered
3. Non-commercial
4. Private

8) Non-commercial applicators may apply pesticides to residential or commercial properties for hire without any additional certification.

1. True
2. False

9) A certified commercial or non-commercial pesticide applicator can stay certified by earning _____ continuing education units (CEUs) before their certification expires.

1. 12 CEU hours with at least one in the category held
2. 9 general and 3 specific CEU hours
3. 12 CEU hours in each category held
4. none, you must take a test every 3 years

10) According to Kentucky pesticide laws and regulations, commercial and non-commercial applicators must keep records of both general and restricted use pesticide applications.

1. True
2. False

11) A certified pesticide operator or applicator who fails to renew his/her license before _____ must take a new examination.

1. January 31
2. March 1
3. June 1
4. November 30

Answers

1: 3 **2: 1** **3: 2** **4: 2** **5: 2** **6: 1**

7: 3 **8: 2** **9: 1** **10: 1** **11: 4**

Aquatic Weed Control

Adapted from North Central Regional Extension Publication No. 241, Carole A. Lembi, Aquatic Weed Specialist, Purdue University and Aquatic Pest Control, University of California Leaflet 2961 and Aquatic Weed Management (SRAC Pub No 361 – 2013)

Specific requirements for commercial applicators in the Aquatic Pest Control category relate to a **practical knowledge in four major areas:**

- **Water use situations**
- **Weed Identification**
- **Weed management alternatives**
- **Principals of limited area application**

Effective management of aquatic pests requires an integrated approach that incorporates cultural, mechanical, biological, and chemical methods as appropriate.

Why is Aquatic Weed Control Necessary?

Aquatic plants are those that grow partly or wholly in water; they may be rooted in the mud or floating freely. Plants are natural and important components of the aquatic environment. Microscopic plants (algae) form the base of the aquatic food chain. Larger algae and plants provide habitat for fish and food organisms, and all plants produce oxygen as they photosynthesize during the daylight hours. However, excessive growths of these plants can have a detrimental effect on a body of water and its inhabitants. Many shallow, nutrient-rich ponds, lakes, and drainage ditches provide ideal conditions for abundant aquatic plant growth. Effective management of aquatic plants requires an integrated approach that incorporates cultural, mechanical, biological, and chemical methods as appropriate.

Aquatic weeds are problematic as they:

- **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.**
- **May cause fish kills due to oxygen depletion when plants die and decompose.**
- **Produce calm water areas that are ideal for mosquito breeding.**
- **Promote certain algae that can give water bad tastes and give off unpleasant odors.**
- **Impede water flow in drainage ditches, irrigation canals, and culverts, causing water to back up.**
- **Deposit dead plant material, sediment, and other debris that over time can cause bodies of water to fill in.**

Water Use Situations

The demand for water resources for recreation, agriculture, and industry is increasing. Several species of aquatic plants are pests because they can interfere with water uses. When control is necessary, it must not harm people or the environment.

Habitats for aquatic weeds involve various proportions of water and soil, including intermittently wet ditches, ditches that always hold standing water, streams, stock ponds, farm ponds, lakes, ornamental ponds, and intermediate habitats. We will consider three types of water situations - static, limited flow impoundments, and moving water.

Static Water is totally confined or confined for much of the year within a known area. There is no downstream movement. However, even totally enclosed bodies of water often have appreciable water movement because of wind and changes in water temperature. Plants commonly grow in static water up to 12 feet deep and may grow in very clear water that is more than 20 feet deep. If a herbicide is applied, there is no reason to expect any appreciable downstream movement unless there is overflow from unusual conditions.

Limited-flow Water Impoundments Ditches may be intermittently wet or dry, depending upon climatic conditions. Their purpose is to drain the surrounding land area so considerable amounts of water must pass through. Herbicides applied to these habitats may move downstream following an influx of water from surrounding areas.

Many farm ponds may have limited flow because there may be an overflow pipe and or an emergency overflow spillway. An overflow pipe permits passage of a more constant and relatively well-defined amount of water. An emergency spillway provides a release when storms dump excess amounts of water into a pond in a short time. Overflow or release water can carry small amounts of aquatic herbicides downstream from the application site. Sudden rainstorms that interrupt or come immediately after a pesticide application can move larger amounts downstream.

John C. French Sr., Retired, Universities: Auburn, GA, Clemson and U of MO, Bugwood.org

Moving Water occurs in streams, creeks, and rivers where there is some detectable downstream current. Varying amounts of pesticides may move downstream from application sites. These situations **present the greatest potential as environmental hazards.**

Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org

Practice Questions

1) A ditch is _____.

1. static water
2. limited flow water impoundment
3. moving water
4. groundwater

2) The normal maximum depth that aquatic plants grow in static water is up to _____ feet.

1. 2
2. 6
3. 12
4. 20

3) Most farm ponds may have _____.

1. static water
2. limited water flow
3. moving water
4. groundwater

4) Applications of aquatic herbicides present the greatest potential environmental hazard when applied to _____.

1. static water
2. limited flow water impoundment
3. moving water
4. ditches

Answers

1: 2 2: 3 3: 2 4: 3

Aquatic Weed Identification

Identification is the first and most important step in managing aquatic weeds. Most control methods target specific weeds or groups of weeds with similar growth habits. Aquatic weeds are divided into two botanical groups; algae and flowering plants. Algae are usually structurally very simple with no apparent roots, leaves, or stems. However, some (for example, *Chara*) can resemble flowering plants. Flowering plants have roots, shoots, and stems. You must be able to distinguish between algae and flowering plants to make effective chemical control decisions.

Algae

Most species of algae live in the water, where they form the base of the aquatic food chain. They shade the bottom of the pond and limit the depth at which other aquatic plants can grow. Blooms occur when there is a rapid increase in algae. This usually results from a combination of factors including excess available nutrients, warm temperatures, sunlight, and limited water flow. Blooms should be treated before the water undergoes a noticeable color change. However, a sudden die-off of these algae can deplete oxygen in the water and cause a fish kill.

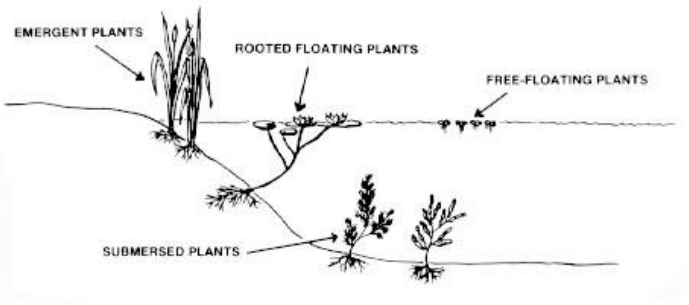
Filamentous algae (or pond moss) form floating, mat-like growths that usually begin around the edges and bottom of ponds in the early spring. Filamentous algae is common in lakes and ponds. Repeated chemical treatments may be needed during the summer for effective control.

***Chara*, or stonewort is a branched alga and** usually grows in hard water and is often calcified and brittle. The plant attaches to the bottom and its leaves are arranged along the stem in whorls. It grows completely underwater and has a musky smell. Once established, *Chara*, with its heavy coating of calcium carbonate, can be difficult to control. Although this plant resembles some flowering plants, it is an alga.

Jim Rathert, courtesy of Missouri Dept. of Conservation

Flowering Plants

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



Emergent Plants

Emergent (shore or marginal) plants commonly include cattails, bulrushes, spike rushes, reed canarygrass, and other grass-like perennial plants. Broadleaves include willow trees and creeping water primrose.

Cattails: Ohio State Weed Lab, The Ohio State University, Bugwood.org

Red canarygrass: John M. Randall, The Nature Conservancy, Bugwood.org

Spike rush; Max Lichner, USDA Forest Service

Willow; Paul Wray, Iowa State University, Bugwood.org

Creeping water primrose; John Hilty, Illinois Wildflowers

Free-Floating Plants

Free-floating plants, such as duckweed and watermeal are **extremely small seed-bearing plants that float free on the water's surface.** They **never become rooted** in the soil, and reproduce by sexual and asexual means. They can completely cover the surface of a pond. Both plants are found in nutrient-rich waters so inflow of wastewater from livestock feedlots, septic fields, etc. should be avoided when possible.

Duckweed (large leaves) mixed with watermeal; Karan A. Rawlins, University of Georgia, Bugwood.org

Watermeal; Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org

Rooted Floating Plants

Rooted floating plants include water lily, spatterdock, and water lotus. While the leaves float roots are anchored in the soil.

Spatterdock; Rebekah D Wallace, University of Georgia, Bugwood.org

Spatterdock is very competitive and can completely fill in shallow areas less than 3 to 4 feet deep. New spatterdock plants sprout from massive underground rhizomes. Spatterdock has a yellow flower.

Water lily; Becca MacDonald, Sault College, Bugwood.org

Water lily differs from spatterdock in having round rather than heart-shaped leaves and often a white flower.

Water lotus; Kelle Sullivan, Florida Fish and Wildlife Conservation Commission, Bugwood.org

Submersed Plants

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

Curly-leaf pondweed; Chris Evans, University of Illinois, Bugwood.org

The leaves of **Curly-leaf pondweed** are somewhat stiff and crinkled, approximately 1/2-inch wide and 2- to 3-inches long. Small teeth are visible along the edges of the leaves, which are arranged alternately around the stem. Leaves become denser toward the end of branches. The plant appears reddish-brown in the water but is actually green when pulled out and examined closely. Curly-leaf pondweed grows best in the spring and tends to die in the summer. It is common in ponds, lakes, and ditches.

Leafy pondweed; John Hilty, Illinois Wildflowers

Leafy pondweed has very narrow leaves with an alternate arrangement. It is more common in ponds than in large lakes.

Waterthread pondweed; Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org

Waterthread pondweed is a perennial plant usually restricted to shallow water. It's relatively small (1-inch long) floating and submerged leaves with distinctive veins distinguishes it from most other pond weeds.

Coontail; Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org

Coontail (also called **hornwort**) is a submerged, free-floating aquatic plant that has branched, spined leaves arranged in a whorl like a bottlebrush. This plant lives mostly in still or slow-moving water and is usually found in areas with moderate to high nutrient levels. Coontail floats in dense masses just beneath the water's surface and can grow near the bottom in channels and other deep areas.

Brittle naiad; John Hilty, Illinois Wildflowers

Brittle naiad is a submersed annual aquatic plant that spreads by seeds and plant fragments. Its oppositely arranged leaves are 1 to 2 inches long and are toothed, stiff, and pointed. Brittle naiad resembles coontail but its leaves are in pairs while coontail leaves are in whorls of 4 or 5. It can form dense mats that outcompete native species and can interfere with recreational activities.

Eurasian watermilfoil; Alison Fox, University of Florida, Bugwood.org

Eurasian watermilfoil is a feathery, submersed aquatic plant that has become a major aquatic invader across much of North America. Plants are rooted at the bottom of still or slow-moving water (3 to 12 feet deep). They grow rapidly creating dense mats. This serious, rapidly spreading invader is found in lakes and ponds throughout the Midwest.

Practice Questions

1) _____ are the base of the aquatic food chain.

1. Underwater weeds
2. Submersed plants
3. Algae
4. Flowering plants

2) Blooms are caused by _____.

1. Underwater weeds
2. Submersed plants
3. Algae
4. Flowering plants

3) Spatterdock is a very competitive _____ that can be found in shallow areas of impounded water.

1. Filamentous algae
2. free-floating plant
3. shore plant
4. rooted floating plant

4) Algae do not have apparent roots, stems, or leaves.

1. True
2. False

5) Which of the following is a free-floating weed?

1. Eurasian watermilfoil
2. Watermeal
3. Spike rush
4. Brittle naiad

6) _____ can be recognized by its branched leaves in a bottlebrush arrangement.

1. *Chara*
2. Waterthread pondweed
3. Coontail
4. Cattail

Answers

1: 3 2: 2 3: 4 4: 1 5: 2 6: 3

Managing Aquatic Weeds

Preventative Control

Proper site selection, design, and construction of ponds are important factors in preventive control of aquatic weeds. Shallow water at the margins provides an ideal habitat for emergent plants. Banks should be sloped steeply so that very little water is less than 2 to 3 feet 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.

Mechanical Control

Mechanical control may be needed to manage severe waterweed infestations. Aquatic herbicides may not be the best option if the water is used for livestock, drinking, or some fish populations. Hand-pulling weeds or dredging the pond may be used, if practical.

Motor-driven underwater weed cutters are available and can be used for the control of such plants as waterlilies and watermilfoil. 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 the use of herbicides. Underwater weed cutting must be done continuously during the summer and usually represents a long-term financial investment.

Other types of habitat manipulation include riprapping shorelines and anchoring screens (e.g., Aquascreen®) or black plastic sheets in the bottom sediments to prevent establishment of rooted plants.

Aquashade® (photo: tricountyfs.com)

Dyes such as Aquashade® **inhibit light penetration.** They can be applied along the shoreline and will mix throughout the body of water within about 24 hours. The dye intercepts light normally used for photosynthesis by underwater plants. A minimum effective concentration must be maintained for effective control. Dyes may not be effective in controlling plants and filamentous algae in shallow water less than 3 feet deep.

Cultural Control and Habitat Alteration

Cultural control and habitat alteration can be effective in managing aquatic weeds. The **drawdown technique**, lowering the water over the winter, can be very effective. 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).

Photo: J. Lennon

Drawdown has been quite successful against Eurasian watermilfoil and waterlilies, but the degree of control depends upon the severity of the winter. There are several management advantages to a winter drawdown in addition to weed control.

Many aquatic plants or their seeds are carried into a pond by wind, birds, stocking fish, people, etc. These plants infest a pond only if the water conditions are just right. Their success usually means that nutrients are, naturally present or entering the pond from runoff or stream inflow.

How to help **prevent serious weed infestations**:

- Pond fertilization may be conducted to increase and enhance fish populations. Fertilization is often conducted in areas where pond soils tend to be acidic and low in available phosphorus First, the soil's agricultural limestone requirement must be met to allow the release of phosphorus into the pond's food chain. No aquatic plant or filamentous algae growth problems should be present during pond fertilization. Once initiated, the pond must be fertilized every spring and early summer as the pond's food chain is now supported by the external source of nutrient (phosphorus). For many pond owners, the benefit of pond fertilization may not justify the additional cost of fertilizer and the labor to apply it.
- **Maintain a good sod and grass cover** around your pond. This will help prevent excessive nutrient runoff and soil erosion. Do not fertilize the turf directly around the pond.
- Unlimited livestock access will pollute the water and increase pond bank erosion. Limit livestock access to portions of the pond **or fence the pond and water animals with a tank outside the fence.**
- **Check septic tanks for possible leakage** or seepage into the pond. Locate new septic drainage fields so that the nutrient-rich effluent will not reach your pond.
- **Do not permit runoff from barns where animals are kept, chicken coops, feedlots, etc.,** to enter your pond. . Farms over ten acres should have a farm management plan to address on-farm runoff issues.

All of these measures will help manage aquatic weed growth, particularly in new ponds. In older more shallow ponds these measures may only aid in reducing infestations of plants and filamentous algae.

Pond aeration and de-stratification may assist in aquatic plant and filamentous algae control by reducing stagnant water areas and cycling nutrient within the pond. s Enhanced aeration and water circulation will benefit fish populations. The most reliable aeration and water circulation devices are dependent on electricity. The cost of electrical service installation, electricity and aeration or water circulation devices are considerable and should be evaluated. Wind and solar options are available but are expensive and may be less reliable.

Biological Controls

Biological control is the **reduction or removal of a plant using grass carp or other species.** It became legal to release the sterile triploid form of the grass carp or white amur (*Ctenopharyngodon idella*) in Kentucky in 1986. This fish feeds on soft, easily digested aquatic plants and branched algae. Grass carp are not recommended for the control of hard to digest plants such as waterlilies, rushes, sedges cattails, or filamentous algae, duckweeds, or watermeal. These fish should have little effect on other fish in the pond and cannot reproduce. **The non-triploid form is illegal to use in Kentucky.**

Grass carp (photo: finfarm.com)

Larger grass carp are less effective at plant control so periodic re-stocking is necessary. These fish can escape ponds through overflows so preventive barriers are needed. They prefer some aquatic plant species but may not effectively control others. Over-stocking may require removal of extra carp after the vegetation is controlled.

The grass carp is one of five carp species found in Kentucky. When stocking your pond be sure to use grass carp; the other species will not work and can harm other fish in the pond. More information on grass carp is available at http://fw.ky.gov/Fish/Pages/Farm-Pond_Management-Biological-Treatment.aspx.

Chemical Controls

Herbicides can be used to control aquatic weeds. Those used primarily to control algae may be called algicides, even though they kill other aquatic plants. Used properly, aquatic herbicides can control vegetation without harming fish or other aquatic life.

Photo: mainelakes.org

Aquatic herbicides must be labeled for that use by the Environmental Protection Agency and registered with the Kentucky Department of Agriculture. They vary in their weed control spectrum, specific application sites, and application methods. After a weed has been correctly identified, read the labels carefully before buying and using any product. Most have restrictions that may prevent their use on particular bodies of water. Also, be sure to include secondary water uses (i.e., swimming, livestock watering and irrigation) when selecting products.

Ideal water temperature (photo: lochnesswatergardens.com)

Most aquatic weeds begin growing in early spring when water temperatures reach 55°F to 60°F. The spring months (March, April, May), when water temperatures are between 70° and 80°F, are an ideal time to apply herbicides to control aquatic weeds. At this time weeds are small and easier to control than during the summer; in addition, dissolved oxygen levels in the water are usually higher due to cooler water temperatures.

Aquatic herbicides are not toxic to fish when applied according to label directions. Failure to follow label directions can result in fish kills. Plants and algae killed by the herbicides often decompose rapidly. This process consumes dissolved oxygen, reducing the amount available to fish. Fish kills can occur if the dissolved oxygen concentration drops too low. Observe treated water for approximately 1 week between treatments.

Treating the pond with herbicides during the hot summer months is risky because dissolved oxygen concentrations tend to be low and weed biomass tends to be high. Treat only 1/4 to 1/3 of the total surface acreage of a pond at one time to minimize the risk of herbicide-induced dissolved oxygen depletions. However, even partial pond treatments can be risky during the summer in ponds that routinely have low dissolved oxygen levels. Some herbicides are not labeled for partial pond treatments.

Multiple application of products with the same mode of action can result in herbicide-resistant plants. Rotate among herbicides with different modes of action and use cultural and biological control when possible.

Herbicide Formulations

Aquatic herbicides generally are available in sprayable or granular formulations.

Sprayable Formulations

Sprayable formulations must be mixed with water and applied so that they disperse evenly. Examples include:

- AS - aqueous solution - liquid formulation with water as carrier
- SP - soluble powders dissolve and form true solutions in water.
- WP - wettable powders
- DF - dry flowable
- WDG - water dispersible granule
- EC - emulsifiable concentrates form milky white "oil-in-water" emulsions

Granular Formulations

G - granular formulations 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.

Granules are used primarily to control algae or submersed weeds. They sink to the bottom and work in 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 or mg/L. They must be broadcast as evenly as possible over the water surface for best results.

Advantages to granular formulations include:

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

Application

A mechanical sprayer or spreader and boat are needed to adequately treat large areas. Sprayable herbicide formulations can be applied with hand-held or mechanical pressurized sprayers or with a boat bailer. Injecting the chemical near the outboard motor propwash will help to disperse it. Submersed plant treatments from boats often require the use of weighted trailing hoses to distribute the herbicide directly on the target plants.

Hand-operated or mechanical rotary spreaders can be used to apply granular or pelleted formulations. Soluble crystals should be dissolved in water and sprayed over the pond. While not ideal, the required amount can be placed in burlap bags and dragged behind a boat or suspended in the water near an aerator until the herbicide dissolves.

Adding a registered aquatic adjuvant (usually a surfactant) to some foliar applied herbicides (e.g., diquat, glyphosate) will help them wet and penetrate the foliage. Use a registered aquatic adjuvant that is recommended by the manufacturer according to the label directions. Using adjuvants to treat submersed weeds is usually not recommended.

What You Need to Know Before Using a Chemical

The most important considerations before buying and applying a herbicide for aquatic weed control are:

☑ Identify the weed correctly. The types of weeds controlled can vary greatly among herbicides. Selecting the wrong product can result in a control failure. Identification help can be obtained from your county Extension Service.

☑ Restrictions on water use. 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 swimming, domestic use, livestock watering or irrigation--dictate which herbicides will be appropriate for your pond or lake. Always check the herbicide label for restrictions.

☑ Dosage. 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. Check the herbicide label for the amount to apply per acre-foot.

☑ Timing. Late spring is usually the best time to apply aquatic herbicides because the plants are actively growing. That is when they are most susceptible to herbicides. Do not wait until late summer to treat. By then the vegetation is usually extensive and thick and the water is 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.

☑ Temperature. Aquatic weeds are not affected by herbicides when the water is too cold. The water temperature

should be in the 60's °F., preferably the upper 60's (in the area to be treated). Plants are usually actively growing from late April to early June.

☑ Retreatment. More than one treatment may be required for adequate control. 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.

Dosage Calculations

Aquatic herbicides must be applied at labeled rates which were developed to provide effective, yet safe, weed control. Applying an excessive rate of a herbicide does not provide better weed control but does increase the cost and may harm the environment. Applying less than the recommended rate usually results in poor weed control. Some herbicide treatments, such as those for controlling emergent plants, are applied on the basis of the surface area to be treated. Others, such as those to control certain submersed weeds, are based on the volume of water to be treated. Read the label instructions carefully because mistakes in calculating treatment rates can be costly and environmentally harmful. .

Surface Area Treatment (in acres)

Calculate the amount of herbicide needed for a surface acre treatment using the following formula:

F = A × R

where:

- **F** = Amount of formulated herbicide product
- **A** = Area of the water surface in acres - The surface area of a rectangular body of water equals length in feet times width divided by 43,560 (the number of square feet in an acre).
- **R** = Recommended rate of product per surface acre

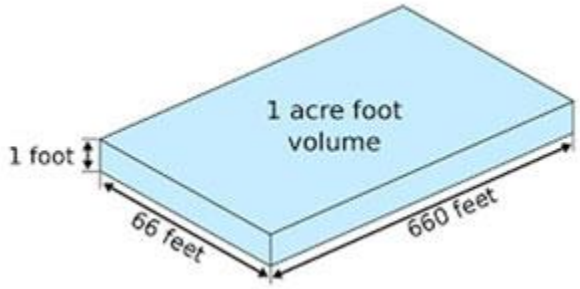
Example

How much product is needed (F) to treat a 500 ft x 100 foot pond (A) at the rate of 3.4 fluid ounces per acre (R)?

(500 ft x 100 ft) = 50,000 sq ft/43,560 sq ft/acre = 1.15 acres

1.15 acres x 3.4 fl oz/acre = 3.9 fl oz of product

Acre-foot Treatment



Many aquatic herbicides list their application rates in terms of the amount of product to use per acre-foot of water. An acre-foot of water is defined as 1 surface acre of water that is 1 foot deep. The number of acre-feet of water can be found by multiplying the number of surface acres times the average water depth.

The amount of herbicide needed for an acre-foot treatment is determined by the following formula:

F = A × D × R

where:

- F = Amount of formulated herbicide product
- A = Area of the water surface in acres
- D = Average depth of the water in feet
- R = Recommended rate of product per acrefoot

Example:

How much product is needed (F) to treat a 500 ft x 100 foot pond (A) that is 3 feet deep at the rate of 6 fluid ounces per acrefoot (R)?

(500 ft x 100 ft) = 50,000 sq ft/43,560 sq ft/acre = 1.15 acres x 4 ft deep = 4.6 acrefeet.

4.6 acrefeet x 6 fl. oz. / acre foot = 27.6 fl oz of product

Parts Per Million (or Billion) Weight Treatment

The treatment rate of some aquatic herbicides may be listed as the final concentration of the chemical in the water on a parts per million weight (ppmw) basis.

Determine the amount of herbicide needed for a ppmw treatment by the following formula:

F = (A × D × CF × ECC) ÷ I

where:

- F = Amount of formulated herbicide product A = Area of the water surface in acres
- D = Average depth of the water in feet
- CF = 2.72 pounds per acre-foot (This is the conversion factor when total water volume is expressed on an acre-foot basis. 2.72 pounds of a herbicide per acre-foot of water is equal to 1 ppm.)
- ECC = Effective chemical concentration of the active ingredient of herbicide needed in water to control the weed
- I = Total amount of active ingredient divided by the total amount of active and inert ingredients. For liquid products, I = pounds of active ingredient per gallon. For dry products, I = percent active ingredient ÷ 100%.

Example:

How much of an 80% WP herbicide formulation is needed (F) to treat a 500 ft x 100 foot pond (A) that is 3 feet deep at the rate of 2 ppm (R)?

(500 ft x 100 ft) = 50,000 sq ft/43,560 sq ft/acre = 1.15 acres x 3 ft deep = 3.45 acre-feet

3.45 acre-feet x 2.72 pounds/acre-foot = 9.38 pounds

9.38 pounds x 2 (ppm) = 18.76 pounds/0.8 (80% WP) = 23.5 lbs

Total Water Volume

The whole body of water from the surface to the bottom is treated OR only 1/4 to 1/3 of the water volume (based on surface area) 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 stated in parts per million (ppm) or parts per billion (ppb). For example, if the toxic concentration for a particular plant is 2 ppm, then the chemical should be applied at the ratio of 2 parts of active ingredient to one million parts of water (2:1,000,000) in the area to be treated.

Calculate the acre-feet of the body of water to be treated. To do that, multiply the surface acres by the average depth in feet.

An acre-foot of water weighs 2.7 million pounds (2,700,000). Multiply 2.7 x the ppm concentration wanted x acre-feet = pounds of active ingredient needed.

Example:

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 * 0.5 * 10 = 13.5 pounds of active ingredient*

Application

Bottom soil surface: Herbicide applications may be made to the bottom soil of a drained pond, lake, or channel.

Floating and immersed weeds: These can be killed with direct sprays on the foliage applied from a boat or the shore.

Submersed weeds and algae: These 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, thermal currents, and wave action. Good control depends upon good dispersion of the chemical.

Weed Control in Large Impoundments

Herbicides that work well in small bodies of water may perform poorly in large impoundments 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
- use bottom treatments in deep water
- select herbicides that are absorbed quickly by the plants

Weed Control in Limited-Flow Waterways

Flood drainage canals, sloughs, 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 crop land 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. Water has many uses and herbicides will not always remain where they are applied.

Improper applications can kill fish directly or deplete the oxygen concentration 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.

In Static Water - Ponds, Lakes, Reservoirs

Weed control may be unsatisfactory if application rates are too low in static water. Excessive application rates may kill fish, prevent use by livestock, or prohibit use for irrigation for an indefinite period. However, there should be little downstream effect because 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-flow water sources were treated with an application rate 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 domestic water supplies. In addition, non-target aquatic organisms may be affected.

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 fish. 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 to escape potential toxic effects. Also, a minimal amount of pesticide is applied. This tends to reduce the potential effect upon downstream environments in the event of spillover from the treated body of water.

Faulty Application

There are two major hazards involved in faulty application of pesticides:

1) damage to non-target organisms such as plants, fish, birds, beneficial insects, and others in the treated aquatic environment and downstream

2) unsatisfactory control.

For example, a granular formulation of an aquatic herbicide might work well in static water or limited-flow situations but it would be useless in fast moving water. 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 as 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.

Precautions

Unforeseen or unexpected conditions or circumstances may lead to less than satisfactory results even when best management practices are used. The applicator is always responsible for the effects of herbicide residues on livestock and crops, as well as problems that could arise from the drift or movement of herbicide from his/her property to that of others. Always read and follow carefully the instructions on the label.

Due to a federal court ruling, all applications of herbicides into or over waters of the U.S. fall under the Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) as of 2011. The regulation reads, “You are required to obtain a permit if you discharge biological pesticide or chemical pesticide that leaves a residue in water

when such applications are made into, over, or near waters of the United States."

Contact the Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water, or Surface Water Permits Branch for more information.

Practice Questions:

1) Aquascreen is an example of _____ control of aquatic plants.

1. biological
2. chemical
3. mechanical
4. cultural

2) Pond banks should be gently sloped so that water is less than 2 feet deep to prevent aquatic weed growth.

1. True
2. False

3) Large amounts of aquatic herbicides can move downstream from limited flow impoundments

1. from sudden rainstorms during or immediately after an application
2. through an overflow pipe
3. over an emergency spillway

4) Drawdown is an example of _____ control of aquatic plants. Most ponds would need to be pumped or siphoned for draining as few can be emptied by gravity.

1. biological
2. chemical
3. mechanical
4. cultural

5) Aeration is an effective means of biological weed control.

1. True
2. False

6) Triploid grass carp can be used for aquatic weed control in Kentucky ponds because they _____.

1. are sterile
2. multiply quickly
3. eat large amounts of algae
4. eat many mosquito larvae

7) Allowing livestock access to ponds and creeks is an effective means of biological weed control.

1. True
2. False

8) The number of acre-feet in a pond or lake is calculated by _____.

1. multiplying its surface area in acres by its depth
2. multiplying its surface area in acres by its average depth
3. one-half of its surface area by its depth
4. dividing its volume by 43,560

9) The most important step in managing aquatic weeds is _____.

1. reading the product label carefully
2. identifying the plant correctly
3. calculating the dose correctly
4. selecting the application equipment

10) _____ is the best time to apply an aquatic herbicide.

1. Early spring
2. Late summer
3. Fall
4. Winter

11) If you must apply an aquatic herbicide in late summer, treat only a portion of the weed growth at a time.

1. True
2. False

12) A pond with a surface area of 1.5 acres and an average depth of 6 feet contains _____ acre-feet.

1. 1.5
2. 6
3. 7.5
4. 9

13) The number of acres of surface area of a pond or lake is calculated by multiplying _____.

1. Length (feet) x width (feet)
2. Length (feet) x width (feet) x depth (feet)
3. Length (feet) x width (feet) divided by 43,560
4. Length (feet) x width (feet) x depth (feet) divided by 43,560

14) There are ___ pounds of active ingredient in 2 pounds of a 75% wettable powder formulation.

1. 0.75
2. 1
3. 1.5
4. 2

15) An acre-foot of water weighs _____ pounds.

1. 2,700,000
2. 272
3. 2.72
4. 1

16) Improper herbicide applications can kill fish directly or deplete the oxygen concentration if the plants die too quickly.

1. True
2. False

17) Weed control methods in moving water are very similar to those in limited-flow waterways.

1. True
2. False

18) The whole body of water should be treated with an aquatic herbicide even if the weed problem is present in only limited areas of the impoundment.

1. True
2. False

19) The two major hazards involving faulty application of aquatic herbicides are _____.

1. damage to non-target organisms AND unsatisfactory control
2. herbicide resistant weeds AND damage to non-target organisms
3. unsatisfactory control AND excessive control costs
4. pesticide drift AND herbicide resistant weeds

20) Which of the following is the most significant consideration when selecting an aquatic herbicide?

1. Control may not be satisfactory
2. The water to be treated may have multiple uses
3. Most weeds are probably already resistant to herbicides
4. The water temperature is between 65°F and 75°F

21) Excessively rapid kill of aquatic weeds may result in _____.

1. increased water temperature
2. oxygen depletion
3. an algal bloom
4. decreased water temperature

22) Bottom treatments are primarily to control _____ weeds.

1. emersed
2. algae
3. floating
4. submersed

Answers:

1: 3	2: 2	3: 1	4: 4	5: 2	6: 1
7: 2	8: 2	9: 2	10: 1	11: 1	12: 4
13: 3	14: 3	15: 1	16: 1	17: 2	18: 2
19: 1	20: 2	21: 2	22: 4		

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